Chapter 15

Relative Clauses in HPSG

Doug Arnold
University of Essex

Danièle Godard
University de Paris Diderot

We provide an extended discussion of analyses of relative clauses (prototypically clauses with a noun modifying function) and related constructions that have appeared in the HPSG literature. The basic theoretical approaches are presented (specifically, the lexical "head-driven" approach associated with earlier work in HPSG, and the more recent constructional approach), followed by descriptions of analyses of different kinds of relative clause across a range of typologically diverse languages (notably Arabic, English, French, German, Japanese, and Korean). Phenomena discussed include *wh*-relatives, relatives headed by complementisers, "bare" relatives, non-restrictive relatives, extraposition of relative clauses, relative clause-like constructions that function as complements, various kinds of "dependent noun" and "pseudo" relative clause, and free (headless) relatives.

1 Introduction

The goal of this paper is to give an overview of HPSG analyses of relative clauses. Relative clauses are, typically, sentential constructions that function as nominal modifiers, like the italicised part of (1), for example.

(1) The person *to whom Kim spoke yesterday* claimed to know nothing.

Relative clauses have been an important topic in HPSG: not only as the focus on a considerable amount of descriptive and theoretical work across a range of languages, but also in terms of the theoretical development of the framework.

Notably, Sag's (1997) analysis of English relative clauses was the first fully developed realisation of the constructional approach involving cross-classifying phrase types that has dominated work in HPSG in the last two decades, and was thus the first step towards the development of Sign-based Construction Grammar (cf. Müller (2019b), Chapter 36 of this volume).

The basic organisation of the discussion is as follows. Section 2 introduces basic ideas and overviews the main analytic techniques that have been used, focusing on one kind of relative clause. Section 3 looks at other kinds of relative clause in a variety of languages. Section 4 looks at a variety of constructions which have some similarity with relative clauses, but which are in some way untypical (e.g. clauses that resemble relative clauses, but which are not nominal modifiers, or which are not adjoined to the nominals they modify). Section 5 provides a conclusion.

2 Basic ideas and approaches

This section introduces basic ideas and intuitions about relative clauses, viewed from an HPSG perspective (Section 2.1), then introduces the two main approaches that have been taken in HPSG: the lexical approach of Pollard & Sag (1994) which makes use of phonologically empty elements (Section 2.2), and the constructional approach of Sag (1997), which makes phonologically empty elements unnecessary (Section 2.3). Section 2.4 presents some interim conclusions, and provides some discussion of some brief discussion alternative approaches.

2.1 Basic ideas and intuitions

Relative clauses are, prototypically, sentential constructions which modify a nominal. (2) is an example of one kind of English relative clause, which we will call a "*wh*-relative". In (3) it is used as a modifier of the nominal *person* (the *antecedent* of the relative clause).

(2)   to whom Kim spoke yesterday

(3)   The person to whom Kim spoke yesterday claimed to know nothing.

Syntactically, this kind of relative clause consists of a preposed *wh*-phrase (*to whom*), i.e. a phrase containing a relative pronoun (*whom*), and a clause with a missing constituent — a gap (the complement of *speak*: *Kim spoke ___ yesterday*). This is often called the *relativised constituent*. Semantically, in (2) the interpretation of the relative clause is *intersective*: (2) denotes the intersection of the set

of people and the set of entities that Kim spoke to. Getting this interpretation involves combining the descriptive content of the antecedent nominal and the propositional content of the relative clause, and equating the referential indices of the nominal and the relative pronoun, to produce something along the lines of "the set of x where x is a person and Kim spoke to x".

Not all relative clauses have these properties, but they provide a good starting point. In the remainder of this section, we will show, in broad terms, how these properties can be accounted for.

As regards their function and distribution, relative clauses are subordinate clauses, which can be captured by assuming they have a HEAD feature like [MC −], "MAIN-CLAUSE *minus*". They are naturally assumed to be adjuncts: their distribution as nominal adjuncts can be dealt with by assuming that (like other adjuncts) they indicate the sort of head they can modify via a feature like MOD or SELECT (cf. **chapters/ChXXX** Chapter **??** of this volume on the treatment of adjuncts). That is, relative clauses such as (2) will be specified as in (4a), whereas adjunct clauses headed by a subordinator like *because* (as in *We're late because it's raining*) will be specified as (4b), and normal, non-adjunct, clauses will typically be specified as (4c):

(4) a. $\left[\text{SYNSEM|LOC|CAT|HEAD|MOD} \left[\text{LOC | CAT | HEAD } \textit{noun}\right]\right]$

   b. $\left[\text{SYNSEM|LOC|CAT|HEAD|MOD} \left[\text{LOC | CAT | HEAD } \textit{verb}\right]\right]$

   c. $\left[\text{SYNSEM|LOC|CAT|HEAD|MOD } \textit{none}\right]$

With this in hand, we will look in more detail at the internal structure of this kind of relative clause (Section 2.1.1), and at the relation between the relative clause and its antecedent (Section 2.1.2).

2.1.1 The internal structure of the relative clause

As regards internal structure, it is characteristic of *wh*-relatives that they consist of a preposed *wh*-phrase, and a clause containing a gap. The dependency between the *wh*-phrase and the associated gap is potentially unbounded, as can be seen from examples like (5).

(5) the person to whom [Sam said [Kim intended [to speak ⎯ yesterday]]]

As regards the *wh*-phrase, it is notable that it must be preposed — English does not allow examples like (6a) without a relative phrase, or (6b) where the relative phrase is *in situ*.

(6) a. *a person Kim spoke to her yesterday

b. *a person Kim spoke to whom yesterday

Despite being forbidden *in situ*, the preposed *wh*-phrase behaves in some respects as though it occupied the gap. For example, in the examples above *to whom* satisfies the subcategorisation requirements of *speak*, and makes a semantic contribution in the gapped clause. Assuming some kind of co-indexation relation between the antecedent and the *wh*-phrase, the same behaviour can be seen with subject-verb agreement, as in (7a), and binding, as in (7a):

(7)   a. a person who [everyone thinks [___ is/*are weird]]
      b. a person who [everyone thinks [___ hates herself/*her]]

In fact, this dependency between the *wh*-phrase and the gap appears to be a typical filler-gap dependency, with the *wh*-phrase as the filler, which can be handled by standard SLASH inheritance techniques (see Borsley & Crysmann (2019), Chapter 14 of this volume), so that these properties are accounted for.

In examples like (2) the *wh*-phrase must contain a relative pronoun. Here we have another apparently unbounded dependency, because the relative pronoun can be embedded arbitrarily deeply inside the *wh*-phrase (example (8d) is due to Ross 1967):

(8)   a. the person [to [whose friends]] Kim spoke ___
      b. the person [to [[whose children's] friends]] Kim spoke ___
      c. the person [to [the children [of [whose friends]]] Kim spoke ___
      d. books [the height [of [the letters [on [the covers [of which]]]]] the government regulates ___

This dependency between a relative pronoun and the phrase that contains it is often called "*wh*-percolation", "relative percolation", or, following Ross (1967), "pied-piping". We will talk about *relative inheritance*.

Notice that as well as being unbounded, relative inheritance resembles SLASH inheritance in that the "bottom" of the inheritance path (i.e. the actual relative pronoun, or the gap in a filler-gap a dependency) is typically not a head (e.g. *whom* is not the head of *to whom*). Moreover, though examples involving multiple independent relative pronouns are rather rare in English (i.e. there are few, if any, relative clauses parallel to interrogatives like *Who gave what to whom?*) they exist in other languages, so it is reasonable to assume that relative inheritance involves a set of some kind.[1] This motivates the introduction of a REL feature

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[1]Examples of languages which allow multiple relative pronouns include Hindi (e.g. Srivastav 1991) and Marathi (e.g. Dhongde & Wali 2009: Ch7). See Pollard & Sag (1994: 227–232) for

which is subject to the same kind of formal mechanisms as SLASH.[2]

The idea is that a relative pronoun will register its presence by introducing a non-empty REL value, which will be inherited upwards until it reaches the preposed *wh*-phrase at the top of the relative clause (equivalently: a relative clause introduces a non-empty REL value on its *wh*-phrase daughter that is inherited downwards till it is realised as a relative pronoun). Within the *wh*-phrase, REL inheritance can be handled by the same sort of formal apparatus as is used for handling SLASH inheritance. Blocking REL inheritance from carrying a REL element upwards beyond the top of relative clause can be achieved with the same formal apparatus as is used to block SLASH inheritance from carrying information about a gap higher than the level at which the associated filler appears.[3]

Co-indexation of the antecedent nominal and the relative pronoun can be achieved simply if the REL value contains an index which is shared by both the antecedent and the relative pronoun. As regards the relative pronoun, at the "bottom" of the REL dependency, this can be a matter of lexical stipulation: relative pronouns can be lexically specified as having a REL value that contains their INDEX value, roughly as in (9a), which we abbreviate to (9b).[4]

$$
(9) \quad a. \quad
\left[\text{SYNSEM} \left[\begin{array}{l} \text{LOC} \left[\begin{array}{l} \text{CAT} \left[\text{HEAD } \textit{noun} \right] \\ \text{CONT} \left[\text{INDEX } \boxed{1} \right] \end{array} \right] \\ \text{NON-LOC} \left[\text{INHER|REL } \{\boxed{1}\} \right] \end{array} \right] \right]
$$

[HPSG analyses. In English, multiple relative pronouns occur in cases of co-ordination (e.g. *the person with whom or for whom you work*), but they are not independent (they relate to the same entity). Kayne (2017) gives some English examples that appear to involve multiple relative pronouns, but they are rather marginal.

[2]The assumption that relative inheritance should be treated as involving an unbounded dependency (i.e. handled with a NON-LOCAL feature, like SLASH), has been challenged in Van Eynde (2004) (Van Eynde argues it should be treated as local dependency).

[3]In case it is not obvious why further upwards inheritance of a REL value would be problematic, notice that while a relative clause can *contain* a *wh*-phrase, it cannot *be* a *wh*-phrase, e.g. it cannot function as the filler in a relative clause. Suppose, counter-factually, the REL value of *who* could be inherited beyond the relative clause *to whom Kim spoke*, so that e.g. *a person to whom Kim spoke* was marked as [REL {$\boxed{1}$}]. This phrase would be able to function as the *wh*-phrase in a relative clause like *[a person to whom Kim spoke] Sam recognised ___ , which would be able to combine with a noun specified as [INDEX $\boxed{1}$] to produce something like *a person [[a person to whom Kim spoke] Sam recognised ___].

[4]Here, and below, we will abbreviate attribute paths where no confusion arises, and use a number of other standard abbreviations, in particular, we write INDEX values as subscripts on nouns and NPs. We use $\overline{\text{N}}$ to indicate a noun with an empty COMPS list, i.e. one which has combined with its complements, if any, and NP for a $\overline{\text{N}}$ with an empty SPEC (SPECIFIER) list (e.g. a combination of determiner and a $\overline{\text{N}}$). Similarly, we use PP to abbreviate a phase consisting of a preposition and its complement, VP for a phrase consisting of verb with its complements, and S for a phrase consisting of a subject and a VP.

b. $\overline{\mathrm{N}}_{\boxed{1}}$ [REL $\{\boxed{1}\}$]

This index can then be inherited upwards via the REL value to the level of the *wh*-phrase. At the top, the index of the antecedent can be accessed via the MOD value of the relative clause: this is simply a matter of replacing the specification of the MOD value in (4a) with that in (10a), abbreviated as in (10b), where $\boxed{1}$ is the index that appears in the REL value of the associated *wh*-phrase.[5]

(10) a. $\left[\text{SYNSEM|LOC|CAT|HEAD|MOD} \left[\text{LOC} \begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{HEAD} & \textit{noun} \end{bmatrix} \\ \text{CONT} & \begin{bmatrix} \text{INDEX} & \boxed{1} \end{bmatrix} \end{bmatrix} \right] \right]$

b. S $\begin{bmatrix} \text{MOD} & \overline{\mathrm{N}}_{\boxed{1}} \end{bmatrix}$
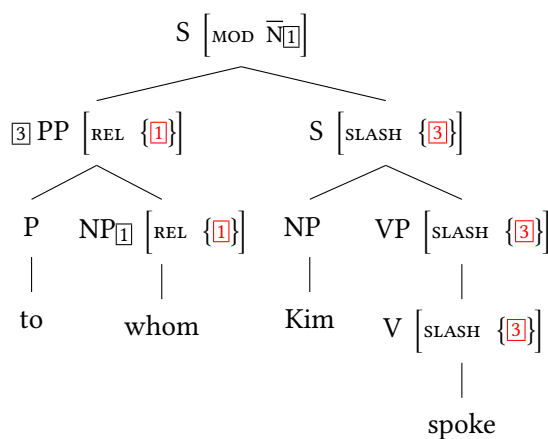

Figure 1: Representation of *to whom Kim spoke*.

Schematically, then, *wh*-relatives should have structures along the lines of Figure 1. The top structure here is a head-filler structure. Notice how SLASH inheritance ensures the relevant properties of the PP are shared by lower nodes so that the subcategorization requirements of the verb can be satisfied, with the PP being interpreted as a complement of the verb (equivalently: SLASH inheritance ensures that the gap caused by the missing complement of *speak* is registered on higher nodes until it is filled by the PP). Similarly, REL inheritance means that the

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[5]We assume, for simplicity, that the value of REL is a set of indices. This is consistent with e.g. Pollard & Sag (1994) and Sag (1997), but not with Ginzburg & Sag (2000: 188), who assume it is a set of *parameters*, that is, indices with restrictions (a kind of *scope-object*), like the QUE attribute which is used for *wh*-inheritance in interrogatives. It is not clear that anything important hangs on this.

INDEX of the relative pronoun appears on higher nodes so that it can be identified with the INDEX of the antecedent noun, via the MOD value of the highest S (equivalently: the index of the antecedent nominal appears on lower nodes down to the relative pronoun, so that the nominal and the relative pronoun are co-indexed).

