Ellipsis in Head-Driven Phrase Structure Grammar

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1 Introduction

1.1 General properties of ellipsis

The characterizing feature of ellipsis is that elements of semantic content are obtained in the absence of any corresponding syntactic form. The syntax thus appears to be incomplete. More specifically, the implicit semantic content is recovered from elements of the linguistic and non-linguistic context. In this sense, ellipsis is similar to anaphora, except that there is no overt anaphoric element involved. The elements present in an elliptical clause are predicates, arguments or adjuncts of what is omitted. It is the presence of these elements that makes it possible to recognize the ellipsis.

It is in principle always possible to reanalyse any elliptical phenomenon as a case of anaphora, by hypothesizing an unpronounced pro-form in the elliptical site (zero-anaphora) and/or by considering the licenser to be anaphoric. It is an interesting point about the structure of the present handbook that there is no chapter on unrealized subjects of finite verbs, often treated in terms of ‘pro’, i.e. zero-anaphora, in mainstream generative grammar. There is no a priori reason not to treat these simply as cases of ellipsis, just as there is no a priori reason not

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to analyze Verb Phrase ellipsis as a case of anaphora (as in Hardt [1993]). Decisions on these topics can only be made on the basis of further theoretical considerations.

As is the case for overt anaphors, ellipsis can be anaphoric or exophoric. Resolution of ellipsis thus requires a theory of context, and specifically a theory of how both non-linguistic and non-semantic material gets incorporated into context. More generally, ellipsis resolution requires a theory of conversation if one is to go beyond isolated examples and monologue. We will explain below how HPSG allows one to provide an account for these phenomena. On the other hand, most mainstream generative approaches fail to take them into account in sufficient depth.

HPSG typically takes the view that there is no single mechanism underlying ‘ellipsis’. Rather, the term covers a variety of cases involving contextually based resolution. Three central cases can be distinguished. The first two of these involve constructional analyses of ellipsis (see section 1.3), the third involves non-canonical correspondence between the phonology of a phrase and its daughters, and is much more restricted and limited in its scope (see section 1.4). First, non-sentential utterances (NSUs, e.g., Bare Argument Ellipsis and Sluicing, see sections 1.3.2 and 6.4), which acquisition data shows are acquired over a span of years (see e.g., Ginzburg and Kolliakou [2009]). These are analyzed as specific constructions typically characterized by the fact that a phrase is taken to be the only constituent of a clausal structure. Second, cases of argument or predicate ellipsis (e.g., null subjects and null objects, VPE, null-complement anaphora, etc., see sections 1.3.1 and 5). These are again analyzed in terms of specific elliptical constructions, typically involving a non-canonical correspondence between argument-structure (ARG-ST) and syntactic subcategorization (SUBJ and COMPS lists), so that arguments that are semantically present can be syntactically absent. Thus, in these two cases, there is no unpronounced syntactic structure. The third case, on the other hand, comprises constructions involving unpronounced syntactic structure, e.g., certain varieties of left- or right-peripheral ellipsis, in particular Right Node Raising. These are analyzed by having the PHON (phonology) feature of the mother not simply be a concatenation of the PHON features of all of its daughters, as is normally the case. The latter analysis is rather similar to various mainstream analyses involving unpronounced syntactic structure, especially to analyses involving PF-deletion. However, HPSG studies have argued.
that this type of analysis is only applicable in a very limited number of cases characterized by specific properties, as discussed in section 1.4. In the following subsections, we will present HPSG in general (section 1.2) and will provide a more detailed introduction to these three types of analyses (sections 1.3 and 1.4). We will conclude the section by a discussion of the importance of corpus studies (section 1.5).

1.2 Head-Driven Phrase Structure Grammar

Head-Driven Phrase Structure Grammar (HPSG) is a constraint-based linguistic theory initially proposed by Pollard and Sag [1987] and further developed in Pollard and Sag [1994] and numerous other papers. It is impossible to provide a detailed description of HPSG within the scope of this paper. We will limit ourselves to sketching the essential elements of the framework that are crucial to understanding its approach to ellipsis.

In HPSG, linguistic objects are modeled in terms of typed feature-value matrices. The value of a feature can be complex and even recursive. A language consists of a set of signs. These are abstract entities that are the locus of constraints on the interface between form, meaning and use. A grammar is a system of constraints that conjointly define the signs of a given language. The theory uses types, organized in inheritance hierarchies, making it possible to express generalizations of varying granularity across linguistic levels. Because signs combine information about all levels of representation (phonology, morphology, syntax, semantics, pragmatics, discourse and usage), HPSG is crucially non-modular. Constraints involving various levels can be easily stated. We will see that this is a powerful property of the framework for the analysis of ellipsis, as it allows one to express simultaneous semantic and syntactic constraints on ellipsis (explaining for instance the connectivity effects among

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1 See Müller [2015] and Sag [2012] for recent synopses and Sag et al. [2003] for a pedagogical introduction. For further references, see the HPSG bibliography, maintained by Stefan Müller: http://hpsg.fu-berlin.de/HPSG-Bib/.

2 The version of HPSG formalized in TTR (Type Theory with Records, cf. Ginzburg [2012], Cooper [2012]) refines this view. It proposes a linguistic ontology that includes both tokens (speech events, modeled as records) and types that characterize such tokens (signs, modeled as record types). This view of grammatical tokens and types plays an important role in our account of conversational interaction, key to understanding various elliptical resolution processes and is further discussed in section 6.

3 Sag et al. [2012] and Sag [2012] propose an integration between Berkeley-style Construction Grammar and HPSG under the name of Sign-Based Construction Grammar (SBCG). Under this view, constructions are understood to be constraints on classes of signs and their components, which are organized into lattice-like arrays of types and subtypes, without a sharp distinction between lexical and constructional constraints.
non-sentential utterances) and provides means to integrate non-semantic information into context. Thus, HPSG allows one to avoid two tendencies that are dominant in the literature:

- losing linguistic complexity, as in logically-based models which abstract away from a linguistic level.
- losing contextual complexity, as in generative accounts that abstract away from dialogue context.

As we will see in more detail below, HPSG initiated the constructional approach to ellipsis resolution, making central use of the notion of Question Under Discussion (QUD), cf. Ginzburg and Sag [2000] (henceforth GS00).

Furthermore, HPSG aims to be psycholinguistically plausible, specifically by providing a theory that is compatible with incremental processing. Finally, work in HPSG typically aims at strong empirical grounding, based on corpus research, field work, acceptability experiments etc. As in the Simpler Syntax framework (see chapter 7 of this volume), no distinction is made between core and periphery. Specifically, it is unclear that phenomena relegated to the “periphery” are less complex than core phenomena, so that nothing is gained by the distinction in explaining acquisition: learning the periphery raises the same problems as learning the core. The ambition is to provide a large-scale description for a broad range of empirical data that is concise, formally precise (and thus falsifiable), and insightful.

In the remainder of this section, we will introduce the two central types of analyses used to characterize ellipsis in HPSG, namely (i) constructional analyses (section 1.3), and (ii) non-canonical correspondence between the phonology of a phrase and its daughters (section 1.4). We will conclude the section with some discussion of corpus studies of elliptical phenomena.

1.3 Constructional analyses of ellipsis

In this section we will discuss two central types of constructional analyses of ellipsis, namely cases where there is a non-canonical correspondence between Argument-Structure and...
Valence and cases of non-sentential utterances.  

1.3.1 Non-canonical correspondence between Argument-Structure and Valence

The feature structures describing lexical items in HPSG contain a feature called ARG-ST (Argument-Structure), whose value is a list of feature structures describing the syntactic and semantic properties of the items they subcategorize for. Canonically, the ARG-ST list is the concatenation of the values of the two valence features, SPR (Specifier) and COMPS (Complements), which respectively govern the combination of the lexical item with its specifier and complements. (1) provides some typical examples of ARG-ST, SPR and COMPS values.

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\begin{align*}
\text{Lexical item} & & \text{ARG-ST} & & \text{SPR} & & \text{COMPS} \\
\text{laugh} & & \langle \text{NP}[\text{nom}] \rangle & & \langle \text{NP}[\text{nom}] \rangle & & \langle \rangle \\
\text{see} & & \langle \text{NP}[\text{nom}], \text{NP}[\text{acc}] \rangle & & \langle \text{NP}[\text{nom}] \rangle & & \langle \text{NP}[\text{acc}] \rangle \\
\text{speak} & & \langle \text{NP}[\text{nom}], \text{PP}[\text{TO}] \rangle & & \langle \text{NP}[\text{nom}] \rangle & & \langle \text{PP}[\text{TO}] \rangle \\
\text{will} & & \langle \text{NP}[\text{nom}], \text{VP}[\text{base}] \rangle & & \langle \text{NP}[\text{nom}] \rangle & & \langle \text{VP}[\text{base}] \rangle \\
\text{try} & & \langle \text{NP}[\text{nom}], \text{VP}[\text{TO}] \rangle & & \langle \text{NP}[\text{nom}] \rangle & & \langle \text{VP}[\text{TO}] \rangle \\
\end{align*}
\]

The **ARGUMENT REALIZATION PRINCIPLE** (ARP, see (38) below for a more precise formulation) states that, canonically, the value of ARG-ST for a given lexical item is the concatenation of the values of the SPR and COMP features, as illustrated in (1).

Given this set up, we can provide an analysis of the ellipsis of complements or specifiers simply by allowing non-canonical constructions for heads in which items mentioned in the ARG-ST do not appear in the valence features (such constructions are non-canonical in the sense that they do not respect the general formulation of the ARP). For instance, we can account for Verb Phrase Ellipsis by a constraint allowing auxiliaries to have alternate non-canonical lexical entries where their VP argument is specified as pronominal in the ARG-ST list and there is no corresponding VP in the COMPS list. This means that the VP meaning will be recovered anaphorically or exophorically from the context, ensuring appropriate semantic interpretation (see e.g., Schachter [1978], Hardt [1993], Kim [2006]), but will not be realized in the syntax, since it is not present on the COMPS list. Thus, a

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5A further case of constructional ellipsis, namely nominal ellipsis, has not been discussed in this paper for reasons of space. See e.g. Nerbonne et al. [1989, 1990], Mullen [2000] for HPSG analyses using a null head and Branco and Costa [2006] for an analysis avoiding an empty morpheme.
sentence like *Kim will.* receives a very simple constituent structure where the VP has only a single daughter, the V[AUX] *will.*

We can provide an analysis for Null Complement Anaphora (NCA), illustrated in (2-a), along the same lines. However, it is well-known that NCA differs from VPE in that there is apparently no independently motivated subclass of verbs to which it is applicable (as shown by the classical contrast between (2-a) and (2-b)). Thus, specific idiosyncratic lexical constraints will be required for verbs like *try* which allow NCA, as opposed to the general constraint which applies in the case of English auxiliaries for VPE.

(2)  
a. Kim could not open the door so Pat tried.  
b. *Kim could not open the door so Pat attempted.*

This type of analysis can also be used for languages that allow null pronominal subjects and/or objects (sometimes called ‘pro-drop’, see e.g., Manning and Sag [1999], Melnik [2007]). In cases where they are systematically available, e.g., null objects in Portuguese and null subjects in Spanish, a general constraint is required, similar to that suggested for English auxiliaries. Null objects, as in the Portuguese example (3-a), will be treated by having a pronominal NP (rather than a VP as in English VPE) as the second item of the ARG-ST list, with no corresponding item on the COMPS list. Null subjects, as in the Spanish example (3-b), are similar except that they require a pronominal NP as first item of the ARG-ST list with no corresponding item on the SUBJ list. This leads to constituent structures where the VP contains only the verb and the indirect object, as in (3-a), or the S contains only a VP daughter, as illustrated in (3-b). Thus the constituent structures for these sentences contain no unpronounced positions in the syntax (see section 5.2 below for further detail).

(3)  
a. Maria escolheu o livro e [s[NP Ana] [VP colocou] [PP na estante]]]. [Pt]  
   ‘Maria chose the book and Ana put [it] in the bookcase.’  
b. Maria llegó. [s[VP Estava] [AP cansada]]. [Es]  
   ‘Maria arrived. [She] was tired.’
In certain languages, null subjects and objects are subject to various restrictions, requiring complexification of the relevant constraints (see e.g. Melnik [2007] for a discussion of null-subjects in Hebrew).

