

CROSS-MODULAR

APPROACHES TO ELLIPSIS

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Jennifer Spenader & Petra Hendriks

PREFACE

The area of ellipsis resolution and generation has long been neglected in work on natural language processing, and there are few examples of working systems or computational algorithms. However, the misuse or non-use of ellipsis in highly preferred contexts can make a dialogue difficult to understand similar to the way inappropriate referential expressions can impede comprehension. Furthermore, we think ellipsis has many more functions than are currently recognized, an idea discussed in our own contribution to this volume. We are grateful that the ESLLI organizers have provided a forum for researchers to present new data and analyses.

The accepted contributions in our opinion give new insights into the nature and function of ellipsis. The work of Ericsson, Alcántara & Bertomeu and Hoeksema all present results based on corpus study, helping to fill the gap in our knowledge about naturally occurring examples of ellipsis. The work of Repp and Fernandez show in particular how discourse structure and effect the interpretation of ellipsis, and Hielkema, Theune & Hendriks use discourse coherence relations to guide the ellipsis generation process. Like Hielkema, Theune & Hendriks, Ericsson also discusses issues in the appropriate generation of ellipsis, an area where more work needs to be done. Finally, both Nielsen and Kreutz discuss VP-ellipsis, one of the more common forms of ellipsis in English. Nielsen shows an actual implementation to resolve VP-ellipsis, while Kreutz emphasizes the need to incorporate more than traditional knowledge sources.

We are certain that the contributions in this proceedings, and the talks in Edinburgh will inspire others to look at the fascinating and challenging problem of incorporating ellipsis into natural language applications. Because without ellipsis, natural language applications will not have the naturalness and functionality present in actual natural language.

Jennifer Spender and Petra Hendriks
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ELLIPSIS IN SPONTANEOUS SPOKEN LANGUAGE

Manuel Alcántara* and Núria Bertomeu

Universidad Autónoma de Madrid; Universität des Saarlandes

manuel@maria.lllf.uam.es; bertomeu@coli.uni-sb.de

Abstract

In this paper we present an empirical study of elliptical phenomena carried out on a spontaneous speech corpus of Spanish annotated with event structures and co-references. The latter have allowed us to automatically identify elliptical fragments, as well as their antecedents and to measure the distance in sentences and turns between them. We also have looked into the nature of elliptical utterances without an explicit linguistic source and to their relation with the context.

1 Introduction

Ellipsis is an implicit reference to some material, either previously mentioned, or somehow inferable. In both cases, this elided material can be successfully recovered and applied to the remnant of the ellipsis, that is, to the piece of information stated explicitly in the elliptical fragment.

Regarding the first case, it is necessary for the elided material to be *accessible* in the dialogue participant's discourse record, that is, activated in the focus of attention or working memory. Some models predict that accessibility of the source is given by the discourse-structure. In (Schlangen 2003) if an utterance is a possible attachment point upon the *right frontier constraint* it can behave as a source. Hardt and Romero (2004) claim that antecedents must c-command elliptical clauses in the discourse-tree. In (Cooper and Ginzburg 2001) the antecedent of an elliptical fragment must be the maximal question under discussion (MAX-QUD), and when this is not like this, resolving a fragment amounts to accommodating the right MAX-QUD (Cooper R. and Ericsson 2000).

On the other hand, recent experimental results from the neuro-psycholinguistic side (Streb and Rösler 2004) show that ellipsis resolution involves syntactic processing, unlike anaphora resolution, which involves semantic processing. This means that the syntactic representation of the source must be still in working-memory at the time when the elliptical fragment is uttered. The syntactic structure of a sentence usually remains in memory for a very short time, a little bit longer than the phonological form, and then decays, unlike the semantic representation of the sentence, which remains longer in memory (Kintsch and van Dijk 1978). However, it is not clear how long syntactic structure keeps being active.

Some of the questions we attempt to answer with this corpus study are how long the distance between source and ellipsis can be, which is the most frequent distance, and which is the nature of the accessibility of the source - whether the presence of its syntactic

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structure in memory, or it being an attachment point in the discourse structure, or whether both levels of representation complement each other.

