Inside-out constraints and Description Languages for HPSG *

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An important contrast between most current syntactic frameworks and Head-Driven Phrase Structure Grammar or Lexical Functional Grammar (hereafter HPSG and LFG respectively) is the common insistence of the latter two on the need to distinguish between the mathematical structures which model utterance types and the logical formulas which describe these structures (see Kaplan and Bresnan (1982), Pollard and Sag (1994), Kaplan (1995) *inter alia*). Grammars are viewed as sets of constraints expressed in a description language whose denotata serve as models of linguistic utterances. In such frameworks, it is possible to change the description language— and the possible grammars which can be written within it— without altering the modeling domain (the linguistic ontology). In this paper, I present a particular class of examples for which this distinction between the modeling domain and the formulas which describe it proves crucial. My goals are two-fold. Empirically, I wish to argue for the need to include a kind of constraints in our models of natural language only sparsely mentioned in previous literature. Methodologically, I want to illustrate the usefulness to linguistic theorizing of the afore mentioned distinction by showing how modeling this new kind of constraints does not require an enrichment of our linguistic ontology, but a change in our descriptive metalanguage.

1 A few examples of inside-out constraints

The class of phenomena with which I am concerned is best introduced by looking back at the notion of subcategorization, first discussed within generative linguistics in Chomsky (1965). The basic idea was that it is useful to keep a record of its complements on a predicator’s lexical entry. What this

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paper illustrates is that from time to time we need the converse, namely keep a record on an argument of the type of predicates it can complement. I am thus interested in cases where certain non-heads are constrained with respect to the environments in which they must be phrase-structurally embedded. I call this class of constraints inside-out after Dalrymple (1993) for reasons that will become clear shortly. References to such an idea appear here and there in the literature (cf. Lakoff (1987)’s notion of bound constructions, Kay (1994)’s concept of conscription, and particularly Dalrymple (1993)’s notion of inside-out functional uncertainty), but for the most part scholars have not systematically gathered such cases. This paper attempts to remedy the situation. My evidence for the linguistic need for inside-out constraints comes from three grammatical areas: predicate argument relations, binding theory, and morphology. Although it is possible that better analyses of some of these data exist which do not require their introduction, I take their apparent relevance to several different areas as further evidence of their usefulness.

1.1 Predicate-argument inside-out constraints

My first class of examples of inside-out constraints concerns predicate argument relations and is closest to the subcategorization parallel which I informally introduced them.

The Dative Predication construction: (1) and (2) illustrate the first class of sentences whose account seems to require inside-out constraints. These sentences exemplify a French construction which I call the Dative Predication construction (DP hereafter), which was discussed by Ruwet (1982) and Koenig (1994).

(1) Je crois des circonstances atténuantes
    I believe some circumstances mitigating
    à certains criminels.
    to certain criminals.
    ‘I believe some criminals have mitigating circumstances’

(2) Il a une Toyota? Je lui croyais une R18.
    he has a Toyota. I to (s)he believed a R18.
    ‘He has a Toyota. I thought he/she had a R18’

The DP applies to sixty so-called object to subject raising verbs and can always be paraphrased in English by a sentential complement whose main predicate is have. Koenig (1994) argues that the best account of (1)-(2) assigns to the preposition à or the corresponding dative clitics lui or leur a
meaning parallel to English *belong*. That is, à in (1) denotes a possession relation (but see below for more details), the NP *des circonstances atténuantes* satisfies its possessed role and the NP *certaines criminels* its possessor role. This analysis thus assigns a meaning to à, following the analysis of non-spatial prepositions as semantically potent in Wechsler (1995) and Davis (1996). The closest English parallel would be the preposition to which complements the verb *belong*. The DP is not the only case where a PP headed by à in French is semantically potent and denotes a possession relation. Some other examples of such semantically potent uses of à are given in (3) and (4).