In all of these cases the resolution of the ellipsis reduces to the resolution of the anaphoric element on the ART-ST list. We will provide further detail of how this works for VPE in

1.3.2 Non-sentential utterances

In this section we will briefly introduce the analyses of non-sentential utterances (NSUs), more specifically SLUICING and SHORT ANSWERS, which have been proposed in HPSG (see in particular Ginzburg and Sag [2000], chapter 8, Ginzburg [2012]). We will also present the analysis of GAPPING proposed by Abeillé et al. [2014], in which the gapped clause is treated as a cluster of NSUs.

Both sluicing and short answers involve XP ‘fragments’ which receive a ‘sentential’ interpretation (e.g., as propositions and questions). Following G&S00, we will analyze these as specific sentential constructions where the verbal projection is reduced to a single phrase. Despite their sentential semantics, treating NSUs as sentences in the sense of verbal projections may not be the best analysis in all cases. For certain cases, e.g., sluices, it clearly is, since it is well-known that they have a sentence-type distribution, rather than an NP or PP (see e.g., Culicover and Jackendoff [2005]:268-70). However, for other cases, there is cross-linguistic variation in this respect. For instance oui, non, si can be embedded under the complementizer que in French (Je crois que oui/non/si. ‘I think that yes/no/yes.’), whereas this is much more difficult in English. Similarly, NP short answers can be embedded in the Brazilian Portuguese example in (4). This is clearly much less natural in English, as shown by the glosses.

(4) A—Quem foi pra festa? B—Acho que o João. [Pt]

‘Who went to the party?’ ‘I think that the João.’

As will be discussed in more detail in sections 2.1 and 6, the form and interpretation of these

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6Ginzburg and Sag [2000] use the feature ±IC to distinguish embeddable from non-embeddable clauses (as in e.g. (51) and (52) below).
NSUs is determined by elements of the previous context.

**Gapping** has received much attention in the literature on ellipsis. Many analyses, following Ross [1967], invoke some form of a deletion process, which, in more recent versions, is sometimes fed by movement of the remnants to the left periphery (see among others Sag [1976], Hartmann [2009], Merchant [2004], as well as Chaves [2009] within an HPSG framework). Other studies have proposed a specific construction mapping a headless structure into a propositional meaning (see among others Sag et al. [1985], Steedman [1990], Gardent [1991], Culicover and Jackendoff [2005], Mouret [2007], Bilbiie [2011]). Following this tradition, Abeillé et al. [2014] provide a series of further arguments against deletion-based analyses (based on French and Romanian data) and propose a construction-based approach set in an HPSG framework. Specifically, they show that syntactic parallelism is less strict than what is usually assumed: each remnant in gapping is required to match some subcategorization frame of the verbal predicate its correlate depends on. On the other hand, discourse parallelism is required. The gapped clause is analyzed as a cluster of major fragments.7

1.4 **Non-canonical correspondence between the phonology of a phrase and its daughters**

*Right Node Raising* (RNR), also known as *Left-Peripheral Ellipsis* has been the subject of numerous studies (see e.g., Hartmann [2009], Culicover and Jackendoff [2005], Johnson [2009]). Within the HPSG literature, Yatabe [2003], Chaves [2008] Crysmann [2008], Beavers and Sag [2004], Chaves [2014], Abeillé et al. [2015] have insisted that it has radically different properties from the constructions discussed in the sections 1.3.1 and 1.3.2 above, which warrant a different type of analysis. Specifically, Chaves [2014] has argued that many of the complexities in the vast literature on RNR can be eliminated if it is recognized that many cases of apparent RNR also have analyses either as cataphoric VPE or N'-ellipsis or as ATB Extraposition. If one restricts oneself to cases which are unambiguously RNR, it appears that RNR “(i) can target any peripheral string of words that can form an independent prosodic

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7For reasons of space, we have not dealt with coordinate ellipsis in this paper, beyond what little is said here about the specific case of gapping. Among the HPSG work on the topic are: Sag et al. [1985], Beavers and Sag [2004], Mouret [2006, 2007], Yatabe [2012].
unit, and (ii) imposes morph form identity.” (Chaves [2014]:864). Chaves furthermore argues that certain cases of RNR cast doubt on the possibility of maintaining classical syntactic accounts of RNR.\(^8\)

(5)  

(a) Robin does NOT PLAY—or PRETENDS not to play—with a full deck. (cf. *It is with a full deck that Robin does not play.__.)  

(b) Do you primarily work with ORTHO- or with PERIO[dontists]? (cf. *Dontists, I don’t think I could work with ortho-.)

(c) It is possible that someone with a GOOD—and assumed that someone with an EXCELLENT—[set of golf irons][would make this hole in one]. (Chaves [2014]:866-7, (94), (95b), (97a))

In (5-a) the putatively RN Raised string is an idiom chunk; in (5-b) it is word-part; in (5-c) it is very difficult to argue that it could be a constituent. In all three cases, there is no reason to believe that the RN Raised string is a syntactically movable entity.

In order to account for these properties, Chaves proposes an analysis which might be considered to be close in spirit to PF-deletion. In general, in HPSG, when signs are combined, the phonology of the mother is assumed to be the concatenation of the phonology of its daughters. The construction for RNR, on the other hand, is exceptional in that it allows one to transfer only the phonology of the second of two sequences of morphophonological constituents that are identical up to morph forms. For technical details, see Chaves [2014], especially pp. 874ff.

The following properties characterize elliptical phenomena that must be analyzed in this way: (i) they require strict syntactic identity;\(^9\) (ii) they are strictly intrasentential; (iii) they are

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8Chaves uses small caps to signal contrastive focus, with an L+H* tone, and square brackets to identify the RN Raised string.

9Abeillé et al. [2015] report corpus data, among which (i) below, and the results of acceptability experiments on RNR in French. These provide evidence that there can be minor mismatches in content-less material (e.g. determiners and prepositions) as in (i). Note that in (i-a) it would be ungrammatical to replace des by de in what corresponds to the ellipted segment so that there is not strict identity. Similarly, in (i-b), parvient requires the preposition à.

(i)  

(a) C’est de la responsabilité de l’Eglise de venir en aide aux migrants et aux réfugiés qu’ils aient des papiers ou qu’ils n’aient pas de papiers. [Fr]  

‘It is the responsibility of the Church to help migrants and refugees whether they have or don’t have papers.’
never exophoric.

1.5 Elliptical phenomena: evidence from corpora

Corpus studies are important since they provide a “lower bound” for what the grammar needs to characterize; due to sparsity issues, admittedly, some rare phenomena (or at least rare in the settings sampled by a given corpus) might be missed. Hence, corpus-based generalizations need to be made on the basis of corpora with a wide range of genres and it is important to combine this source of data gathering with an experimental program. In this section, we review some studies that form an important backdrop to the HPSG/KoS work described below. We begin with a presentation of the corpus-based classification of clarification requests developed by Purver et al. [2001], because it provides an example of how the extensive discussions of certain elliptical constructions in the literature (in particular sluicing and bare argument ellipsis) have ignored important aspects of the relevant range of data, which are brought to light by corpus investigation. We will then mention more briefly other corpus-based work on ellipsis in HPSG. Successful coverage of the empirical phenomena presented in these papers, we believe, constitutes a significant test of adequacy for any theory of ellipsis.

Purver et al. [2001] propose a classification of the range of form/contents of clarification requests in the British National Corpus (BNC). These can take many forms, as illustrated in Table 1, all but the first three being elliptical. The examples in this table are to be understood as clarification requests in a discourse context where A has just uttered ‘Did Bo leave?’ (except for the last case, **Filler**, where A utters the incomplete utterance ‘Did Bo . . . ’).

Providing explicit formal analyses of just about any of these classes is a formidable challenge for any approach where ellipsis resolution is not embedded within a theory of

They consequently suggest an analysis which allows content-less material to be asymmetrically ellipted on the left, whereas content-full peripheral material must be shared on the right. Bilbié [2013] reports similar examples in English found in the Penn Tree Bank, e.g. **They were also as liberal or more liberal than any other age group in the 1986 through 1989 surveys** (WSJ). Experimental work is required to decide whether these should or should not be considered as errors.

**KoS**—a toponym, not an acronym—is a framework for describing dialogue interaction, which we introduce in section 6.
dialogical interaction; for detailed discussion see Ginzburg and Cooper [2004], Ginzburg [2012], who argue that neither deletion-type accounts, nor higher-order unification-type accounts can deliver the requisite readings. Indeed, to date, we are not aware of analyses of these phenomena in existing formal grammatical frameworks apart from HPSG. We highlight just several of the most significant issues.

The first point to note is that a number of these forms are ones whose **sole analysis** is as clarification requests—this applies to the classes **Wh-substituted Reprise** and to **Gap**. These constitute instances of forms whose meanings cannot be analyzed in interaction-free grammar.

A second point relates to cross-turn parallelism. Ginzburg and Cooper [2004], Ginzburg [2012] argue in detail that **reprise fragments** have two main classes of uses, one to request confirmation about the content of a previous sub-utterance; the other to find out about the intended content of a previous sub-utterance. Both uses have strong parallelism requirements, which require semantic and structural information to be projected across multiple turns into context. Thus, the former requires identity of syntactic category between source and target, as illustrated in (6-a) and (6-b); the latter requires segmental identity between source and target, as exemplified in (6-c). Parallelism of the latter kind seems needed also for the **Gap** class of CRs:

(6) a. A: Did she hit him? B: #He? / Him?
   c. A: Did Bo leave? B: Bo? [Intended content reading: *Who are you referring to?* or *Who do you mean?*] Alternative reprise: B: Max? [Lacks intended content reading; can only mean: *Are you referring to Max?*]
More generally, Fernández and Ginzburg [2002], Schlangen [2003] characterize the range of NSU types in the BNC, showing that they can be reliably classified into a small number of categories, revolving around the commonality in semantic resolution process. Subsequently, detailed semantic and syntactic accounts of these classes have been developed in Schlangen [2003], Fernández [2006], Ginzburg [2012], some of which we sketch in section 6. These classifications have been extended cross-linguistically, with minor modifications (French Guida [2013], Chinese Wong and Ginzburg [2013], Spanish Marchena [2015]) and to other genres (see e.g., Filtopoulos [2015]).

Focusing on one subclass of NSUs, which has attracted much attention, namely sluicing, the large generative literature on the topic (see e.g. Ross [1969], Chung et al. [1995], Merchant [2001] and many chapters in this volume), has, with very few exceptions, ignored the fact that bare *wh*-phrases are systematically ambiguous and concentrated almost exclusively on what Ginzburg and Sag [2000] dubbed *direct* uses of sluicing. Fernández et al. [2007] propose the existence of a four way ambiguity, an ambiguity they demonstrate to be reliably coded by human subjects:

- **Direct** The utterer of the sluice understands the antecedent of the sluice without difficulty. The sluice queries for additional information that was explicitly or implicitly quantified away in the previous utterance.

(7) a. A: Can I have some toast please?
   B: Which sort? [BNC, KCH, 104-105]

b. Caroline: I’m leaving this school.
   Lyne: When? [BNC, KP3, 538]

- **Reprise** The utterer of the sluice cannot understand some aspect of the previous utterance which the previous speaker assumed as presupposed:

(8) a. Geoffrey: What a useless fairy he was.
   Susan: Who? [BNC, KCT, 1753]

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11Fernández et al. [2007] develop a machine-learning based algorithm for this classification which achieves F-scores of approx 85%. 

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b. Pat: You might find something in there actually.
    Carole: Where? [BNC, KBH, 1817]

- **Repetition** The sluice is used to ask for repetition of the previous utterance as a whole.

(9) June: Only wanted a couple weeks.
    Ada: What?
    June: Only wanted a couple weeks. [BNC, KB1, 3312]

- **Wh-anaphor** The utterer of the sluice cedes the turn to the previous speaker, who has indicated his wish to answer a (possibly embedded) wh-question s/he has just uttered:

(10) A: We’re gonna find poison apple and I know where that one is.
    B: Where? [BNC, KD1, 2370-2371]

‘Repetition what’ can be produced after any utterance, regardless of its content and is indeed the highest frequency type of sluice in the BNC; wh-anaphor uses are significantly more selective and complex in that they both presuppose that the previous utterance embeds a question and involve phonological parallelism between the fragment and the wh-phrase in the prior utterance. We discuss direct and reprise sluicing below, whereas the other two classes are analysed in Ginzburg [2012].