We also will consider cases of ellipsis without an antecedent in the preceding discourse, where the missing part has to be inferred, and look at their relation to the context, i.e. whether they refer to some previously mentioned entity, as well as find out which are the most frequently omitted lemmas.

Finally, we want to find out whether remnants tend to be of a particular argument type. Following Centering Theory (Grosz and Weinstein n.d.), less oblique argument types carry referential continuity, while entities referred to in more oblique arguments tend to be discourse and/or hearer new, and to be expressed explicitly. Besides, remnants usually convey new information (in the information-structure sense). This new information is not necessarily discourse/hearer new, but in many cases it is. Upon this, we would expect remnants of ellipsis to be more oblique arguments types.

In section 2, we speak about the corpus and the methodology we have employed to carry out our experiments. In section 3 we present the results for the three topics presented above and in section 4 we discuss them and conclude.

2 Corpus and Methodology

The present experiments have been carried out on a 50000 words subcorpus of the Spanish part of C-ORAL-ROM (Moreno and la Torre 2005), a corpus of spoken language which was recorded following strict requirements of spontaneity and variety of speakers and contexts. This corpus represents a wide variety of speech acts performed in the daily use of language.

Sentence tokenization has been done following semantic constraints and every sentence corresponds to a complete event-structure¹. That's why a sentence may contain several turns if these are overlapping and interrupt its utterance. It is also distinguished between the continuation of a sentence after a filled pause and a fragment which elaborates on a previous sentence according to pause lengths. The transcriptions are manually annotated with semantic information following the tag set of SESCO, a tagging system which allows the semantic representation of linguistic corpora (Alcántara 2005).

SESCO provides general information about predicates and their argument structures. This tagging system follows a compositional approach based on event structures. Events are classified under only three major types: states, processes and actions, and these major types can be divided into subtypes according to the arguments they require. This approach is compositional because a state has two arguments (an entity and its property/location), a process is made up of a transition from one state to another, and an action is a process with an agent and a patient; besides, those parts of an event which are not arguments are tagged as indirect relations.

SESCO has particular tags for linking different references related to the same entity or event. The first time an element is mentioned an identifier (IDE) is assigned to it by means of a unique code. The following occurrences of this element are annotated with a reference (REF) to the same code. We have used these tags in order to identify elliptical

¹In the rest of the paper we will refer as sentences to those semantically complete main event structures.

utterances and their sources and to study the distances between them.

In our study we have considered cases of intra-sentential and inter-sentential ellipsis. We have looked at cases of verbal ellipsis². The main strategy was to find those events lacking a finite verb lexeme and being co-referent with another event. The second strategy was to find those events lacking a finite verb lexeme and not co-referent with any previous event, and look for entities within them being co-referent with some other entity recently mentioned in the discourse. Each strategy returned a different kind of fragment, those with an explicit linguistic source and those without it, respectively. All information was automatically retrieved and the results manually checked to ensure that the tagging was correct.

3 Experiments and results

From a total of 6922 events in the corpus 522 were found to be elliptical. This corresponds with a 7.5%, a considerable amount which confirms the importance of ellipsis resolution when attempting to understand spontaneous spoken texts. The absolute frequency of elliptical utterances with an antecedent is 306, and of those without, 216 - in relative terms, 58.62% and 41.38%, respectively.

3.1 Ellipsis with Antecedent

With the aim of finding out how far an elliptical construction can be from its antecedent we calculated the distance in sentences and turns from the ellipsis to the first and last preceding occurrences of the event co-referent with it. The idea of calculating the last preceding occurrence aroused from the hypothesis that fragments can behave themselves as sources, that is, that they keep accessible the structure implicitly expressed in them. We decided to calculate also the distance from the first occurrence of the event in order to study the information that these elliptical sources carry from their own source and the changes they introduce to it. Of course, when there was only one preceding occurrence of the event, only this one was considered. The distances from the last preceding occurrence of the event are the following:

Distance (sentences)	total	percentage
1	219	71.57%
2	43	14.05%
3	16	5.23%
0	14	4.58%
4	11	3.59%
5	1	0.33%
6	1	0.33%
16	1	0.33%

As shown in the table the most frequent distance is 1 sentence, followed by 2, 3, 0 (intra-sentential ellipsis) and 4. However, we also find one case of 16 sentences of distance.