(3) a. La table est à lui.
   the table is to him/her
   ‘The table belongs to him/her’

   b. La table lui appartient
   the table to him/her belongs
   ‘The table belongs to him/her’

(4) La police lui a retiré son permis de conduire.
   The police to him/her have take his permit of drive
   ‘The police took away his driving permit’

Crucially, though, which kind of possession relation is denoted by à or the corresponding clitics depends on which verb the PP headed by à complements, thus providing our first example of an inside-out constraint—here, an instance where a complement PP selects for the head it complements. The need to restrict the à PP to the appropriate class of verbs is apparent when we look closely at the particular range of possession relations denoted by the use of à or lui in (1) or (2): the range is less restricted for DP sentences than for other uses of à or lui which encode a relation of possession. I present two cases here and refer the reader to Koenig (1993) and Koenig (1994) for more details.

(5) a. Je lui aimerai davantage d’enthousiasme
   I to.him like.cond more of enthusiasm
   ‘I would like him to have more enthusiasm’

   b. *Du charme est à lui
   of the charm is to her
   ‘*She has some charm’
(6) a. Nous lui savons plusieurs contacts au pentagone.
   We to her know several contacts at the Pentagon
   ‘We know that she has several contacts at the Pentagon’

   b. *Plusieurs contacts au pentagone lui appartiennent
   several contacts at the Pentagon to him are
   ‘*He has several contacts at the Pentagon’

Whereas à when used in the DP construction can express possession of an
abstract property, it cannot when complementing the copula, as the contrast
between (5a) and (5b) shows. Similarly, lui in (6a) expresses the idea that
someone has contacts, but the same notion cannot be expressed by lui in
the non-DP context in (6b). To cover these contrasts and other similar ones,
we must restrict the use of à or lui to mark non-literal notions of possession
to examples such as (1)-(2), that is to sentences where it complements verbs
such croire ‘to believe’ or more generally, verbs of propositional attitude and
verbs of saying. We thus need to include in the grammar of French the
statement in (7), our first example of an inside-out constraint.

(7) ‘If a phrase is headed by a dative-predication sign, it must complement
   a verb whose semantic content is a relation of type say or represent.’

Romance faire-infinite construction: The Romance faire-infinite
construction illustrated in (8) provides the second example of inside-out
statements.

(8) Marc a fait arrêter Paul par la police.
   Marc has made arrest Paul by the police
   ‘Marc had the police arrest John’

As is well-known, this use of faire involves clause-union, which HPSG
models through the composition of the argument structures of faire and
its verbal complement (see Abeillé, Godard, Miller, and Sag (1997) and
Koenig (1994), among many others). The relevant fact for us here is that
the demotion of the external-argument of the verbal complement to faire
(arrêter in (8)) takes place within the complement verb’s argument structure
(or maximal projection in GB approaches), “before” it is composed with that
of faire. The sensitivity of the adjunct expressing the demoted external-argument to the Aktionsart of the complement verb shows this unequivocally.
The contrast between (9) and (10) shows that a PP headed by de can only
express the external argument of stative verbs, whereas a PP headed by par
must express the external argument of dynamic verbs. The same contrast
holds for the faire-infinite construction: the PP headed by de can only

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express the external argument of stative verbal complement to \textit{faire} and the PP headed by \textit{par} that of dynamic verbal complements (see the contrast between (11) and (12)). Since \textit{faire} is consistently dynamic, the PP selection must take place within the argument-structure of the complement verb, and, consequently, so must the demotion of the external argument.

(9) Jean a été volontairement suivi \textit{*de/par} Paul  
  Jean has been voluntarily followed \textit{of/by} Paul  
  ‘Jean was voluntarily followed/preceded by Paul’

(10) Le poisson a été suivi \textit{de/par} rôtis  
  The fish has been followed \textit{of/by} roasts  
  ‘The fish was followed/preceded by roasts’

(11) Marc a fait volontairement suivre Jean \textit{*de/par} Paul  
  Marc has made voluntarily follow Jean \textit{of/by} Paul  
  ‘Marc had Jean followed/preceded by Paul voluntarily’

(12) Marc a fait suivre le poisson \textit{de/par} rôtis  
  Marc has made follow the fish \textit{of} roasts  
  ‘Marc had the fish be followed/preceded by a roast’

I conclude that, as argued by Moore (1991) and several scholars within HPSG (see op.cit.), in \textit{faire}-infinitive structures the complement verb’s external argument is demoted. But such ‘spontaneous demotion’ is strictly restricted to the context of verbal complements of clause-union verbs. Conditions must therefore be attached to verbs whose external arguments undergo ‘spontaneous demotion’ to indicate they must complement clause-union verbs so as to rule out the ungrammatical (13).

