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Quantifiers : weak crossover and focus

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QUANTIFIERS: WEAK CROSSOVER AND FOCUS

1 Intro

In my article I would like to articulate some regularities concerning the possibilities and impossibilities of referential dependencies in Czech. In particular I will focus on pronoun binding and on what can be deduced from the possibilities and impossibilities of pronoun binding for the structure of Czech sentences.

What is the use of logic or formal semantics for the treatment of pronouns? The most elementary lecture is that there are two basic ways to interpret pronouns:

1. they can be interpreted as bound variables
2. and they can be interpreted as free variables

For instance, in the example (1) the pronoun *ho* is most naturally interpreted as a bound variable because we understand the sentence (in this reading) as the assertion about every student and about a mental state which is attributed to this student and which can be described as "teachers underrate me".

(1)   Každý student si myslí, že   ho učitelé   podceňují.
        Every student thinks   that him teachers underrate
        ‚Every student thinks that teachers underrate him.'

What is the use of it? We can infer from this that every theory which would treat pronouns as simple substitutes for their antecedents would go wrong. Because if pronouns were substitutes for their antecedents then (1) would mean the same as (2). However, it is clear that (2) has different truth-conditions than (1), e.g. the sentence (1) would be true in the situation where Karel (student) believes that teachers underrate him but he doesn't believe that teachers underrate Pavel (also student); the sentence (2) would be false in this situation and it follows that these two sentences are truth-conditionally different.

(2)   Každý student si myslí, že každého studenta učitelé   podceňují.
        Every student thinks that every   student   teachers underrate
        ‚Every student thinks that teachers underrate every student.'

   This looks like a prima facie paradox. We all understand sentences with pro-
nouns as sentences where the pronoun is in some sense a proxy for its antecedent.
But as can be seen from sentences like (2), this proxy cannot be a literal substi-
tution. The classical solution to this problem dates back to Frege and is one of
the standard components of predicate logic nowadays. In the examples like (1)
the pronoun is taken to be a bound variable. That means that the pronoun is not
a substitute for its antecedent but it is bound by its antecedent in the same way as
variables are bound by existential or general quantifiers in predicate logic. Semi-
logical transcription of (1) can be rendered as (3):

(3) $every_x$ [x is a student & x thinks that teachers underrate x]

   In the example (3) *x* is a variable which means that it does not have a value by
itself (reference in natural language, number in algebra). So we can say that the
meaning of pronouns is formally best captured by treating them as variables. A
pronoun/variable can acquire its value in two possible ways. The first possibility
is called bound variable interpretation. It is exemplified in (3) or (4-a), whose
semilogical form is in (4-b)

(4)   a. Some students danced and sang.
         b. $some_x$[x is a student & x danced & x sang]

   The other way to interpret a pronoun/variable is called valuation in logic. This
is the way a variable acquires its value when it is not bound. In the natural lan-
guage it is the case when a pronoun does not have an anaphoric antecedent in
the sentence surroundings (I will make this point clearer in the following text).
Traditionally, this interpretation is called the **deictic** use of a pronoun and the
bound variable is referred to as the **anaphoric** use of pronoun. However, I will
use the distinction bound/free variable instead. The free variable interpretation of a
pronoun is exemplified by the sentence (5). From the theoretical point of view, this
sentence is ambiguous between the bound variable reading (5-a) and the free vari-
able reading (5-b), but certain universally accepted facts about human minds and
their existence dependent on living brains make the reading (5-a) very unlikely and
the reading (5-b) the first and the most natural reading of the sentence (5). Never-
theless, if some scientists achieved one day that human minds can exist without
material substance then the reading (5-a) would become as natural as (5-b).

(5)   Everybody knew that he was already killed.
         a. $every_x$ [x knew that x was already killed]
         b. $every_x$ [x knew that y was already killed]

This observation tells us that there is always an ambiguity when the pronoun is in the surroundings of a quantifier (it can be bound, but it can be free as well). However, a more interesting problem is whether this is valid the other way round, too (i.e. whether the pronoun can be bound without a quantifier in the surroundings). Another important question concerns the exact delimitation of the surroundings: how far from a pronoun can a quantifier be if it should bind the pronoun? This question, which may be called the locality question, will be addressed in the next section.

