Exclusion phrases and criticisms of semantic compositionality

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1 Introduction

Any reasonable version of the principle of semantic compositionality uses in its formulation three conceptually non-trivial and theoretically loaded notions: function, meaning and (syntactic) part. (cf. Janssen 1996 and Pelletier 1994a for the review of various problems related to the principle of compositionality). This means that the principle can be relativized to any of these notions, none of which can be arbitrary, otherwise the principle would be formally void. In particular, groupings of constituants, simple or complex, into more complex constituants not only cannot be arbitrary but can also be tested relative to their compatibility with the principle of compositionality.

Obviously the notion of function should also be properly understood when testing the validity of the principle. Various criticisms of the principle ignore the fact that values of functions can be given by a finite enumeration of cases to which various conditions on values of arguments can give rise. In this way it can be easily seen that for instance complex idioms which are often given as supposed counter-examples to the compositionality principle in fact are not genuine counter-examples. Indeed, since the number of idioms with a given syntactic structure is finite (and in addition the structure is usually "frozen") in order to get the computing function it is sufficient to enumerate separately all these finite "idiomatic" cases as special cases associating semantic values with the meanings the corresponding idioms have.

The purpose of this paper is to discuss some more recent and more sophistiocated criticisms of the principle of compositionality. I will consider a specific version of it in the context of exclusion phrases (EXCL phrases), i.e. phrases of the type *No/every student except Leo/Albanian(s)*. The version of the principle I am interested is as follows: let E be a complex expression and SA its syntactic analysis. According to SA, for $0 \leq i \leq n$, each E_i is an immediate part of E and for $0 \leq k \leq m$, each E_{i_k} is an immediate part of E_i. We will say that analysis SA is compatible with the principle of semantic compositionality iff the meaning of E is a function of the meanings of E_i and the meaning of every E_i is a function of the meanings of E_{i_k}. I will show in particular that, contrary to what one could claim, there are two natural syntactic analyses of EXCL phrases which are both compatible with the principle of compositionality in the above version. Furthermore, I will relate the discussion of this case to some arguments against compositionality which were given in the context of complex sentences with *unless.*

There are many reasons to do this. First, EXCL phrases are formed syntactically from very specific syntactic elements, namely nominal determiners, and consequently their denotations are also specific since they are higher order objects. Since in general the principle of compositionality has been discussed in connection with major categories such as sentences, noun phrases or verb phrases, the discussion of the principle in relation to "minor" categories may be enlightening. This is even more obvious if it appears that some results obtained in connection with one category are easily generalisable to other categories: I show that the connective *except* occurring in EXCL phrases is in fact categorially polyvalent. Consequently any discussion of the validity of the principle of compositionality at sentential level appears directly relevant for other levels.
At the background of this paper are two discussions of the semantics of natural languages, one in Higginbotham 1986 evoking semantic compositionality and the other, a reply to it, in Pelletier (1994b). In order to show that natural languages cannot be compositional in general, Higginbotham considers sentences with the connective *unless* like those in (1):

(1a) John will eat steak unless he eats lobster
(1b) Every person will eat steak unless he eats lobster
(1c) No person will eat steak unless he eats lobster

Higginbotham notices that *unless* in (1a) and (1b) corresponds to the (exclusive) disjunction whereas in (1c) it corresponds to the connective "and not". Thus, *unless* "means" different things in different contexts. From this observation Higginbotham draws the conclusion that a semantic principle which he calls the Principle of Indifference and which is related to the principle of compositionality, is false, and consequently that the facts like those in (1) show that the principle of compositionality is false for natural languages.

Pelletier (1994b) discusses Higginbotham's argument and proposes two solutions to the problem it raises. According to the first solution, *unless* is "vague", and its meaning is neither the disjunction nor the connective "and not" but rather some connective or other from a given set of possible connectives. The second solution makes *unless* "ambiguous" in the sense that this connective could be replaced by two different words corresponding to different "meanings" one finds in (1a) and (1b) on the one hand and in (1c) on the other hand. Since the notion of ambiguity seems to play an important role in this argument, I will first make some related comments.