(13) \textit{*Marc a arrêté par la police}  
  Marc have arrested by the police  
  ‘Marc was arrested by the police’ (intended meaning)

To effect this restriction, one possibility is to assume that the valence-wise passive, but morphologically active class of verbs that complement \textit{faire} in the \textit{faire}-infinitive construction must have an empty \textsc{subj} list (this is the solution proposed by Koenig (1994) within Construction Grammar). Even though it is descriptively adequate, this solution relies on theory-internal and parochial assumptions. Another possibility is that we bite the bullet and directly model the descriptive fact by attaching an inside-out constraint to the entry of the complement verb of a \textit{faire}-infinitive clause-union pattern. One formulation of such a constraint is given in (14).

(14) ‘If a verb is valence-wise passive, but morphologically active, it must be the complement of a verb that belongs to the \textit{clause-union} class.’
1.2 Binding domains ‘inside-out’ constraints: body-part binding in French

Let me now turn to the second class of phenomena for which ‘inside-out’ constraints are needed. As much recent work has shown, different anaphors can select different binding domains within a single language (see Manzini and Wexler (1987), Dalrymple (1993) among others). Binding domains within which anaphors must be bound must therefore be lexically specified. We must attach to the lexical entries of particular anaphors a record of the phrase-structural domain within which their antecedent must be located. The need for such constraints was at the root of the introduction of inside-out functional uncertainty within LFG (see Dalrymple (1993)). In this section, I illustrate this need with a less well-known example of anaphors which pertains to an entire class of nouns. My example comes from French again, and the basic pattern is illustrated in (15) (from Zola, Son excellence Eugène Rougon, p.140.)

(15) ‘Il haussait le menton, comme si
he raised the chin, as if
le cou lui avait fait du mal.
the neck to him had caused some pain
‘He was raising his chin as if his neck hurt him.’

The NP’s denoting body parts in bold face in (15) contain an unexpressed inalienable possessor argument which is co-indexed with the NP’s in italics. I call body-part-NP’s NP’s which denote body-parts and which do not contain a complement satisfying the inalienable possessor argument of their head noun, such as le menton ‘the chin’ in (15) (to be contrasted with son menton ‘his chin’). The co-indexing of the unexpressed arguments of body-part-NP’s with their antecedent is subject to two inside-out constraints. The first is a binding domain constraint and simply says that the unexpressed possessor argument of the body-part noun must be bound within the minimal predicative phrase (the minimal complete nucleus in Dalrymple’s terms). Its effects are illustrated in the contrast between (16a) and (16b) and between (17a) and (17b) (subscripts indicate co-indexing between the antecedent and the unexpressed possessor argument of the ‘body-part-NP’). The possessor of the NP la main in (16) can be bound to the (local) subject of lever, but not to the subject of persuadé, indicating it must be bound within the first phrase containing a subject. The contrast between (17a) and (17b) shows that the constraint cannot be reduced to a pragmatic ‘first available antecedent’ condition, but is indeed a syntactic locality condition: il is the first available antecedent in (17b), but is too far syntactically to serve as antecedent of the unexpressed possessor argument.
(16) a. Je l’i ai persuadé de lever la main
I her have persuaded of raise the hand
‘I persuaded her to raise her hand’

b. *Je l’ ai persuadé de lever la main
I her have persuaded of raise the hand
‘I persuaded her to raise my hand’

(17) a. Il croit que le vin lui barbouille l’estomac
he believes that the wine to her upsets the stomach
‘He believes that the wine upset her stomach’

b. *Il croit que le vin barbouille l’estomac.
he believes that the wine upsets the stomach
‘He believes that the wine upset his stomach’

The second constraint on the construction is semantic in nature. To simplify, the body-part must be instrumental in the possessor argument’s antecedent satisfying its semantic role (it must be what Langacker (1984) call its active-zone). The constraint is illustrated in (18). Marc’s feet are instrumental to his movement in (18a), but not to his bathing (18b). Marc can therefore bind the possessor argument of les pieds ‘les pieds’ in the former but not the latter. Note that adding a dative reflexive clitic playing an affected entity role as in (18c) reverses the grammaticality of (18b). In this case, the possessor of pieds is indeed instrumental in the reflexive satisfying an affected entity role and can therefore be bound by it.