²We leave fragments formed by the alone-standing affirmative and negative adverbs (yes/no) and nominal ellipsis - null-objects and semantic ellipsis - for future research.

According to what hierarchical models of discourse structure would predict (see for example (Schlangen 2003)) in this case the fragment and all the intervening material are subordinated to the source.

These results are not very different from the ones obtained when calculating the distance to the first occurrence of the event, since in 196 of 289 cases there is only one preceding occurrence. The maximum distance to the first occurrence is also 16 sentences and 6, 7, 8 and 9 sentences have frequencies of 1.7%, 2%, 1.03% and 1.03%, respectively. In most cases the following occurrences of the event are elliptical themselves. It was worth to look at them because of the interest of cases like the following:

- (1) BLA:Quedamos en la escuela?
Meet at the school
'Shall we meet at school?'
- YOL:O si te viene mejor en Moncloa?
Or if you suit better in Moncloa
'Or if it suits you better (to meet) in Moncloa (we can meet in Moncloa)'
- BLA:Vale, mejor.
O.K. better.
'O.K., (we'd) better (meet in Moncloa).'
- YOL:Como el otro día y así no tienes que subir ni nada.
Like the other day and so not have to go up neither nothing
'(We are meeting) Like the other day, and so you don't need to come upstairs.'
- BLA:Vale. En como el viernes.
O.K. In like the Friday.
'O.K. (We are meeting) Where (we met) on Friday.'
- YOL:Sí. Quedamos a menos diez o menos cuarto.
Yes. Meet minus ten or minus quarter.
'Yes. Let's meet at ten to or quarter to.'
- BLA:A las ocho menos diez?
At the eight minus ten?
'(Are we meeting) At ten to eight?'

This example is interesting for two reasons. In the second fragment we find a conditional sentence which is itself elliptical. Moreover, the missing main sentence is structurally identical with the source, but it must be inferred that in the resolution 'Moncloa' substitutes 'en la escuela'. It doesn't matter how the following fragment is resolved, but it establishes the fact that the meeting is going to be in Moncloa³. So a full resolution of the last fragments has to contain that the meeting is taking place in Moncloa, although this is not explicitly said anywhere. That is, although there is structural identity, some kind of reasoning is needed in order to successfully resolve those fragments. This is an example of how successive material changes the original event and, thus, a full explicit source is not to be found.

³Here and in the examples 2 and 5, we have chosen to write between parenthesis what we think could be a surface resolution of the fragment, however it is not very clear, at least for the surface, how these fragments should be resolved, though they are semantically unambiguous.

We also calculated the distance in turns between source and fragments. We excluded monologues, since there is no turn-taking in them. Again we calculated the distance from the first and last occurrences of the event previous to the fragment. Figures for the former are not shown because they are very similar to those for the latter. For the latter we found distances of up to 7 turns with the most frequent being 1 turn (42.15%), followed by 0 (36.27%), 2 (11.76%), 3 (4.24%), 4 (2.65%), 5 (1.63%), 6 (0.65%) and 7 (0.65%).

In order to see whether the speaker's own utterances are more accessible as antecedents, we looked at the frequency and distance between those fragment-antecedent pairs uttered by the same speaker and those uttered by different speakers. For calculating the frequency we left monologues away again. In our corpus both kinds of pairs have approximately the same frequency, 49.4% and 50.5% respectively. However, the range of distances for those uttered by the same speaker is a little bit larger than for those uttered by different speakers. For a single speaker we find distances up to 16 sentences, while for several speakers up to 9. However, we do not think this fact is sufficient to conclude anything since those distances up to 9 for a single speaker are quite unimportant in number. Moreover, while the frequencies for 2 sentences of distance are higher for one speaker, those of 3, 4 and 5 are higher for several speakers; 7 is then higher for one speaker and 8 and 9 for several. Our data do not show, thus, any clear tendency, but rather speak for a great degree of similarity among the discourse representations of the different dialogue participants.