It is well-known that Boolean connectives in specific contexts tend to have different meanings than the one they have in isolation. There may be various reasons for this. One of them is the scopal influence of other operators present in the context. Consider for instance (2a) which is naturally interpreted by (2b) and not by (2c):

(2a) No student or teacher (2b) No student and no teacher

(2c) No person who is a student or a teacher

Now the fact that the connective *or* in (2a) is interpreted by *and* (in conjunction with *no*) in no way indicates that *or* is ambigous or vague or that expressions containing it do not have a compositional semantics. This is just a manifestation of the well-known fact that many Boolean connectives are logically dependent and some of them can be used to define others. As for the logical status of (2a) Keenan and Moss (1985) provide a simple semantics for expressions of this type.

Another case, which leads to a similar "ambiguity" of logical connectives is a phenomenon which may be called *local equivalence*, i.e. the fact that two globally different connectives can take the same value when the value of their arguments is restricted to a particular domain or when their arguments are logically related. For instance, if **p** is equivalent to **q** then **p or q** is equivalent to **p and q**. Similar examples can be given for many other pairs, and the "local equivalences" to which they give rise look less trivial when one considers functions taking their arguments in more complex Boolean algebras. Take, for instance, the binary function $\star$ corresponding to so-called symmetric difference): $A \star B = (A - B) \wedge (B - A)$. One can easily show that if $A \leq B$ then $A \star B = B - A$ ("B and not-A") and when $A \cap B = 0$ then $A \star B = A \vee B$ ("A or B"). So in some contexts the symmetric difference corresponds to the exclusive disjunction and in others to *and not*. Whatever the complexity of arguments of Boolean functions, however, the existence of such local equivalences in no way indicates that Boolean functions are vague or ambiguous, and even less that they are evidence for non-compositionality.

As for the connective *unless* various difficulties concerning its analysis are well known. It is important to realize, however, that this variety of proposed analyses, even if many of the proposed solutions are truth-functionally equivalent, does not address the problem of compositionality but rather the question of whether there is a unique (binary) truth-functional connective corresponding to *unless.*

2 Formal preliminaries

The theoretical tools which will be used are those which are by now standard in formal semantics: these are the tools of generalized quantifiers theory enriched by Boolean semantics as developed by Keenan (Keenan 1983, Keenan and Faltz 1985). This means in particular that all logical types D_C, denotations of the category C, form atomic (and complete) Boolean algebras. The meet operation in any Boolean algebra will be noted, ambiguously, by *and.* The partial order in these denotational algebras is interpreted as a generalized entailment. Thus it is meaningful to say that an entailment holds between two NPs or between two nominal determiners, etc. Thus we can now (truthfully) say that the NP in (3a) entails the NP in (3b) and in (3c) and that the determiner in (4a) entails the determiner in (4b):

(3a) Every student except Albanian ones

(3b) No Albanian student (3c) Not all students
(4a) No...except twelve (4b) twelve

So we need algebras in which NPs denote, as well as algebras in which nominal determiners denote. NPs denote in the algebra D_{NP} of functions from properties onto truth values; they are quantifiers of type $< 1 >$. Denotations of nominal determiners, dets for short, are those functions from properties into a set of properties which satisfy the property of conservativity. For any property P and any det D we define D_P, det D restricted by P, as $D_P(X) = D(P \cap X)$. Dets restricted by a property are denotations of some pseudo-noun phrases like *Albanian ones* occurring for instance in (3a).

There are two important sub-classes of conservative functions: intersective functions, INT, and co-intersective functions, $CO - INT$ (Keenan 1993). By definition $F \in INT$, iff for all properties X, Y, Z and W, if $X \cap Y = Z \cap W$ then $F(X)(Y)$ is true iff $F(Z)(W)$ is true. Similarly, $F \in CO - INT$ iff for all properties X, Y, Z and W, if $X - Y = Z - W$ then $F(X)(Y)$ is true iff $F(Z)(W)$ is true. Both sets INT and $CO - INT$ form atomic (and complete) Boolean algebras with the Boolean operations defined pointwise. Atoms of INT are functions at_P, where P is a property, such that $at_P(X)(Y)$ is true iff $X \cap Y = P$. Similarly atoms of $CO - INT$ are functions at_P such that $at_P(X)(Y)$ is true iff $X - Y = P$.