(18) a. Marc i a avancé le pied
Marc i has moved forward the foot
‘Marc moved his foot forward’

b. *Marc i a lavé les pieds.
Marc i has washed the feet
‘Marc washed his feet’

c. Marc i s ’ i est lavé les pieds.
Marc i self i is washed the feet
‘Marc washed his feet’

To express these two constraints on French body-part NP’s, we need to define a new lexical type corresponding to what I called body-part NP’s, say the type body-part-noun— and have it be subject to the two inside-out constraints expressed in (19). One is identical to Dalrymple’s minimal nucleus domain constraint. The other is particular to the construction under discussion.
(19) a. ‘If an anaphor is a minimal complete nucleus anaphor, it must be bound within its minimal complete nucleus (Dalrymple, op.cit).’

b. ‘If a phrase is headed by a body-part-noun, the body-part must be instrumental in the antecedent’s referent satisfying its semantic role.’

1.3 Inside-out constraints in morphology: bound-roots

My third class of examples comes from morphology and is illustrated in the well-known data from English in (20). Even though aggression and aggressive are derived stems formed through the affixation of -ion and -ive respectively, the base to which these suffixes attach does not exist in modern English. Inkelas (1989) propose that a bound root selects for a particular morphological context, alongside the affix’s subcategorizing for the root. She suggests that aggressive is formed by suffixing -ive to aggress (-ive, as most affixes, subcategorizes for a class of stems in Inkelas’ approach). To insure that we cannot use the root *agress by itself, she proposes to attach the prosodic domain condition in (20b) to the entry for aggress. (20b) says that aggress must attach to a prosodic domain of type $\alpha$ to form another prosodic domain of type $\alpha$. The particulars of her analysis are not the concerns of this paper. It is sufficient to note that her account of bound roots requires one form of inside-out constraints: the non-head of a morphological tree (its base) selects for the morphological (prosodic) constituent structure within which it must be embedded. (21) expresses the relevant constraint in more theory-neutral terms.

(20) a. *agress, aggression, aggressive

b. $\alpha$ aggress $\alpha$

(21) ‘The stem aggress must be the morphological daughter of a multimorphemic word’

As suggested by an anonymous reviewer, we could forego the constraint in (21) by dividing stems into two classes, real-stem and fake-stem and requiring stems of the class of simple-lezeme words to be of type real-stem. The simple-lezeme *agress would then be ill-formed because the stem on which it is based is of type fake-stem. Note, that this solution crucially relies on the existence of a distinct class of simple-lezeme words to properly differentiate the ill-formed *agress from the well-formed aggression or aggressive. Only the former belongs to the category simple-lezeme and is subject to the constraint that its stem be a real-stem. I know of no independent evidence that would justify this division among words. In general,
the “derivational history” of word formation is morphologically irrelevant; the crucial division between simple and complex lexemes required by this proposal is morphologically unmotivated.

Before closing this section, let me briefly mention a fourth area where ‘inside-out’ constraints might be useful. I owe the example to Carl Pollard and Adam Prezpiórkowski. Pollard and Yoo ((to appear)) observe that Wh-phrases which do not appear in situ cannot have wider scope than that indicated by their surface position. The formulation of the relevant constraint is given in (22). Now, if we assume lexical retrieval of quantifiers as proposed in Manning, Sag, and Iida ((to appear)) and Prezpiórkowski (1997), we cannot attach the constraint to a phrasal constituent as in (22). Prezpiórkowski rephrases lexically the constraint as in (23).

(22) ‘At any filler-head node, if the filler has a nonempty QUE value, then its member must belong to the node’s RETRIEVED value.

(23) ‘If QUANTS of a psqa contains a wh-quantifier, there must be a projection with the same psqa involving a left-periphery wh-phrase.’

Clearly, the constraint in (23) is yet another example of ‘inside-out’ condition—it requires lexical items at which interrogative quantifiers are retrieved to be inserted in certain phrase-structural contexts. By contrast with previous examples, the motivation for an inside-out constraint is more theory-internal here, since it depends on the theory of quantifiers retrieval we adopt. But the usefulness of inside-out conditions in yet another grammatical area is still significant to my general point in this section, namely that such constraints must be recognized as part and parcel of the grammars of natural languages.