As regards (CONTENT, the effect of this will be to give the relative clause *to whom$_i$ Kim spoke* an interpretation along the lines of *Kim spoke to whom$_i$*, where *i* is the index of its antecedent. In terms of standard HPSG semantics, this "internal" content (i.e. the content associated with a verbal head with its complements and modifiers) is a *state-of-affairs* (*soa*), and can be represented as in (11a), abbreviated to (11b):[6]

(11)   a. $\begin{bmatrix} soa \\ \text{NUC} \begin{bmatrix} speak\_to \\ \text{SPEAKER} & Kim \\ \text{ADDRESSEE} & \boxed{1} \end{bmatrix} \end{bmatrix}$

      b.   *speak_to(Kim,$\boxed{1}$)*

There are restrictions on what can occur as the preposed *wh*-phrase in a relative clause, as can be seen in (12). To a first approximation, NPs and PPs are fine in English, but VPs and Ss are not.[7]

(12)   a.   the person [NP who] we want Kim to speak to ___

      b.   the person [PP to whom] we want Kim to speak ___

      c.   * the person [VP speak to whom] we want Kim to ___

      d.   * the person [VP to speak to whom] we want Kim ___

      e.   * the person [S Kim to speak to whom] we want ___

It is rather natural to interpret this as indicating restrictions on relative inheritance (i.e. pied-piping in relative clauses) — e.g. as indicating that while relative inheritance from NP to PP (and through an upward chain of NPs and PPs, as in (8d)), is permitted, it is blocked by VP and S nodes. The can be achieved by requiring that the REL value on VP and S nodes to be empty (cf. the Clausal REL Prohibition of Pollard & Sag 1994: 220). While important, these restrictions are

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[6]In fact (17) is already somewhat abbreviated: [SPEAKER *Kim*] is an abbreviation for a structure including an index, and a BACKGROUND restriction on that index indicating that it stands in the *naming* relation to the name *Kim*.

[7]This is a considerable simplification: e.g. English allows VPs like that in (12d) so long as they function as subjects, so *person to speak to whom is a privilege* is allowed. German allows REL inheritance to VP more freely than English, and an analogue of (12d) is grammatical in German. See De Kuthy (1999), Hinrichs & Nakazawa (1999) and Müller (1999b) for discussion and HPSG analyses.

poorly understood and we will have nothing to say about them here, except to emphasise that they are different from the restrictions on QUE inheritance (i.e. pied-piping in interrogatives). For example, QUE-inheritance is not possible from the complement of a noun, but REL inheritance is fine, so *some pictures of whom* is not possible as the focus of a question, as in (13), but is fine as the initial phrase of a relative clause, as in (14):

(13) *I wonder [some pictures of whom] they were admiring.

(14) the children [some pictures of whom] they were admiring

Notice that REL and QUE also differ in other ways: e.g. as Sag (2010: 490–493) emphasises, there are *wh*-words that can function as interrogative pronouns, but not as relative pronouns (i.e. which have non-empty QUE values, but empty REL values), and *vice versa*. For example, *how* and (in standard English) *what* function as interrogative pronouns, but not relative pronouns, as the following show (as Sag 2010: 493 puts it, there is "no morphological or syntactic unity underlying the concept of an English *wh*-expression):[8]

(15) a. I wonder how she did it.   (interrogative)
      b. *the way how she did it   (relative)

(16) a. I wonder what (things) she bought.   (interrogative)
      b. *the book what (things) she bought   (relative)

With this overview of the internal structure of a relative clause in place, we now turn to relation between the relative clause and the nominal it modifies (its antecedent).

2.1.2 The relative clause and its antecedent

The combination of a relative clauses and the nominal it modifies is traditionally regarded as a head-adjunct structure, where the nominal is the head and the relative clause is the adjunct, as in Figure 2.

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[8]See also Müller (1999a: 81–85) on differences between interrogative and relative pronouns in German. Several non-standard English dialects allow NP *what* as a relative pronoun like *which* (cf. non-standard %*the book what she bought*, vs standard *the book which she bought*), no dialect allows determiner *what* as a relative pronoun (though it is fine as an interrogative, as can be seen in (16a)). Sag (2010: 491, note 10) suggests that NP *which* is only ever a relative pronoun (an apparent counter-example like *Which did you buy?* involves determiner *which* with an elliptical noun.)

Figure 2: A relative clause and its antecedent.

The content we want for a modified nominal such as *person to whom Kim spoke*, as for an unmodified nominal such as *person*, is a *restricted index*, i.e. in HPSG terms a *scope-object* — an INDEX and a RESTR (RESTRICTION) set (a set of objects of type *fact*).[9] For *person*, this is as in (17), abbreviated as in (18), for *person to whom Kim spoke* it is as in (19), abbreviated as in (20).

(17)
$$\begin{bmatrix} \textit{scope-obj} \\ \text{INDEX } \boxed{1} \\ \text{RESTR } \left\{ \begin{bmatrix} \textit{fact} \\ \text{PROP|SOA } \begin{bmatrix} \textit{soa} \\ \text{NUC } \begin{bmatrix} \textit{person} \\ \text{INSTANCE } \boxed{1} \end{bmatrix} \end{bmatrix} \end{bmatrix} \right\} \end{bmatrix}$$

(18) $\boxed{1} : \{ \textit{person}(\boxed{1}) \}$

(19)
$$\begin{bmatrix} \textit{scope-obj} \\ \text{INDEX } \boxed{1} \\ \text{RESTR } \left\{ \begin{bmatrix} \textit{fact} \\ \text{PROP|SOA } \begin{bmatrix} \textit{soa} \\ \text{NUC } \begin{bmatrix} \textit{person} \\ \text{INSTANCE } \boxed{1} \end{bmatrix} \end{bmatrix} \end{bmatrix}, \begin{bmatrix} \textit{fact} \\ \text{PROP|SOA } \begin{bmatrix} \textit{soa} \\ \text{NUC } \begin{bmatrix} \textit{speak\_to} \\ \text{SPEAKER } \textit{Kim} \\ \text{ADDRESSEE } \boxed{1} \end{bmatrix} \end{bmatrix} \end{bmatrix} \right\} \end{bmatrix}$$

(20) $\boxed{1} : \{ \textit{person}(\boxed{1}), \textit{speak\_to}(\textit{Kim}, \boxed{1}) \}$

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[9]In Pollard & Sag (1994), *scope-object*s were called *nom-object*s, and restrictions were sets of *parameterized states of affairs* (*psoa*s), rather than *fact*s. The difference reflects the more comprehensive semantics of Ginzburg & Sag (2000), which involves different kinds of *message* (e.g. *proposition*, *outcome*, and *question*, as well as *fact*). For our purposes, this is just a minor change in feature geometry: *fact*s contain Pollard & Sag style *state-of-affairs* content as the value of the PROP | SOA path, as can be seen in (17).

To get the content of *person to whom Kim spoke* from the content of *person* is a matter of producing a *scope-object* whose index is the index of *person* (and the relative pronoun), and whose restrictions are the union of the restrictions of *person* with a set containing a *fact* corresponding to the *state-of-affairs* that is the content of the relative clause. Unioning the restrictions gives the intersective interpretation.

Conceptually, this is straightforward, but there is technical difficulty: the structure in Figure 2 is a head-adjunct structure, and in such structures the content should come from the adjunct daughter, the relative clause. That is, for "external" semantic purposes (purposes of semantic composition) relative clauses should have *scope-object* content, but as we have seen their "internal" content is a *soa*. So some special apparatus will be required, as will appear in the following discussion.[10]

This should give the reader an idea of the general shape of an approach to relative clauses like (2) using HPSG apparatus. In the following sections we will make this more precise by outlining the two main approaches that have been taken to the analysis of relative clauses in HPSG: the lexical approach of Pollard & Sag (1994: Chapter 5), which makes use of phonologically empty elements, and the constructional approach of Sag (1997), which does not.[11]

2.2 The lexical approach of Pollard & Sag (1994)

The idea that relative clauses have a lexical head is appealing for some kinds of relative clause in many languages (see below, e.g. Section 3.2, Section 3.3), but it is

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[10]Though the details are HPSG specific, this is a general problem, regardless of semantic theory. For example, in a setting using standard logical types, relative clauses *qua* clauses (saturated predications) might be assigned type t, but in order to act as nominal modifiers this predicative semantics must be converted into "attributive" (noun-modifying) semantics, i.e. logical type $\langle et, et \rangle$. See, e.g. Sag (2010: 521–524) where an HPSG syntax is combined with a conventional predicate-logic based semantics for relative clauses.

[11]Müller (1999a) presents what might be considered a third approach, which resembles Sag (1997) in avoiding empty elements, but uses a rule schema for German relative clauses rather than constructional apparatus of phrasal types (see Müller 1999a: 95 for details). The overview of HPSG in Müller & Machicao y Priemer (2019) also presents a rule schema for relative clauses (*loc cit* Section 6.1). Rule schemas were a crucial piece of apparatus in the framework of Pollard & Sag (1994), but they have fallen out of favour with the rise of construction based analyses since Sag (1997). A rule schema is essentially just a phrasal type — that is, a type describing constraints on a mother and daughters — with the difference that unlike phrasal types, rule schemas do not stand in inheritance relations, so it is not possible to factor out generalisations in the way of construction based analyses. This is not an issue for Müller, who claims that a description of restrictive relatives in German requires only a single schema (Müller 1999a: 74).

problematic for relative clauses like (2) — there is no obvious candidate to serve as the head. This is clearly problematic for a lexical, "head-driven" approach, such as HPSG. Building on an approach originally proposed by Borsley (1989), the analysis proposed in Pollard & Sag (1994: Chapter 5), overcomes this problem by assuming that relative clauses involve a phonologically empty head, which Pollard & Sag call R ("relativiser"), and which projects an RP (that is, a relative clause).

R is lexically specified to be a nominal modifier (i.e. [MOD *noun*]) which takes two arguments. The first is an XP, the *wh*-phrase, with a REL value which contains the index of the antecedent nominal. The second is sentential, and constrained to have a SLASH value that includes the XP. With some simplifications and some minor modifications to fit the framework we assume here, this is along the lines of (21) (cf. Pollard & Sag 1994: 216). Here XP $\boxed{4}$ is intended to mean an XP whose LOCAL value is $\boxed{4}$, and S:$\boxed{3}$ means a clause (a saturated *verb* – i.e. one with empty SUBJ and COMPS specifications) whose CONTENT is $\boxed{3}$. The $\boxed{2}$ that appears in the value of RESTR is intended to be the RESTR set of the antecedent nominal (this should be specified as part of the MOD value, but we have not done this, in the interests of readability).

$$
(21)\quad
\begin{bmatrix}
\text{SYNSEM} & \begin{bmatrix}
\text{LOC} & \begin{bmatrix}
\text{CAT} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \text{MOD} & \overline{\text{N}}_{\boxed{1}} \end{bmatrix} \end{bmatrix} \\
\text{CONT} & \begin{bmatrix}
\textit{scope-obj} \\
\text{INDEX} & \boxed{1} \\
\text{RESTR} & \boxed{2} \cup \left\{ \begin{bmatrix} \textit{fact} \\ \text{PROP|SOA} & \boxed{3} \end{bmatrix} \right\}
\end{bmatrix}
\end{bmatrix}
\end{bmatrix} \\
\text{ARG-ST} & \left\langle \begin{matrix} \text{XP } \boxed{4} \\ \begin{bmatrix} \text{REL} & \{\boxed{1}\} \end{bmatrix} \end{matrix}, \begin{matrix} \text{S:}\boxed{3} \\ \begin{bmatrix} \text{SLASH} & \{\boxed{4}\} \end{bmatrix} \end{matrix} \right\rangle
\end{bmatrix}
$$

Standard schemas for combining heads with arguments will produce structures like the RP in Figure 3, which (since MOD is a head feature) will inherit the MOD feature from R, and hence combine with a nominal like *person* in a head-adjunct phrase to produce the structure in Figure 3.[12]

This captures the properties described above, and resolves the issues mentioned in the following way.

The first argument of R is specified as [REL {$\boxed{1}$}]. Thus, it must contain a relative pronoun. Moreover, (21) specifies that the first argument must correspond to a gap in the second argument. Hence cases like (6) where there is no *wh*-phrase, or where the *wh*-phrase is *in situ*, are excluded.

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[12]Here again we have used PP $\boxed{4}$ to indicate a PP whose LOCAL value is $\boxed{4}$.

$$\overline{N}_{[1]}$$

Tree structure (Figure 3):

- $\overline{N}_{[1]}$ branches into $_{[7]}\overline{N}_{[1]}$ and RP $\left[\text{REL } \{[1]\}\right]$
- $_{[7]}\overline{N}_{[1]}$ → person
- RP $\left[\text{REL } \{[1]\}\right]$ branches into PP $_{[4]}\left[\text{REL } \{[1]\}\right]$ and $\overline{R}$
- PP $_{[4]}$ → to whom
- $\overline{R}$ branches into R $\left[\begin{matrix}\text{MOD} & [7] \\ \text{ARG-ST} & \langle [4], [6]\rangle\end{matrix}\right]$ and $_{[6]}$ S $\left[\text{SLASH } \{[4]\}\right]$
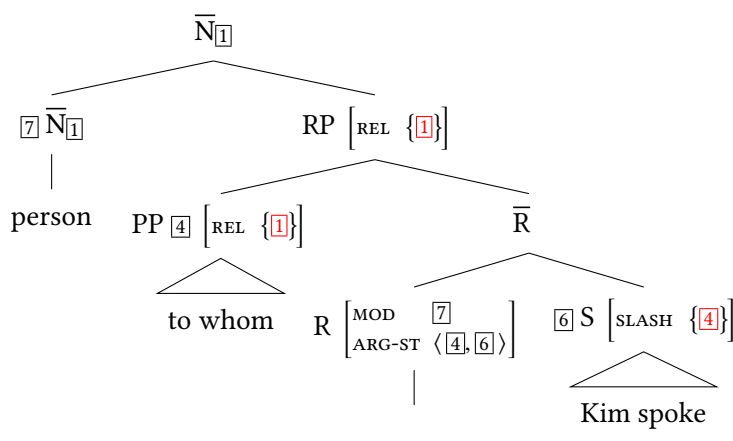- R → _ (empty)
- S → Kim spoke

Figure 3: A Pollard & Sag (1994) style structure involving a finite *wh-*relative clause.

Since R, not the slashed S, is the head of RP, there is no problem of mismatch between the content of the S and the relative clause: R is lexically specified as having *fact* (i.e. *scope-object*) content incorporating the "internal" content of its complement clause (tagged $_{[3]}$) in the appropriate way. This *fact* content will be projected to RP by normal principles of semantic composition relating to heads, complements, and subjects, and RP will produce the right content by unioning the restrictions that come from the head nominal with this *fact* content.

