Binding – Data, Theory, Typology

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Abstract. The tutorial gave an overview of the treatment of variable binding in natural language semantics. A set of data was singled out, two families of approaches to deal with reflexivity were presented which yield a comparable data coverage, and the cross-linguistic variation of reflexivization strategies was reviewed. The modelling options map neatly onto the variation found in natural language.

Keywords: variable binding, reflexivity, pronoun, semantics, typology.

1   Introduction

The tutorial gave a three-fold overview of aspects pertaining to the issue of variable binding in natural language. In a first step, a set of phenomena was singled out, phenomena which constitute the core data in the domain under scrutiny. Each binding theory must be able to account for this set of data. Section 2 of the present article reviews some of these data patterns. In a second step, two families of analyses used to model reflexivity were introduced (section 3 of the present article). Reflexivity was used as a domain of illustration, because this phenomenon constitutes a widely discussed paradigm case within the larger domain of variable binding phenomena in natural language. The first kind of analysis centers around the reflexivization of verbs. The second kind of analysis leads to the reflexivization of larger constituents; it requires powerful composition tools that go well beyond functional application. The cross-linguistic overview of the third part of the tutorial aimed at showing that, in all likelihood, both families of theories are justified if a close form-function match is aimed at (section 4 of the present article).

2   Data and Descriptive Generalizations

2.1   Three Uses of Pronouns

(1) lists examples of different pronoun uses that occur side by side in many languages. Some of them have a long tradition of being analyzed as natural language counterparts of bound variables (Ross 1967).

(1)   a.   **anaphoric**
                A boy came in. He wore a red hat.
        b.   **deictic**
                Look, the two over there!
                [pointing:] *She$_i$'s my boss, and she$_j$'s my colleague.*
        c.   **bound**
                i.   *Paul$_i$/Everybody$_i$ likes himself$_i$.*
                ii.   *Mary$_i$/[None of the girls]$_i$ thinks she$_i$'s a genius.*

It depends on the individual grammar framework whether the pronouns in (1a/b) are analyzed as bound variables. The pronouns in (1c) will be analyzed as bound variables in the great majority of frameworks. What sets them apart from the examples in (1a/b) is that they have an overt antecedent in the same sentence. With a formal understanding of variable binding in mind, it is maybe not immediately clear why proper name antecedents as in (1c) should count as variable binders. It will not be possible to elucidate in this short survey how proper names can be expressions referring to individuals, and still be variable binders in a formal sense at the same time. Suffice it to say here that the most influential proposal in this domain manages to reconcile these two things (Heim and Kratzer 1998). With the quantified subject variants in (1c) (*everybody*, *none of the girls*), a variable binding analysis offers itself straightforwardly.

Another issue to comment on in connection with (1cii) is the fact that *she* (with antecedent *Mary*) has the form of a pronoun which may occur without sentence-internal antecedents. This may nourish suspicion about its bound status in (1cii); could one not say instead that *she* may refer to any salient discourse antecedent, and this antecedent just happens to be the same referent as who *Mary* refers to? Put differently, does one have to postulate a difference between *he* in (1a) and *she* in (1cii)? The following subsection will introduce the diagnostics to establish the fact that there is a difference.

2.2   Strict and Sloppy Identity: Some Classic Contrasts

The sentence in (2) has at least three different readings. Names for these readings are introduced in (i)-(iii) (Ross 1967).

(2)   *Paul likes his teacher, and Peter does [~~like his teacher~~]$_{ELLIPSIS}$, too.*
        i.   'Paul likes Paul's teacher, and Peter likes Peter's teacher.
                sloppy identity (bound use of of *his*)
        ii.   'Paul likes Paul's teacher, and Peter likes Paul's teacher.'
                strict identity (anaphoric use of *his*; it co-refers with *Paul*)
        (iii.   'Paul$_i$ likes c$_j$'s teacher, and Peter$_k$ likes c$_j$'s teacher.'
                'third reading' (anaphoric use of *his* not co-referent with the subject; really a special case of the more general case to which (ii) belongs; Büring 2005)

The elliptical possessor in the second conjunct may either co-vary with the local antecedent (binding/sloppy identity), or be fixed to a single referent (the subject referent as with strict identity, or some discourse-given referent as with the 'third reading'). Sloppy identity phenomena invite analyses in terms of variable binding. Note in passing that, if the second conjunct is disregarded, strict and sloppy identity construals make no difference in the first conjunct. Which analysis should, then, be chosen for such sentences without second conjuncts? Büring (2005: 121) argues that natural languages generalize the binding construal.

