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Simple Trees with Complex Semantics: On Epistemic Modals and Strong Quantifiers

The sentences in (1) have a reading in which the epistemic modal intervenes between the negation and the universal quantifier. This reading constitutes a genuine challenge for semantic composition as the semantic contribution of the subject NP seems to be split by that of the modal.

(1) a. Nicht jeder kann gewinnen. $\neg \succ$ **CAN** $\succ \forall$
not everyone can win "It is not possible that everyone can win."

b. Not every boy can make the basketball team. $\neg \succ$ **CAN** $\succ \forall$
"It is not possible that every boy makes the basketball team" [2]

Lechner [2] cites this reading as evidence of head movement at a syntactic level of LF. To derive the reading, he has to make a whole series of assumptions: (i) strong NPs do not reconstruct under raising verbs, (ii) NPs of the form *not NP* contain a semantically vacuous *not* but require to be contained in a NegP which contributes the negation, (iii) the NegP is high in the tree but has a variable position, (iv) an epistemic modal can syntactically move over the subject. This results in the structure in (2):

(2) The structure of (1-b) according to [2]:

$[_{NegP}$ NEG $[_{Neg^0}$ *can*$_i$ $[_{TP}$ *not every boy*$_j$ $[t_i\ [_{VP}\ t_j$ make the team]]]]]
$\lambda p.\neg p$ λp**CAN**(p) $\lambda P.\forall x($**boy**$(x) \rightarrow P(x)$ $\lambda x.$**make-team**(x)

Assumptions (i)–(iv) follow from nothing else in the grammar, they capture the empirical observations with the mechanisms of Lechner's framework. The advantage of the analysis is that the semantics can be read off the (LF-)syntactic structure directly. The price to pay is a highly complex syntactic derivation with many empty and functional categories for which there is no purely syntactic evidence. [3] argues against this type of theory from a methodological perspective, showing that the inclusion of semantic distinctions in syntactic analyses makes it almost impossible to derive the basic syntactic generalizations about English modals: English modal verbs differ syntactically from non-modal verbs, but their syntactic behavior is independent of their epistemic or deontic interpretation, and of their scope. Turning to crosslinguistic data, whereas verb placement in German and English obeys different syntactic constraints (V2 position of all finite verbs in German root clauses), the possible readings of the modals in the sentences in (1) are the same. We take this as further evidence that the split reading in (1) is not due to the availability of head movement. The generalization that universal quantifiers as subjects of raising verbs do not show de dicto readings in English (3-a) does not seem to be syntactic in nature either. [5] shows that strong quantifiers also lack de dicto readings in the direct argument position of opaque verbs such as *seek* (3-c).

(3) a. Every student seems to have passed the test. (only de re)

b. A student seems to have passed the test. (de re/de dicto)

c. John seeks every unicorn. (only de re)

Although epistemic modals are raising verbs, they may take scope over strong quantifiers in subject position. To account for this apparent violation of constraint (i), designed to capture (3-a), [2] introduces the head-movement option (iv) for modals to derive (1-b). But then the syntactic generalizations only capture part of a phenomenon that, in our view, should receive a uniform account: If a strong quantifier occurs in a (surface) argument position of an opaque non-modal verb, it must take scope over the verb.

We propose a syntax-semantics interface with the syntactic structure (4) for all readings of sentence (1-b).

(4) $[_S\ [_{NP}$ not every boy] $[_{VP}$ can $[_{VP}$ make the team]]]

A simpler syntax such as (4) requires a more elaborate syntax-semantics interface, as also advocated in [1]. Our surface-oriented syntax is provided by HPSG, while the interface to semantics is couched in *Lexical Resource Semantics* (LRS, [4]). There is a clear division of work: The syntactic structure reflects syntactic generalizations; constraints on readings express the semantic generalizations at the interface. Using techniques of underspecified semantics, the interface conditions are formulated in terms of (i) scope specifications in lexical entries and (ii) general scope principles. There is no empty abstract negation NEG, and the word *not* itself contributes semantic negation, in contrast to Lechner's (ii) and (iii) above.

The core idea of the LRS interface is that the semantic representations of sentences result from accumulating the meaning contributions and semantic constraints associated with lexical entries in accordance with general semantic principles. Logical representations of a higher-order logic such as Ty2 are not derived by the lambda calculus like in most systems. Instead, logical representations are combined by unification. LRS distinguishes between (i) the main content of a lexical item (underlined), (ii) the internal content of a lexical item (stated as '$\{\ldots\}$') and (iii) its external content (stated as '$\hat{}\ldots$') to mark scope boundaries within a

head projection. All operators take scope over the internal content of the lexical head.