Notice that many determiners found in ECXL phrases denote atoms of INT or $CO - INT$. For instance let the common noun *student* denote the property S, the verb phrase *danced* denote the property D, the proper name *Leo* denote the (atomic) property $\{L\}$ and the conjunction *Leo and Sue* denote the set $\{L, S\}$. Consider now the following sentences:

(5a) No student except Leo and Sue danced
(5b) Every student except Leo danced

Sentence (5a) is true iff $S \cap D = \{L, S\}$ and (5b) is true iff $S - D = \{L\}$. So both these sentences contain "atomic" determiners from which EXCL phrases are formed.

Sentences with EXCL phrases in which the second argument of the connector *except* is a bare plural or a common noun do not denote atoms of INT or CO-INT. For instance (6a) is true under condition specified in (6a):

(6a) Every student except Albanians danced (6b) $\{S \cap A\} = \{S - D\}$

To analyse such cases we will need two classes of conservative functions defined by a property: $CONSP(P)$, positive conservative functions defined by property the P and $CONSN(P)$, negative conservative functions defined by the property P. By definition $F_P \in CONSP(P)$ (resp. $F_P \in CONSN(P)$) iff $F_P(X)(Y) = 1$ iff iff $P \cap X \leq X \cap Y$ (resp. $P \cap X \leq Y$).
Finally, I will make use of restricting algebras, i.e. algebras of restricting functions. Such algebras constitute possible denotations of modifiers. A modifier is a

functional expression of category C/C for various choices of C. Given the categorisation of modifiers they denote functions from D_C into D_C and the set of all such functions with operations defined pointwise constitutes an atomic (and complete) Boolean algebra. Now, it is an important empirical fact that not all logically possible functions of this type are denotations of modifiers found in natural language. As Keenan (1983) claims, and he considers this claim as a language universal, all extensional modifiers denote restrictive functions in the following sense: F is restricting (in the algebra $D_{C/C}$) iff for all $X \in D_C$, $F(X) \leq X$. I will consider in some detail some modifiers modifying determiners occuring in EXCL phrases.

3 Exclusion phrases and compositionality

The italicised NPs in the sentences below are examples of EXCL phrases:

(7a) *Every student except Leo* was sleeping
(7b) *No student except Leo* was sleeping
(8a) *Every student except Albanians* is bald
(8b) *No student, except Albanians* is bald
(9a) *No student except Leo and Lea* was sleeping
(9b) *Every student, except Leo and Lea* is sleeping

Sentences with EXCL phrases and the phrases themselves have been the object of important recent studies (von Fintel 1993, Hoeksema 1996, Keenan 1993, Moltmann 1996, Zuber 1998). Roughly speaking, one can distinguish in the literature two approaches in the analysis of EXCL phrases. Keenan (Keenan and Stavi 1986, Keenan 1996) considers that they result from the application of a discontinous determiner to a common noun. Thus *Every student except Leo* is a result of the application of the (discontinous) determiner *Every...except Leo* to the common noun *student.* Such determiners denote a co-intersective function and consequently the noun phrase corresponding to the EXCL phrase denotes the value of this function at the property corresponding to *students.* Keenan shows that exclusion determiners (with the exclusion complement different from a common noun) denote in the algebra of intersective or co-intersective functions (Keenan 1993). So Keenan's analysis of EXCL phrases is directly compositional.