This leaves the question of how upwards inheritance of the REL and SLASH values can be prevented. The same method is used for both. The idea is that for features like REL and SLASH (non-local features) the value on the mother is the union of the values on the daughters, less any indicated as being discharged ("bound-off") on the head daughter (the values that are bound-off in this way are specified as elements of the value of a TO-BIND attribute). Thus, R can be specified so as to discharge the SLASH value on its S sister (so that $\overline{R}$ is [SLASH {}]), and we can ensure that the topmost $\overline{N}$ is [REL {}], so long as its head $\overline{N}$ daughter is specified as binding-off the REL value on RP. This specification can be imposed by stipulation in the MOD value of R. See Pollard & Sag (1994: 164) for details.

The approach can be extended to deal with other kinds of relative clause by positing alternative forms of empty relativiser (see below and Pollard & Sag 1994: Chapter 5).

The great attraction of the approach is that, apart from R, it requires no special apparatus of any kind. On the other hand, it requires the introduction of a novel

part of speech (R), and the need to posit phonologically empty elements for which there is no independent evidence. Reservations about this lead Sag to develop the constructional approach presented in Sag (1997).[13]

2.3 The constructional approach of Sag (1997)

The analysis of English relative clauses in Sag (1997) is constructional and completely dispenses with phonologically empty elements.[14] It involves three main constructions: one for combining relative clauses and nominals, and two for relative clauses themselves. One of these is the standard construction for head-filler phrases. The other involves a number of sub-constructions specific to relative clauses, which are treated as a subtype of *clause* (alongside e.g. *declaratives* and *imperatives*). These are outlined (with some simplifications and minor adjustments) in Figure 4.[15]

The *rel-cl* clause type is associated with the constraints in (22), which simply state that relative clauses are subordinate clauses ([MC −]) that modify nouns and have *propositional* content, and that they do not permit subject-aux inversion ([INV −]).[16]

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[13] One detail we ignore here concerns the analysis of "subject" relatives: relative clauses where the relative phrase is a grammatical subject inside the relative clause, as in (i):

    (i)   person who spoke to Kim

Pollard & Sag (1994) treat such examples specially (cf. Pollard & Sag 1994: 218–219), using the "Subject Extraction Lexical Rule" (SELR) which in essence permits a VP to replace an S in an ARG-ST in the presence of a gap, Pollard & Sag (1994: 174), so that R combines with a VP rather than an S. But this is not an essential part of the analysis of relative clauses: it is motivated by quite independent theoretical considerations (specifically, the assumption that gaps are associated only with non-initial members of ARG-ST lists — cf. the "Trace-Principle", Pollard & Sag (1994: 172)). Hence we ignore it here.

[14] See Müller (2019b), Chapter 36 of this volume, for broader discussion of the constructional approach to HPSG.

[15] See Kim & Sells (2008: Chapter 11) for an introductory overview of English relative clauses on similar lines to Sag (1997). Sag (2010: 521–524) outlines an approach which is stated using the Sign-based Construction Grammar style notation (Boas & Sag 2012). Apart from the semantics (which is formulated using conventional λ-calculus apparatus), it is generally compatible with the earlier analysis described here. One simplification we make here is that we follow the more recent work (e.g. Sag 2010: 523) and do not distinguish subject and non-subject finite relative clauses: Sag (1997) follows Pollard & Sag (1994) in treating them differently (cf. footnote 13; and see Sag 1997: 452–454), but it is not clear how important this is in the framework of Sag (1997).

[16] Giving relative clauses *propositional* content puts them on a par with other kinds of clause, and is not very different from Pollard & Sag's assumption that clauses have *state-of-affairs* content (since *proposition*s are simply semantic objects which contain a SOA).

Figure 4: Type hierarch for *clause*, based on Sag (1997).

$$(22) \quad \textit{rel-cl} \Rightarrow \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \text{MC} & - \\ \text{INV} & - \\ \text{MOD} & \begin{bmatrix} \text{HEAD} & \textit{noun} \end{bmatrix} \end{bmatrix} \\ \text{CONT} & \textit{proposition} \end{bmatrix}$$

Relative clauses such as that in (2) are what Sag calls *fin-wh-rel-cl*, a sub-type of *wh-rel-cl*. This is associated with the constraints in (23). In words: *wh*-relatives are a subtype of relative clause (as stated in the type hierarchy in Figure 4), where the non-head daughter is required to have a REL value which contains the INDEX of the antecedent.[17]

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[17]For simplicity and to avoid distractions, we have presented *wh*-relatives as $\overline{\text{N}}$ modifiers in (23). This is a conventional assumption, because standard methods of semantic composition ensure that the content of the relative clause is included in the restrictions of a quantificational determiner (as in *every person to whom Kim spoke*), but it is not Sag's analysis. Instead he takes *wh*-relatives to be NP modifiers, which allows him to account for facts about the ordering of *wh*-relatives and bare relatives, see Sag (1997: 465–469). Kiss (2005: 293–294) gives a number of arguments in favour of this view, for example, the existence of what Link (1984) called "hydras", like (i), where the relative clause must be interpreted as modifying the coordinate structure consisting of the conjoined NPs.

(23)   *wh-rel-cl* $\Rightarrow$ $\begin{bmatrix} \text{HEAD} & \begin{bmatrix} \text{MOD} & \overline{\text{N}}\boxed{1} \end{bmatrix} \\ \text{NON-HD-DTRS} & \left\langle \begin{bmatrix} \text{REL} & \{\boxed{1}\} \end{bmatrix} \right\rangle \end{bmatrix}$

The framework assumed in Sag (1997) allows multiple inheritance of constraints from different dimensions (cf. **chapters/ChXXXX** Chapter **??** of this volume). As well as inheriting properties in the clausal dimension, expressions of type *fin-wh-rel-cl* are also classified in the phrasal dimension as belonging to a sub-type of head-filler phrase (*hd-fill-ph*), thus inheriting constraints as in (24).[18]

(24)   *hd-fill-ph* $\Rightarrow$ $\begin{bmatrix} \text{SLASH} & \boxed{2} \\ \text{HD-DTR} & \begin{bmatrix} \text{HEAD} & \textit{verbal} \\ \text{SLASH} & \{\boxed{1}\} \uplus \boxed{2} \end{bmatrix} \\ \text{NON-HD-DTRS} & \left\langle \begin{bmatrix} \text{LOCAL} & \boxed{1} \end{bmatrix} \right\rangle \end{bmatrix}$

In words: they are *verbal* — e.g. clausal — phrases where the SLASH value of the head daughter is the SLASH value of the mother plus the LOCAL value of the non-head daughter (equivalently, the SLASH value of the mother is the SLASH value of the head daughter less the LOCAL value of the non-head daughter). Head-filler phrases are a sub-type of another phrase type (*head-nexus-phrase*) which specifies identity of content between mother and head daughter.

   Putting these together with a constraint that requires clauses to have empty REL values will license local trees like that in Figure 5 for a finite relative clause (*fin-wh-rel-cl*) like (2) (simplifying, and disregarding most empty and irrelevant attributes).[19] The REL specification on the non-head daughter (the PP) in (23) ensures the presence of a *wh*-phrase, and the fact that this is a head-filler phrase ensures that the *wh*-phrase cannot be *in situ* (cf. (6), above); the [REL {}] on the daughter S excludes the possibility of additional relative pronouns inside the S (i.e. the possibility of multiple relative pronouns, cf. **(the person) to whom Kim*

(i)   The boy$_i$ and the girl$_j$ who$_{i+j}$ dated each other are Kim's friends.

Sag's analysis requires a different approach to semantic composition to that assumed here, e.g. one using Minimal Recursion Semantics (MRS, Copestake et al. 2005) or Lexical Resource Semantics (LRS, Richter & Sailer 2004) — see, in particular Walker (2017), where such an approach is worked out in detail using LRS.

[18]The $\uplus$ symbol here signifies *disjoint union*. This is like normal set union, except that it is undefined for pairs of sets that share common elements. Here, the intention is that restrictions are to distributed between the noun and the clause, so the restrictions associated with the noun do not include the restrictions associated with the clause, and *vice versa*.

[19]This assumption about REL values is one of many minor technical differences between Sag (1997) and Pollard & Sag (1994), where the non-empty REL value is inherited upwards to RP, and is discharged there. This means that for Pollard & Sag, but not for Sag (1997), a *wh*-relative clause is a REL marked clause.
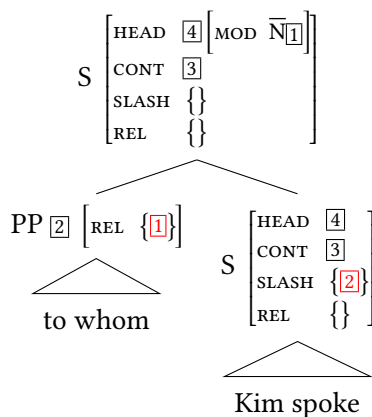
$$S \begin{bmatrix} \text{HEAD} & \boxed{4}\begin{bmatrix} \text{MOD} & \overline{\text{N}}\boxed{1} \end{bmatrix} \\ \text{CONT} & \boxed{3} \\ \text{SLASH} & \{\} \\ \text{REL} & \{\} \end{bmatrix}$$

$$\text{PP}\,\boxed{2}\ \begin{bmatrix} \text{REL} & \{\boxed{1}\} \end{bmatrix}$$

to whom

$$S \begin{bmatrix} \text{HEAD} & \boxed{4} \\ \text{CONT} & \boxed{3} \\ \text{SLASH} & \{\boxed{2}\} \\ \text{REL} & \{\} \end{bmatrix}$$

Kim spoke

Figure 5: A Sag (1997) style structure for a finite *wh*-relative clause.

spoke about whom). REL inheritance will carry the index of the antecedent down into the PP, guaranteeing the presence of a relative pronoun co-indexed with any nominal that this relative clause is used to modify. Further upwards inheritance of this REL value is prevented by a requirement that all clauses (including relative clauses) have empty REL values.[20] The SLASH specification on the head S daughter will ensure that the LOCAL value of the PP is inherited lower down inside the S, so that the subcategorisation requirements of *speak* can be satisfied, and the right content produced for this S (and passed to the mother S, because this is a head-filler phrase).

The task of combining a nominal and a relative clause (in particular, identifying indices and unioning restrictions) involves a further phrase type *head-relative-phrase*, as in (25).

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[20]Sag's account of the propagation of REL values is a special case of the apparatus that is now standardly assumed for propagation of all non-local features, SLASH, WH (i.e. QUE), and BACK-GROUND (Ginzburg & Sag 2000: Ch5). Upwards inheritance is handled by a constraint on *word*s that says that (by default) the REL value of a word is the union of the REL values of its arguments. In the absence of a lexical head with arguments (e.g. in *of whom* and *of whose friends* if *of* is treated simply as a marker) the REL value on a phrase is that of its head daughter (the "Wh-Inheritance Principle", WHIP), see Sag (1997: 449). Since these are only default principles, they can be overridden, e.g. by the requirement that clauses have empty REL values.

(25)   *head-relative-phrase* ⇒

$$
\begin{bmatrix}
\text{HEAD} & noun \\
\text{CONT} & \begin{bmatrix} \text{INDEX} & \boxed{2} \\ \text{RESTR} & \boxed{3} \uplus \left\{ \begin{bmatrix} fact \\ \text{PROP} & \boxed{4} \end{bmatrix} \right\} \end{bmatrix} \\
\text{HD-DTR} & \begin{bmatrix} \text{INDEX} & \boxed{2} \\ \text{RESTR} & \boxed{3} \end{bmatrix} \\
\text{NON-HD-DTR} & \begin{bmatrix} \text{CONT} & \boxed{4} \end{bmatrix}
\end{bmatrix}
$$

In words, this specifies a nominal construction (i.e. one whose head is a noun), whose CONTENT is the same as that of its head daughter, except that the content of the non-head-daughter (the relative clause) has been added to its restriction set. (Thus, it is this construction that takes care of the mismatch between the "internal", propositional, CONTENT of the relative clause itself, and its "external" contribution of restrictions on the nominal it modifies). Since *head-relative-phrase*s are a subtype of *head-adjunct-phrase*, which requires the MOD value of the non-head to be identical to the SYNSEM value of the head (Sag 1997: 475), this will give rise to structures like that in Figure 6.[21]
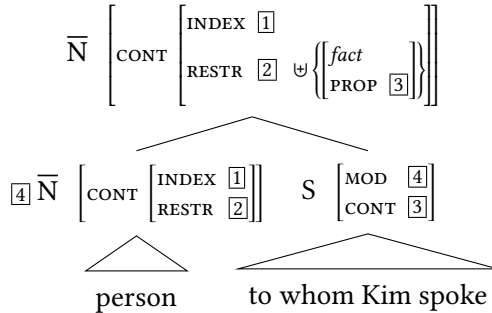

Figure 6: Sag's (1997) analysis of a relative clause plus its antecedent.

From a purely formal point of view the *head-relative-phrase* construction is not strictly necessary. It would be possible to build its semantic effects into the *rel-cl* construction, so that the structure in Figure 6 would be an entirely normal head-adjunct phrase where the content comes from the adjunct daughter. There

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[21]This is not the normal semantics associated with head-adjunct phrases (where the content is simply the content of the adjunct daughter). This could be dealt with by introducing a separate sub-type of *head-adjunct-ph* which deals with content in this way: *head-adjunct-ph* itself would impose no constraints on content. Notice that we again follow Ginzburg & Sag (2000) in taking restrictions to be sets of *facts* (Sag 1997 assumes they are sets of *propositions*). Nothing hangs on this.

are two arguments against this. One is that it would require the relative clause to have nominal (i.e. *scope-object*) content, which is somewhat at odds with its status as a clause. The other is that it would push the semantic mismatch into the relative clause itself. That is, semantically, relative clauses like *to whom Kim spoke* would no longer be normal head-filler phrases where CONTENT is shared between head and mother. Perhaps neither argument is compelling — in fact, the discussion of relative clauses in Sag (2010) suggests essentially this approach (Sag 2010: 522).

2.4 Interim Conclusions

The discussion so far has focused on one kind of relative clause, sketched the basic ideas and intuitions behind the HPSG approach, and outlined the two main approaches: that of Pollard & Sag (1994) and that of Sag (1997). At some levels they seem very different (e.g. in the use of phonologically empty lexical heads vs. the use of constructions), and there are differences in terms of low level technical details (e.g. precisely which phrases are specified as having empty REL values, and in the precise way inheritance of SLASH and REL values is terminated). But in other respects they are very similar: for the most part the same features are used in ways that are not radically different.