1.1 Scope

In logic the answer to the locality question is quite simple. The variable must be in the scope of the quantifier. What is the scope of a quantifier? The scope of a token of an expression is the shortest well-formed formula in which this expression occurs. E.g. the scope of the $\forall$ quantifier in the example (6) is the formula "$[P(x) \rightarrow Q(x)]$", because "$\forall x[P(x) \rightarrow Q(x)]$" is the shortest well-formed formula (WFF) in which the quantifier $\forall$ occurs ("$\forall x[P(x) \rightarrow$" is not a WFF and "$\forall x[P(x) \rightarrow Q(x)]$ & $R(x)$" is a WFF but not the shortest).

(6) $\forall x[P(x) \rightarrow Q(x)]$ & $R(x)$

In the natural language the situation is (as always) a bit more complicated. Nevertheless, some notion similar to the scope works here as well. Consider the example (7-a) with the semilogical form (7-b). The (7-b) is close enough to the predicate logic (PL) formalization to show that the pronoun/variable is in the scope of the quantifier, so this quantifier can bind the pronoun. Everything works well.

(7)   a. No student knew how much the teachers love him.
       b. no student$_x$ [x knew how much teachers love x]

So why do we not simply rewrite the sentence from natural language to predicate logic and see? Unfortunately, it does not work this way. As can be seen from the sentence (8-a) and its semilogical form (8-b): if we end a sentence containing a quantifier, then it is not possible to bind a pronoun in the following sentences even though the semilogical form looks perfectly well (under the generally accepted assumption that sequence of natural language sentences can be translated into PL as a conjunction of the meaning of these sentences).

(8)   a. *[Every student]$_i$ arrived. He$_i$ wore sunglasses.
       b. every student$_x$[x arrived & x wore sunglasses]

This looks a bit puzzling but the answer is easy enough. Sentences separated by commas do not make a constituent and every new sentence is a new syntactic

structure. In generative grammar, this fact is reflected simply by separate trees for every new sentence. Unlike a sequence of sentences separated by commas, a sentence containing embedded clauses forms a single tree. And as can be seen from (9-a) and its formalization in (9-b) it is in an accordance with the data.

(9)   a. Every student who arrived wore sunglasses.
        b. every student$_x$[x arrived $\rightarrow$ x wore sunglasses]

   Note that even when a quantifier and a pronoun belong to the same sentence, it is not enough for them to cooperate. As can be seen from the Czech sentence (10-a) there are some syntactic configurations which do not allow quantifier binding even when the quantifier and the pronoun are in the same sentence. What is also puzzling is the fact that the semilogical form (10-b) is perfectly fine – both variables are in the scope of their respective quantifiers.

(10) a. *Každý učitel$_i$, který dnes nezkoušel   žádného studenta$_j$, ho$_j$ vyzkouší zítra.
        Every teacher who today not examined none   student   him examine tomorrow
        ‚Every teacher$_i$ who did not examined any student$_j$ today, will examine him$_j$ tomorrow.‘
    b. every$_x$no$_y$ [[x is a teacher & y is a student & x didn't examined y] $\rightarrow$ [x will examine y tomorrow]]

   This is a perfect example of Chomsky's autonomy thesis: I have got a very plausible, logically correct and semantically normal meaning, but I cannot express this meaning with a certain sentence. It is clear that the meaning *every teacher who didn't examined any student today, will examine all unexamined students tomorrow* does make sense and we all can imagine a situation where this sentence would be true, but "accidentally" this sentence cannot be expressed by the sentence (10-a). This sentence is not ungrammatical because of semantics. This sentence is bad because of syntax. There are some modules of grammar: semantics, syntax, morphology, etc., but they work independently of each other. They communicate with each other, but their inner working is opaque for other modules.

   The reason why the coreference between the quantifier and the pronoun is not possible in (10) is certainly not the "emptiness" of a set to which the quantifier *žádný student* points. The first reason why it is not so is that generally quantifiers of *žádný* type do not refer to an empty set.[1] For reasons of space I am not going to develop this point more thoroughly here, but see the end of this section. Another reason (which confirms the previous claim) is that exactly this pattern (coreference between some "empty set" quantifier and a pronoun) can be seen in the example (7), which is a perfectly grammatical sentence. From these considerations it follows that there must be some syntactic difference between the examples (7) and (10). This syntactic difference must tell us why it is possible to bind the pronoun in (7) but not in (10).