There are classes of pronouns which force binding construals. Reflexive pronouns like English *x-self* are like this. This is illustrated in (3).

(3)   *Mary pinched herself, and Paula did, too.*
      i.   'Mary pinched Mary, and Paula pinched Paula.' (sloppy identity)
    *ii.   'Mary pinched Mary, and Paula pinched Mary.' (*strict identity)
    *iii.   'Mary pinched Sue, and Paula pinched Sue.' (*3rd)

Apart from the lexical class of the pronoun at hand, there are certain syntactic restrictions which have to be fulfilled for a pronoun to receive a bound reading as in (2i) or (3) (command relations such as c-command or o-command, depending on the grammar framework chosen; Büring 2005). For lack of space, we will not go into the syntax of variable binding.

The next section will briefly sketch two ways of arriving at bound-variable construals in a compositional semantics, implemented for the empirical domain of reflexivity.

3   Bound Variables and Reflexivity in a Compositional Semantics

3.1   Verb-Centered Reflexivization

A reflexive clause with a referring expression as its subject as in (3) is characterized by the fact that the subject referent and a second participant of the event described by the verb are identical. Importantly, the identical reference of the two arguments is of the kind which produces sloppy-identity effects in diagnostic contexts such as (3). The reference of the clausal subject is biconditionally linked to a second event participant. In a compositional semantics, it is a natural move to implement this biconditional link at the level of verb meanings, because verb meanings allow simultaneous access to the argument positions of the subject and the object (this only holds *cum grano salis*; in an agent-severed event semantics as propagated by Kratzer (1996), verb meanings have no direct access to the agent argument position). The first of the two major modelling options for reflexivity centers around this property of verbs (Keenan 1987, Jacobson 1999).

(4a) gives a simplified lexical entry of the verb *pinch*, represented as a lambda-term.[1] (4b) is its reflexivized counterpart.

(4)   a. $\lambda x_e . \lambda y_e . y$ pinches x
            'the (smallest) function which maps every x, x an individual of se-mantic type e, to the smallest function which maps every y, y an individual of semantic type e, to 1 if y pinches x, and to 0 otherwise'
            [a function from individuals to [a function from individuals to truth-values]]

       b. $\lambda x_e . x$ pinches x
            'the (smallest) function which maps every x, x an individual of se-mantic type e, to 1 if x pinches x, and to 0 otherwise'
            [a function from individuals to truth-values]

(5a) represents a function which takes transitive verb meanings as in (4a) as input and yields reflexivized verb meanings as in (4b) as output. (5b) applies this function to the denotation of *pinch*. This is one way to arrive at reflexivied verb meanings.

(5)   a. $\lambda f_{\langle e, \langle e, t \rangle \rangle} . \lambda x_e . f(x)(x)=1$
            'a function which reflexivizes transitive verbs'

       b. $\lambda f_{\langle e, \langle e, t \rangle \rangle} . \lambda x_e . f(x)(x)=1[\lambda x_e . \lambda y_e . y$ pinches x$]$
            $= \lambda x_e . x$ pinches x

If a denotation as in the last line of (5b) is available as the term with which the subject argument combines by Functional Application, then sloppy identity readings may be derived; the object denotation will co-vary with whatever is the (local) subject.[2] We will return to the merits and deficits of this general account of reflexivization in section 4. In the following subsection we will turn to the second family of reflexivization theories.