More significantly, the approaches involve a common view of the relation between relative clause and antecedent: the view that the relative clause is adjoined to the antecedent, with the relation between the antecedent and the relativised constituent within the relative clause being one of co-indexation (a more or less anaphoric relation): a view that can be traced back to Chomsky (1977).

Outside HPSG this style of analysis stands in contrast to two others: the *raising* analysis (see *inter alia* Schachter 1973; Vergnaud 1974; Kayne 1994), and the *matching* analysis (see *inter alia* Chomsky 1965; Lees 1961; Sauerland 1998). Under the raising analysis, the relative clause contains a DP of the form *which*+noun, which is preposed to the beginning of the clause; then the noun is moved out of the relative clause ("raised") to combine with a determiner, which selects both the noun and the relative clause. According to the matching analysis, the relative clause is adjoined to the antecedent, as in the adjunction analysis, but, as in the raising analysis, the relative clause contains a DP *which*+noun, which is preposed to the beginning of the clause; the noun is not raised, but the noun is deleted under identity with the antecedent nominal.

Neither analysis has any appeal from an HPSG perspective: as normally understood, both are fundamentally derivational in nature, presupposing at least two levels of syntactic structure. Moreover, many of the motivations usually

cited are absent given standard HPSG assumptions (e.g. arguments from binding theory which taken be taken as indicating the presence of *wh*-phrase inside the relative clause fall out naturally without this assumption given the argument-structure based account of binding theory which is standard in HPSG, see Wechsler, Koenig & Davis (2019), Chapter 9 of this volume). More important, as discussed in Webelhuth et al. (2018), both face numerous empirical difficulties and miss important generalisations which are unproblematic for the style of analysis described here.[22]

3 Varieties of relative clause

In this section we will look at how the approaches introduced above have been adapted and extended to deal with other kinds of relative clause in a variety of languages.[23] Section 3.1 looks at other kinds of relative clauses which involve a relative pronoun, notably ones which do not involve a finite verb. Section 3.2 and Section 3.3 look at relative clauses which do not involve relative pronouns: Section 3.2 looks at relative clauses which can be analysed as involving a complementiser; Section 3.3 looks at "bare" relatives, which involve neither relative pronouns nor complementisers. Section 3.4 looks at non-restrictive relative clauses, which lack the intersective semantics associated with prototypical relative clauses.

One dimension of variation among relative clause constructions which we will discuss only in passing relates to whether, in the case of relative clauses that involve a filler-gap construction, the gap is genuinely absent phonologically (as in the examples we have looked at so far), or whether it is realised as a full pronoun (a so-called *resumptive pronoun*) as in (26) from Alqurashi & Borsley (2012: 28), or the English example in (27) — the resumptive pronouns are indicated in bold.

(26) wajadtu l-kitab-a [llaði tuħib-**hu** Hind-un] (Arabic)
found.1.SG DEF-book-ACC that.M.SG like.3.F.SG-3.M.SG Hind-NOM

'I found the book that Hind likes.'

---

[22]For example, for example, both analyses treat *wh*-words like *who*, *what* and *which* and their equivalents as determiners, whereas in fact they behave like pronouns. Case assignment appears to pose a fundamental problem for the raising analysis, since it seems to predict that the case properties of the antecedent NP should be assigned "downstairs" inside the relative clause. But they never are. (see Webelhuth et al. 2018).

[23]In addition to the phenomena and languages we discuss, the HPSG literature includes more or less detailed treatments of relative clauses in Bulgarian (Avgustinova 1996), German (Müller 1999a,b; Müller & Machicao y Priemer 2019), Hausa (Crysmann 2016), Polish (Mykowiecka et al. 2003; Bolc 2005), and Turkish (Güngördü 1996).

(27)   This is the road which I don't know where **it** goes.

The analysis of resumptive pronouns is discussed elsewhere in this volume (**chapters/ChYYYY** Chapter **??** of this volume), and while they are an important feature of relative clause constructions in many languages (see e.g. Vaillette 2001; Vaillette 2002; Tagh-vaipour 2005; Abeillé & Godard 2007; Alotaibi & Borsley 2013), the issues seem to be similar in all constructions involving unbounded dependencies, and not specific to relative clauses.

3.1 *Wh*-relatives

Finite *wh*-relatives in English have been discussed above (Section 2). English also allows *wh*-relatives which are headed by non-finite verbs, such as (28); (29) is a similar example from French.

(28)   a person [on whom to place the blame]

(29)   un paon   [dans les plumes duquel] mettre le   courrier   (French)
        a   peacock in   the feathers of.which to.place the mail

        'a peacock in whose feathers to place the mail'

Non-finite relatives were not discussed by Pollard & Sag (1994), but Sag's (1997) constructional approach provides a straightforward account. It involves distin-guishing two sub-types of *hd-fill-ph*: a finite subtype which has an empty SUBJ list, and a non-finite subtype whose SUBJ list is required to contain just a PRO (that is, a pronominal that is not syntactically expressed as a syntactic daughter). This requirement reflects the fact that non-finite *wh*-relatives do not allow overt subjects:

(30)   *a person [on whom (for) Sam to place the blame]

The relative clause in (28) receives a structure like that in Figure 7. Apart from the finite specification, this differs from the finite *wh*-relative in (5) above only in the presence of the PRO on the SUBJ list.[24]

The exclusion of overt subjects is not peculiar to non-finite relatives (it is shared by non-finite interrogatives, cf. *I wonder on whom (*for Sam) to put the*

---

[24]The use of S$_{inf}$ in Figure 7 is an approximation. First, S is standardly an abbreviation for something of type *verb* with empty SUBJ and COMPS values, and here there is a non-emtpy SUBJ. Second, Sag would have CP instead of S here, reflecting his analysis of *to* as a complementiser rather than an auxiliary verb, as is often assumed in HPSG analyses (e.g. Ginzburg & Sag 2000: 51–52). S and CP are not very different (both *verb* and *comp* are subtypes of *verbal*), but Sag is careful to treat *to* as a *comp* and non-finite *wh*-relatives as CPs because this gives a principled basis for excluding overt subjects.

$$S_{inf} \begin{bmatrix} \text{HEAD} & \boxed{4}\begin{bmatrix} \text{MOD} & \overline{\text{N}}\boxed{1} \end{bmatrix} \\ \text{CONT} & \boxed{3} \\ \text{SLASH} & \{\} \\ \text{REL} & \{\} \\ \text{SUBJ} & \langle \boxed{5} \rangle \end{bmatrix}$$

$$\boxed{2}\ \text{PP}\ \begin{bmatrix} \text{REL} & \{\boxed{1}\} \end{bmatrix} \qquad S_{inf}\begin{bmatrix} \text{HEAD} & \boxed{4} \\ \text{CONT} & \boxed{3} \\ \text{SLASH} & \{\boxed{2}\} \\ \text{REL} & \{\} \\ \text{SUBJ} & \langle \boxed{5}\ PRO \rangle \end{bmatrix}$$

on whom

to put the blame

Figure 7: Sag's (1997) analysis of a non-finite *wh*-relative clause (*inf-wh-rel-cl*).

blame), but non-finite *wh*-relatives are subject to the apparently idiosyncratic restriction that the *wh*-phrase must be a PP:

(31)   a.   * a person who(m) to place the blame on   (relative)

         b.   I wonder who(m) to place the blame on   (interrogative)

The relevant constraints can be stated directly — roughly as in (32) (disregarding constraints that are inherited from elsewhere). In words these constraints say that a non-finite head-filler phrase must have an unexpressed subject, and a non-finite *wh*-relative clause is a non-finite head-filler phrase whose non-head daughter is a PP.

(32)   a.   *inf-hd-fill-ph* $\Rightarrow \begin{bmatrix} \text{HD-DTR} & \begin{bmatrix} \text{HEAD} & [\text{VFORM} \quad non\text{-}finite] \\ \text{SUBJ} & \langle PRO \rangle \end{bmatrix} \end{bmatrix}$

         b.   *inf-hd-fill-rel-cl* $\Rightarrow$ *inf-hd-fill-ph* & $[\text{NON-HD-DTRS} \quad \langle PP \rangle]$

3.2 Complementizer relatives

As well as *wh*-relatives, which involve relative pronouns, there are cases of relative clauses which appear to be headed by what is plausibly analysed as a complementiser. In this section we look first at Arabic, where a complementiser

analysis has been proposed, then at English, where such an analysis seems possible for some cases, but where it is controversial, and an interesting construction in French.[25]

3.2.1 Arabic

Alqurashi & Borsley (2012) argue that in Arabic finite relatives the word *ʔallaði* 'that' (transliterated as *llaði* in (33), from Alqurashi & Borsley 2012: 27) and its inflectional variants should be analysed as a complementiser, with a SYNSEM value roughly as in (34).[26]

(33) jaaʔa   l-walad-u   llaði   qaabala   l-malik-a.   (Arabic)
     came.3.M.SG DEF-boy-NOM that.M.SG met.3.M.SG DEF-king-ACC

     'The boy who met the king came.'

(34)
$$
\begin{bmatrix}
synsem \\
\text{LOC} \begin{bmatrix}
\text{CAT} \begin{bmatrix}
\text{HEAD} \begin{bmatrix} c \\ \text{MOD } \text{NP}_{def}: \begin{bmatrix} \text{INDEX } \boxed{1} \\ \text{RESTR } \boxed{2} \end{bmatrix} \end{bmatrix} \\
\text{COMPS} \left\langle \begin{bmatrix} \text{LOC} \begin{bmatrix} \text{CAT } \text{S}_{fin} \\ \text{CONT } \boxed{3} \end{bmatrix} \\ \text{NON-LOC} \begin{bmatrix} \text{SLASH } \{\text{NP}\boxed{1}\} \end{bmatrix} \end{bmatrix} \right\rangle
\end{bmatrix} \\
\text{CONT} \begin{bmatrix} \text{INDEX } \boxed{1} \\ \text{RESTR } \boxed{2} \uplus \{\boxed{3}\} \end{bmatrix}
\end{bmatrix} \\
\text{NON-LOC} \begin{bmatrix} \text{SLASH } \{\} \end{bmatrix}
\end{bmatrix}
$$

According to this, *ʔallaði* will combine with a slashed finite sentential complement, to produce a phrase which will modify a definite NP. When it combines with that NP, its content will have the same INDEX as the NP, and the restrictions

---

[25]There are also cases which involve a relative pronoun *and* a complementiser, as in the following from Hinrichs & Nakazawa's (2002) discussion of Bavarian German:

(i)   der Mantl (den)   wo i kaffd   hob   (Bavarian German)
      the coat   which that I bought have

      'the coat which I bought'

Hinrichs & Nakazawa (2002) analyse these as *wh*-relatives, even when the relative pronoun is omitted, as it can be under certain circumstances.

[26]Here S$_{fin}$ means a finite clause (a *verb* which is COMPS and SUBJ saturated) NP$_{def}$ in the MOD means a fully saturated definite nominal whose CONTENT is given after the colon. According to (34) the content of the S$_{fin}$ is merged with the restrictions of this modified NP. This is imprecise: as discussed above, what should be merged is a *fact* constructed from the content of the S$_{fin}$.

of the NP combined with the propositional content of the sentential complement. The SLASH value on the sentential complement means that it will contain a gap (or a resumptive pronoun) which also bears the same index.

Notice that there no role for a REL feature here (obviously, since there is no relative pronoun). The presence of the SLASH value indicates that Alqurashi & Borsley assume that Arabic relatives involve an unbounded dependency (i.e. that the gap or resumptive pronoun may be embedded arbitrarily deeply within the relative clause). In *wh*-relatives, as described above, the unbounded dependency is what Pollard & Sag (1994: 155) call a "strong" unbounded dependency, i.e. one that is terminated by at the top by a filler (the *wh*-phrase), in a head-filler phrase. This is not the case here — here there is no filler, and upward inheritance of the gap is halted by the head *ʔallaði* itself (cf. its own empty SLASH specification). That is, Arabic relatives (and complementiser relatives generally) are normal head-complement structures, involving what Pollard & Sag (*loc cit*) call a "weak" unbounded dependency construction (like English purpose clauses and *tough*-constructions).[27]

Since *ʔallaði* shows inflections agreeing with the antecedent NP for NUMBER, GENDER, and CASE, different forms will impose additional restrictions on the modified NP (e.g. the form transliterated as *llaði* in (33) will add to (34) the additional requirement that the NP which is modified must be masculine singular).

Notice that Alqurashi & Borsley's account is entirely lexical: no constructional apparatus is used at all. Hahn (2012) argues for a constructional alternative.[28]

3.2.2 English

A similar analysis could be proposed for English *that*-relatives as in (35). However, this is controversial: Pollard & Sag (1994) treat some uses of *that* as simply a marker (i.e. the realisation of a MARKING feature whose value is *that*, as opposed to *unmarked*), and others as a relative pronoun, see Pollard & Sag (1994: 221–222). Sag (1997: 462–464) prefers to treat *that* as a relative pronoun.[29]

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[27]Alqurashi & Borsley (2012: 42) assume that the SLASH inheritance is governed by a default principle, so the empty SLASH specification on *ʔallaði* prevents upwards inheritance. The same effect could be achieved with an appropriate TO-BIND specification.

[28]Arabic also has finite relatives that do not have an overt relativiser (and which occur with indefinite antecedents). Alqurashi & Borsley analyse these as involving a phonetically null complementiser. In addition, Arabic also has non-finite and free relatives, which have received some attention. See Melnik (2006); Haddar et al. (2009); Zalila & Haddar (2011); Hahn (2012); Crysmann & Reintges (2014) for further discussion.

[29]Pollard & Sag (1994) treat instances of *that* in relative clauses involving relativisation of a top level subject, like (35a), as a relative pronoun. In other relative clauses, in particular those

(35)   a. person that ____ admires Kim

        b. person that everyone thinks ____ admires Kim

On Pollard & Sag's (1994) analysis, some support for a relative pronoun analysis comes from coordination. It is possible to coordinate *that* relatives with normal *wh*-relatives quite freely, as in (36). This is a natural consequence if the REL value of the coordinate structure is shared by both conjuncts (implying that both conjuncts contain relative pronouns, of course).[30]

(36)   a book [that/which you own or that/which you can borrow]

Potential evidence against this, and in favour of a complementiser (or perhaps marker) style analysis would be that *that* differs from normal relative pronouns in not allowing pied-piping, cf. (37b).