Under the second approach, proposed in particular by Moltmann (1996) the EXCL phrases result, syntactically, from the application of some functional expressions, in fact modifiers, to quantified NPs. One gets an NP in the form of an EXCL phrase by applying the "complement expression" *except NP* considered as a modifier, to an NP of the form *All CN* or *No CN*. So in this case, according to Moltmann, we have a modification of NPs. Interestingly enough, in order to account for certain semantic properties of EXCL phrases Moltmann has to take into account the internal structure of the modified NPs, and in particular the denotation of the common noun which occurs in it. Notice that if we consider, following Moltmann, that it is the first argument, the quantified NP, which is modified by the exclusion complement, then the function denoted by this modifier is not restricting. This is because (10a) does not entail (10b) and (11a) does not entail (11b):

(10a) Every student except Leo	(10b) Every student
(11a) No student except Leo	(11b) No student

An analysis of the type proposed by Moltmann can be suspected of being non compositional with respect to one of basic components it distinguishes, namely with respect to the modifier constituted by the complement expression *except NP*. However, the meaning of this latter complex expression, the modifier in Moltmann's analysis, can also be compositionally determined.

Concerning the proposal made in von Fintel, Moltmann (1996) notices that he proposes in his description two conditions one of which is global and as such renderss his approach incompatible with compositionality. For indeed his global uniqueness condition requires that the entire sentence without the EXCL phrase already be evaluated in order to predict the semantic effect of the phrase in the sentence.

This is a good place to come back to Higginbotham's "argument" against compositionality. It is possible to construct with EXCL phrases and sentences in which they occur an "argument against compositionality" quite similar to the one given by Higginbotham in connection with *unless*. The first "argument", although rough and hardly plausible (but in the spirit of the one given by Higginbotham) could be based on the observation that (7a) entails (12a) whereas (7b) entails (12b):

(12a) Not every student was sleeping and Leo was not sleeping
(12b) (It is not the case that no student was sleeping) and Leo was sleeping

Since the second conjuncts in (12a) and (12b) are contradictory, one could claim that the meaning of *except* cannot be compositionally predicted because sentences in which it occurs gives rise in a systematic way, depending on some parts of the considered sentences, to contradictory entailments. I do not think that anybody would take this "argument" seriously and this is for two reasons: first (12a) and (12b) are not equivalent to (7a) and (7b), respectively, and second, the entailments in question are contradictory only by chance, so to speak, because the exclusion complement is a proper noun. It is possible, however to push further this line of thought and argue against compositionality on the basis of observation that for instance (9a) is equivalent to (13a) and (9b) is equivalent to (13b):

(13a) Not no student is sleeping and the only students who are sleeping are Leo and Lea
(13b) Not every student is sleeping and the only students who are not sleeping are Leo and Lea

Notice that (8a) can be expressed by (14a) and (8b) by (14b):

(14a) Every student is either Albanian or bald
(14b) No student is Albanian and not bald

In this case the analogy with the argument given by Higginbotham is clear: *except* sometimes "means" *or* and sometimes *and not*. So one should conclude that it is not possible to have a compositional description of *except*.

In fact it is possible to give a compositional description of the connective *except*, and this is done in various papers concerning EXCL phrases already quoted. I will provide here two such descriptions based on Zuber (1998).

As the examples in (7) to (9) show the general form of EXCL phrases is the following: **Q except E** where **Q** is a quantified NP of the form **Every CN** or **No CN**. The expression **E**, the so-called complement of exclusion, is in many cases the remnant of an ellipsis and for this reason it can stand for many expressions. What is interesting, however, is that in all cases, either directly or "before elliptic ellision" these expressions all denote intersective or co-intersective functions determined by a property. In order to see this, notice first the following equivalences between the sentences in (a) and the corresponding sentences in (b):

(15a) No students except Albanians
(15b) No students except the students who are Albanians
(16a) No student except Leo
(16b) No student except the student who is Leo
(17a) No student except Leo and Lea
(17b) No student except the students who are either Leo or Lea

In examples in (b) the connective *except* connects two NPs. The second NP, the complement of exclusion is composed of two parts: a common noun, which is the same as the one occuring in the first NP, and a (discontinous) determiner. As we have already seen such determiners denote functions from $CONSP(P)$. In (15a), and consequently in (15b) the determining property P is the property denoted by the common noun *Albanians* and in (16a) the determining property corresponds to the singleton containing as the only element Leo. In (17) the determining property is the union of individuals denoted by each member of the conjunction of proper nouns occurring in the complement of the exclusion phrase.