Beyond the cases of clarification requests and NSUs just discussed, other work in HPSG has been based on detailed corpus investigations, e.g. Bîlbîie [2011] on gapping in Romanian and French, Abeillé et al. [2014] on gapping in Romance, Abeillé et al. [2015] on peripheral ellipsis in French, Miller and Pullum [2014] on exophoric VPE, Miller [2014] on pseudogapping.12

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12Nielsen [2005], Bos and Spenader [2011] on VPE and Beecher [2008] on sluicing also show how corpus studies allow one to bring to late new theoretically important phenomena. Though these studies are not set in an HPSG framework, their assumptions are largely compatible.
2 The structure of the ellipsis site

Overall, the default assumption in HPSG is that there are no empty morphemes or unpronounced syntactic structures. This is a consequence of a general principle of economy (Occam’s razor, cf. Miller [1997]). For elliptical constructions this means that, in the absence of strong evidence to the contrary position, there should be no syntactic structure at the ellipsis site, as mentioned above for argument ellipsis and NSUs in section 1.3. Similarly in long-distance \textit{wh}-dependencies, it is assumed that there is no empty syntactic node at the foot of the construction (i.e. there is no “trace”, cf. Sag and Fodor [1994]). On the other hand, HPSG does not make the assumption that all forms of ellipsis should necessarily be treated by a single formal mechanism, so that unpronounced structure \textit{can} be assumed if warranted in a given case, as was argued for RNR in section 1.4.

With respect to unpronounced syntactic structure, HPSG is in clear disagreement with much mainstream generative syntax. Numerous publications have argued in detail that such unpronounced structure is necessary to provide a motivated explanation for various constraints on ellipsis. It is thus important in the context of this paper to review the central types of evidence that have been brought to bear on this question and to present the counter-arguments that have been advanced on the HPSG side (in line with numerous other studies, see e.g. chapters 5, 7, 8, 9 of this volume). We will discuss connectivity and locality effects in turn.

2.1 Connectivity effects

Since Ross’ and Morgan’s seminal papers on sluicing and short answers (Ross [1969], Morgan [1973]) it has been known that fragment answers and sluices exhibit connectivity effects, i.e. fragments typically appear in the form that would be theirs in the corresponding understood full clause. Various types of connectivity can be distinguished. In languages with morphological case, NP fragments typically appear in the case that they would have in the understood complete sentence, as in the classical examples (11) from Ross [1969]. Similarly, PP fragments appear with the preposition that they would have, as in (12).

\begin{enumerate}
\item (11) a. Er will jemandem schmeicheln, aber sie wissen nicht wem/#wen.
\end{enumerate}
He wants someone.\textit{DAT} flatter, but they know not who.\textit{DAT}/#who.\textit{ACC} \\
‘He wants to flatter someone, but they don’t know whom.’

b. Er will jemandem loben, aber sie wissen nicht wen/#wen.
He wants someone.\textit{ACC} praise, but they know not who.\textit{ACC}/#who.\textit{DAT} \\
‘He wants to praise someone, but they don’t know whom.’

(12) a. I gave it away. I do not know to whom/#with whom. (COCA)

b. He seemed to be competing with someone, though we never knew with 
   whom/#to whom. (COCA)

Along the same lines, the form of pronoun fragments is frequently the one you would find in 
the corresponding complete sentence and thus appears to be explained by the usual application 
of the binding theory:

(13) Who did Pat see in the mirror? Herself/#Her. [cf. Pat saw herself/#her in the mirror.]

The apparent generalization is that fragments appear in a form that would be appropriate in the 
corresponding understood full sentence.

On the face of it, this might seem to be a convincing argument for hidden syntactic 
structure, since the presence of such structure would explain why the fragment has the form it 
has, rather than some other. However, a closer look at the data shows the limits of the putative 
generalization and makes such an analysis less plausible than it initially seems. First, there are 
numerous cases where fragments appear in a form that would be impossible in a complete 
sentence. Specifically, in English, only pronouns have a nominative/accusative distinction. 
Possessive case, on the other hand, appears both with pronouns and with NPs (realized as an 
NP final ‘s). Possessives exhibit typical connectivity effects as in (14-a). However, in all cases 
where a possessive is not expected, it is the accusative pronouns that appear in elliptical 
utterances, as expected by connectivity in (14-b), but also when a nominative would be 
necessary in a full clause, as in (14-c), and when there is no obvious full clausal structure to be 
recovered, as in (14-d).

(14) a. Whose book is that? Kim’s/#Kim/Mine/#Me/#I. [cf. That is Kim’s/mine/#me/#I]
b. Who did Sandy see? Kim/Me/#I/#Mine. [cf. Sandy saw Kim/me/#I/#mine]
d. [Choosing players for a ball game, captain gestures towards prospective players]: Me, him, her, . . . [cf. #I, he, her, . . .]

Similarly, for binding effects, it turns out that pronouns often appear in forms that would not be licensed in a full clause.

(15) a. A: Who will punish Bill if he fails?
   He himself/Himself/#He/#Him (He himself/#himself will punish Bill if he fails). (GS00:376(4a))
b. A: What caused the computer to break down?
   B: A power surge?
   A: Perhaps, but the most intriguing answer is: [the computer itself]/itself/#it. (#The computer itself/#Itself caused the computer to break down.)
c. A: Who appeared to be the cause of John and Mary’s problems?
   B: Each other. (*Each other appeared to be the cause of John and Mary’s problems.)

It thus appears that although connectivity is a common situation, there are various cases where fragments could not be reintegrated as such into a well formed complete clause. Such examples of non-connectivity raise problems for any analysis that wishes to explain the cases where connectivity holds in terms of unpronounced syntactic structure and require various ad hoc assumptions to account for the absence of the expected connectivity effects. For detailed exemplification, see e.g., Ginzburg [1999], Stainton [2006], Ginzburg [2012], Nykiel [2013]. Furthermore, even in those cases where connectivity does hold, deletion or reconstruction-based accounts almost invariably fail to offer an explicit account of how the reconstructed syntactic material is accessed in the context and introduced into syntactic structure. This is true even in cases where the antecedent is anaphorically retrieved, but is even more problematic in exophoric cases.
On the other hand, cases where connectivity does hold (as it typically does cross-linguistically with case morphology, for instance) raise the symmetrically inverse problem for analyses whose architecture enforces the assumption that the context used for interpreting fragments is purely semantic e.g. higher order unification accounts Pulman [1997] and categorial grammar (see e.g., Jacobson’s contribution in this volume).

Because of the non-modularity of the sign, HPSG has no problem in accounting for connectivity effects without reference to hidden structure. In section 6.2, we sketch an account of parallelism in NSUs originating in Ginzburg and Sag [2000], which amplifies QUDs to include a restricted amount of non-semantic information. Syntactic parallelism is obtained by imposing matching conditions between a fragment and a prior utterance. Thus prior syntactic structure is not used in constructing the content of a fragmentary utterance; it functions merely in establishing the appropriateness of the fragment in the given context. In embedding the antecedent information within QUD, Ginzburg and Sag [2000] (p. 301) make strong predictions about the extent of categorial parallelism. Specifically, only properties of the MAX-QUD can trigger syntactic or phonological parallelism.

2.2 Locality effects

Locality effects have provided another classical motivation for unpronounced syntactic structure. Specifically, it has been argued that various cases of ill-formedness in elliptical constructions can be explained in terms of island violations involving such structure. Consider the following examples:

(16) a. *We left before they started playing party games. What did you leave before they did?

       b. *What did you leave before they (did) [vp start(ed) playing t]? (Chung et al. [1995]:275, (92), (93))

Sentence (16-a) is claimed to be ungrammatical because it exhibits the same island violation in unpronounced structure as its non-elliptical counterpart (16-b). The same point is made by Merchant for the pair (17-a) and (17-b).
a. They want to hire someone who speaks a Balkan language, but I don’t remember which they do \[_{vp\, want\to\,hire\,someone\,who\,speaks}\]. (Merchant [2001]:6, (5))

b. *They want to hire someone who speaks a Balkan language, but I don’t remember which they want to hire someone who speaks. (Merchant [2001]:6, (4b))

However, these facts raise a number of problems. First, as is known since Ross [1969], sluicing appears to absolve island violations, as illustrated by the contrast between (17) and (18).

(17) a. They want to hire someone who speaks a Balkan language, but I don’t remember which they do \[_{vp\, want\to\,hire\,someone\,who\,speaks}\]. (Merchant [2001]:6, (5))

b. *They want to hire someone who speaks a Balkan language, but I don’t remember which they want to hire someone who speaks. (Merchant [2001]:6, (4b))

Second, there are cases where what would be putative island violations in unpronounced structure do not lead to ungrammaticality (though some speakers may find acceptability slightly reduced, their status is not at all comparable to that of (16-a) and (17-a):

(18) They want to hire someone who speaks a Balkan language, but I don’t remember which. (Merchant [2001]:6, (4a))

(19) a. He managed to find someone who speaks a Romance language, but a Germanic language, he didn’t \[_{manage\,to\,find\,someone\,who\,speaks\,t}\].

b. He was able to find a bakery where they make good baguette, but croissants, he couldn’t \[_{find\,a\,bakery\,where\,they\,make\,good\,t}\].

Furthermore, as pointed out by Fox and Lasnik [2003], there are cases where VPE interacts with \(wh\)-movement triggering unacceptability, despite the absence of island violations in the putative unpronounced structure. For example, neither the non-elliptical variant, nor the sluice in (20-a) raise a problem, but the VPE variant in (20-b) is ungrammatical:

(20) a. They heard a lecture about a Balkan language, but I don’t know which Balkan language (they heard a lecture about).

b. *They heard a lecture about a Balkan language, but I don’t know which Balkan language they did. (Fox and Lasnik [2003]:148, (27), (28))
In sum, the factors that constrain the interaction of wh-movement and VPE are at present not understood and it is hard to see how a strong argument for unpronounced structure can be made from these facts.

Similar arguments have been made, for instance, for Bare Argument Ellipsis (see e.g., Merchant [2004]) and Gapping (see e.g., Coppock [2001]), purporting to show that they are affected by similar island violations in unpronounced structure. However, once again, it has been argued that similar examples which should exhibit the same island violations can also be perfectly acceptable, e.g. by Culicover and Jackendoff [2005] chapter 7.

Thus, overall, the evidence appears to be mixed and does not at present allow one to draw strong conclusions either in favor of or against unpronounced structure. Our expectation is that a better understanding of the discourse conditions on the elliptical constructions in question and their interaction with wh-movement might lead to a more satisfactory explanation of the data.

To conclude this section, we mention one final argument provided against hidden structure in an HPSG framework. Arnold and Borsley [2008] show that fragment answers do not allow non-restrictive relative clauses connected with part of the “missing” material, contrary to anaphoric “it” which does.

(21)  a. A: Who owns a dog?
     B: Kim, which is regrettable.
  b. A: Who owns a dog?
     B: *Kim, which is a dachshund.
  c. A: Who owns a dog?
     B: Kim, and it’s a dachshund. (Arnold and Borsley [2008]:327-328)

As shown in (21-a), a non restrictive relative clause can have as its antecedent the whole proposition expressed by the fragment, but it cannot have an understood but syntactically unrealized NP as its antecedent, as (21-b) shows. In this, which differs from the pronoun it which can access such a referent. Arnold and Borsley argue that the difference in grammaticality between (21-a) and (21-b) is difficult to capture under the assumption that the fragment Kim has a syntactic structure where the entire understood structure is present but
unpronounced. They show, on the other hand, that the analysis for fragments proposed by Ginzburg and Sag [2000] (presented below in section 6) immediately predicts the data.

3 Recoverability

Following Sag and Hankamer [1984], HPSG studies have assumed that the central condition on recoverability is the availability of an appropriate antecedent in the discourse context (which combines both linguistic and non-linguistic information). Providing formal conditions on recoverability therefore requires an articulated theory of context, and in particular of conversational context, which is sketched in Ginzburg and Sag [2000] and elaborated in detail in Ginzburg [2012].