(37)   a. the person that I spoke to ____

        b. * the person to that I spoke ____

Sag (1997: 464) and Pollard & Sag (1994: 220) argue that this restriction is compatible with a relative pronoun analysis on the assumption that *that* has nominative case, so that it cannot occur as e.g. the complement of a preposition. Notice also that *who* (which is generally regarded as a relative pronoun) follows the same pattern:

(38)   a. the person who I spoke to ____

        b. * the person to who I spoke ____

    However, this response is not very convincing. What (37) and (38) show is that *that* and *who* cannot appear as complement of a preposition, but can be associated with a gap that is complement of a preposition. But this is inconsistent with them being fillers in a head-filler phrase, where SLASH inheritance ensures

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involving relativisation of embedded subjects, like (35b), or non-subjects, *that* is treated as a marker, meaning that such clauses are treated as instances of bare relatives. It is hard to find clear empirical evidence against this, but an analysis which provides a uniform treatment of English *that*-relatives is clearly more appealing.

[30]The same argument can be made given Sag's (1997) assumptions, but it is less direct. Recall that, on Sag's (1997) analysis, relative clauses have empty REL values, so a coordination of relative clauses will have an empty REL value too (cf. above Section 2.3, especially Footnote 19). For Sag (1997) the argument relies on the assumption that all and only *wh*-relatives are NP modifiers, rather than N̄ modifiers as we have presented them here (cf. Footnote 17). Since coordination involves identity of MOD values, data like (36) show that *that*-relatives must be NP modifiers, and consequently must be *wh*-relatives, i.e. must contain a relative pronoun (namely, *that*).XXXXX

identity between the LOCAL values of filler and gap (including, of course CASE): if *that* and *who* are nominative, then they should not be compatible with non-nominative gaps, such as we see in (37a) and (38a). But if they are not fillers, then they must be heads (or markers). Developing an analysis along these lines is beyond the scope of this paper, but it is worth pointing out that it would not involve a radical change to the analyses described above (for example, modifying Sag's (1997) analysis might involve creating a new subtype of *rel-cl* for *that* and *who* relatives, separate from *wh-rel-cl*, and new lexical entries for *that* and *who*, but could otherwise use the same apparatus, and produce the same distribution of properties).

3.2.3 French

Besides *wh*-relatives, French has relatives introduced by complementisers: *que* 'that' and *dont* 'of-which'. *Dont*-relatives present something of a challenge, which is addressed in Abeillé & Godard (2007). *Dont* is generally analysed as a complementiser introducing finite relatives (Godard 1992). It can introduce a relative with a PP$_{de}$ gap (i.e. a gap that could be occupied by a PP marked with the preposition *de* 'of'). The contrast between the grammatical (39a) and the ungrammatical (39b) arises because whereas *parler* 'talk' in (39a) takes a PP$_{de}$ complement, *comprendre* 'understand' in (39b) takes an NP complement, and so cannot cannot contain a gap licensed by *dont*, as can be seen in (40a) and (40b).

(39) a.   un problème dont   on a   parlé   (French)
           a   problem   of-which one has talked

           'a problem that we have talked about'

      b. *un problème dont   on résoudra   (French)
           a   problem   of-which one will.resolve

           'intended: a problem that we will resolve'

(40) a.   On a   parlé d' un problème.   (French)
           One has talked of a   problem

           'We have talked about a problem.'

      b. *On résoudra   d' un problème.   (French)
           One will.resolve of a   problem

Abeillé & Godard suggest a lexical entry for *dont* with a SYNSEM value along the lines of (41).

$$(41) \quad \begin{bmatrix} synsem \\ \text{LOC} \begin{bmatrix} \text{CAT} \begin{bmatrix} \text{HEAD} \begin{bmatrix} c \\ \text{MOD} \ \overline{\text{N}}\boxed{1} \end{bmatrix} \\ \text{COMPS} \left\langle \begin{bmatrix} \text{LOC} \begin{bmatrix} \text{CAT} \ \text{S}_{fin} \\ \text{CONT} \ \boxed{2} \end{bmatrix} \\ \text{NON-LOC} \begin{bmatrix} \text{SLASH} \ \left\{ \boxed{3} \begin{bmatrix} nprl \\ \text{CAT} \ \text{PP}_{de}\boxed{1} \end{bmatrix} \right\} \end{bmatrix} \end{bmatrix} \right\rangle \end{bmatrix} \\ \text{CONT} \ \boxed{2} \end{bmatrix} \\ \text{TO-BIND} \ \{ \boxed{3} \} \end{bmatrix}$$

In words: *dont* is a complementiser that takes a finite S complement, and heads a phrase that can act as an $\overline{\text{N}}$ modifier. *Dont* itself has no inherent semantic content (its CONTENT is just that of its complement S). The complement S is associated with a SLASH value that contains a PP_{de} which is co-indexed with the antecedent nominal, as specified in the MOD value. The TO-BIND value simply prevents this SLASH element being inherited upwards beyond the phrase headed by *dont*. This SLASH element is non-pronominal (*nprl*) — that is, a genuine gap, rather than a resumptive pronoun.[31]

Given this, one might expect that it is generally impossible for a *dont*-relative to have an NP as the relativised constituent, but this is not the case. It is in fact possible providing the relativised constituent is realised by an overt pronoun (i.e. a resumptive pronoun) and is somewhere inside the complement of (some) propositional attitude and communication predicates. For example, in (42) the pronoun *le* represents the relativised constituent, which appears in the complement of *être certain* 'be sure'.[32]

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[31] Abeillé & Godard (2007) assume that gaps and resumptive pronouns are associated with distinct subtypes of *local* value: *plr* (pronominal) for pronouns and *nprl* (non-pronominal) for genuine gaps. The relevance of this will appear directly.

[32] One might consider an alternative analysis where *dont* is associated with a PP_{de} gap dependent of *certain*, and the resumptive pronoun is a normal anaphoric pronoun — this would correspond to a main clause along the lines of *Paul is sure, of this problem, that we will resolve it*. One problem with this alternative is that this sort of PP_{de} dependent is not very good with *certain*, see (i). Another is that it would not explain the fact that the personal pronoun is obligatory — (ii), with no personal pronoun, is ungrammatical, though semantically coherent:

(i)   ?? Paul est certain de ce problème qu' on le résoudra.   (French)
       Paul is sure of this problem that one it will.solve.

(ii)   * un problème dont   [Paul est certain que tout   va se résoudre]
      a problem of-which Paul is sure that everything goes itself to.solve
                                                          (French)

(42) un problème dont   [Paul est certain [qu' on **le** résoudra]] (French)
      a problem of-which Paul is sure   that one it will.solve
      'a problem that Paul is sure that we will solve'

Unsurprisingly, the presence of a resumptive pronoun is associated with immunity to island constraints. So, for example, in (43) we have a relative where the relativised constituent is within a relative clause inside an embedded NP, which is impossible for a genuine gap.

(43) un problème dont   [Paul est certain [qu' il y a   [quelqu'un qui **le**
      a problem of-which Paul is sure   that there is someone   that it
      résoudra]]]   (French)
      will.solve
      'a problem such that Paul is sure that there is someone who will solve it'

What is surprising, however, is that the path between *dont* and the predicate that licenses the resumptive *is* sensitive to island constraints. To see this, compare the grammatical (42) and (43) with the ungrammatical (44). All involve a *dont* relative containing a resumptive pronoun licensed by *être certain*, but in (44) *être certain* is separated from *dont* by an island boundary (*être certain* is inside a relative clause).

(44) * un problème dont   il y a   [quelqu'un qui est certain qu' on le
        a problem of-which there is   someone   who is sure   that one it
        résoudra]   (French)
        will.solve

In short, though the dependency between the licensing predicate and the resumptive pronoun can cross island boundaries, the dependency between the licensing predicate and *dont* cannot. Abeillé & Godard's (2007) account of this is that while the dependency between the licensing predicate and the relativised constituent involves inheritance of a resumptive element, that between the licensing predicate and *dont* involves inheritance of a gap. They suggest that this should be dealt with by a lexical rule along the lines of (45):

(45) Lexical Rule for Propositional attitude predicates in French

$$
\begin{bmatrix} \text{COMPS} \left\langle \begin{bmatrix} \text{CP} \\ \text{SLASH} \left\{ \boxed{1}\begin{bmatrix} prl \\ \text{CONT|INDEX } \boxed{2} \end{bmatrix} \right\} \end{bmatrix} \right\rangle \oplus \dots \end{bmatrix} \mapsto \begin{bmatrix} \text{SLASH} \left\{ \begin{bmatrix} nprl \\ \text{CAT } \text{PP}_{de}\boxed{2} \end{bmatrix} \right\} \\ \text{TO-BIND } \{ \boxed{1} \} \end{bmatrix}
$$

In words, the left-hand side of this describes a lexeme that takes a CP complement with a SLASH value containing pronominal (*plr*) elements (that is, a CP that can

contain resumptive pronouns). The effect of the rule is to provide a lexical entry that binds-off the resumptive pronoun, and introduces an PP_{de} gap co-indexed to the resumptive pronoun. That is, the sort of gap that can legitimately be associated with *dont*. Thinking from the top down, this rule produces a predicate that can appear in a context with an inherited requirement for a PP_{de} gap (e.g. a relative clause headed by *dont*), and convert this into a requirement for a resumptive pronoun further down. Thinking from the bottom up, the predicate can bind-off a resumptive pronoun, and replace it with a gap dependency.[33]

3.3 Bare relatives

Not all languages realise relative clauses using relative pronouns or complementisers. In this section we will discuss HPSG analyses of what we will call *bare relatives* in Japanese and Korean (Section 3.3.1) and in English, where they are often called "*that*-less" relatives (Section 3.3.2). The absence of relative pronouns means there is no question of pied-piping, hence no role for a REL feature in these constructions.

3.3.1 Bare relatives in Japanese and Korean

Japanese relative clauses corresponding to (2) contain a gap, but are otherwise similar to normal clauses, cf. (46) (from Sirai & Gunji 1998: 18); in Korean they are distinguished by special marking on the topmost verb — cf. the *-nun* affix on *sayngkakha* "think" in (47) (from Kim 2016b: 285).

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[33]As Abeillé & Godard (2007) point out, the facts are not quite as simple as this. In particular there is an interesting complication involving coordination. It is possible for a *dont*-clause containing a predicate like *être certain* to involve a coordinate structure, where one conjunct contains a PP_{de} gap and the other contains a pronoun, as in (i) (the second conjunct here contains the pronominal *y* 'to-it'; the English translation is intended to make it clear that the second conjunct is in the scope of *être certain*).

(i) un problème dont   Paul est certain [que nous avons parlé ___] [et   que
     a problem of-which Paul is sure   that we   have spoken   and that
     nous y   reviendrons   plus tard]   (French)
     we   to-it will.come.back more late

     Lit: 'a problem of which Paul is sure that we have spoken and that he is sure that we will come back to it later'

Dealing with this involves a formal complication that we leave aside here. See Abeillé & Godard (2007).

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(46) Naomi-ga   ___ $_i$ yon-da   hon$_i$ (Japanese)
     Naomi-NOM   read-PAST book
     'the book (that) Naomi read'

(47) [motwu-ka   [Kim-i   ___ $_i$ ilk-ess-ta-ko]   sayngkakha-nun]
     everyone-NOM Kim-NOM   read-PST-DECL-COMP think-PRES.MOD
     chayk$_i$ (Korean)
     book
     'the book (that) everyone thinks Kim read'

Evidence for a gap in these examples is that it is not possible to put an overt NP in place of the gap (e.g. putting *sore-wo* 'it-ACC' in (46), or *sosel-u* 'novel-ACC' in (47) renders them ungrammatical).[34]

Sirai & Gunji (1998) provide a non-constructional account of Japanese bare relatives like (46). They show how an account that uses SLASH inheritance could work, but their actual proposal is SLASH-less. They assume that the tense affixes are heads of verbal predications, and operate via "predicate composition" — by inheriting the subcategorisation requirements of the associated verb. The adnominal tense affixes are special in that a) they are specified as nominal modifiers, and b) they inherit the subcategorisation requirements of the associated verb, less an NP that is co-indexed with the modified nominal. (A lexical equivalent of this could be implemented with a lexical rule which removes an element from a verb's ARG-ST and introduces a MOD value containing a nominal with the corresponding index). Of course, a SLASH-less account like this will only deal with cases of local relativization — where the relativised NP is an argument of the highest verb. Sirai & Gunji argue that cases of non-local relativization, like (48), should be treated as involving null-pronominals (which are a common feature of Japanese). They suggest that the requirement that the modified noun and the pronoun be co-indexed should be captured via a pragmatic condition that requires the relative clause be "about" the modified noun.

(48) [Ken-ga [Eiko-ga   ___ $_i$ yon-da]   to   sinzitei-ru] hon$_i$ (Japanese)
     Ken-NOM Eiko-NOM   read.PAST COMP believe-PRES book
     'the book that Ken believes Eiko read'

Kim (2016b) provides a constructional analysis for Korean which resembles Sag's (1997) analysis of English — see also Kim (1998a); Kim & Yang (2003). He

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[34] As well as these "standard" relatives, Korean and Japanese both have other kinds of relative construction, notably what are sometimes called *internally headed* relatives, and so-called *pseudo-relatives*, which are briefly discussed below. See Section 4.2.2.

suggests that Korean allows verb lexemes to be realised as "modifier verbs" (*v-mod*) subject to a constraint along the lines of (49) — these are verbs that can head a subordinate clause ([MC −]) which modifies a nominal (N).[35]

$$(49) \quad \begin{bmatrix} \text{HEAD} & \begin{bmatrix} verb \\ \text{MC} & - \\ \text{MOD} & noun \end{bmatrix} \end{bmatrix}$$

He also proposes a construction (the *head-relative-mod* construction, see Kim 2016b: 290) to combine a structure headed by such a modifier verb with a head nominal, along the lines of (50).[36]

$$(50) \quad \textit{hd-relative-mod-phrase} \Rightarrow \begin{bmatrix} \text{HEAD} & noun \\ \text{SLASH} & \{\} \\ \text{HD-DTR} & \boxed{2}\,\text{N}\boxed{1} \\ \text{NON-HD-DTRS} & \left\langle \text{S} \begin{bmatrix} \text{HEAD|MOD} & \boxed{2} \\ \text{SLASH} & \{\text{NP}\boxed{1}\} \end{bmatrix} \right\rangle \end{bmatrix}$$

In words: a nominal structure can consist of a head noun, and a clause headed by a modifier verb containing an NP gap which is co-indexed with the head noun. The empty SLASH value on the mother is necessary to prevent the gap being inherited upwards. The SLASH value on the S daughter ensures the presence of an appropriate gap, the MOD value on the S daughter ensures that it is headed by a verb with the right morphology. It will license structures like that in Figure 8. Kim does not discuss the semantics, but it would be straightforward to add constraints to this construction along the lines of those presented above.