The situation is similar with EXCL phrases beginning with the universal quantifier *every* the connective *except* connects two NPs formed with determiners denoting negative conservative functions (determined by a property). This is because in this case a post-negation must be used as indicated in equivalences in (16) and more precisely in (17):

(18a) Every student, except Albanians
(18b) Every student, except Albanian students who did not
(19a) Every student, except Albanians, is bald

(19b) Every student, except the Albanians students who are not bald, is bald

So now we can give a compositional description of the determiner occurring in EXCL phrases when it has three syntactic parts of the form given in (20a) or in (20b)

(20a) No... except P (20b) Every ... except P

A possible semantics of the determiner of the form (20a) is given in (21a) and the semantics of determiner of the form (20b) is given in (21b), where F_P is a function from $CONSP(P)$ determined by the property P, $No_{P'}$ is the det denoted by *No* restricted by the property P' and $Every_{P'}$ is the det denoted by *every* restricted by the property P':

(21a) $No_{P'}$ *and* F_P (21b) $Every_{P'}$ *and* $F_P - not$

Thus according to (21a) the semantics of EXCL phrase in (15a) is informally indicated in (22) and the semantics of EXCL phrase in (18a) is informally indicated in (23), where the equivalence via post-negation between intersective and co-intersective functions is used:

(22) No student who is not Albanian and All Albanian students
(23) Every student who is not Albanian and No Albanian student

The complex determiner with descriptions given in (21) has the form *D except A*, i. e. it has three syntactic parts: the connective *except* and its two arguments. We can now ask the question of whether the proposed description allows for compositional description of all parts when other groupings of basic elements are applied. Since in this case only binary branchings are possible let us consider the two most plausible ones.

Take first left-to-right binary branching, i.e. the following grouping: ((*D except*) *A*). It can be considered as an application of the modifier *D except* to the complement *A*. Semantically such a move gives us a nice formal interpretation, according to descriptions given in (21) (cf. Zuber 1997): the restricting function denoted by the modifier *No... except* (*every... except*) applies to the (positive or negative) conservative function determined by the property P (denoted by A) and gives as the result, when the complement A is a proiper noun (or a conjonction of proper nouns) the atom determined by the property P of the intersective (co-intersective) algebra.

We can now ask about the validity of the particular version of the principle, indicated in the introduction. For this let us consider the grouping of the form (*D*(*except A*)), i.e. the one in which we have a "post-modifier" *except A* having as its argument the quantifier *No* or *Every* on the initial position. One could suspect that it is not possible to compute compositionally the meaning of such complex modifier because the complement A can be interpreted either by a positive conservative function (determined by the denotation of A) or by a negative conservative function. Which function it is exactly depends on the missing argument in initial position. If the missing argument is the determiner *No* then the complement, being a remnant of an ellipsis, is interpreted by a positive function, and if the missing argument is the determiner *Every* then the complement is interpreted by a negative function. Less formally the supposed non-compositionality of the modifier *except A* can be expressed in the following way. The connective *except* indicates that its second argument is exceptional, relative to a given set of objects. Now, an object can be exceptional in a given set of objects because either it has a property that other objects do not have or because it lacks the property that all other objects have. In the full EXCL phrase the first type of exception is induced by the initial determiner *No* and the second type by the initial determiner *Every*. So, one could claim, the meaning of the complex sub-part in which these determiners are missing cannot be compositionally determined. In fact a compositional interpretation of such a modifier is obtainable directly from surface forms, without making use of ellipses which are indicated in (15) - (19). Indeed, in this case the connector *except* denotes the function $EXCEPT$ which maps properties (denoted by the complement A) to a function $EXCEPT(P)$ (where P is the denotation of A) which has as its domain the set of two quantifiers, No and $Every$ (by which EXCL phrases can begin). The values of such function are quantifiers of type $< 1, 1 >$ corresponding to the exclusion determiners. These values are given as follows:

(24) $EXCEPT(P)(No)(X)(Y) = 1$ iff $P \cap X = X \cap Y$
(25) $EXCEPT(P)(Every)(X)(Y) = 1$ iff $P \cap X = X - Y$

It is easy to check that these definitions give us the desired results.