3.2 Ellipsis without antecedent

For those cases of ellipsis without an explicit linguistic source we took as starting point the hypothesis that, at least for non script-like situations, there must be some salient entity in the preceding discourse to which the fragment stands in some kind of relation. 126 of the 216 cases turned to have an antecedent in the previous discourse. This amounts to the 58.3% of the total. In most fragments of this type the missing relation is an identity relation between the entity or property provided by the fragment and a salient entity in the context. However, sometimes, there is more than one salient entity in the context and it is knowledge of the world that tells us which is the one referred to by the fragment, like in the following example. Moreover, without the necessary knowledge one still does not know that what is meant is the title of the movie *A Room With a View*.

- (2) MIG:Una habitación sin vistas?
 A room without views
 '(Is it) A room without views?'
 CRI:No, es una habitación con vistas. Pero es yo qué sé...
 No is a room with views. But is I what know
 'No, it is a room with views, but it is, how would I say...'
 PAT:En Cuatroca.
 In Cuatroca
 '(It is) In Cuatroca.'
 MIG:Como la película.
 Like the movie.
 '(It is a room with views) Like (the title of) the movie.'

90 items (41.7%) did not have an antecedent in the preceding discourse. Within those we found some which do indeed refer to some salient entity in the context, not explicitly uttered in the discourse, but part of the surrounding environment. The corpus contains some situation and environment descriptions but they aren't part of the semantic tagging, so at the moment we cannot recover this kind of references. For example:

- (3) **Situation:** Two friends looking at a shop window. One points to a necklace and says:

Qué chulo!
How cool
'(This necklace is) So cool!'

We also found cases where it is the situation which tells us how to resolve the fragment. In the following example the fragment is interpreted as 'Speak louder' but in a situation where somebody is hanging something on the wall, it should be interpreted as 'Hang it higher', since the Spanish word 'alto' means both 'high' and 'loud'.

- (4) **Situation:** After having asked a question to the whole group, the teacher says:

Más alto.
More loud
'(Speak) Louder.'

Others, however, do not seem to have any relation with the context. These are cases of alone-standing gapping, where the omitted verbal predicate has never been uttered explicitly. It seems that the syntactic marking of the arguments allows them to be recognized as such and default basic predicates expressing identity, location or movement can be inferred. However, as Spanish has no morphological case-marking the communicative context may sometimes play an important role when disambiguating between a location and a movement, for example.

- (5) Junto a los números la interpretación.
Next to the numbers the interpretation
'Next to the numbers (is) the interpretation.'

For those fragments without an explicit linguistic source but which refer to some salient entity in the preceding discourse we calculated the distance in sentences between the fragment and the salient entity. The results are similar as for the fragments with an explicit linguistic source. In 67.08% of the cases the distance is 1 sentence; in 20%, 2 sentences; 4.5%, 3 sentences. Surprisingly, 2.5% of the cases are cataphoras, with a distance -1.

Finally, we also looked at the lemmas of the most frequently omitted relations. Not surprisingly, these are the lemmas 'ser', 'estar' (both translated as 'to be'), 'haber' (there is) and 'tener' (to have). The table shows the most frequent ones⁴:

⁴The annotation recovers the omitted lemma. Since this one hasn't been uttered explicitly, the most basic default lemma is chosen.

Lemma	total	percentage
ser	139	64.1
estar	48	21.7
haber	10	4.6
tener	4	1.8

3.3 Event parts

We have looked at the types of arguments filled by remnants and the results show a clear predominance of indirect relations. These are followed by patients and properties, that is, second arguments of events. Finally, entities, locations and agents are the less frequent argument types. This confirms our expectations that remnants tend to be of oblique argument types. The following table shows the results:

Event part	% Occurrences
Indirect relations	37.12%
Properties	26.65%
Patients	14.37%
Entities	11.98%
Locations	7.19%
Agents	2.69%

4 Discussion and Conclusion

In this study we have analysed two kinds of ellipsis - on the one hand, those having a linguistic source, and, on the other hand, those having no linguistic source. For the first group the most frequent distance from the source turned out to be 1 sentence. When looking at long distances, we have seen that the source is accessible because of its position in the discourse structure. However, when looking at more intermediate distances, like in the following example (3 sentences), we have sometimes found that the source is not in an accessible position in the discourse structure, but it is still available as the source of ellipsis.