3.3.2 Bare relatives in English

English also has bare relative clauses, both finite, as in (51a), and non-finite as in (51b):

(51)   a.   the cakes Kim bought ⎯⎯
       b.   some cakes (for Sam) to eat ⎯⎯

In English, there is no obvious motivation for suggesting a special sub-type of "relative clause heading" verb, so an alternative way of licensing noun-modifying

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[35]Different sub-types of *v-mod* are associated with different tense affixes. (49) differs from Kim's formulation, e.g. Kim's formulation involves a POS (part-of-speech) feature and he assumes that MOD is list valued (see Kim 2016b: 285). This is not important here.

[36]Again, our formulation is slightly different from Kim's for the sake of consistency with the rest of our presentation.
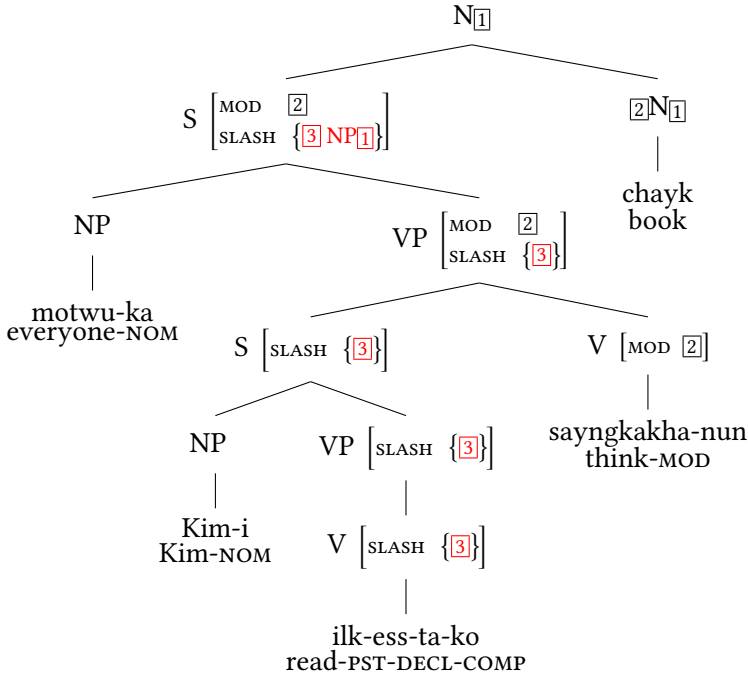
Figure 8: A Korean relative clause, based on Kim (2016b: 295).

clauses with appropriate SLASH values is required. In Pollard & Sag (1994) this was the role of an empty relativiser similar to that described above, differing only in taking a single argument — a slashed clause (see Pollard & Sag 1994: 222; recall that the relativiser discussed above takes two arguments: a *wh*-phrase, and a slashed clause). This gives structures like that in Figure 9.[37]

In Sag (1997) the task of licensing such bare relatives is carried out by a construction (an immediate subtype of *rel-cl*) as in (52). In words: a relative clause can be a noun-modifying clause whose head daughter contains an NP gap that is co-indexed with the modified nominal.

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[37] According to Pollard & Sag (1994: 222), the clausal argument of this single argument version of R can either be bare, as here, or marked by *that*. Thus, terminological accuracy demands the observation that for Pollard & Sag some instances of *that*-relatives are actually "bare" in the sense of containing neither a relative pronoun nor a complementiser (though others, in particular those involving relativisation of a top level subject, are analysed as containing a version of *that* which is actually a relative pronoun). See above Footnote 29.
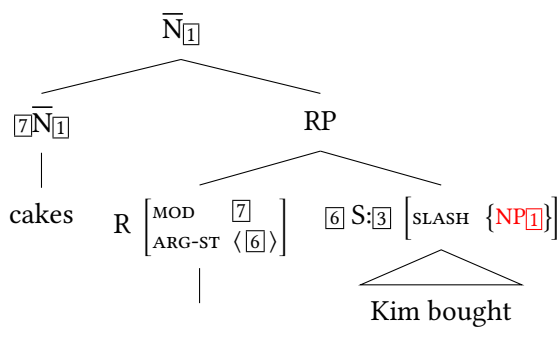
Figure 9: A Pollard & Sag (1994) style structure for an English bare relative.

(52)   *non-wh-rel-cl* $\Rightarrow$ $\begin{bmatrix} \text{HEAD} & \begin{bmatrix} \text{MOD} & \begin{bmatrix} \text{HEAD} & \overline{\text{N}}_{\boxed{1}} \end{bmatrix} \end{bmatrix} \\ \text{SLASH} & \{\} \\ \text{HD-DTR} & \begin{bmatrix} \text{SLASH} & \{\text{NP}_{\boxed{1}}\} \end{bmatrix} \end{bmatrix}$

This licenses structures like that in Figure 10.[38]

This differs from Kim's proposal for Korean in where the SLASH value is bound-off: in particular, where Kim's analysis involves a nominal and a slashed S, Sag's involves a nominal and an *un*slashed S — the clause is [SLASH {}], it is the VP which is [SLASH {NP}]. This reflects the fact that in English the gap in the relative clause cannot be the subject, accounting for the contrast in (53).[39]

(53)   a.   * person spoke to Sam
         b.   person who spoke to Sam

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[38]Sag also proposes a subtype of (52) to deal with non-finite bare relatives, like (i), which he calls *simple infinitival relatives*, cf. *simp-inf-rel-cl* in Figure 4. See Sag (1997: 469). Abeillé et al. (1997) includes discussion of a similar construction in French — 'infinitival *à*-relatives', like (ii):

   (i)   book (for Sam) to read

   (ii)   un livre à lire   (French)
         a   book to read

Neither discussion addresses the special modal semantics associated with non-finites, e.g. (i) means something like "books that Sam can (or should) read".

[39]Examples like (53a) are acceptable in some non-standard dialects of English. Sag suggests this is not problematic, since they could be analysed as reduced relatives (see Sag 1997: 471), but see immediately below where we cast doubt on this. If we are right, then the non-standard dialects would have something like (50) instead of (52).

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Figure 10: A Sag (1997) style structure for an English bare relative.

The issue of where upwards termination of SLASH inheritance should occur highlights the impossibility of having an entirely lexical and non-constructional account of bare relatives that does not employ empty elements. At first glance, a purely lexical approach might seem simple: since all we need is to create clauses specified as [MOD $\overline{\text{N}}$] which contain a co-indexed gap, all we seem to need is verbs specified as in (54).

$$(54) \quad \begin{bmatrix} \text{HEAD} & \begin{bmatrix} verb \\ \text{MOD} & \overline{\text{N}}_{[1]} \end{bmatrix} \\ \text{COMPS} & \langle \text{PP} \rangle \\ \text{SLASH} & \{ \text{NP}_{[1]} \} \end{bmatrix}$$

In the absence of special constructions or empty elements, this would license structures like that in Figure 10, except that the upwards inheritance of the SLASH value will not be terminated, allowing an additional spurious filler for the gap, as in (55):[40]

(55) *That book$_i$, I enjoyed [the book$_i$ Kim read ___ $_i$]

There is one class of exceptions to this — that is, phrases which might be analysed as relative clauses for which a purely lexical account *is* possible. Examples involving participal phrases and a variety of other post-nominal modifiers, notably APs and PPs, are often called *reduced relatives*, and analysed as a type of

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[40]The SLASH based analysis of Japanese relatives outlined in Sirai & Gunji (1998) manages to avoid this problem, without either special constructions or empty elements, but it is not fully lexical, because it assumes tense affixes combine with the associated lexical verb in the syntax (hence the affix is able to block higher inheritance of the gap introduced by the lexical verb).

relative clause. Sag (1997: 471) follows this tradition (*red-rel-cl* in Figure 4). What this comes down to is the assumption that such examples involve clauses containing predicative phrases with PRO subjects, co-indexed with the nominals they modify.

(56) a. a person standing by the door   (VP-*pres-part*)

  b. a train recently arrived at platform four   (VP-*past-part*)

  c. a person given a pay rise   (VP-*passive-part*)

  d. a person in the doorway   (PP)

  e. a person fond of children   (AP)

It is not obvious to us what is gained by treating these as relative clauses introduced by a special construction. A lexical account seems at least as appealing, where the relevant properties of the phrases (e.g. noun modifying semantics) are projected directly from lexical entries for the head words. The reason such a non-constructional approach is possible is that such examples involve neither relative pronouns nor genuine gaps, so there are neither REL nor SLASH dependencies to terminate.[41] This approach seems particularly appealing in the cases like (56e), which would be analysed as just involving an attributive adjective (*fond*) which happens to take a complement, along the lines of (57), where {...} stands for the restrictions the adjective itself imposes. But we think a similar account of verbal participles and prepositions is equally plausible.[42]

$$
(57) \quad \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \text{MOD} & \begin{bmatrix} noun \\ \text{INDEX} & \boxed{1} \\ \text{RESTR} & \boxed{2} \end{bmatrix} \end{bmatrix} \\ \text{CONT} & \begin{bmatrix} \text{INDEX} & \boxed{1} \\ \text{RESTR} & \boxed{2} \uplus \{\ldots\} \end{bmatrix} \end{bmatrix}
$$

Notice that in (57) we omit mention of the SUBJ. If we assume the noun-modifying entry is derived from a predicative entry, there are two obvious alternatives: a) that the predicative subject is suppressed; or b) that it is constrained to be unexpressed (i.e. PRO). In the latter case, the two approaches are very similar, the only difference being whether examples like those in (56) are classified as clausal. It is not clear whether this has empirical consequences.

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[41]This argument does not necessarily carry over to languages which allow relativisation of non-subjects in reduced relatives, such as Arabic. See Melnik (2006: 241).

[42]For example, Müller (2002: 159–164) deals with adjectival passive participles in this way.

3.4 Non-restrictive (supplemental) relatives

The examples of relative clauses considered so far have been *restrictive relatives* (RRCs); they are interpreted as restricting the denotation of their antecedent to a subset of what it would be without the relative clause. So-called *supplemental*, *supplementary*, *appositive*, or *non-restrictive* relatives (NRCs) are different. They do not affect the interpretation of any associated nominal, and are generally interpreted with wide scope, much like independent utterances. For example, if *who understand logic* is read as an NRC as in (58a) it will be interpreted outside the scope of *Kim thinks*.

(58)   a.   Kim thinks linguists, who understand logic, are clever.   (NRC)
       b.   Kim thinks linguists who understand logic are clever.   (RRC)

NRCs are often set off intonationally, and are subject to a number of surface morphosyntactic restrictions in English. In particular, they must be finite and contain a *wh*-pronoun, witness the ungrammaticality of (59a) and (59b).[43]

(59)   a.   *Kim, for Sandy to speak to, will arrive later.
       b.   *Kim, (that) Sandy spoke to, will arrive later.

The analysis of non-restrictives has attracted some attention in the HPSG literature.[44]

Where RRCs are typically nominal modifiers, NRCs are compatible with a wide range of antecedents. Holler (2003) provides an analysis of German non-restrictives which are adjoined to S, as in (60). Her account uses a version of the empty relativiser from Pollard & Sag (1994) whose MOD value specifies a clausal (rather than nominal) target for modification, and looks for an appropriate antecedent for its first argument (the *wh*-phrase) among the discourse referents

---

[43]More extensive discussion of differences between NRCs and RRCs can be found in Arnold (2007).

[44]Bîlbîie & Laurens (2009) discuss what they call *verbless relative adjuncts*, such as (i), in French and Romanian:

   (i)   Trois personnes, [parmi lesquelles Jean], sont venues.   (French)
         three people(FEM) among which.FEM John   AUX come
         'Three people, among which John, have come.'

These have non-restrictive semantics, and some similarities with relative clauses, but Bîlbîie & Laurens point out significant differences, and argue for an analysis that treats them rather differently, as a distinct construction.

contributed by the modification target (for example, the discourse referent corresponding to the proposition expressed by the main clause in (60)). The relative pronoun is thus treated rather like a normal pronoun.

(60) Anna gewann die Schachpartie, was   Peter ärgerte.   (German)
      Anna won   the game of chess which Peter annoyed
      'Anna won the game of chess, which annoyed Peter.'

Arnold (2004) provides an analysis of English non-restrictives of all kinds. This analysis also takes the relative pronouns involved in NRCs to be much like normal pronouns, but accounts for the syntactic restrictions by making minor modifications to constructions given in Sag's (1997) analysis of restrictives. It assumes a uniform syntax for restrictives and NRCs, but provides a way for relative clauses to combine with their heads in two semantically distinct ways, either restrictively (in the normal way) or non-restrictively (making their semantic contribution at the same level as the root clause, accounting for the wide-scope interpretation). The fact that supplementary relatives are required to be finite and contain a *wh*-pronoun can then be simply stated (e.g. non-restrictive semantics entails a non-head daughter which is a *fin-wh-rel-cl*).[45] Likewise, the wider range of antecedents available to NRCs can be captured by relaxing the [MOD *noun*] constraint associated with *rel-cl* (so in principle all kinds of relative clause are compatible with any antecedent), and adding it as requirement associated with restrictive semantics.

The approach to NRCs developed in Arnold (2004) is *syntactically integrated* — NRCs are treated as normal parts of the syntactic structure on a par with restrictive relatives. On the face of it, examples like (61b) are problematic for such an approach:

(61) a. What did Jo think?
      b. You should say nothing, which is regrettable.

When uttered in the context provided by (61a), the interpretation of (61b) is that it is regrettable that *Jo thinks* you should say nothing. This has been taken as an indication that the interpretation of NRCs requires antecedents that are not syntactically realised and only available at a level of conceptual structure (see Blakemore 2006). However, Arnold & Borsley (2008) show that this is incorrect,

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[45]As stated, given Sag's (1997) assumption that *that*-relatives are a variety of *wh*-relative, this wrongly predicts that supplemental *that*-relatives should normally be allowed. One way round this is to adopt an different analysis of *that*, but Arnold (2004) also considers an analysis whereby *that* has a different kind of REL value from "real" relative pronouns.