Of course, as discussed in the preceding section, HPSG also provides means for accounting for well-known syntactic constraints on the relationship between the elliptical material and its antecedent-trigger, though these are argued to be less numerous than is usually thought. Specifically, it has been argued that many of the classical cases where acceptability is reduced in the absence of a syntactically identical antecedent can in fact receive an alternative explanation, namely that the reduced acceptability is due to violations of general discourse conditions (cf. Kehler [2002], Kertz [2013]) or of construction specific discourse conditions (cf. Miller and Hemforth [2014], Miller and Pullum [2014]. We will discuss in turn: split antecedents and syntactic mismatches; exophoric uses; and incrementality.

3.1 Split antecedents and syntactic mismatches

A first class of cases that argue against the idea that recoverability should be based on syntactic identity are those where the previous linguistic context provides no identical antecedent-trigger (we ignore here cases of morphological mismatch known not to affect grammaticality). These include the well known cases of split antecedents and those where there is some form of syntactic mismatch between the antecedent-trigger and the ellipted

13We take the term ‘antecedent-trigger’ from Cornish [1999], who uses it to designate the segment of text allowing one to construct the antecedent (he uses ‘antecedent’ to refer to the discourse-model representation making interpretation of the anaphor or ellipsis possible).
material. We will illustrate these in turn.

VPE with split antecedents was first discussed by Webber [1979], who gave examples like (22):

(22) Wendy is eager to sail around the world and Bruce is eager to climb the Kilimanjaro, but neither of them can because money is too tight. (=can do what s/he is eager to do) [her (63), p.4-39].

In fact, split antecedents are a special case of a more general situation where the antecedent is recoverable from the contents of the previous discourse without actually being present in it in any appropriate form. Consider the following example:

(23) “Thanks for the ride,” Dicey said. “Any time,” Jeff answered. “[. . .] I was hoping to meet your sister who sings.” “We’re in a hurry for dinner tomorrow,” Sammy [=Dicey’s brother] said. “Because it’s Thanksgiving. […]” “Maybe another day,” Dicey said. “You mean that?” he [=Jeff] asked. […] “Sure,” she said. “Because I will,” he [=Jeff] warned her. “Good,” she answered, puzzled and amused. (Cynthia Voigt, Dicey’s Song, p.140)

In this example, the previous context makes it clear that the elliptical clause is intended to mean something like “I will come back to meet your sister who sings”. However this content appears nowhere as such in the conversational context; rather it is directly inferrable from it.

Similarly, in the second instance of sluicing in (24), the intended antecedent is recovered by inference from the discourse context.

(24) She always knew exactly who was in and who was missing; and if you were missing, Madame probably knew why, and with whom. (Neil Bartlett, Ready to Catch Him Should He Fall) [= knew why you were missing and with whom you had left, rather than with whom you were missing]

Cases of syntactic mismatch between the antecedent and the elliptical sentence (e.g. voice mismatches, category mismatches) have been extensively discussed in the literature,
especially for the cases of VPE and sluicing (see, among many others, Hardt [1993], Merchant [2001], Kehler [2002], Kertz [2013], Merchant [2013]). For sluicing, the great majority of the literature has agreed that mismatches are impossible. For VPE, the situation is much more complex because of the fact that there is a wide range of different acceptabilities for different cases of VPE with mismatched antecedents, ranging from the perfectly acceptable to the very unacceptable. This has led to two different positions. Either one assumes that the syntax disallows mismatches, in which case acceptable cases of mismatch are analyzed as ungrammatical but repaired. This position has been defended by Lyn Frazier and her colleagues in a series of studies (see e.g. Arregui et al. [2006], Grant et al. [2012]). The other is to assume that mismatches are always grammatical, and that unacceptable instances arise from the violation of independent discourse constraints (e.g. Kehler [2002], Kertz [2013]).

Within this debate, HPSG studies have followed the lead of Kehler and Kertz, but have focused on developing construction-specific discourse constraints. For VPE, Miller [2011], Miller and Pullum [2014], Miller and Hemforth [2014] distinguish two subtypes of non-comparative VPE, which they call Auxiliary-Choice and Subject-Choice respectively, and propose the following constraints.

**Type 1: Auxiliary Choice VPE**

**Formal Characteristics:** The subject of the antecedent is identical with the subject of the VPE construction and the auxiliary is (at least weakly) stressed, signaling a new choice of tense, aspect, modality, or (in the most overwhelmingly frequent case) polarity.

**Discourse Requirement** A choice between the members of a jointly exhaustive set of alternative situations must be highly salient in the discourse context, and the point of the utterance containing the VPE is limited to selecting one member of that set.

**Type 2: Subject Choice**

**Formal Characteristics:** The subject of the antecedent is distinct from the subject of the VPE construction, and stressed if it is a pronoun.

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14Kim et al. [2011] develop an alternate proposal suggesting that the reduced acceptability of mismatches can be attributed to processing difficulties. Miller and Hemforth [2014] point out that the two positions are compatible and suggest that discourse factors and processing factors can cumulatively reduce acceptability.
DISCOURSE REQUIREMENT: A particular property must be highly salient in the discourse context, and the point of the utterance containing the VPE must be limited to identifying something or someone possessing that property.

Importantly, they point out that when these discourse constraints are satisfied, VP anaphors like do it are dispreferred. This is illustrated in (25-a) for an Aux-Choice case. Note that asking a polar question is a central way of making a polar alternative salient (or of making it the Question Under Discussion, using the terminology developed in section 6.2). (25-b) provides a Subj-Choice case.

(25)  
   a. A—Does Bo eat meat? B—She does. [vs. #She does it.]
   b. A—Bo eats meat. B—Kim does too. [vs. #Kim does it too.]

For VPE with nominal antecedents, Miller and Hemforth [2014] show how these discourse constraints can explain the unacceptability of most cases. Specifically, for the case of Aux-Choice VPE, nouns are typically incapable of making an alternative salient. However, they point out the existence of a small class of ‘polar nouns’ that can be interpreted as concealed polar questions, as is the case for survival in (26-a), which can be paraphrased by an indirect polar interrogative as shown in (26-b).

(26)  
   a. Mubarak’s survival is impossible to predict and, even if he does [survive], his plan to make his son his heir apparent is now in serious jeopardy. [COCA: CBS Evening News]
   b. Whether or not Mubarak will survive is impossible to predict and even if he does [survive], his plan […]

Miller and Hemforth show that when a polar noun appears in a discourse context that makes its interpretation as a concealed polar question salient, it can serve as a highly acceptable antecedent for VPE. These observations are corroborated through a series of acceptability experiments. On the other hand, NPs are incapable of making open propositions salient, so that Subj-Choice VPE is never acceptable with a nominal antecedent.

Similarly, though no detailed study has been conducted, we expect that the discourse
conditions on sluicing (namely that it requires that a quantified proposition be at issue) can account for the fact that voice mismatches are unacceptable. On the other hand, examples such as (27), due to Beecher 2008, illustrate the possibility of sluicing with a nominal antecedent. In both cases, there exists an entailment of the requisite quantified proposition and, despite the lack of a clausal (verbal) antecedent, the sluice seems acceptable, as expected from an account based on the above discourse condition:

(27)  

a. We’re on to the semi-finals, though I don’t know who against. (Beecher 2008:6:(8a))  
b. The only thing I can come up with is contamination but I do not know what from. (Beecher 2008:8:(10a))

3.2 Exophoricity

Let us now consider exophoric uses. In these, there simply is no linguistic antecedent at all. Examples of exophoric VPE are provided in (28).

(28)  

a. [Entering a construction site, A hands a helmet to B] Do I have to? [compare: #Do I have to do it?] (Miller and Pullum [2014]:20, (24a))  
b. When the rain began on Thursday, I simply had the kids throw on slickers and use plastic grocery bags to cover backpacks. I rode with them to school, for solidarity, but when we pulled up, an upperclassman looked at them, then me, and said half-accusingly, “How could you?” Our family experiment had suddenly gone from cool and hip to strange and compulsive. [compare: #How could you do it?] (COCA, Miller and Pullum [2014]:21, (26))

Miller and Pullum [2014] argue that exophoric VPE is in fact freely available syntactically (contrary to Hankamer [1978] who claims that the rare cases of exophoric VPE are idioms) but that it is relatively rare because the discourse conditions on VPE are hard to satisfy through extralinguistic context. Specifically, for Aux-Choice VPE, they argue that, in general, it is difficult for non-linguistic context to make an alternative salient. The most usual means for doing so are polar questions and assertions (see section 6.2), but these typically cannot be
performed non-linguistically. Thus, only less frequent strategies for establishing an alternative as the QUD can give rise to exophoric VPE. Directives, for example, can make an alternative salient (whether or not to comply), whether they are performed linguistically or deictically, as in (28-a). Similarly uttering a reproach, as in (28-b), forces accommodation of the alternative between doing or not doing the incriminated behavior, satisfying the discourse conditions. Crucially, they point out that when the discourse conditions on VPE are satisfied, do it is less felicitous, as shown in the variants of (28) above. On the other hand, they suggest that it is almost impossible for non-linguistic context to make an open proposition salient, so that exophoric Subj-Choice cases are almost impossible.

Similarly, though exophoric sluicing is rare in corpora, it is clearly attested, as shown by examples like (29).

(29)  
a. She had reached the head of the line. Her eye caught a name on the list, and she made a snap decision. When the ticket seller said “Where to? ” she answered, “Gmintagad”. (COCA)  
b. “Bonsoir,” he said. “How may I help you?” [...] Sophie [...] simply laid the gold key on the counter in front of the man. The man glanced down and immediately stood straighter. “Of course. Your elevator is at the end of the hall. I will alert someone that you are on your way.” Sophie nodded and took her key back. “Which floor?” The man gave her an odd look. “Your key instructs the elevator which floor.” She smiled. “Ah, yes.” (COCA)  
c. In Treatment, but in Which Language? [Title of Article, New York Times, Mar 31 2015; intended interpretation: in (psychotherapeutical) treatment, but in which language should the treatment be taking place?)]  
d. Thomas Kebussyan wagged his bald head. “We can’t hold a meeting in the church square. Nor in the church. There are the saptiehhs... And others too. God knows who wouldn’t creep in and listen and then betray us. And besides, the church is too small for us. So where?” [Intended interpretation: ‘Where can we hold the meeting’]. (The Forty Days of Musa Dagh, Franz Werfel, pp. 207).
Once again, we assume that the relative rarity of exophoric sluices is due to the discourse conditions on the use of the construction: sluicing requires that a quantified proposition be at issue (see discussion of example (56) below and Ginzburg [2012], section 7.8).\footnote{Below, we mention the case of sluices of the form ‘Who else?’, which are compatible with a referential antecedent ‘X V’ed’. Nonetheless, their salience clearly requires the issue ‘Somebody else apart from X V’ed’ to be worthy of discussion.} This is difficult to construct non-linguistically, in a way parallel to what is proposed for VPE.

Another class of exophoric ellipsis are declarative fragments tied to various interactional genres, as in (30):

(30) a. (Buying a train ticket):
    Client: A return to Newcastle please. (= I want a return . . . , please give me a return . . .)

b. (Buying in a boulangerie): Baker: Two Euros, forty cents. (=This costs two Euros, forty cents . . . , please pay me two Euros, forty cents . . .)

Finally, we note here a class of non-sentential utterances, for which exophoric resolution is close to being the rule. This involves the little discussed phenomenon of exclamative sluices Ginzburg [2012], exemplified in (31):

(31) a. It makes people “easy to control and easy to handle,” he said, “but, God forbid, at what a cost!” (COCA)

b. What a mess / relief / surprise / goal / jerk / view!

Example (31-a) illustrates a case of an anaphoric exclamative sluice that is parallel to typical interrogative sluices. As for examples like (31-b), they are by far the most frequent and are typically exophoric. This shows that any account of sluicing based on the long standing assumption that \textit{wh}-binding requires a linguistic antecedent is not viable.

It is important to emphasize the real difficulty these exophoric cases pose for analyses that claim that recoverability must be stated in terms of syntactic identity. It is completely unclear how such analyses can make sense of exophoric uses at all, barring the assumption that a speaker constructs a specific syntactic representation of the relevant extralinguistic properties,
which could then be used as an “antecedent”. However, this idea defeats the basic purpose of the idea of “recoverability” of deletions, as initially proposed by Chomsky.