In this section, I have presented five phenomena from four different grammatical areas (predicate-argument relations, binding constraints, morphology, quantifier scoping) where something like inside-out constraints are needed. Now, leaving aside the admittedly more theory-internal case of quantifier scoping, there are still various ways in which we could handle the cited phenomena without appealing to inside-out statements. One only needs a little ingenuity and a willingness to introduce otherwise unmotivated features. But I think this is the wrong approach. By contrast to, say, subcategorization features, such putative new features one would need to introduce to handle the data are not linguistically motivated. They are not grounded in the unescapable predicate/argument organization of semantic information; furthermore, they are not a general property of words, like subcategorization. The addition of new properties to our inventory of lexical features to mimic the effects of inside-out constraint is therefore not optimal from a linguist’s perspective: their functional load would simply be too small. In
the next section, I propose that instead of resorting to new features in our modeling domain, we allow inside-out statements in our metalanguage describing linguistic structures. Our linguistic ontology is thus left unchanged, although not our linguistic metalanguage.

2 A description language for inside-out constraints

If, as just suggested, inside-out constraints ought to receive a ‘metalinguistic’ rather than ontological treatment, how shall we model them? What makes inside-out constraints interesting methodologically is that their inclusion in our description language is not equally easy for all languages used to formalize HPFG. In fact, as I show in this section, some description languages typically assumed for HPFG grammars cannot directly express inside-out constraints.

2.1 The sorted Rounds-Kasper Description Language

The description languages typically assumed to underlie typed feature structures and HPFG are either a (sorted) Rounds-Kasper style logic (hence RKL) or King’s Speciate Reentrant Logic (hereafter SRL).\(^1\) Since the numerous points of difference between these two types of description languages are irrelevant to my point, I focus on only one in this paper, RKL, for simplicity. RKL recognizes four types of formulas:

\[ \text{(24) } \begin{align*} 
\text{a. } & \sigma \text{ is a description, } \sigma \text{ a type} \\
\text{b. } & \pi : \sigma \text{ is a description, } \pi \text{ a path of attributes, } \sigma \text{ a type} \\
\text{c. } & \pi = \pi' \text{ is a description, } \pi, \pi' \text{ two paths of attributes} \\
\text{d. } & \phi \land \psi, \phi \lor \psi \text{ are descriptions, } \phi, \psi \text{ descriptions} 
\end{align*} \]

The crucial property of RKL for our purposes is that although feature structures are individuals of the universe of discourse, there are no terms (variables or constants) of the description language which denote them. The graph-theoretic interpretation of HPFG constraints is built in the description language via an isomorphism between paths (sequences of labels) and sequences of edges in the denoted graphs. Consider the conjoined description in (25).

\[ \text{(25) } \text{SIGN} \land \text{SYNSEM: SYNSEM} \]

\(^1\)See Kasper and Rounds (1990), Pollard (1991), Carpenter (1992), among others for the former, and King (1994) for the latter.
The first conjunct describes feature structures whose root vertex is of type \textit{sign}; the second conjunct describes feature structures with an edge labeled \textit{SYNSEM} stemming from the root vertex and pointing toward a vertex whose type is \textit{synsem}. The zero length of the path in the first conjunct entails that the type is true of the root vertex of feature structures it describes; the fact that the path in the second conjunct is of length one entails that the type \textit{synsem} is true of the vertex at the end of the edge stemming from the root vertex. Because of this built-in isomorphism grammatical constraints on feature-structures expressed in \textsc{rkl} must always take an outside-in form— that is, go from the root of the overall graph to its leaves. Inside-out constraints of the kind discussed in section 1 contravene this built-in isomorphism and cannot be expressed.

2.2 Predicate-calculus inspired description languages

\textsc{rkl}-style languages are not the only description languages for feature structures. There is at least one other class of languages which is inspired by first-order predicate logic (see Johnson (1988), Smolka (1992)). As I show in this section, such description languages are well-adapted to our problem, as one could surmise from the fact that \textsc{lfg} uses this kind of languages to describe inside-out functional uncertainty (see Dalrymple, Maxwell III, and Zaenen (1995)).