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and in fact a syntactically integrated account combined with the approach to ellipsis and fragmentary utterances of Ginzburg & Sag (2000) makes precisely the right predictions in this case and in a range of others.

Arnold & Borsley (2010) look at NRCs where the antecedent is a VP, and where the gap is the complement of an auxiliary, as in (62).

(62)   Kim has ridden a camel, which Sam never would ⸺.

This is unexpected, because such examples seem to involve an NP filler (*which*) being associated with a gap in a position where an NP is generally impossible, cf. **Sam never would that activity*. Arnold & Borsley consider a number of analyses, including an analysis which treats *which* as a potential VP, and an analysis which introduces a special relative clause construction. However, they argue that the best analysis is one which relates examples like (62) to cases of VP ellipsis (as in *Kim has ridden a camel but Sam never would*), which involve the VP argument of an auxiliary verb being omitted from its COMPS list. The idea is that auxiliary verbs allow such an elided VP argument to have (optionally) a SLASH value that contains an appropriately co-indexed NP. If such a SLASH value is present, normal SLASH amalgamation and inheritance will yield (62) as a normal relative clause, without further stipulation.

NRCs normally follow their antecedents. However, as Lee-Goldman (2012) observes, there are some special cases where the NRC precedes the antecedent. Such cases involve the relative pronouns *which* and *what* with antecedents that have clausal interpretations, i.e. either actual clauses, as in (63a) and (63b), or other expressions interpreted elliptically as with *later* in (63c).

(63)   a.   It may happen now, or — *which would be worse* — it may happen later.
        b.   It may happen now, or — *which would be worse* — later.
        c.   It may happen now. *What is worse*, it may happen later.

Lee-Goldman provides a constructional account. It makes use of a feature RELZR, introduced by Sag (2010), which is shared between a relative clause and its filler daughter, and whose value reflects the identity of the relative pronoun (so possible values include *which*, *what*, etc.). Cases like (63c) are dealt with simply by means of a special construction which combines a *what*-relative clause with its antecedent in the desired order. The account of cases like (63a) and (63c) makes use of the idea of constituent order domains for linearisation originally proposed by Reape (e.g. Reape (1994), and Müller (2019a), Chapter 10 of this volume). The relevant construction combines a phrase whose RELZR value is *which* (e.g. *which would be worse*) with a clause whose constituent order DOMAIN has a coordinator

as its first element (e.g. the DOMAIN associated with *or it may happen later*) and produces a phrase where the DOMAIN value of the *which* phrase appears after the coordinator and before the remainder of the clause, giving the desired result.[46]

4 Other functions, other issues

For reasons of space, we have so far restricted the notion *relative clause* to the typical case: clauses which are nominal modifiers, adjoined to nominals. This ignores a number of relevant phenomena, notably the fact that relative clauses are not necessarily nominal modifiers, and the possibility that even when they function as nominal modifiers they need not be adjoined to nominals. In this section we will provide some discussion of these issues. Section 4.1 will briefly review HPSG analyses of cases where relative clauses are not adjoined to nominals. Section 4.2 will overview HPSG approaches on cases where clauses resembling relative clauses are not nominal modifiers.[47]

4.1 Extraposition

As noted above, relative clauses are typically nominal modifiers, and typically adjoined to the nominals they modify. However, this is not invariably the case: under certain circumstances relative clauses can be *extraposed*, as in (64), where the relative clauses (emphasised) have been extraposed from the subject NP to the end of the clause.

(64) a. Someone might win *who does not deserve it.*

   b. Something happened then *(that) I can't really talk about here.*

   c. Something may arise *for us to talk about.*

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[46]Lee-Goldman handles the wide scope interpretation of NRCs by implementing a multidimensional notion of CONTENT inspired by Potts (2005). He also extends the analysis described here to deal with cases of *as*-parentheticals (e.g. *As most of you are aware, we have been under severe stress lately*), arguing that *as* should be analysed as a relativiser, and that such clauses should be analysed as relative clauses.

[47]Among the other phenomena we have neglected, one should mention *amount* relatives (e.g. Grosu & Landman 2017), that is, relative clauses where what is modified semantically is not a nominal, but an *amount* related to the nominal, as for example in (i) where the relative clause clause gives information about the *amount* of wine, rather than the wine itself.

   (i) It would take me a year to drink the wine [that Kim drinks on a normal night].

Several different approaches to extraposition have been proposed in the HPSG literature.

One approach uses the idea of constituent order domains, mentioned briefly in Section 3.4 above (and see Müller (2019a), Chapter 10 of this volume). The idea is that an extraposed relative clause is composed with its antecedent nominal in the normal way as regards syntax and semantics, but that rather than being *compacted* into a single DOMAIN element, the nominal and the relative clause remain as separate DOMAIN elements, with the effect that that relative clause can be *liberated* away from the nominal, so that its phonology is contributed discontinuously from the phonology of the nominal, as in the examples in (64). See e.g. Nerbonne (1994), and Kathol & Pollard (1995) for details.

A second approach treats extraposition as involving a non-local dependency, introducing a non-local feature, typically called something like EXTRA, which functions much like other non-local features (e.g. SLASH). The idea is that a relative clause can make its semantic contribution as a nominal modifier "downstairs", but rather than being realised as a syntactic DAUGHTER (sister to the nominal), the relevant properties (e.g. the LOCAL features) are added to the EXTRA list of the head, and inherited up the tree until they are discharged from the EXTRA list by the appearance of an appropriate phrase-final daughter constituent, which contributes its phonology in the normal way, but makes no semantic contribution. Thinking from the top downwards, this is equivalent having a construction which allows a relative clause to appear e.g. as sister to a VP (as in (64a)) without affecting the VP's syntax or semantics, so long as it is pushed onto the EXTRA list of the VP, from where it will be inherited downwards until a nominal occurs which it can be interpreted as modifying (the apparatus needed to deal with the "bottom" of the dependency might be a family of lexical items derived by lexical rule, or a non-branching construction). See e.g. Keller (1995); Bouma (1996); Müller (1999a); Müller (2004); Crysmann (2005); Crysmann (2013).

A third approach is suggested in Kiss (2005), and adopted in Crysmann (2004) and Walker (2017). This approach exploits the more flexible approach to semantic composition provided by Minimal Recursion Semantics (MRS, Copestake et al. 2005), in the case of Kiss (2005), and Lexical Resource Semantics (LRS, Richter & Sailer 2004) in Walker (2017). The idea is that an extraposed relative clause appears as a normal syntactic daughter in its surface position, but the notion of semantic modification is generalised so that rather than the index of a modifying phrase being identified with that of a sister constituent (as standardly assumed), it may be identified with that of any suitable constituent *within* the sister. That is, adjuncts can be interpreted as modifying not just their sisters, but anything

contained in their sisters — words and phrase to which they have no direct syntactic connection. This is implemented by means of a set valued ANCHORS feature, which is inherited upwards in the manner of a non-local feature, and which allows access to the indices of constituents from lower down. The flexibility of semantic composition afforded by MRS and LRS means that the right interpretations can be obtained.

A number of authors have argued for the superiority of an approach using EXTRA-style apparatus (e.g. Müller (2004) and Crysmann (2013)), but in terms of theoretical costs and benefits there seems to be little to choose between these alternatives — the first and third approaches rely on particular approaches to constituent order and semantic composition, while EXTRA-style analyses involve only on the more commonplace apparatus of non-local features (though with the added cost of special constructions or lexical operations to introduce and remove elements from EXTRA lists). Empirically, there are several issues that all approaches deal with more or less successfully (for example, the Right Roof Constraint from Ross 1967 that prevents extraposition beyond the clause, cf. (65b)). However, a more significant factor may be how well different accounts integrate with analyses of extraposition involving other kinds of adjunct and complement (e.g. complement clauses, as in (66)), capturing similarities and differences (see e.g. Crysmann 2013).

(65) a. [That someone might win *who does not deserve it*] is irrelevant.

    b. * [That someone might win] is irrelevant *who does not deserve it.*

(66) The question then arises *whether we should continue in this way.*

4.2 Other functions

In this section we will briefly discuss phenomena involving clauses whose internal structures resemble relative clauses but which do not function as nominal modifiers.[48]

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[48]One omission here is discussion of *relative-corelative* constructions, which can be found in Hindi and Marathi, *inter alia*, and which were given an analysis in Pollard & Sag (1994: 227–232). These involve the paratactic combination of a clause that contains one or more relative pronouns, and what looks like a main clause containing coreferential pronouns, something like 'which boy$_i$ saw which girl$_j$, he$_i$ proposed to her$_j$' (meaning *the boy who saw the girl proposed to her*). Pollard & Sag's analysis involves associating a set of indices in the REL value of the first clause, which are realised by relative pronouns in the normal way, and an identical set of indices as encoded as the value of a CORRELATIVE feature in the main clause, which are realised by normal pronouns.

4.2.1 Complement clauses

Perhaps the most obvious cases of this kind involve clauses with the internal structure of a relative clause which occur as complements, rather than adjuncts. The following are some examples.[49]

(67) a. This story is the *(most) interesting *that we have heard*.

  b. diejenige Frau *(*die dort steht*) (German)
      the.that   woman   who there stands

      'the very woman who is standing there'

  c. It was Kim *that solved the problem*.

  d. It was from Kim *that we got the news*.

  e. On l'   a   vu *qui s'enfuyait* (French)
      We him have seen who run.away.IMPERF

      'We saw him running away'

In (67a) we have what looks like a *that* relative which is plausibly analysed as the complement of the superlative (notice that omitting the superlative makes (67a) ungrammatical).

The German example in (67b) exemplifies the *diejenigen* class of determiners, which require a complement that looks like a relative clause (and is analysed as such in Walker (2017)).

In (67c) we have a so-called *it*-cleft, a construction which features a clause resembling a relative clause, but rather than adding information about an associated nominal (as it would if it were a normal relative clause), the clause is interpreted as providing a presupposition ("someone/something solved the problem"), for an associated focus phrase (here the nominal *Kim*, so the interpretation is roughly "... and that person/thing was Kim"). Notice that the focus phrase need not be nominal (e.g. in (67d) it is a PP *from Kim*), again this is unlike normal (restrictive) relatives clauses (which are nominal modifiers).[50] In HPSG, following Pollard & Sag (1994: 260–262), *it*-clefts have typically been analysed as involving a lexical entry for *be* that takes an *it* subject, and two complements: an XP and an S which is marked as containing an XP gap. This makes *it*-clefts look rather different from relative clauses (the only real similarity being the existence of an

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[49]Another case where a relative clause should be analysed as a complement is discussed in Arnold & Lucas (2016).

[50]Notice also that *that*-relatives are usually incompatible with proper name antecedents, but proper names are perfectly acceptable as the focus of an *it*-cleft with a *that*-clause, as in (67c) (Huddleston & Pullum 2002: 1416-1417).

unbounded dependency). One problem is that is not clear how this approach can be extended to examples like (68), where we seem to have an NP focus (*Sam*) which is not directly associated with an XP gap — we have instead a PP gap that seems to be associated with a normal relative phrase filler (*on whom*), i.e. where the similarity of the clefted clause to a relative clause is quite strong. It is not obvious how this problem should be dealt with.

(68)   It was Sam [on whom she particularly focused her attention ⎯].

The French example in (67e) contains a so-called *predicative relative clause* (PRC).[51] Such clauses have the superficial form of a finite relative clause, but differ from them syntactically, semantically, and pragmatically. Koenig & Lambrecht (1999) analyse them as a form of *secondary predicate* (cf. *running away* in English *We saw them running away*). Syntactically, they are restricted to post-verbal positions, and are only permitted with certain kinds of verb (notably verbs of perception, like *voir* 'see', and discovery, like *trouver* 'find'), and the relative pronoun must be a top level subject. Semantically, they are subject to constraints on tense, modality and negation (there must be temporal overlap between the perception/discover event and the event reported in the relative clause, and the relative clause content cannot be either modal or negative). Pragmatically, their content must be asserted (rather than presupposed). Koenig & Lambrecht provide an analysis which treats PRCs as REL marked clauses with both an internal and an external subject (instances of *head-subject-ph* which have a non-empty SUBJ value), and which can consequently function as secondary predicates.

4.2.2 Dependent noun and pseudo-relative constructions

The following exemplifies a Korean structure that contains what looks superficially like a relative clause:

(69)   Kim-u   [[sakwa-ka cayngpan-wi-ey iss-nun] kes]-ul mek-ess-ta.
       Kim-TOP   apple-NOM tray-TOP-LOC   exist-MOD KES-ACC eat-PST-DECL
                                                                (Korean)

       'Kim ate an apple which was on the tray.'

Here what is traditionally called a *dependent noun* (*kes*) is preceded by a clause whose verb bears the morphological marking that is characteristic of relative clauses (the *-nun* affix).[52]

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[51]The French term is *proposition relative dépendante attribut* (Sandfeld 1965).

[52]Japanese has a similar construction, involving the nominalising particle *no*, which has received some attention in the HPSG literature (e.g. Kikuta 1998; 2001; 2002). A difference is that there

However, unlike a normal relative clause, this "dependent" clause does not contain a gap, instead it contains what might be regarded as the semantic head of the construction (in this case, *sakwa-ka* 'apple'), notice that the clause+*kes* constituent satisfies the selection restriction of the verb *mek-ess-ta* 'ate'; this is what motivates the translation and explains why such clauses are often regarded as "internally headed" relatives. Kim (2016b: 303–317) notes a number of differences between *kes*-clauses and normal relatives (e.g. *kes*-clauses do not allow the full range of relative affixes to appear), and suggests these clauses are better analysed as complements of *kes*. See also Kim (1996), Chan & Kim (2002), Kim (2016a), and references there.[53]

Another Korean structure that has some similarity with relative clauses is the so-called *pseudo-relative* construction, exemplified in (70).[54]

(70) [komwu-ka tha-nun] naymsay   (Korean)
     rubber-NOM burn-MOD smell

     'the smell that characterises the burning of rubber'

There is again no gap in the relative clause; again, only one kind of marking is allowed on the verb (only past tense *-un*); and only a limited range of nouns allow this kind of relative clause; this makes them rather like complement clauses. However, it is less plausible to think of a noun like *naymsay* 'smell' taking a com-

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is no special morphology on the clause in Japanese, as noted above, in Section 3.3.1.