3.3 Incrementality

An additional argument against viewing a construction such as sluicing as S-deletion (or similar) is that it is possible as soon as its nominal antecedent has been introduced, as in (32); it need not occur as part of a completed sentential construction. This can occur either in monological examples such as (32-a) or in dialogical cases such as (32-b) and (32-c). Once one adopts an incremental view of semantic processing, accommodating such data becomes straightforward, as we will show in section 6.4.3.

(32) a. Someone, {John? / I can’t figure who}, has taken the kitchen scissors.


c. A: Somewhere B: Where? A: not far from here B: Aha A: someone is enjoying the cheese I forgot on the train.

4 Licensing

As has been mentioned above and as will be developed in much more detail in section 6 below, the HPSG approach to ellipsis resolution makes central use of the notion of Question Under Discussion (QUD), which is augmented to include restricted amounts of non-semantic information. In a sense then, HPSG assumes that QUD is the central factor in the licensing of ellipsis. This make sense under a more general view of anaphora resolution involving some notion of accessibility or givenness (see e.g. Ariel [1990], Gundel et al. [1993]), as it is known that, in general, phonologically weaker anaphors require more accessible antecedents. Since ellipsis can be seen as the phonologically weakest form of anaphor, it requires antecedents that are most accessible, namely, antecedents involved in the most salient QUD at any moment in the discourse. This feature of the model thus makes strong general predictions about the syntax, phonology, semantics and pragmatics of elliptical constructions, namely that only
properties of the most salient QUD can be relevant in determining their form and interpretation.

Beyond this, HPSG does not assume that there is a single mechanism underlying ellipsis. Rather, elliptical constructions each have their own specific licensing conditions. To the extent that generalizations can be made, they can be captured through the hierarchy of types. For example, it is known that different subtypes of VPE have subtly different properties (see e.g. Miller [2011], Kertz [2013]). The general properties of VPE can be attributed to the construction-type VPE, whereas the various subconstructions can be specified for their specific properties, while inheriting the general properties from the more general construction. Similarly it would be possible represent the generalizations available for different types of argument ellipsis (see section 1.3.1 and next section), including VPE, through the type hierarchy, and more generally to associate the general properties of ellipsis involving QUD to an overarching ellipsis-type, though to our knowledge this has not yet been attempted. In sum, the basic methodological assumption of HPSG is that one should not move too quickly in assuming that properties of constructions are generalizable. The complexity of the varieties of subconstructions must first be established in as much detail as possible before meaningful generalizations can be made.

Throughout this paper, the discussion of the various elliptical constructions highlights their specific licensing properties. We have distinguished three central cases: (i) certain constructions license non sentential constituents as complete utterances (e.g. Bare Argument Ellipsis, Sluicing, Gapping); (ii) certain constructions license non-canonical correspondence between ARG-ST and Valence features (e.g. Null subjects and objects, VPE, NCA); (iii) certain constructions license a non-canonical correspondence between the PHON of a mother and its daughters (e.g. Peripheral ellipsis, RNR). More specific constructions involve more specific licensing conditions, e.g. VPE is licensed by the presence of an auxiliary in English, whereas sluicing requires a \(w/h\)-phrase.
5 The syntax of argument ellipsis

In this section we provide a more explicit discussion of the constructional analysis of argument ellipsis which was sketched in section 1.3.1 above. As mentioned there, the crucial insight underlying the analysis is that there is a non-canonical correspondence between the argument structure of a head and its valence. More specifically, the value of the ARG-ST feature is not simply the concatenation of the values of the valence features SPR and COMPS.

5.1 Phrase structure and valence features in HPSG

In HPSG, the combination of heads with their daughters is governed by two rules. The HEAD-COMPLEMENT RULE combines the head (H in (33-a)) with its complements ([1] to [n] in (33-a)). The resulting phrase inherits the HEAD value of its head-daughter, but crucially, not the value of the COMPS feature whose specification has been satisfied, so that it has an empty list as the value for COMPS. Similarly, the HEAD-SPECIFIER RULE combines the head with its specifier ([1] in (33-b)), satisfying the valence requirement.

\[
\begin{align*}
(33)\quad & a. \text{Head-Complement Rule} \\
& \begin{array}{l}
\text{phrase} \\
\text{VAL} \quad \text{COMPS} \quad \langle \rangle
\end{array} \rightarrow H \\
& \begin{array}{l}
\text{word} \\
\text{VAL} \quad \text{COMPS} \quad \langle 1, \ldots, n \rangle
\end{array}
\end{align*}
\]

\[
\begin{align*}
(33)\quad & b. \text{Head-Specifier Rule} \\
& \begin{array}{l}
\text{phrase} \\
\text{VAL} \quad \text{SPR} \quad \langle \rangle
\end{array} \rightarrow 1 \\
& \begin{array}{l}
H \\
\text{VAL} \quad \text{SPR} \quad \langle 1 \rangle \\
\text{COMPS} \quad \langle \rangle
\end{array}
\end{align*}
\]

This is illustrated in tree (34). In order to make these rules and the tree fully clear, we need to introduce the way STRUCTURE SHARING works in HPSG. It is indicated by boxed numbers. Putting the same boxed number in several places in a feature structure or rule, indicates that the corresponding values are token identical. Thus, in tree (34), the 2 expresses the fact that the feature structure which is the sole element in the value of the COMPS list of *saw* is token identical to the feature structure describing the NP *Pat*. This means that it would be entirely redundant to replace ‘COMPS⟨2⟩’ by ‘COMPS⟨2NP⟩’ (of course, the tree would have expressed exactly the same property if we had had the latter above *saw* and only
the former above *Pat*). Similarly, in (33-a), the shared box numbers indicate that the feature structures describing the items on the COMPS list and those describing the corresponding daughters are token identical.\(^{16}\)

\[ (34) \]

```
S
  \[
    \begin{array}{c}
      \text{SPR} \\
      \text{COMPS}
    \end{array}
  \]
  \[
    \begin{array}{c}
      \text{NP} \\
      \text{VP}
    \end{array}
  \]
```

```
\[
\begin{array}{c}
\text{SPR} \\
\text{COMPS}
\end{array}
\]
```

```
\[
\begin{array}{c}
\text{NP} \\
\text{VP}
\end{array}
\]
```

```
\[
\begin{array}{c}
\text{SPR} \\
\text{COMPS}
\end{array}
\]
```

```
\[
\begin{array}{c}
\text{ARG-ST}
\end{array}
\]
```

```
saw
```

Similarly, tree (35) provides an example with the auxiliary *will*.

\(^{16}\)Signs in HPSG can be lexical or phrasal. In the latter case, formally speaking, the constituent structure is modeled within the feature structures using the features MOTHER, HEAD-DTR (Head-Daughter) and NON-HEAD-DTRS (Non-Head-Daughters). Thus tree representations of the type given in (34) are an informal simplification enhancing readability.
5.2 The Argument Realization Principle and ellipsis

Given this set up, we can provide an analysis of the ellipsis of complements or specifiers simply by allowing non-canonical constructions for heads, in which items mentioned in the ARG-ST do not appear in the valence features (such constructions are non-canonical in the sense that they do not respect the general formulation of the ARGUMENT REALIZATION PRINCIPLE provided in (38) below). For instance, we can account for Verb Phrase Ellipsis by constraint (36-a) which provides auxiliaries with a non-canonical relation between the
COMPS and ARG-ST lists. Constraint (36-a) will be inherited by will (since it is an aux), providing it with the alternate COMPS list given in (36-b), giving rise to a structure like (37) (see e.g., Kim [2006]; note that the properties [nom] for the NP subject and [base] for the VP are inherited from the basic lexical constraints for aux).  

(36) a. aux: \[
\begin{array}{l}
\text{SUBJ} \langle A \rangle \\
\text{COMPS} \langle \rangle \\
\text{ARG-ST} \langle A, \text{VP[pro]} \rangle \\
\end{array}
\]
b. will: \[
\begin{array}{l}
\text{SUBJ} \langle 1, \text{NP[nom]} \rangle \\
\text{COMPS} \langle \rangle \\
\text{ARG-ST} \langle 1, \text{VP[pro, base]} \rangle \\
\end{array}
\]

(37) \[
S \\
\begin{array}{l}
\text{SPR} \langle \rangle \\
\text{COMPS} \langle \rangle \\
\end{array}
\]

\[
\text{[1NP} \\
\text{Kim} \\
\text{VP} \\
\end{array}
\]

Since (36-a) applies to all auxiliaries, we correctly express the classical generalization that VPE is systematically available behind auxiliaries. Specifying that the VP argument of pre-elliptical auxiliaries is pronominal essentially captures the intuition of Schachter [1978] and means that it will be interpreted through general principles for resolving anaphoric and/or exophoric dependencies (cf. e.g., Hardt [1993]).

In the light of this example, we can state the **ARGUMENT REALIZATION PRINCIPLE** as follows:

\[
\text{(38) Argument Realization Principle} \\
\text{word } \Rightarrow \begin{bmatrix}
\text{VALENCE} \\
\text{SPR} & 1 \\
\text{COMPS} & 2 \\
\text{ARG-ST} & 1 \oplus 2 \oplus \text{list (non-canonical)}
\end{bmatrix}
\]

In (38), \( \oplus \) is the list concatenation operator. For the purposes of the present article, non-canonical items on the ARG-ST list will always correspond to null pronouns.\(^{18}\)

We can now more precisely indicate the analysis for null pronominal subjects and objects, as in the Spanish and Portuguese examples (3-b) and (3-a), repeated here.

\[
\text{(39) a. Maria llegó. Estaba cansada. [Es]} \\
\text{‘Maria arrived. [She] was tired.’} \\
\text{b. Maria escolheu o livro e Ana colocou na estante. [Pt]} \\
\text{‘Maria chose the book and Ana put [it] in the bookcase.’}
\]

The constraint in (40-a) allows a pronominal subject argument to appear on the ARG-ST list but not on the SUBJ list, giving rise to (41) as the analysis for (39-a). (40-b), on the other hand, allows for a pronominal object argument that does not appear on the COMPS list, and provides (39-b) with an analysis similar to that given for *will* in (37).\(^{19}\)

\[\text{\textsuperscript{18}Other non-canonical items include extracted elements and certain types of clitics, see e.g., Miller and Sag [1997].}\]

\[\text{\textsuperscript{19}Brazilian Portuguese allows Ana colocou ele na estante, with the overt strong object pronoun ele, as a variant of (39-b). These two sentences will receive exactly the same analysis wrt syntax and semantics, except that the pronominal NP will appear both on the ARG-ST and on the COMPS list in the latter case, causing the object pronoun to be overtly realized. The intended anaphoric link to the object of the previous sentence in the context provided is mediated through the ARG-ST list, which is the same in both cases, so that anaphoric resolution works similarly. Note however that the details of the discourse pragmatics will be different, so that constraint (40-b) will also have to impose additional properties at that level.}\]
In (40-a), B is the COMPS list which is concatenated to a list consisting of a non-canonical nominative personal pronoun NP in the ARG-ST. In (40-b), this non-canonical argument is missing in the COMPS list (list B may of course be empty).

(41)  

In (40-a), B is the COMPS list which is concatenated to a list consisting of a non-canonical nominative personal pronoun NP in the ARG-ST. In (40-b), this non-canonical argument is missing in the COMPS list (list B may of course be empty).
6 HPSG ellipsis resolution in practice

6.1 A dialogical working example

We will illustrate how HPSG analyzes ellipsis constructions with reference to the constructed example in (42). A poses a wh-question. This triggers clarification interaction concerning the intended reference of the NP ‘Bo’ via a reprise fragment (see section 6.4.4); B’s question in (2) is answered via the short answer in (3) (see section 6.4.2); the original question posed in (1), three turns earlier, is then the antecedent for the VPE utterance in (4); via inference, (4) triggers a (direct) sluice in (5) (see section 6.4.3). B responds with the short answer in (6). This, in turn, triggers the VPE query in (7), which exemplifies a self-correction utterance (see section 6.4.5). This gets answered by the polar particle ‘no’ (see section 6.4.1).

(42) A(1): Who visited Bo?
B(2): Bo?
A(3): My cousin.
B(4): Jack did.
A(5): Who else? (#Whom else?)
B(6): No one.
A(7): Didn’t Bill, I mean Mary?
B(8): No.