1.2 C-command

One of the central notions in the generative grammar is the notion of c-command (sometimes also called command). It is essential for a number of aspects including the relation between moved constituent and its trace, licensing of the anaphors, negative polarity items, and scope interactions. Tanya Reinhart (1983), who introduced the notion of c-command for the first time, even claims that it is not possible to have a meaning relation between two constituents without one of them c-commanding the other. By this, of course, we mean structural (syntactic) meaning relation like scope interaction, not a lexical one (e.g. subset and superset relation). Following Reinhart (1983) this relation is defined as in (11) and illustration is given in the abstract tree in (12).

(11)   Node A c(onstituent)-commands node B iff the branching node most immediately dominating A also dominates B.

(12)
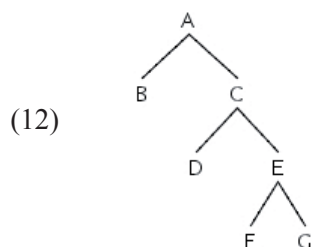
The definition (11) determines the following examples:

- A   doesn't c-command anything;
- B   c-commands C, D, E, F and G;
- C   c-commands B;
- D   c-commands E, F and G;
- E   c-commands D;
- F   c-commands G;
- G   c-commands F;

If we apply c-command to the examples (7) and (10), we immediately see (more illustratively on the graphs (13) and (14)) that there is a distinction: in the example (7) the NP *no student* c-commands the pronoun *him*, whereas in the example (10) the NP *žádného studenta* does not c-command the pronoun *ho*.

(13)

(14)
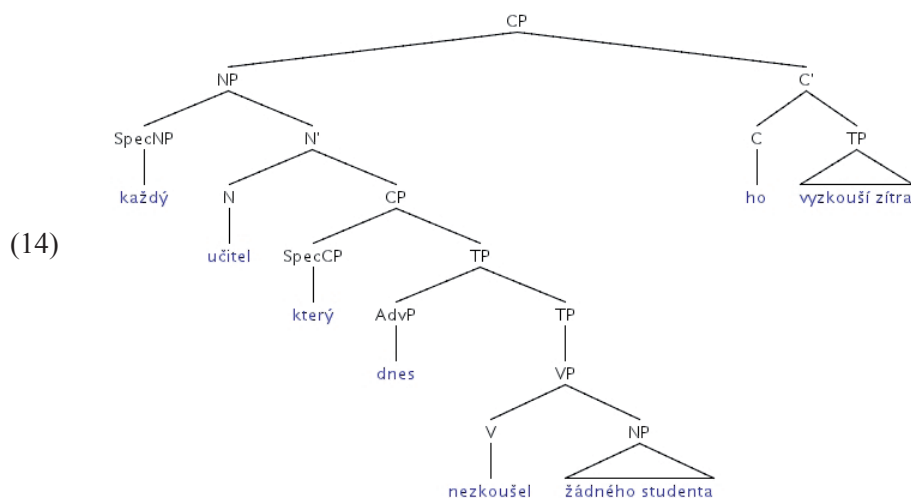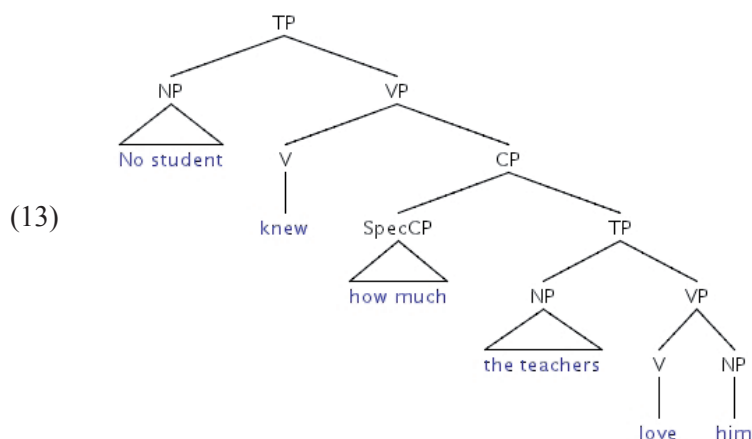
This is another hint that the autonomy thesis is on the right track. Because it shows us that semantics cannot simply change what has been done in syntax. The semantic module interprets the structures (trees) which enter into it from the syntax. These structures are completed and semantics can only interpret them. The meaning of a quantifier is not a set, but some operation on sets.[2] Thus, for example the meaning of the NP *all Prague dogs* is not a set of all actual dogs in Prague, but the set of the sets which have the set of Prague dogs for the subset, thus the sentence (15-a) is true, because the set of Prague dogs is certainly a subset of a set of individuals who like meat. But the sentence (15-b) is not true, because the set of Prague dogs is not a subset of individuals who visited Brno. Maybe the set of Prague dogs does have a intersection with the set of Brno visitors, so the sentence