[53] Pollard & Sag (1994: 232–236) discuss a number of cases of what appear to be more plausible instances of *internally headed* relatives from a number of languages (Lakhota, Dogon, and Quechua); the following is from Dogon:

    (i) [ya   indɛ   mi wɛ   gɔ] yimaa boli.   (Dogon)
        yesterday person 1sg see.PN.∅ DEF die.PSP go.PN.3sg

        'The person I saw yesterday is dead.'

Here we have a determiner *gɔ* preceded by a clause containing what would be the external head of a standard relative (in this case *indɛ* 'person'). The key difference between this and the Korean case is the absence here of any obvious clause external nominal like *kes* which can be treated as the head which takes the relative clause as a complement. Pollard & Sag (1994: 234) suggest (following Culy 1990) that NPs like that in (i) involve an exocentric construction, but no empty elements (neither an empty nominal, nor an empty relativiser). The NP consists of a determiner and a nominal, where the nominal consists of just a clause whose REL value contains the index of the nominal. This REL value is inherited downwards into the clause where it is identified with the index of one of the NPs, here the index of *indɛ* 'person': the effect of this is that the index of *indɛ* 'person' becomes the index of the whole NP (This ignores a number of technical and empirical issues to do with the inheritance and binding-off of REL values).

[54] A similar construction can be found in Japanese, cf. Kikuta (1998; 2001; 2002); Chan & Kim (2002).

plement (unlike *kes*), and these clauses are like prototypical relative clauses in not allowing topic marking. Kim suggests this is a special construction where the relation of head noun and relative clause is that the noun describes the perceptive result of the situation described by the clause (e.g. the smell is the perceptive result of the rubber burning. See Kim (1998b); Yoon (1993); Chan & Kim (2002); Cha (2005); Kim (2016b).

4.2.3 Free relatives

Perhaps the most significant case of a clause type that resembles a relative clause but which does not function as a nominal modifier consists of the so-called *free* (*headless*, or *fused*) *relatives*, exemplified in (71). These have received considerable attention in the HPSG literature.

(71)　a.　She ate *what I suggested.*
　　　b.　She ate *whatever I suggested.*
　　　c.　She put it *where I suggested.*

As these examples suggest, free relatives can be interpreted as involving either definite descriptions, as in (71a) "the thing that I suggested", or universal quantification, as in (71b) "everything that I suggested". They can also have adverbial or prepositional interpretations, as in (71c) "in the place that I suggested". The interpretation is related to the choice of *wh*-phrase. There are some special restrictions. For example, in English free relatives must be finite, as can be seen from (72a), and there are restrictions on what *wh*-words are allowed (e.g. *what* is permitted, as in (71a), but *which* is not, witness (72b)).

(72)　a.　*She ate *what to cook.*
　　　b.　*She ate *which I suggested.*

Free relatives resemble prototypical *wh*-relatives (and interrogative clauses) in containing a gap, and an initial *wh*-phrase in which is interpreted as filling the gap. They differ from interrogatives in having the external distribution of NPs or PPs rather than clauses (for example in (71a) *what I suggested* is the complement of *eat*, and in (71c) *where suggested* is a complement of *put*, neither of which allow clausal complements). They differ from prototypical relative clauses in not being associated with a nominal antecedent. They can contain relative pronouns which are not permitted in normal *wh*-relatives, notably the *-ever* pronouns, *whatever*, *whoever*, etc, and *what*, witness the ungrammaticality of the following:[55]

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[55] *What* is not a relative pronoun in standard English, but it is in some other varieties, and (73b) is grammatical in those.

(73) a. *She ate the thing(s) *whatever I suggested.*
      b. *She ate the things(s) *what I suggested.*

In general the possibilities of relative inheritance (pied-piping) in free relatives are dramatically reduced compared to prototypical relatives and interrogatives. For example in English, relative inheritance is not possible from the complement of a preposition, as can be seen from (74b):

(74) a. Try to describe *what you talked about.*
      b. *Try to describe *about what you talked.*

In fact, in English relative inheritance only seems to be possible from *wh*-phrases in in pre-nominal position (determiners and genitive NPs), as in (75), and (77a) below.[56]

(75) They will steal *what(ever) things they can carry.*

As with prototypical relatives, the initial *wh*-phrase in a free relative has to satisfy restrictions imposed "downstairs" in the relative clause (i.e. restrictions that follow from the location of the gap). In addition, however, it seems that with free relatives the *wh*-phrase is also sensitive to restrictions imposed from the outside the relative clause — the *wh*-phrase of a free relative has to be of the appropriate category for the position where the free relative appears. For example, as a first approximation, a free relative with *what* is only possible where an NP is possible, and a free relative with *where* is only possible where a locative PP is possible. This is the so-called *matching effect* in free relatives.[57]

One interesting instance of this involves case marking. Consider, for example, the German data in (76). These show a free relative in a position which requires nominative case marking, containing a relative pronoun whose role within the relative clause requires nominative marking. Since *wer* 'who' is nominative, all is well. By contrast, in (76b) while the nominative *wer* satisfies the requirements within the relative clause, there is a case conflict because the free relative as a whole is the complement of a verb *vertrauen* 'trust' that requires a dative complement. The result is ungrammatical. Examples like (76c) show a complication. Here again there is a case conflict: within the relative clause, the relative pronoun is required to be accusative (complement of *empfehlen* 'recommend'), and

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[56]Other languages are less restrictive, e.g. Müller (1999a: 57) gives German examples analogous to (74b). See Footnote 59.

[57]In fact, things are more complicated. For example, in *He walked to [where his horse was waiting].* we have a free relative with *where* in an NP position (object of a preposition) rather than a PP position. See e.g. Kim (2017) for discussion.

the free relative as a whole is in a nominative position. However, the result is grammatical, presumably because the morphological form of the neuter relative pronoun *was* 'what' can realise either nominative or accusative case (unlike the masculine *wer*).

(76) a. Wer   schwach ist, muss klug   sein.   (German)
         who.NOM weak   is   must clever be

         'Whoever is weak must be clever.'

      b. * Wer   klug   ist, vertraue ich immer.   (German)
         who.NOM clever is   trust   I   ever

         intended: 'I trust whoever is clever.'

      c. Was   du   mir empfiehlst, macht einen guten Eindruck.
         what.NOM/ACC you me recommend makes a   good impression
                                                                  (German)

         'What you recommend me makes a good impression.'

The agreement properties of free relatives are somewhat surprising, and reveal a potential complication in the matching effect. Notice that in (77a) the *wh*-phrase, *whoever's dogs*, is plural, and triggers plural agreement on the verb in relative clause.

(77) a. [[Whoever's$_{sg}$ dogs]$_{pl}$ are running around]$_{sg}$ is in trouble.
      b. Whoever is/*are running around (is in trouble).

This is not surprising since *whoever's dogs* is headed by a plural noun (*dogs*). However, the free relative as a whole triggers singular agreement, consistent with the agreement properties coming from the relative pronoun — *whoever* is singular, as can be seen from (77b). This is also consistent with the semantics: the free relative in (77a) denotes the person whose dogs are running around, not the dogs (in this it resembles an NP like *anyone whose dogs are running around*, which involves a normal relative clause construction).[58] This shows a complication of the matching effect: it seems that within clause requirements are reflected on the initial *wh*-phrase (*whoever's dogs* is the subject of the relative), but the external distribution reflects the properties of the relative *word* (*whoever*). Of course, the fact that relative inheritance is so limited in free relatives means that usually the *wh*-phrase consists of just the *wh*-word, so that is very difficult to tease these

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[58]This is not a universal property: Borsley (2008) notes that examples in Welsh resembling (77a) are interpreted as meaning that the dogs are in big trouble, not the owner.

things apart.[59]

Following Müller (1999a) on German, free relatives have received considerable attention in the HPSG literature, with analyses dealing with a variety of languages, including: Arabic (Alqurashi 2012; Hahn 2012), Danish (Bjerre 2012; 2014), English (Kim & Park 1996; Kim 2001; Wright & Kathol 2003; Francis 2007; Yoo 2008; Kim 2017), German (Hinrichs & Nakazawa 2002; Kubota 2003), Persian (Taghvaipour 2005), and Welsh (Borsley 2008).

The central analytic problem is this: leaving aside the complication arising from case syncretism and relative inheritance just mentioned, the existence of matching effects has suggested to some (e.g. Kubota (2003)) that the *wh*-phrase should be the head of the free relative, because the distribution of free relatives depends on the properties of the *wh*-phrase. So, for example, the NP *what* would be the head of *what I suggested*. But this is inconsistent with *what* being the filler of the gap in *what I suggested* (i.e. the missing object of *suggested*), because in a normal filler-gap construction the filler is *non*-head. If, instead, we assume that *what* is primarily the filler of the gap in the free relative, then we should assume that the clause *I suggested ___* is the head of the free relative — and the distributional properties of the free relative are unexplained.

4.2.4 Pseudo-clefts and transparent free relatives

Two constructions that show some similarity with free relatives, and have received some attention in the HPSG literature, are *specificational pseudo-clefts*, exemplified in (78), and so-called *transparent free relatives* (TFRs), exemplified in (79).

(78)　a.　A new coat is [what Kim will be wearing].

　　　b.　[What Kim will be wearing] is a new coat.

　　　c.　[What she did] was cut her hair.

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[59] Müller (1999a: 90) discusses the following German example of a free relative with an initial PP containing the nominal relative word *wem* 'whom' (i.e. showing relative inheritance to PP):

　(i)　Ihr　könnt　beginnen, [mit wem　ihr　(beginnen) wollt].　　　(German)
　　　you can　start　　with whom you start　　want
　　　'You can start with whoever you like.'

He observes that the free relative functions as a PP, just like *mit wem*, and in the variant where the parenthesised instance of *beginnen* is present, the within clause role is also that of a PP. However, *mit* here is a non-predicative preposition, so the index associated with the PP is just that of the *wh*-word that it contains, so it is still not possible to fully distinguish the properties of the *wh*-phase and the properties of the *wh*-word it contains.

d. [What she did not bring] was any wine.

(79) a. She replied in [what anyone would consider ⎯ a belligerent tone].
   b. Her reply was [what anyone would consider ⎯ belligerent].

Specificational pseudo-clefts typically consist of a *wh*-clause, *be*, and a *focal phrase* (e.g. *any wine* in (78d)). The focal phrase corresponds to a gap in the *wh*-clause (e.g. in (78d) *any wine* is interpreted as the missing object of *bring*). They raise a number of issues that are not typical of relative clauses, notably the existence of *connectivity effects* whereby the focal phrase behaves as though it was part of the *wh*-clause (e.g. in (78d) the negative polarity item *any* is licensed by the negation in the *wh*-clause). Beyond this, it is not obvious whether the *wh*-clauses should be analysed as related to interrogatives, as in Yoo (2003), or as related to free relatives, as in Gerbl (2007).[60]

In TFRs the relative appears to function somewhat like a parenthetical modifier of a *nucleus* (e.g. *a belligerent tone* in (79a)), which seems to provide the head properties of the phrase as a whole — so for example the TFR in (79a) has the characteristics of an NP, that in (79b) has those of an AP (it is a natural starting point to assume the nucleus is internal to the relative clause, since otherwise one has the puzzle of a relative clause which is both incomplete and occurs before the head it modifies). TFRs are in some ways even more restricted than other kinds of relative (only *what* is allowed as the relative expression), but in others less restricted (e.g. free relatives have the external distribution of NPs, but the TFR in (79b) has the distribution of an AP, like its nucleus *belligerent*). Some approaches to TFRs employ novel kinds of structure (e.g. *grafts*, cf. van Riemskijk 2006), but Yoo (2008) and Kim (2011) provide HPSG analyses which capture the relevant properties using existing apparatus with only minor adjustments.

5 Conclusion

The analysis of relative clauses has been important in the theoretical evolution of HPSG, notably in the development of constructional approach involving inheritance from cross classifying dimensions of description. Empirically, relative

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[60]It can be difficult to distinguish this kind of pseudo-cleft from cases involving a normal free relative. An example like *What she is wearing is a mess* is superficially similar to (78b), but it involves a free relative. Notice, for example, it can be paraphrased with a normal NP plus relative clause (as "The thing that she is wearing is a mess") and *what* can be replaced with *whatever*. It does not have a paraphrase with an *it*-cleft or a simple proposition — it cannot be paraphrased as "It is mess that she is wearing" or "She is wearing a mess".

clauses have been the focus of a significant amount of descriptive work in a variety of typologically diverse languages. Our goal in this paper has been exposition and survey rather than argumentation towards particular conclusions, but, perhaps paradoxically given what we have just said, we think one conclusion that clearly emerges is that, from an HPSG perspective at least, *relative clauses are not a natural kind*. There is *nothing* one can say that will be true of everything that has been described as a "relative clause" in the literature. As regards internal structure, some are *head-filler* structures (*wh*-relatives), while others are *head-complement* structures (complementiser relatives, some kinds of bare relative); correspondingly, some involve relative pronouns (hence a REL feature), some do not. It is true that most involve some kind of SLASH dependency, but this is hardly unique to relative clauses, and even this does not hold of the dependent noun and pseudo-relatives mentioned in Section 4.2.2. There is no semantic unity — while restrictive relatives are noun-modifiers, non-restrictives function more like independent clauses, and free relatives have nominal or adverbial semantics. Similarly, as regards external distribution: prototypical relatives are noun modifiers, and appear in *head-adjunct-ph* structures, but expressions with similar internal structure occur as complements (e.g. free relatives, clefts, and complements of superlative adjectives).

We do not think it is a bad thing that this conclusion should emerge from a discussion of HPSG approaches. Rather, it suggests to us that an approach that tries to impose unity will end up being procrustean. In fact, discussion of relative clauses seems to us to show some of the best features of HPSG — the analyses we have summarised are generally well formalised, carefully constructed (detailed, precise, and coherent), and both empirically satisfying and insightful, with relatively few *ad hoc* assumptions or special stipulations. The discussion shows how the expressivity and flexibility of the descriptive machinery of the framework are compatible with a wide range of phenomena across a range of languages.

Abbreviations

- AP, XP, PP, NP, VP, CP, S, DP, PRO (standard linguistic abbreviations)

- RP – a phrase headed by the empty relativiser R – put in the index?

- SELR – Subject Extraction Lexical Rule

- MRS – Minimal Recursion Semantics

- LRS – Lexical Resource Semantics

- WHIP – Wh-Inheritance Principle
- NRC – non-restrictive relative clause
- RRC – restrictive relative clause
- PRC – predicative relative clause
- TFR – transparent free relative

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