The semantic contribution of the NP *not every boy* is given in (5). The universal quantifier is the external content of the NP. The negation must take scope over the external content, but there may be semantic material intervening between the negation and the quantifier. This is indicated with the upper case variable A, which is a *meta-variable*. Meta-variables stand for semantic nodes that are still underspecified. A:[$\phi_1, \ldots, \phi_n$] means that A has the subexpressions $\phi_1, \ldots, \phi_n$.

(5) Meaning contribution of the NP *not every boy*: $\neg A : [^\wedge\forall x(\{\underline{\textbf{boy}}(x)\} \rightarrow B : [x])]$

Modals contribute a quantification over possible worlds. The restrictor specifies the type of modality in terms of accessibility relations between possible worlds. The semantic contribution of *can* is given in (6):

(6) Meaning contribution of the verb *can*: $^\wedge\lambda w.A : [\exists w'(\underline{\textbf{acc}}(w, w') \wedge B : [w', \{C\}])]$

The VP *make the team* is represented as $^\wedge A : [\{\underline{\textbf{make-team}}(w', x)\}]$. The LRS analysis of modal verbs identifies their internal content with that of their complement VP [4], leading to the representation (7):

(7) Semantic representation of the VP *can make the team*:
$^\wedge\lambda w.A : [\exists w'(\underline{\textbf{acc}}(w, w') \wedge B : [w', \{\textbf{make-team}(w', x)\}])]$

When a VP combines with a quantified argument, general LRS principles require that the argument take scope over the internal content of the VP. This leads to the underspecified representation in (8):

(8) $^\wedge\lambda w.A : [\exists w'(\underline{\textbf{acc}}(w, w') \wedge B : [w', \{\textbf{make-team}(w', x)\}]),$
$\neg D : [\forall x(\textbf{boy}(x) \rightarrow E : [\textbf{make-team}(w', x)])]]$

(8) subsumes several readings, including the split reading in (1-b), which is obtained by resolving the meta-variable values as shown in (9). Other resolutions for different readings are ignored here for brevity.

(9) $A = \neg D, \quad B = \forall x(\textbf{boy}(x) \rightarrow E), \quad D = \exists w'(\textbf{acc}(w, w') \wedge B), \quad E = \textbf{make-team}(w', x)$

The analysis of opaque verbs in [4] predicts the existence of a de dicto reading for all sentences in (3). To exclude this, we assume the lexical specification of the opaque verbs *seem* and *seek* in (10).

(10) a. Meaning contribution of the verb *seem*: $^\wedge\lambda w.A : [\underline{\textbf{seem}}(w, \lambda w'.B[w', \{C\}])]$
b. Meaning contribution of the verb *seek*: $^\wedge\lambda w.A : [\underline{\textbf{seek}}(w, x, \lambda w'.B[w', \{C\}])]$

The general constraint (11) governs the scope options of strong quantifiers at the syntax-semantics interface:

(11) Constraint on strong quantifiers:
If the nonhead is a strong quantifier and the head is a verb, then the external content of the nonhead may not be a subexpression of an argument of the main content of the head.

The split reading of (1-b) obeys (11) since the main content of the modal is the accessibility relation (**acc**). (12) shows the de re and the unavailable de dicto reading of a strong quantifier with *seem*. The main content of *seem* is **seem**. In (12-b) the strong quantifier appears inside an argument position of **seem**, violating (11).

(12) Everyone seems to sleep.
a. $\lambda w.\forall x(\textbf{human}(w, x) \rightarrow \underline{\textbf{seem}}(w, \lambda w'.\textbf{sleep}(w', x))$ (de re)
b. $^*\lambda w.\underline{\textbf{seem}}(w, \lambda w'.\forall x(\textbf{human}(x) \rightarrow \textbf{sleep}(w', x))$ (de dicto)

We argued that the syntactic structure of a sentence should not be made dependent upon the semantic interpretation of modal verbs. A flexible syntax-semantics interface, based on underspecification techniques, can capture the attested ambiguities in a principled fashion. LRS permits the formulation of the necessary scope constraints in a direct way. The overall architecture of the interface is not more complicated than Lechner's since our system is not bound to cast its conditions in terms of syntactic operations. In the talk, we will extend the analysis to a full account of negated vorfeld constituents in German such as (1-a), which are problematic for traditional interfaces under the standard syntactic assumption of a single vorfeld constituent.

References

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