(15-c) can be true, which only shows that the quantifier *some* does have different semantic properties from the quantifier *all*.

(15)   a. All Prague dogs like meat.
            b. All Prague dogs visited Brno.
            c. Some Prague dogs visited Brno.

The fact that the quantifiers do not refer to sets also explains the following contrast: although the binding of the pronoun in (10) repeated as (16) is illicit, the coreference between proper name and the pronoun is not limited in the same way. As can be seen from the sentence (17), a proper name and a pronoun can be coindexed even when the proper name does not c-command the pronoun. This follows from the fact that the proper name is a rigid designator, it picks up its reference directly and also the pronoun which is coreferent with the proper name must refer directly to the individual labeled by the name, so the anaphoric interpretation is excluded in this case. This means that the only way for the proper names to be coreferent with the pronoun is the deictic interpretation.

(16)   a. *Každý učitel$_i$, který dnes nezkoušel žádného studenta$_j$, ho$_j$ vyzkouší zítra.
            Every teacher who today not examined none student him examine tomorrow
            ‚Every teacher$_i$ who did not examined any student$_j$ today, will examine him$_j$ tomorrow.'

(17)   Každý učitel$_i$, který dnes nezkoušel Karla$_j$, ho$_j$ vyzkouší zítra.

On the other hand, quantifiers do not refer, so the only way for them to be coreferent with some pronoun is by the binding of the variable. For quantifiers the deictic use is excluded. And anaphoric use, as a syntactic operation in principle, is subject to syntactic restrictions. In this case it is subject to c-command. That is why in the examples (13) and (14) the quantifier *no student/žádného studenta* has to c-command the pronoun which it should bind; if the c-command relation is missing, then it is impossible for the quantifier to bind the pronoun and the coreference in the example (14) leads to ungrammaticality.

1.3 Weak Crossover

We have seen that the c-command relation is a necessary condition for a quantifier to bind a pronoun. However, it is not the only condition as can easily be seen from the sentences like (18) and (19). In both sentences the pronoun is c-commanded by the quantifier but only in (18) it is possible for the quantifier to bind the pronoun. An influential idea in generative grammar is that pronoun binding always involves an argument slot binding (into) a lower coargument. The examples like (19) are called crossover (this particular type is called Weak Crossover

– WCO) because the element that has 'crossed over' does not occupy an argument slot and hence is incapable of binding variables.

(18) $[_{CP}$ Kdo$_i$ $[_{TP}$ ~~kdo~~ $[_{VP}$ miluje svou$_i$ matku]]]?
              Who   loves   his   mother
        ‚Who loves his mother?'

(19)   *$[_{CP}$ Koho$_i$ $[_{TP}$ svá$_i$ matka $[_{VP}$ miluje ~~koho~~]]]?
              Who   his   mother   loves
        ‚Who his mother loves?'

In the transformational literature, Tanya Reinhart again, in Reinhart (1983) and other works, has presented what is sometimes called Reinhart's Generalization:

(20)   Pronoun binding can only take place from a c-commanding A-position.

The crucial qualification here is "from an A-position", which excludes binding from a position derived by a wh-movement or a quantifier raising, but allow the case of a raising, so the example like (21) is fine.