- (6) AS: Lleva un año fuera del sindicato CCOO. Por dónde ha orientado
 Is a year out of the syndicate CCOO. For where have
 ahora su vida? Porque decían que pretendía ser incluso presidente
 orientated now your life? Because said that tried be even
 del CES. Del Consejo Económico Social.
 president of the CES. Of the Council Economic Social.
 ‘You have been out of the CCOO syndicate for a year. Which direction have
 you given to your life? Because some said that you hoped to become even
 the president of the ESC. Of the Economic Social Council.’

REZ: Bueno fuera del sindicato no. Sigo como afiliado.
 Well out of the syndicate not. Am as member.
 ‘Well (I have) not (been) out of the syndicate. I am still there as a member’

A possible explanation for this phenomenon is that the syntactic structure of the source is still in working-memory and it can be accessed to resolve the ellipsis.

For ellipsis far away from the source and ellipsis without antecedent, we believe that there is no syntactic representation available in memory. In the first case there must be a semantic representation of the source because, while syntactic structure decays gradually, semantic structure may remain in memory depending on its degree of importance for the overall discourse or whether it is a topic not concluded yet.

Ellipsis without antecedent and referring to some salient entity in the context have some similarity with 0-anaphors. Their resolution involves to find a referent in working-memory, like in anaphora resolution and to infer some relation holding between the entity and the remnant. The cases of gapping without antecedent involve finding a relation holding between the several remnant constituents. It is logical to think that these are intrinsically semantic processes, since it is the meaning of the entities together with the meaning of the argument roles which helps to find the missing relation.

Even when the ellipsis has a source, it is sometimes not clear how the fragment should be resolved, that is, there are many surface form possibilities for the resolution, though it may be clear what it is meant or at least which are the ultimate goals which the fragment accomplishes, as illustrated in (1). This makes desirable to have a semantic representation (sometimes rather general) as the result of ellipsis resolution. (1) also shows that even when there is structural identity between source and fragment pragmatic reasoning may play an important role on resolving the ellipsis.

We would like to emphasize the importance of working with corpora when studying this kind of phenomena. Although there are very few resources (corpus annotated with co-reference information), ellipsis is specially important in spontaneous spoken language and we think it is worth to study it.

References

- Alcántara, M.: 2005, *Anotación y recuperación de información semántica eventiva en corpus*, PhD thesis, Universidad Autónoma de Madrid.
- Cooper, R. and Ginzburg, J.: 2001, Resolving ellipsis in clarification, *Proceedings of the 39th Meeting of the Association for Computational Linguistics (ACL)*, Morgan Kaufman Publishers, San Francisco, pp. 236–243.
- Cooper R., E. Engdahl, S. L. and Ericsson, S.: 2000, Accommodating questions and the nature of qud, *Proceedings of the GÖTALOG*, pp. 57–61.
- Grosz, B. J., A. K. J. and Weinstein, S.: n.d., Centering: A framework for modelling the local coherence of discourse, journal =.
- Hardt, D. and Romero, M.: 2004, Ellipsis and the structure of discourse, *Journal of Semantics*.
- Kintsch, W. and van Dijk, T. A.: 1978, Toward a model of text comprehension and production, *Psychology Review*.

- Moreno, A. G. De la Madrid, M. A. A. G. J. M. G. and la Torre, R. D.: 2005, *C-ORAL-ROM: Integrated Reference Corpora for Spoken Romance Languages*, John Benjamins, chapter The Spanish Corpus.
- Schlangen, D.: 2003, *A Coherence-Based Approach to the Interpretation of Non-Sentential Utterances in Dialogue*, PhD thesis, Institute for Communication and Collaborative Systems, School of Informatics, University of Edinburgh.
- Streb, J., E. H. and Rösler, F.: 2004, Different anaphoric expressions are investigated by event-related brain potentials, *Journal of Psycholinguistic Research*.