(42) exemplifies various claims we made earlier:

• The role of inference in ellipsis resolution (e.g., in (2) resolution emerges from the inability to resolve the reference of ‘Bo’ in (1)—there is no salient linguistic content around to provide the content ‘Who do you mean ‘Bo’?’ for this NSU; similarly, in (5) the resolution emerges from the possibility that Jack does not constitute the sole answer to (1)).

• The need for resolution to operate across turns (virtually all cases), in some cases multiple turns (e.g., (4)).

• The need to project structural (categorial and phonological) information into context in
order to capture cross-turn parallelism of varying degrees (e.g., segmental identity in (2), categorial identity in (5)).

- The interleaving of self- and other-repair in ellipsis resolution (e.g., (2) and (7)).

The account we propose is based on two main components. First, independently motivated processes of dialogue context dynamics—these are described in section 6.2, with a brief sketch of the presupposed semantic framework in section 6.3. Second, constructional/lexical specification that can interface directly with dialogue context that contains both linguistic and non-linguistic information. These are sketched in section 6.4. The two components are combined in an analysis of the above dialogue in section 6.5.

### 6.2 The Dialogue Gameboard

Our account of dialogue context follows that developed within KoS Ginzburg [1994], Ginzburg and Cooper [2004], Larsson [2002], Purver [2006], Fernández [2006], Ginzburg and Fernández [2010], Ginzburg [2012]. KoS is a theory that combines an approach to semantics inspired by situation semantics and dynamic semantics with a view of interaction influenced by Conversational Analysis. On the approach developed in KoS, there is actually no single context — instead of a single context, analysis is formulated at a level of information states, one per conversational participant. Each information state consists of two ‘parts’, a private part and the dialogue gameboard, inspired by Lewis Lewis [1979], that represents information that arises from public interactions. For recent psycholinguistic evidence supporting this partition see, for instance, (Brown-Schmidt et al. [2008]).

The structure of the dialogue gameboard is given in (43). The Spkr and Addressee fields allow one to track turn ownership; Facts represents conversationally shared assumptions; VisualSit represents the dialogue participant’s view of the visual situation and attended entities; Pending represents moves that are in the process of being grounded and Moves represents moves that have been grounded; QUD tracks the questions currently under discussion, though not simply questions qua semantic objects, but pairs of entities which we

---

20For an alternative view on how to integrate pragmatic information from context in HPSG, see Bertomeu and Kordoni [2005].
call *InfoStrucs*: a question and an antecedent sub-utterance; motivation for this view of QUD is given below.

(43)

**Dialogue Gameboard**

<table>
<thead>
<tr>
<th>component</th>
<th>type</th>
<th>keeps track of</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spkr: Individual</td>
<td>Addressee: Individual</td>
<td>Turn ownership</td>
</tr>
<tr>
<td>Facts : Set(propositions)</td>
<td></td>
<td>Shared assumptions</td>
</tr>
<tr>
<td>VisualSit : Situation</td>
<td></td>
<td>Visual scene</td>
</tr>
<tr>
<td>Moves: List(Locutionary propositions)</td>
<td></td>
<td>Grounded utterances</td>
</tr>
<tr>
<td>QUD: partially ordered set(&lt;question,fec&gt; pairs)</td>
<td>fec=focus-establishing-constituent</td>
<td>Live issues</td>
</tr>
<tr>
<td>Pending: List(Locutionary propositions)</td>
<td></td>
<td>Ungrounded utterances</td>
</tr>
</tbody>
</table>

In terms of the DGB, the model of context in Sag and Hankamer [1984] had some version of FACTS (a mental model Johnson-Laird [1983] or situational model Zwaan and Radvansky [1998]) and of Moves (a ‘propositional textbase’ Fletcher [1994]). The DGB, then, goes beyond such a view of context in at least two significant ways which derive from the fact that it is intended as a contextual resource for dialogical *interaction*, in contrast to earlier models of context, intended to process text or monologue. The two fundamental innovations relate to QUD and Pending.

Questions get introduced into QUD by a number of processes. These include: querying (asking $q$ makes the question $q$ QUD-maximal); assertion (asserting $p$ makes the (polar) question $p$? QUD-maximal); accommodation triggered by clarification interaction (e.g. if A’s sub-utterance $u$ is difficult to resolve or involves an error, the issue ‘what did A mean by $u$?’ can become QUD-maximal); accommodation triggered by interaction in a conversational genre (e.g. in a customer/client interaction, the issue ‘what does the client require’ can become QUD-maximal). Adopting the assumption that (structural) parallelism typically exhibits a
similar time course to the salience of the relevant entity of QUD, we can capture such effects by viewing QUD as tracking not simply questions qua semantic objects, but pairs of entities: a question and an antecedent sub-utterance. This latter entity provides a partial specification of the focal (sub)utterance, and hence it is dubbed the *focus establishing constituent* (FEC) (cf. *parallel element* in higher order unification-based approaches to ellipsis resolution e.g. Gardent and Kohlhase [1997]); Vallduví [2015] relates the FEC with a notion needed to capture *contrast*. Thus, the FEC in the QUD associated with a *wh*-query will be the *wh*-phrase utterance, the FEC in the QUD emerging from a quantificational utterance will be the QNP utterance, whereas the FEC in a QUD accommodated in a clarification context will be the sub-utterance under clarification.

Pending is the contextual resource corresponding to utterances that are still in progress or under clarification. One of the key structuring aspects of conversational interaction is the ubiquitous metacommunicative interaction between the participants observable via periodic verbal and gestural backchannels, and occasionally via clarification questions of various kinds (e.g. ‘What did the speaker mean by “...” ’). This cycle of grounding Clark [1996] or clarification interaction Ginzburg and Cooper [2004] is also present for a given speech participant monitoring her own speech, overt evidence for which are various dysfluencies such as hesitations (‘the next thing to say is problematic’) and self-corrections (‘the recent sub-utterance needs fixing’). Ginzburg [2012] offers detailed arguments on this issue, including considerations of the phonological/syntactic parallelism exhibited between CRs and their antecedents and the existence of CRs whose function is to request repetition of (parts of) an utterance, see (6) above. Taken together with the obvious need for Pending to include values for the contextual parameters specified by the utterance type, Ginzburg concludes that the type of Pending combines tokens of the utterance, its parts, and of the constituents of the content with the utterance type associated with the utterance. An entity that fits this specification is the *locutionary proposition* defined by the utterance: in the immediate aftermath of a speech event $u$, Pending gets updated with a record whose two components are $u$ and $T_u$, a grammatical type for classifying $u$ that emerges during the process of parsing $u$. Locutionary propositions are instances of *Austinian propositions* Barwise and Etchemendy [1987]. The original Austinian conception was that $s$ is a situation deictically indicated by a
speaker making an assertion whose truth involves \( s \) being of type \( T \). A *locutionary proposition* specializes this notion to the case of a speech event \( u \) and a grammatical type \( T_u \), in other words, an entity such as the *sign* in the sense of HPSG.

The relationship between \( u \) and \( T_u \)—describable in terms of the proposition \( p_u = \begin{bmatrix} \text{sit} = u \\ \text{sit-type} = T_u \end{bmatrix} \)— can be utilized in providing an analysis of grounding/clarification-interaction conditions of an utterance:

\[(44)\]

\begin{enumerate}
\item Grounding: \( p_u \) is true: the utterance type fully classifies the utterance token.
\item Clarification-interaction: \( p_u \) is false, either because \( T_u \) is weak (e.g. incomplete word recognition) or because \( u \) is incompletely specified (e.g. incomplete contextual resolution—problems with reference resolution or sense disambiguation).
\end{enumerate}

### 6.3 Semantics in Type Theory with Records

In this section, we introduce the basic semantic and grammatical notions we use in the rest of this section. KoS is formulated within the framework of Type Theory with Records (TTR) Cooper [2005], Cooper and Ginzburg [2015], a model-theoretic descendant of Martin-Löf Type Theory Ranta [1994] and of situation semantics Barwise and Perry [1983], Ginzburg and Sag [2000]. TTR enables one to develop a semantic ontology, including entities such as events, propositions, and questions. With the same means TTR enables the construction of a grammatical ontology consisting of utterance types and tokens and of an interactional domain in which agents utilize utterances to talk about the semantic universe. What makes TTR advantageous for a dialogically oriented grammar is that it provides access to both types and tokens at the object level. This plays a key role in developing metacommunicative interaction, as we shall see below, in that it enables simultaneous reference to both utterances and utterance types.

For current purposes, the key notions of TTR are the notion of a *judgement* and the notion of a *record*.

- The typing judgement: \( a : T \) classifies an object \( a \) as being of type \( T \).
• Records: A record is a set of fields assigning entities to labels of the form (45-a), partially ordered by a notion of dependence between the fields—dependent fields must follow fields on which their values depend. A concrete instance is exemplified in (45-b). Records are used here to model events and states, including utterances, and dialogue gameboards.

\[(45)\]

a. \[
\begin{align*}
l_1 &= val_1 \\
l_2 &= val_2 \\
\vdots \\
l_n &= val_n
\end{align*}
\]

b. \[
\begin{align*}
x &= -28 \\
etime &= 2AM, Feb 17, 2011 \\
e-loc &= Nome \\
c_{temp-at-in} &= 01
\end{align*}
\]

• Record Types: a record type is simply a record where each field represents a judgement rather than an assignment, as in (46-a). Records types are used to model utterance types (HPSG signs,\(^{21}\) as in (46-b)) and to express rules of conversational interaction.

\[(46)\]

a. \[
\begin{align*}
l_1 &\colon T_1 \\
l_2 &\colon T_2 \\
\vdots \\
l_n &\colon T_n
\end{align*}
\]

\(^{21}\)Ginzburg [2012], chapter 5 provides detailed argumentation for the advantages of analyzing signs in terms of record types rather than typed feature structures, as common in HPSG and other “unification-based” frameworks.
b. \[
\begin{align*}
\text{PHON}: & \text{is georges here} \\
\text{CAT} &= \mathcal{V}[+\text{fin}] : \text{syncat} \\
\text{CONSTITS} &= \{ \text{is}, \text{georges}, \text{here}, \text{is georges here} \} : \text{set(\text{sign})} \\
\text{spkr} &= \text{IND} \\
\text{addr} &= \text{IND} \\
\text{DGB-PARAMS}: & \begin{cases}
\text{s0} : \text{SIT} \\
\text{l} : \text{LOC} \\
\text{g} : \text{IND}
\end{cases} \\
\text{cont} &= \text{Ask(\text{spkr},\text{addr}, ?[\text{sit-type} = \text{In(l,g)}])} : \text{IllocProp}
\end{align*}
\]

The basic relationship between records and record types is that a record \( r \) is of type \( RT \) if each value in \( r \) assigned to a given label \( l_i \) satisfies the typing constraints imposed by \( RT \) on \( l_i \). To take a simple example (47-a) classifies the situation in Nome at a certain point in time, assuming the conditions in (47-b) hold. To take a more linguistic example, a conversational state \( r_1 \) will be a record such that ((47-c-e) hold—it is of the type dialogue game boards must satisfy; in other words, \( r_1 \) should have the make up in (47-d) and the constraints in (47-e) need to be met:

\[
\begin{align*}
\text{(47)} & \quad \text{a.} & \begin{cases}
x : \text{Ind} \\
e\text{-time} : \text{Time} \\
e\text{-loc} : \text{Loc} \\
\text{c}_{\text{temp-at-in}} : \text{temp_at_in}(\text{e-time, e-location, x})
\end{cases} \\
\text{b.} & \quad -28 : \text{Ind}; 3:45AM, Feb 17, 2011 : \text{Time}; \text{Nome} : \text{Loc}; \text{o1} : \text{temp_at_in}(3:45AM, \\
                        \text{Feb 17, 2011, Nome, -28}) \\
\text{c.} & \quad \text{c1} : \text{DGBType}
\end{align*}
\]
The final two notions we need are propositions and questions. We already mentioned above the notion of an Austinian proposition. Truth conditions for Austinian propositions are defined in ((48)):

\[(48) \quad \text{A proposition } \mathbf{p} = \begin{bmatrix} \text{sit} = s_0 \\ \text{sit-type} = ST_0 \end{bmatrix} \text{ is true iff } s_0 : ST_0 \]

Extensive motivation for the view of questions as propositional abstracts has been provided in Ginzburg [1995], Ginzburg and Sag [2000]—TTR contributes to this by providing an improved notion of simultaneous, restricted abstraction: A (basic, non-compound) question is a function from records into propositions. In particular, a polar question is a 0-ary propositional abstract, which in TTR makes it a constant function from the universe of all records into propositions.