The distinguishing characteristic of first-order predicate-logic inspired languages is that they include terms that refer to feature structures. Because of the inclusion of these terms, reference to two different feature structures within a formula can be made without relying on path-position. Space considerations prevent me from adequately discussing Johnson’s or Smolka’s features logics. So as to ease the comparison with a \textsc{rkl}-style language, I define in (26) a quantifier-free first-order language (henceforth \textsc{qfql}) corresponding to the \textsc{rkl} language introduced in (24). (27) adds regular expressions and conditionals descriptions to the language. The relevant satisfaction relation for the language defined in (27) is given in (28).

\begin{enumerate}
\item[26] a. \((\sigma x)\) is a description, \(\sigma\) a type, \(x\) a variable
\item[b. \((\pi x_1) \approx x_2\) is a description, \(\pi\) a path, \(x_1, x_2\) variables
\item[c. \(\phi \land \psi, \phi \lor \psi\) are descriptions, if \(\phi, \psi\) are descriptions
\end{enumerate}

\footnote{Carl Pollard pointed out to me (p.c.) that the Relational Speculative Re-entrant Logic of Frank Richter and Manfred Sailer (see Richter (1997)) also allows for the statement of inside-out constraints. As other description languages discussed in this section, it crucially includes terms denoting feature structures.}
(27) a. $(σx)$ is a description, $σ$ a type, $x$ a variable
   b. $(πx_1) ≈ x_2$ is a description, $π$ a path, $x_1$, $x_2$ variables
   c. $(r_x)$, $r$ a regular expression over paths
   d. $φ ∧ ψ$, $φ ∨ ψ$, $φ → ψ$ are descriptions, $φ$, $ψ$ descriptions.

* Satisfaction of basic formulas for a model $M = <F, q>$, $F$ a Typed Feature Structure $F = <Q, Q_θ, δ>$, $q$ an assignment function from variables into $Q$.

(28) a. $M ⊨ (σ x)$ if $σ$ is a type, $[x]^M = q$ and $σ ⊆ θ(q)$
   b. $M ⊨ (π x_1) ≈ x_2$ if $δ^*(π, [x_1]^M) = [x_2]^M$
   c. $M ⊨ (r · x_1) ≈ x_2$ if there is a path $π ∈ r$ such that
      $δ^*(π, [x_1]^M) = [x_2]^M$
   d. $M ⊨ φ ∧ ψ$ if $M ⊨ φ$ and $M ⊨ ψ$
   e. $M ⊨ φ ∨ ψ$ if $M ⊨ φ$ or $M ⊨ ψ$
   f. $M ⊨ φ → ψ$ if it is not the case that $M ⊨ φ$ or $M ⊨ ψ$

Crucially, because of the presence of variables that help keep track of the described feature structures, we can now directly encode in our description language inside-out constraints. (29), for example, represents within the just introduced language the constraint on *aggress* informally stated in (21). The constraint reads: if a feature structure $x_1$ is of type *aggress*, a feature structure $x_2$ of type *complex-lexeme* must have $x_1$ as the value of its STEM attribute. (30) represents the more complex Dative Predication constraint informally stated in (7) in all its HPSG details; (31) expresses the same constraint semi-formally using an AVM notation. The constraint reads: if a feature structure $x_1$ is of type *dative-predication*, then a feature structure $x_2$ of type *phrase* must have the SYNSEM of $x_1$ as one element of its subcategorization list as well as have a head-daughter whose semantic nucleus is of type *say-rel* or *represent-rel*.

(29) \((aggress\ x_1) ⟷ ((complex-lexeme\ x_2) \land (STEM\ x_2) ≈ x_1)\)

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3 As is customary, $Q$ is a non-empty, finite set of states; $q^0$ is the start state; $δ$ is a partial transition function, and $θ$ is a type assignment function. $δ^*$ is defined as follows: for empty paths $p$, $δ^*(p, x) = x$, for non-empty paths $p = l[l' \cdots]$.