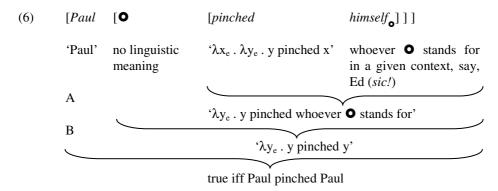## 3.2   Pronoun-and-VP-Centered Reflexivization

The second way of modelling reflexivity does not take the verb as its starting point, but the pronoun in object position, in conjunction with a mechanism which operates

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[1]   Transitive verbs like *pinch* are represented as schönfinkeled, or curried, functions by many semanticists (cf. Heim and Kratzer 1998: 29-31). This means that a transitive predicate is not modelled as a function which takes a pair as its argument. Instead, transitive verbs take a single individual argument and yield another function as output. This second function then yields a truth-value as output (or whatever intermediate level the semantics assumes at the level where the highest argument has been filled in for the first time). With such a nested functional structure, denotations become available for each node in a syntactic tree with binary branching.

[2]   It is usually assumed that ellipsis as in the diagnostic contexts of (2) and (3) requires exact identity of structure and interpretation between the elided and the non-elided counterparts. If this is assumed, then (5b) is a denotation of the right kind.

across a distance. With a cross-linguistically common type of reflexive pronoun, a clause will only be grammatical if the reflexive pronoun co-refers with the subject of the clause. If one insists on implementing the idea that it is not the verb which establishes the 'identity link' between subject and object, but the object pronoun, then some other mechanism must kick in to yield the desired result. The mechanism which delivers this result in current semantic binding theories which do not rely on reflexivized verbs is predicate abstraction, or variants thereof (Heim and Kratzer 1998, Büring 2005, Hole 2008). Due to limitations of space we will not be able to delve into the details of any specific semantic binding theory. I will present a highly simplified narrative of what object-and-VP-centered implementations of reflexivization amount to. The interested reader is referred to the literature for further details.

The narrative goes like this. (i) Pronouns come with a birthmark, or index, that allows one to identify their referent in a given context. The birthmark is visible in the syntactic structure, and it gets interpreted as the individual which has it. As such, pronouns refer in a way that is not very different from proper names (if a Rigid Designator account of proper names is adopted; Kripke 1972), except that pronouns get recycled again and again (whereas there are as many fictitiously different names *Paul* as there are individuals called Paul). A proper name refers to exactly one indivdual, or group of individuals. A pronoun refers to exactly one individual, or group of individuals, per context. (ii) Some mechanisms introduce bare birthmarks, birthmarks that are not interpreted as individuals. If, in the larger linguistic structure, the pronoun birthmark and the second birthmark happen to be the same, and if the command relations alluded to at the end of 2.2 are fulfilled between this second occurrence of the birthmark and the first one, then a predicate is abstracted over the whole constituent minus the second, commanding, birthmark. (iii) Pronoun classes differ in their ability to undergo predicate abstraction. Some must undergo it (reflexive pronouns), some may (English possessive pronouns), some may not (English ordinary personal pronouns in object position with the binder-to-be in the local subject position). (6) illustrates major components of this narrative (❍ symbolizes the birthmark (index)).

(6)   [*Paul*   [❍   [*pinched*   *himself*$_❍$]]]

'Paul'   no linguistic   '$\lambda x_e . \lambda y_e$. y pinched x'   whoever ❍ stands for
         meaning   in a given context, say,
                                                                          Ed (*sic!*)

A
                         'λy_e . y pinched whoever ❍ stands for'
B
                              'λy_e . y pinched y'

true iff Paul pinched Paul

The difficult step, the one which cannot be achieved by functional application, is the one from A to B. The birthmark argument must be 're-extracted', and the resulting argument slot must be identified with the subject argument slot. At this point the

different proposals mentioned above all use slightly different tools. None of them makes do without some costly or inelegant mechanism. The last lambda-term in (6) is again of the right type to derive sloppy-identity/bound-variable construals.

In the last section I will discuss the empirical justification for assuming both types of reflexivization theories side by side.

4   A Typology of Reflexivization Strategies in Natural Language

The verb-centered implementation of reflexivization is simple, but it leaves no room for reflexive pronouns. Speakers have the intuition that a pronoun like *himself* in English refers, and this is not predicted by verb-centered theories. So we do need a pronoun-centered construal of reflexivity. In some other languages, no pronouns are required to construct a reflexive clause. An affix on the verb, or some other morphological mechanism, reflexivizes the predicate instead. This is precisely what one expects if one endorses a verb-centered approach to reflexivization. Examples from languages with clear verbal reflexivization strategies are provided in (7) (taken from Gast et al. 2007).