Notice that in the above definitions we use essentially the syntactic information that EXCL phrases can begin only with NPs *No* or *Every.*

4 From *except* to *unless*

The analysis proposed for EXCL phrases can easily be extended to complex sentences with *unless.* Since the purpose of this paper is not a full description of *unless* I will give here only some indications of how it can be done.

It is useful to distinguish two cases of sentences with the connective *unless.* In the first case, which in fact is only relevant for the Higginbotham discussion, *unless* connects two sentences, the first of which contains a quantified noun phrase (formed from *every* or *no*) binding a pronoun occurring in the second sentence connected by *unless.* One observes that in such sentences the connective *unless* can be replaced by *except* in conjunction with *if* to give a logically equivalent sentence. Furthermore, the equivalent sentences thus obtained can be further reduced to equivalent sentences in which EXCL phrases occur. Examples of logically equivalent sentences obtained this way are given in (25) and in (26):

(25a) Every student will go to the party unless he is tired
(25b) Every student will go to the party except if he is tired
(25c) Every student except the tired ones will go to the party
(26a) No person will eat steak unless he eats lobster
(26b) No person will eat steak except if he eats lobster
(26c) No person except lobster eating persons will eat steak

Moreover, many sentences with *except* can be transformed into equivalent sentences with *unless* by replacing *except* by *unless* and by operating some changes in the structure of the remaining part. Thus (27) and (28) are logically equivalent:

(27a) Every student, except Albanians, is dancing
(27b) Every student is dancing, unless he is Albanian
(28a) No animal, except cats, are dangerous
(28b) No animal is dangerous, unless it is a cat

In the second case of *unless*-sentences there is no quantified noun phrase of the type *Every CN* or *No CN* which binds a pronoun in the second sentential argument of *unless.* It is possible to transform such sentences into roughly equivalent ones by replacing the connective *unless* by *except if.* Examples are given in (29) and (30):

(29a) Every student will swim unless it is raining
(29b) Every student will swim except if it is raining
(30a) Leo will go to the party unless he is tired
(30b) Leo will go to the party except if he is tired

Now it is clear that given the above equivalent sentences of the first type can be directly analysed in the same way as the sentences in which EXCL phrases occur and which are analysed in the preceeding section. They have a syntactic structure compatible with the principle of compositionality.

Concerning sentences of the second type it is also possible to provide a compositional analysis for them. To do this we need to make use of the application of generalized quantifiers theory to the study of conditionals as proposed by van Benthem (1984) and studied in some more detail in Lapierre (1996). Under this appproach IF is considered as a propositional determiner relating sets of situations (occasions, states of affairs, possible worlds, etc.) supposed to be denoted by sentences. These situations correspond to situations in which the two sentential arguments of IF are true. In this way IF induces a quantification over situations and the type of quantification induced may depend on the precise meaning of IF in question. The simplest case, the one illustrated by the examples above, is when IF corresponds to the universal quantifier. In this case $EXCEPT\ IF$ creates "exclusion sentential phrases" analogous to those of EXCL phrases and which denote the set of sets of occasions. Such hidden quantifications over situations is better seen when the explicit translations using the notion of occasion of the sentences involved are given: (30a) and (30b) can be roughly translated as (31):

(31) In all situations except in situations in which Leo is tired, Leo will go to the party

I will not spell out details of this proposal because it does not concern directly sentences relevant to Higginbotham and Pelletier's discussion. It seems obvious to me, however, that a relatively simple enrichment of the model, necessary anyway for a serious analysis of sentence denotations, will allow for a semantic treatment of sentences with *unless* of both types mentioned in a way compatible with the principle of compositionality.