Here we assume a minor refinement of this view,\(^{22}\) proposed in Ginzburg et al. [2014a]. This involves introducing a notion of Austinian questions, defined as records containing a record and a function into record types, the latter associated with the label ‘abstr(act)’. The role of wh-words on this view is to specify the domains of these functions; in the case of polar questions there is no restriction, hence the function component of such a question is a constant

\(^{22}\)This refinement is motivated in part by the need to enable conjunction and disjunction to be defined for questions; it also enables an account to be provided of the interaction between questions and adjectives, as in ‘difficult/quick/philosophical question’.
function. (49) exemplifies this for a unary ‘who’ question and a polar question. For notational simplicity, we will notate questions in what follows just in terms of the associated abstract.

(49)  

a. \[ \text{Who} = \begin{bmatrix} x_1 & : & \text{Ind} \\ c_1 & : & \text{person}(x_1) \end{bmatrix}; \text{Whether} = \text{Rec}; \]

b. ‘Who runs’ \(\rightarrow\) \[ \begin{bmatrix} \text{sit} = r_1 \\ \text{abstr} = \lambda r: \text{Who}(c : \text{run}(r.x_1)) \end{bmatrix} \]

c. ‘Whether Bo runs’ \(\rightarrow\) \[ \begin{bmatrix} \text{sit} = r_1 \\ \text{abstr} = \lambda r: \text{Whether}(c : \text{run}(b)) \end{bmatrix} \]

We combine all elements introduced in this section in a sketch of how clarification interaction can be specified. In principle one could have a theory of clarification interaction based on generating all available CRs an utterance could give rise to. But in practice, there are simply too many to be associated in a ‘precompiled’ form with a given utterance type.

Instead, CRs can be specified by means of a uniform class of conversational rules, dubbed \textit{Clarification Context Update Rules (CCURs)} in Ginzburg [2012]. Each CCUR specifies an accommodated MaxQUD built up from a sub-utterance \(u_1\) of the target utterance, the maximal element of Pending (MaxPending). Common to all CCURs is a license to follow up MaxPending with an utterance which is \textit{co-propositional} with MaxQud.\(^{23}\) (50) is a simplified formulation of one CCUR, \textit{Parameter identification}, which allows B to raise the issue about A’s sub-utterance \(u_0\): \textit{what did A mean by }\(u_0\)?:

\(^{23}\)Two utterances \(u_0\) and \(u_1\) are \textit{co-propositional} iff the questions \(q_0\) and \(q_1\) they contribute to QUD are co-propositional. Co-propositionality for two questions \(q_0\) and \(q_1\) means that their range is not disjoint, i.e., there exists a record \(r\) such that \(q_0(r) = q_1(r)\).
6.4 Non Sentential Utterance Constructions

The detailed theory of context sketched in previous sections enables the development of a grammar of the various types of sentential fragments discussed earlier. The basic strategy adopted in KoS/HPSG to analyze NSUs is to specify construction types where the combinatorial operations integrate the denotata of the fragments with elements of the DGB. We sketch how this can be done with several such construction types; a detailed account of a wide variety of sentential fragments analyzed in such terms can be found in Fernández [2006], Ginzburg [2012].

6.4.1 Propositional Lexemes

yes In its most straightforward use, ‘yes’ affirms the proposition \( p \), where \( p? \) is the maximal element in QUD, either because the polar question \( p? \) was posed or as a side effect of an assertion of \( p \). Hence, the lexical entry in (51): categorically it is classified here as an adverbial that can only occur as a root utterance, \(^{24}\) whereas semantically its content is the proposition component of a polar question. \(^{25}\)

\(^{24}\)The rationale behind this proposal is that it makes ‘yes’ resemble its counterparts in other languages (see discussion above (4)), as well as other adverbials in English (‘probably’, ‘possibly’) which have a use as a propositional lexeme; for English, one might make other decisions on this score, e.g., classifying ‘yes’ as an interjection.

\(^{25}\)Applying a function \((r : [\square]).p\) to any record \( r \) yields as result \( p \).
‘No’ has a number of distinct uses, including an exophoric use (on which see Cooper and Ginzburg [2015], where a treatment of negation in TTR is discussed.). Here we provide a lexical entry that captures the basic fact about the most prototypical use of ‘no’ in dialogue—its content is always a negative proposition. This can arise either by negating a proposition, when MaxQUD is a positive polar question, or by affirming it when MaxQUD is a negative polar question.

(52)

\[
\begin{align*}
\text{phon} & : \text{no} \\
\text{cat.head} & = \text{adv}\{+IC\} : \text{syncat} \\
\text{dgb-params.max-qud} & : \text{PolQuestion} \\
\text{cont} & = \text{max-qud}([]) : \text{Prop} \\
c1 & : (\text{cont} = \text{maxqud}([])) \lor \\
\text{maxqud}([]) \not\in \text{NegProp} \land \text{cont} = \neg \text{maxqud}([])
\end{align*}
\]

6.4.2 Declarative Fragments

Consider the declarative fragment (53-a):

(53)

a. B: Four croissants.

b. Context: A: What did you buy in the bakery?
   Content: I bought four croissants in the bakery.

c. Context: [A: smiles at B, who has become the next customer to be served at the bakery.]
   Content: I would like to buy four croissants.

d. Context: A: Dad bought four crescents.
   Content: You mean that Dad bought four croissants.
B’s utterance in (53-a) can receive a variety of contents, depending on the context in which it is uttered and the intonation contour it receives: it can be interpreted as a short answer, as in (53-b); it can be interpreted without any prior utterance, as in (53-c), though in such a case various paraphrases are possible, depending on the conversational genre;26 it can also be interpreted as the (‘metalinguistic’) correction in (53-d).

The different mechanisms underlying these resolutions can be uniformly described by the schema in (53-e). This indicates that the content of the construction type *Declarative-fragment-clause* arises by predicating the propositional function constituted by the maximal element of QUD of the content of the bare fragment utterance, a generalization of a rule proposed already in Hausser and Zaefferer [1979]. The particular content exhibited in (53-b) could arise because the issue ‘What did you buy in the bakery’ is MaxQUD as a result of A’s query; (53-c) arises given that the issue ‘What does the current customer want to buy’ is a characteristic issue of the BakeryShopping genre (as it is of many related genres); the content in (53-d) could arise if B decided not to ground A’s utterance, but using the parameter identification conversational rule, discussed in section 6.4.4 to initiate repair interaction, accommodates the issue ‘What did you mean by utterance ‘four crescents’?’ as MaxQUD.

We have also emphasized that different NSU constructions exhibit morphosyntactic and/or phonological parallelism with their antecedents. In other words, not only the combinatorial semantics of NSU constructions integrates information from the DGB, but that this is also potentially true of the morphosyntactic and phonological specifications of such constructions. Here we utilize this to deal with connectivity: we specify that the fragment has to match the categorial specification of the FEC. In light of this, we can write a specification of *decl-frag-cl* as in (54). Categorically the construction is sentential, as discussed in section 1.3.2; it has one dgb parameter—i.e. contextual parameter—the maximal element of QUD, whereas as just mentioned, its content arises by functional application of MaxQUD to the entity denoted by the fragment:

26See Wittgenstein [1953], Clark [1996] for discussion and exemplification.
6.4.3 Direct Sluicing

Direct sluices are analyzed in a similar fashion. In Ginzburg and Sag [2000] declarative fragment clauses and sluices are unified as subtypes of a phrasal type dubbed \(hd-frag-ph\). This construction builds a verbally headed phrase from an NP or PP under the constraint that the context’s FEC is categorically identical to and co-indexed with it.\(^{27}\)

Three aspects distinguish a direct sluice, specified by the clause type \(sluice-int-cl\) from a declarative fragment clause: the sluice is constructed from a \(wh\)-phrase, the sluice clause denotes a question and, arguably, it has a distinct contextual background. What is the contextual background of a direct sluice? Ginzburg and Sag [2000] and Ginzburg [2012] argued that this involved the QUD-maximality of a quantified polar question. This seems to be accurate in most cases. There are, however, several cases where this is less persuasively so. An alternative, suggested by Ivan Sag (p.c.), is to assume that it is the corresponding \(wh\)-question. This, however, requires a somewhat more ‘inferential’ view of QUD since in many cases there will not have been a prior utterance of a \(wh\)-interrogative. Nonetheless, since it is clear that QUD needs to be updated by some restricted inferences in a number of cases, as we have already discussed, this is not a qualitative modification. Indeed, as will become clear from the discussion below, from a compositional semantics point of view, it makes little difference.

\(^{27}\)Of course, in languages where connectivity properties are not as strict as in English, this constraint can be weakened. See Sag and Nykiel [2011], Nykiel [2013] for an example of how this can be done for sluicing in Polish. Similar analyses are possible for languages like French or Portuguese where a \(wh\)-NP can have a PP correlate. See also Kim [2015] on sluicing in Korean.
Assuming the view of *wh*-phrase content sketched in section 6.3 and remaining agnostic for the moment as to the QUD-specification of a sluice’s context, we can explicate how the content of a sluice arises straightforwardly, using exactly the content of the *wh*-phrase and MaxQUD. As summarized in (55-a), the sluice denotes a question (i.e., a function from records into propositions) whose domain is the type denoted by the *wh*-phrase and whose range is that given by MaxQUD’s proposition where the *wh*-phrase’s variable is substituted for that associated with the FEC.

\[
\text{sluice-int-cl.cont} = (\text{whP.rest})\text{MaxQUD.q.prop}\{\text{FEC.x} \mapsto whP.x\}
\]

b. A: A student left. B: Who?

c. \[
[[\text{Who}]] = (r: \begin{cases} x: \text{Ind} \\
\text{c1: person(x)} \\
\text{c2: student(z)} \\
\text{c3: leave(z)}
\end{cases} (z \mapsto x) \\
\sim \begin{cases} x: \text{Ind} \\
\text{c2: student(x)} \\
\text{c3: leave(x)}
\end{cases}
\]

We note that this view extends to two tricky cases for deletion-based accounts.

First, exophoric cases like (29). In such cases awareness of the genre is what leads QUD to be updated (see Ginzburg [2012] for details.). The essential idea of that proposal is that a given genre can be characterized, in part, by a partially ordered set of questions, discussion of which constitutes its defining subject matter. At appropriate points these questions can be accommodated into QUD without being uttered overtly. The way this account applies to declarative fragments was explained in the discussion of (53-c). This is what licenses exophoric sluices as in (56), illustrating the taxi-cab genre.

\[
\text{(56) a. Where does customer want to travel to? What is the price of the trip?}
\]

\[
\]

Second, incremental cases like (57-a), already discussed in section 3.3. Assuming an
incremental view of semantic processing Rieser and Schlangen [2011], Ginzburg et al. [2014b], Purver et al. [2011], the sluice in (57-a) is predicted to mean immediately after it is uttered ‘Who is that person (that has some as yet uninstantiated property), whereas ‘John? means ‘Is it John (that has some as yet uninstantiated property)’?’. The incremental view merely needs the (incremental context) assumption that QUD can get updated word by word (rather than at turn boundaries), roughly as in (57-b):

(57)  
   a. Someone—John?/Any idea who?—took the kettle and didn’t return it.  
   b. content: $\exists x, P[Person(x) \land P(x)]; \text{QUD: } ?\exists x, P[Person(x) \land P(x)]$

6.4.4 Reprise Sluicing and Reprise Fragments

A key component of our analyses of elliptical reprise constructions are the questions accommodated into QUD as a consequence of the clarification interaction process triggered by incomplete understanding of the previous utterance, as described in section 6.3. With that in place, the existing grammar can then directly yield the requisite readings for reprise sluicing and for the confirmation readings of reprise fragments.