(7)   a.   Shona (Niger-Congo; Volta-Congo)
                á-ká-zvi-rwádzísá
                NOUNCLASS1.3SG-PAST-REFLEXIVE-suffer.CAUSATIVE
                'He hurt himself.'
         b.   Abkhaz (North(west)-Caucasian; Abkhaz-Abasin)
                sarà   *s-ʈʂə̀-s-š-we-yt'*
                ich   POSSESSIVE.1.SG-REFLEXIVE-1.SG-kill-DYNAMIC-FINITE
                'I kill myself.'
         c.   Classical Nahuatl (Uto-Aztecan; Aztecan)
                mo-tlaʔsoʔtla
                REFLEXIV.3-lieb
                'He/She loves him-/herself.'/'They love themselves.'

Upon closer inspection, it is a typical feature of European languages to have two reflexivization strategies, one of them pronominal, and the other one similar to a verbal reflexivization strategy. (The case of English is not covered by this generalization.) Typically, one finds a reflexivization strategy with a reflexive pronoun which may be stressed, which can move in the sentence and which is canonically used with verbs describing typically other-directed actions like 'hating', 'criticizing', or 'attacking' (cf. König and Vezzosi 2004 for the notion of (non-)other-directedness). The (more) verbal reflexivization strategy of European languages makes use of a bleached pronominal element which is restricted to a position adjacent to the verb, which cannot be stressed and which is canonically used with typically self-directed actions (body-care, grooming; cf., again, König and Vezzosi 2004). The Russian pair *sebja* vs. *-sja* is a case in point, Italian *se (stesso)* vs. *si* another one. (8) provides examples from Dutch; capital letters indicate focal stress.

(8) a.   *Jan   waste   zich.*
           Jan   washed   REFLEVIVE
           'Jan washed/got washed.' (as one does in the morning)
     b.   *Jan   waste   zichself/*ZICH.*
           Jan   washed   himself/REFLEXIVE
           'Jan washed himSELF.' (as opposed to washing other people)

The difference between the Dutch and the other European systems, on the one side, and the ones exemplified in (7), on the other, lies in the fact that Dutch *zich* (or Italian *si*) is an element with a clearly pronominal morphology. The verbal reflexive markers in (7) do not have this property. Still, a lot speaks in favor of treating *zich* as developing towards a non-referential reflexivizer, and the same can be said about the reflexive clitic pronouns of other European languages.[3]

The strategies to express reflexivity that were surveyed in this section were classified as pronominal, as verbal, or as somewhere in between. The verb-centered reflexivization mechanism as introduced in 3.1 matches well with affixal reflexive markers as in (7). The pronoun-and-VP-centered reflexivization mechanism matches well with English reflexive markers like *x-self*. And the clitic reflexive markers with a pronominal morphology of many European languages may be on their way from shifting from the pronoun-and-VP-centered mechanism to the verb-centered mechanism. (I will leave it open here whether there may be a semantic middleground in this domain corresponding to the morphological middleground that we are describing here.) In a nutshell, the constructional array of reflexivization patterns in the languages of the world justifies the assumption of the two major semantic mechanisms that have been proposed in the semantic literature.

5   Conclusions

The tutorial aimed at showing that major modelling options for variable binding, exemplified for the domain of reflexivity, find a neat counterpart in the major reflexivization stratregies that natural languages employ.

The slides of the tutorial can be accessed through the following link: http://www.illc.uva.nl/Tbilisi/Tbilisi2011/uploaded_files/mediaitem/kutaisi-hole.pdf

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[3]   Cf. Reinhart and Reuland's (1993) influential account of the system of reflexization in Dutch and other European languages. Their analysis constitutes one way of spelling out the position of European reflexive pronouns as somewhere in between a verbal and a full pronominal reflexivization strategy. Another important reference for the typology of reflexive pronouns is Faltz (1985).

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