5 Conclusions

Given the semantic and syntactic complexity of exclusion determiners and exclusion noun phrases I have discussed certain aspects of semantic compositionality in their context. I have been in particular interested in a stronger version of the principle of semantic compositionality, the version which takes into account the compositionality up to "second level", i.e. not only the compositionality of a given complex expression but also the compositionality of any complex immediate part of it. It appears that such a stronger version holds also for exclusion determiners of the form D *except* A, where D is either *No* or *Every*, even if the determiner is grouped as (D (*except* A)). This shows that the function computing semantic value can have, contrary to Higginbotham's claim, some of its values contingent on the nature of its argument. Thus if the expression $M(A)$ is interpreted by $F(a)$, where F is the function interpreting the functional expression M, the fact that the values F can assign to an argument can vary with the nature of that argument does not bear on the question of whether $M(A)$ is compositionally interpreted.
I have also shown that the methods used to analyse EXCL phrases can be extended to sentences with the connective *unless* since *unless* is equivalent to *except if* and *if* can be considered as a sentential determiner which denotes a relation between sets of occasions in the same way as nominal determiners denote relations between sets of individuals. Consequently, and this is a side result, sentences with *unless* do not challenge compositional analysis, contrary to some claims made in the literature*)

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References

[1] van Benthem, J. (1984) Foundations of Conditional Logic, *Journal of Philosophical Logic* 13, pp.303-349.

[2] von Fintel, K. (1993) Exceptive constructions, *Natural Language Semantics* 1, pp. 123-148.

[3] Higginbothom, J. (1986) Linguistic Theory and Davidson's Program in Semantics, *in* E. LePore (ed) *The Philosophy of Donald Davidson: Perspectives on Truth and Interpretation*, Blackwell, pp. 29-48.

[4] Hoeksema, J. (1996) The Semantics of Exception Phrases, *in* van der Does, J. and van Eijck, J. (eds.) *Quantifiers, Logic, and Language*, CSLI Publications, Stanford pp.145-178.

[5] Janssen, M. V. T. (1997) Compositionality, *in* van Benthem, J. and ter Meulen, A. (eds.) *Handbook of Logic and Language*, Elsevier, pp. 417-473.

[6] Keenan, E. L. (1983) Boolean Algebra for Linguists, *in* Mordechay, S. (ed.) *UCLA Working Papers in Semantics* pp. 1-75

[7] Keenan, E. L. (1993) Natural Language, Sortal Reducibility and Generalized Quantifiers, *Journal of Symbolic logic* 58:1, pp. 314-325.

[8] Keenan, E. L. and Faltz, L. M. (1985) *Boolean Semantics for Natural Language*, D. Reidel Publishing Company, Dordrecht.

[9] Keenan, E. L. and Moss, L. (1985) Generalized Quantifiers and the Expressive Power of Natural Language, *in* van Benthem, J. and ter Meulen, A. (eds.) *Generalized Quantifiers in Natural Language*, Foris Publications, pp.73-126

[10] Lapierre, S. (1996) Conditionals and Quantifiers, *in* van der Does, J. and van Eijck, J. (eds.) *Quantifiers, Logic, and Language*, CSLI Publications, Stanford, pp. 237-253.

[11] Moltmann, F (1996) Resumptive Quantifiers in Exception Sentences, *in* Kanazawa et al. (eds.) *Quantifiers, Deduction, and Context*, CSLI Publications, Stanford, pp. 139-170.

[12] Pelletier, F. J. (1994a) The principle of semantic compositionality, *Topoi* 13, pp.11-24.

[13] Pelletier, F.J. (1994b) On an argument against semantic compositionality, *in* Prawitz, D. and Wasterstahl, D. (eds.) *Logic and Philosophy of Science in Uppsala*, Kluwer Academic Publishers, pp. 599-610.

[14] Zuber, R. (1997) Some algebraic properties of higher order modifiers, *in* Becker, T. and Krieger (eds.) *Proceedings of the Fifth Meeting on Mathematics of Language*, Deutsches Forschungszentrum fur Kunstlische Intelligenz, pp.161-168.

[15] Zuber, R. (1998) On the Semantics of Exclusion and Inclusion Phrases, *in* Lawson, A. (ed.) *SALT8*, Cornell University Press.