Assume the utterance to be clarified is (58-a). B uses the CCUR parameter identification to build a context as in (58-b):

(58)  
   a. A: Did Bo leave? B: Bo? (= Did you mean Bo?)  
   b. $\text{MAX-QUD} = \lambda x \text{Mean}(A,u2,x); \text{FEC} = A’s\, \text{utterance} ‘\text{Bo}’$

Given this, the analysis of the construction is illustrated in (59): the construction $\text{decl-frag-cl}$ builds the proposition $\text{Mean}(A,u2,b)$; the construction $\text{polarization}$ builds a polar question from this:

(59)
Intended content readings of RFs involve a complex mix of a prima facie non-transparent semantics and phonological parallelism. Independently of intended content readings, we need to capture the utterance anaphoricity of “quotative” utterances such as (60):

(60)   a. A: Bo is coming. B: Who do you mean ‘Bo’?

We assume the existence of a grammatical constraint allowing reference to a sub-utterance under phonological parallelism. (61) exemplifies one way of formulating such a constraint:

the PHON value is type identical with the PHON value of an utterance identified with the focus establishing constituent, whereas the content is stipulated to be the utterance event associated with the focus establishing constituent:

28

Postulating such an ambiguity goes back to Frege and Quine, who suggested phrases within quotative operators denoted the string itself. (61) makes one simplifying assumption: identifying the PHON value of the focus establishing constituent with that of the utterance anaphoric phrase. In practice this should only be the segmental phonological value.
With this in hand, we turn back to consider the issue of how intended content RFs arise grammmatically. It is worth emphasizing that there is no way to bring about the desired content using \textit{decl-frag-cl}, the short-answer/reprise sluice phrasal type we have been appealing to above, regardless of whether we analyze the NP fragment as denoting its standard conventional content or alternatively as denoting an anaphoric element to the phonologically identical to-be-clarified sub-utterance. This is a prototypical instance of appeal to constructional meaning—a complex content that cannot be plausibly constructed using “standard combinatorial operations” (function application, unification etc) from its constituents. Thus, one way of accommodating \textit{intended content} RF is to posit a new phrasal type, \textit{qud-anaph-int-cl}. This will encapsulate the two idiosyncratic facets of such utterances, namely the MAX-QUD/CONTENT identity and the HD-DTR being an \textit{utt-anaph-ph}:

(62) \[ \text{qud-anaph-int-cl} = \begin{bmatrix} \text{MAX-QUD : InfoStruc} \\ \text{cont=max-qud.q:Question} \\ \text{hd-dtr: utt-anaph-ph} \end{bmatrix} \]

Given this, we can offer the following analysis of ((63)):

(63) A: Is Bo here? B: Bo?

B lacks referent for ‘Bo’; uses \textit{parameter identification} to update MaxQUD accordingly:
6.4.5 Disfluency

Disfluencies are viewed as a performance phenomenon in most formal grammatical treatments. Ginzburg et al. [2014b] provide extensive argumentation for the need to integrate disfluencies in the competence grammar, demonstrating that they participate in semantic and pragmatic processes like anaphora, implicature, and discourse marker content, as well as being subject to cross-linguistic variation and also exhibiting some universals. Ginzburg et al. [2014b] develop their account in KoS of disfluencies by extending the account mentioned in

\[\text{spkr} = B\]
\[\text{addr} = A\]
\[\text{pending} = \left\{
\begin{align*}
\text{sit} &= w0' \\
\text{sit-type} &= \text{IGH}
\end{align*}
\right\}
\]
\[\text{maxqud} = \left\{
\begin{align*}
\text{q} &= \lambda x \text{Mean}(A,p2,x) : \text{Question} \\
\text{fec} &= p2 : \text{LocProp}
\end{align*}
\right\} : \text{InfoStruc}
\]

Using \textit{qud-anaph-int-cl} yields:

\[\text{maxqud} = \left[\text{q} = \lambda x \text{Mean}(A,p2,x) : \text{Question}, \text{fec} = p2 : \text{LocProp}\right] : \text{InfoStruc}, \text{cont} = \text{maxqud.q}
\]
\[\text{bu} = \text{max-qud.fec.sit-type.phon} : \text{Type}, \text{phon} : \text{bu}
\]
\[\text{BO}
\]

\[\text{S}
\]
\[\text{quad-anaph-int-cl}
\]
\[\text{maxqud} = \left[\text{q} = \lambda x \text{Mean}(A,p2,x) : \text{Question}, \text{fec} = p2 : \text{LocProp}\right] : \text{InfoStruc}
\]
\[\text{cont} = \text{maxqud.q}
\]
\[\text{bu} = \text{max-qud.fec.sit-type.phon} : \text{Type}, \text{phon} : \text{bu}
\]
\[\text{BO}
\]

\[\text{S}
\]
\[\text{utt-anaph-ph}
\]
\[\text{bu} = \text{max-qud.fec.sit-type.phon} : \text{Type}, \text{phon} : \text{bu}
\]
\[\text{BO}
\]

\[\text{6.4.5 Disfluency}
\]

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\[\text{29 Though not by psycholinguists, see e.g., Levelt [1983], Clark and FoxTree [2002].}
\]
previous sections of the coherence and realization of clarification requests: as the utterance unfolds incrementally there potentially arise questions about what has happened so far (e.g. *what did the speaker mean with sub-utterance u1?*) or what is still to come (e.g. *what word does the speaker mean to utter after sub-utterance u2?*). These can be accommodated into the context if either uncertainty about the correctness of a sub-utterance arises or the speaker has planning or realizational problems. Thus, the monitoring and update/clarification cycle is modified to happen at the end of each word utterance event, and in case of the need for repair, a repair question gets accommodated into QUD. In this way, the coherence of “spelled out” self-repairs such as (66-a) can be explained, but also of elliptical self-repairs such as (66-b). The latter is analyzed as a declarative fragment clause (see section 6.4.2), where the antecedent question is the accommodated “what did A mean by ‘earphones’?” with the utterance ‘earphones’ being the FEC:

(66)  a. Take that book in I mean from the shelf.
     b. Have you seen Mark’s erm earphones? Headphones. (BNC, KP0 369-370)

6.5 A worked example

As exemplification of what we have done in this section, we return to the example we introduced earlier, (42). Our illustration involves a sequence of dialogue gameboards that arise sequentially via updates triggered by conversational rules. We will abuse notation somewhat and notate by ‘:=’ cases where a field gets assigned a new value. Another point to note is that in some cases we consider the dialogue from A’s point of view (in which case we have fields such ‘A.LatestMove’); in other cases from B’s point of view (in which case e.g., ‘B.QUD’). Finally, when

(1)   **A: Who visited Bo?**

Initial query: posed by A; updates his DGB accordingly with the question expressed by the utterance in (1).
A.LatestMove := Ask(A,B,q0)
A.QUD := \[[q=\lambda x visit(x,b)\]
          [fec = Who])\]

B: Bo?

A’s utterance cannot be grounded by B, hence it remains in Pending. B accommodates
a clarification question (‘Who did A mean by the utterance ‘Bo’?) ; thereby licensing a
clarification question expressed as a reprise (the construction type qud-anaph-int-cl).

B.Pending = \[[sit = (1)\]
            [sit-type = WVB]]
B.QUD = \[[q=\lambda x Mean(A,u0,x)\]
           [fec = Bo]]

A: My cousin.

B’s question receives an answer in the form of a short answer, licensed by the QUD
above (the construction type decl-frag-cl); ‘Bo is A’s cousin’ is added to FACTS and
the initial question is now MaXQUD for B as well:
B.LatestMove := Assert(A,B,p1)
p1 = Cousins(A,b)
B.QUD := \[[p1?,\]
          [q=\lambda x visit(x,b)\]
          [fec = Who]]
B.FACTS = \{Cousins(A,b)\}
B.QUD := \[[q=\lambda x visit(x,b)\]
           [fec = Who]]

B: Jack did.

B can now ground the utterance (1) with the referent she was provided in (3): the
question from (1) has become MaxQUD. This licenses an utterance using the
Subj-Choice VPE construction (cf. section 3.1, \( \lambda x \) \text{Visit}(x,b) \) is the salient question). B asserts \( p_2 \), hence \( p_2? \) becomes MaxQUD.

\[
\begin{align*}
A.DGB.LatestMove & := \text{Assert}(B,A,p_2) \\
p_2 & = \text{Visit}(j,b) \\
A.QUD & : = \left\langle p_2?, \begin{bmatrix} q = \lambda x \text{Visit}(x,b) \\ \text{fec} = \text{Who} \end{bmatrix} \right\rangle 
\end{align*}
\]

\[(5)\] **A: Who else?**

A deduces from B’s utterance the question \( p_3? = \text{whether someone other than Jack visited Bo.} \) The info-struc \( \begin{bmatrix} q=p_3? \\ \text{FEC}='\text{Jack}' \end{bmatrix} \) licenses the sluice (the construction type \textit{slu-int-cl}): \[
\text{FACTS} := \{ \text{Cousins}(A,b), \text{Visit}(j,b) \} \\
A.QUD : = \left\langle \begin{bmatrix} q=p_3? \\ \text{FEC}='\text{Jack}' \end{bmatrix} \right\rangle \\
A.LatestMove := \text{Ask}(A,B,q_2) \\
\left\{ \begin{bmatrix} q=q_2 \\ \text{FEC}='\text{Who else}' \end{bmatrix} \right\} \\
A.QUD : = \left\langle \begin{bmatrix} q=p_3? \\ \text{FEC}='\text{Jack}' \end{bmatrix} \right\rangle
\]

\[(6)\] **B: No one.**

A’s question receives an answer in the form of a short answer, licensed by the QUD above:
B.DGB.LatestMove := Assert(B,A,p4)

\[ p4 = \neg \exists x, x \neq j, \text{Visit}(x,b) \]

B.QUD :=
\[
\langle
q=q2, \quad \text{FEC='Who else'}
\rangle
\]

FACTS := \{ Cousins(A,b), \text{Visit}(j,b) \}

(7) a. **A: Didn’t Bill . . .**

A does not accept B’s assertion and using the question q2 to license VPE\(^{30}\). In mid-utterance (i.e. with Pending consisting of the initial segment ‘Didn’t Bill’) A realises that ‘Bill’ was not what she meant to utter. She accommodates the issue ‘Who did A mean to utter with ‘Bill’?’ as MaxQUD:

\[
A.Pending := \langle
\quad \text{sit = (7a)}
\quad \text{sit-type = Dn’tB}
\rangle
\]

\[
A.QUD := \langle
q=\lambda x \text{Mean}(A, ‘Bill’, x), \quad \text{FEC='Bill'}
\rangle
\]

\[
p4?, \quad \text{FEC='Who else'}, \quad \text{FEC='Jack'}
\]

b. . . . **I mean Mary?**

A self-corrects, addressing the issue of ‘Who did A mean to utter with ‘Bill’?’ which leads to her intended utterance—a polar question about Mary:

\(^{30}\)Why is q2 MaxQUD? In KoS QUD is not taken to be a stack, but rather a partially ordered set. Ginzburg [2012], motivated in part by from multi-party dialogue, proposed that when a question q is pushed onto QUD it doesn’t subsume all existing questions in QUD, but rather only those on which q does not depend. Hence, Wh-questions do not get outranked by polar questions which are their sub-questions.
A.LatestMove := Assert(A,B,p5)

\[ p5 = \text{Mean}(A,'Bill',m) \]

A.QUD := \[ p5?, [q=\lambda x \text{Mean}(A,'Bill',x), \text{FEC}='Bill'] [q=q2, \text{FEC}='Who else'],
q=p3?, \text{FEC}='Jack'] \]

B.LatestMove := Assert(B,A,p6)

\[ p6 = \neg \text{Visit}(m,b) \]

FACTS := \{ Mean(A,'Bill',m), Cousins(A,b), Visit(j,b) \}

A.QUD := \[ p6?, [q=q2, \text{FEC}='Who else'], [q=p3?, \text{FEC}='Jack'] \]

(8) B: No.

B refutes A’s hypothesis, using ‘No’, which reaffirms MaxQUD: the negative proposition p6:

B.LatestMove := Assert(B,A,p6)

\[ p6 = \neg \text{Visit}(m,b) \]

FACTS := \{ Mean(A,'Bill',m), Cousins(A,b), Visit(j,b) \}

A.QUD := \[ p6?, [q=q2, \text{FEC}='Who else'], [q=p3?, \text{FEC}='Jack'] \]

References


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