(21) $[_{TP}$ Petr$_i$ $[_{VP}$ se zdál $[_{NP}$ svému$_i$ strýčkovi] $[_{TP}$ ~~Petr~~ být unavený]]].

1.4 WCO and Focus in Czech

It is widely accepted that the wh-movement and the focus movement behave alike, because both types of operations are created by A'-movement. Thus (22) and (23) are bad, since *JOHN* in (22) moves covertly to some A'-position in the same way as *who* moves overtly in (23):

(22) *His$_i$ mother loves JOHN$_i$.
(23) *Who$_i$ does his$_i$ mother love t$_i$?

However there are some data which show that this assumption is not accurate. As can be seen from sentences[3] like (24), island-creating operators intervening between the operator and the focus do not interfere whereas the same sentence with wh-movement would be ungrammatical - (25). A possible solution is to claim that focus configurations consist of a focus licensing operator such as *even* which has to c-command the focused element.

(24) Sam even saw the man who was wearing the $[_F$ RED] hat.
(25) *What$_i$ did Sam even see the man who was wearing t$_i$?

As can be seen from the Czech sentences like (26) and (27) in configuration where a wh-phrase or focus stay in situ wh-phrases and focused elements give rise to WCO:

(26) *Jeho$_i$ matka miluje KARLA$_i$.
        His   mother loves CHARLES
        ‚His$_i$ mother loves CHARLES‘

(27) *Jeho$_i$ matka miluje koho$_i$?
        His   mother loves who?
        ‚His$_i$ mother does love who$_i$?‘

But surprisingly if we move wh-phrase or focused element upwards, then WCO nearly disappears:

(28) ?KARLA$_i$ jeho$_i$ matka miluje t$_i$.
        CHARLES his   mother loves   t
        ‚His$_i$ mother loves CHARLES$_i$ ‚

(29) ?Koho$_i$ jeho$_i$ matka   miluje t$_i$?
        who   his   mother love   t?
        ‚Who$_i$ does his$_i$ mother love t$_i$?‘

Wh-movement and focus movement behave alike in this respect, which poses a problem for the focus operator approach. Apart from that this is also a problem if we assume that focus movement and wh-movement are covert in the examples like (26) and (27). We can still claim (as Puskas 1997 does) that in (28) the NP *Karla* is a topic and topics are not operators because topicalized constituents do not lead to WCO like in the following Hungarian sentence:[4]

(30) Jànost$_i$ SZERETI az   pro$_i$ anya t$_i$
        John   loves   the pro mother
        ‚John$_i$, his$_i$ mother loves him‘

However, this solution does not work with the example (29) because the wh-phrase can hardly be a topic. Besides, there are Hungarian sentences[5] like (31) and (32) where *Kit* is a wh-phrase and *Jànost* is a focus expression and these sentences are grammatical:

(31) Kit$_i$ szeret az pro$_i$ anyja?
        who loves the pro mother
        ‚Who does his mother love?‘

(32)   (?)JÀNOST$_i$ szereti az pro$_i$ anyja.
        John loves the pro mother
        'His$_i$ mother loves JOHN$_i$'

This set of data poses a problem for the straightforward analysis of the Czech CP domain by simply splitting this domain into the FocusP, TopicP, ... I do not know the answer to these problems but I hope to explore this area in a future work and come to some explanation.

Notes:

[1]   See the chapter 6 of Heim & Kratzer (1998).

[2]   See Russell (1967) for early treatment and Barwise & Cooper (1981) for the classical reference.

[3]   This sentence is from Meinunger (2003).

[4]   Example (42) from Puskas (1997).

[5]   Sentence from footnotes 7 and 12 from Puskas (1997).

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KVANTIFIKÁTORY: SLABÉ PŘEKŘÍŽENÍ A FOKUS

V tomto článku jsem se obecně věnoval tomu, jak syntaktická pravidla omezují možné významy, které lze přiřadit větám přirozeného jazyka. Zabýval jsem se tím, jaká jsou omezení na lokalitu a konfiguraci kvantifikátoru, který váže zájmeno. Zvláštní pozornost jsem věnoval tomu, jak vázání zájmen souvisí s lineárním uspořádáním a topik/fokusovou artikulací v češtině.

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