4 Clearly, the statement in (30) is partial. It only includes information which cannot be inferred from general principles or the grammar of French.
(30) \((\text{dative-predication } x_1) \rightarrow ((\text{phrase } x_2) \land (\text{DGHTERS } x_2) \approx x_3 \land
(\text{HEAD-DGHTER } x_3) \approx x_4 \land (\text{SYNSEM } x_1) \approx x_5 \land (\text{LOCAL } x_5) \approx x_6 \land
(\text{CONTENT } x_6) \approx x_7 \land (\text{NUCLEUS } x_7) \approx x_8 \land ((\text{say-rel } x_8) \lor (\text{represent-rel } x_8)) \land (\text{CATEGORY } x_6) \approx x_9 \land (\text{ARG-S } x_9) \approx x_{10} \land ((\text{REST}^*) \cdot \text{FIRST } x_{10}) \approx x_{11} \land (\text{SYNSEM } x_1) \approx x_{11})\)

(31) \[
x_1
\begin{array}{c}
\text{dat-predication} \\
\text{SYNSEM} \\
x_{11}
\end{array}
\rightarrow
\]

\[
x_2
\begin{array}{c}
\text{DGHTERS} \mid \text{HD-DGTR} \\
\text{SYNSEM} \mid \text{LOCAL} \\
\text{CONTENT} \\
\text{say-rel} \lor \text{represent-rel} \\
\text{CAT} \\
\text{ARG-S} \\
\langle \ldots, x_{11}, \ldots \rangle
\end{array}
\]

Now that I have briefly introduced a predicate logic based language within which inside-out constraints can be stated, the reader might wonder what the logical properties of the languages defined in (26) and (27) are. Firstly, note that adopting a quantifier-free first-order description language is not ‘conservative’ with respect to sorted RKL. RKL logics rely on the partiality of denoted objects and unification. Conjunction of formulas, in particular, corresponds to unification of the conjuncts’ denotata. But in QFFOP conjuncts do not have to share variables and conjoined formulas in general are not insured to denote connected graphs. Conjunction of formulas cannot therefore translate model-theoretically into unification of denotata. More generally, as in Johnson’s AVL or King’s SRL, we cannot rely on partiality of information and unification. An immediate consequence is that we cannot directly translate Pollard (1991) or Carpenter (1992)’s axiomatization of sorted RKL, since these logics depend on the correspondence between conjunction and unification. Secondly, the satisfiability of a QFFOP formula without functional uncertainty is decidable only if appropriateness conditions on types are not included as axioms in the logic (as mentioned in Johnson (1995)). Finally, whether the satisfiability of a formula with functional uncertainty is decidable depends on how negative descriptions are interpreted (the same restriction applies to LFG-style equations for inside-out functional uncertainty).

3 Conclusion

I have argued in this paper that grammars must include a new kind of constraints which attach to stems and words and stipulate the phrase-structural
environment in which they can appear. I suggested that the existence of these constraints should not prompt us to change anything in the structures that model information associated with strings (our linguistic ontology). The needed change is in the metalanguage of linguistic descriptions. I then showed that within current path-based descriptions languages for HPSG such constraints cannot be expressed, but they can within a quantifier-free first-order predicate logic-based description language (more generally, languages that include terms denoting feature structures). Aside from their inherent grammatical interest, inside-out constraints thus provide us with a methodological lesson. By distinguishing between modeling domains and description languages, HPSG and LFG enable us to differentiate between two methods for modeling descriptive generalizations we uncover: by augmenting our repertoire of linguistic objects and their properties or by adding to our list of constraints on those objects. Which course is better depends on the particulars of the case at hand. It is important, though, that we are provided with the choice.

References


Manning, C., Sag, I., & Iida, M. ((to appear)). The lexical integrity of japanese causatives. In G. Green & R. Levine (Eds.), Readings in HPSG. Cambridge: Cambridge University Press.


(Ohio State University)

Chicago: Chicago University Press.

Pollard, C., & Yoo, E. J. ((to appear)). A unified theory of scope for
quantifiers and wh-phrases. *Journal of Linguistics*

Przepiórkowski. (1997). *Quantifiers, adjuncts as complements, and scope
ambiguities.* University of Tuebingen. (Manuscript)

Richter, F. (1997). Die satzstruktur des deutschen und die behandlung langer
abhängigkeiten in einer linearisierungsgrammatik. In E. H. et al. (Ed.),
Tuebingen, Germany: SFB 340, Universität Tübingen.

de chomsky. In *Grammaire des insultes et autres études* (p. 172-204).
Paris: Seuil.