A CORPUS STUDY TOWARDS THE GENERATION OF ELLIPTICAL UTTERANCES IN A DIALOGUE SYSTEM

Stina Ericsson
Göteborg University
stinae@ling.gu.se

Abstract

This paper presents a corpus study that investigates elliptical utterances in human-human dialogue. The utterance is characterised using information structure, and the structure of context for elliptical utterances is investigated. Constraints on elliptical utterances are also presented. The paper concludes with a brief look at the formalisation of elliptical utterances for generation using HPSG and OT, and the implementation currently under way.

1 Introduction

The goal behind the work presented here is two-fold: the investigation of elliptical utterances in human-human dialogue, and the generation of appropriate elliptical utterances in a dialogue system. Below I will concentrate on the studies of human-human dialogue, notably question-answer dialogues, focusing on the following questions: (i) how much material is there in an elliptical utterance and how can this be described (section 2)? (ii) how is context structured for elliptical utterances (section 3)? (iii) what constraints govern the generation of ellipsis (section 4)? I also briefly present my work on formalisation and implementation in section 5.

The examples I discuss have been manually extracted from the following corpora, covering three languages and several different domains: SRI's Amex travel agent data,¹ the HCRC map task corpus,² a route explanation corpus in French,³ the OTG tourist information corpus in French,⁴ and the Göteborg Spoken Language Corpus in Swedish.⁵ The examples have been edited to increase readability.

2 Corpus study: the information structure of ellipsis

Elliptical utterances crucially rely on the context for their production and interpretation. One aspect of the relation between elliptical utterances and the context is *informativeness*: an elliptical utterance must minimally contain the informative part of a message. Another aspect is that some elliptical utterances involve a contrast with some other entity in the context. These notions concern the information structure of the utterance, and information

¹<http://www.ai.sri.com/~communic/amex/amex.html>

²<http://www.hcrc.ed.ac.uk/dialogue/maptask.html>

³<http://www.irit.fr/ACTIVITES/LILaC/Pers/Prevot/Corpus.html>

⁴http://www-valoria.univ-ubs.fr/antoine/parole_publicque/OTG/

⁵<http://www.ling.gu.se/projekt/tal/>

structural primitives help give part of the answer to the question of the amount of material that an elliptical utterance must and can contain.

I use a basic distinction between the ground and the focus of an utterance in roughly the sense of Vallduví (1992). The *ground* of an utterance is a reflection of the context, and is the part in italics in *B*'s utterance:

- (1) A: What are you reading?
B: *I am reading* **a book** B': **A book**

The *focus* is informative in relation to the ground, and is marked using boldface. The underlined portion of *A*'s utterance is that part of the context that the ground in *B*'s utterance reflects.

The elliptical utterance *B'* contains only the focus as part of what I will call its *compositional content*. The full interpretation of *B'* involves connecting it to the underlined material in *A*, forming a content that may be paraphrased as “I am reading a book”. I will call this content the *contextual content* of an elliptical utterance. For a non-elliptical utterance, like *B*, both the compositional and the contextual content consist of a full focus and ground.

An example of an elliptical utterance consisting of just the focus is the travel agent's answer in the following exchange (again, a focus is marked using boldface, and the material out of which the ground in the contextual content of the elliptical utterance is constructed, is underlined):

- (2) C: At what time does it get to Toronto? [Amex tape 6 call 1]
TA: **Three thirty five p.m.**

Such examples – utterances whose compositional content contain only the focus – are very frequent among elliptical utterances and exist in all the corpora I have studied. *TA*'s utterance in (2) is a *non-contrastive* focus: it does not have an explicit alternative in the preceding context. *F2* in (3), on the other hand, is an example of a *contrastive* focus:

- (3) F1: Est-ce que tu vois le bar du Matin? [French Route 2.9]
eng. Do you see the Matin bar?
R1: Non pas du tout *eng.* No not at all
F2: **La rue Saint-Rome?** *eng.* **The Saint-Rome Street?**

The contextual content of the elliptical *F2* can be paraphrased as “Do you see the Saint-Rome Street?”, and the focus, “the Saint-Rome Street”, is an alternative to “the Matin bar” in the parallel utterance *F1*, parallel in the sense of Dalrymple, Shieber and Pereira (1991), Pulman (1997). In the examples studied here, a contrastive focus involves an explicitly mentioned alternative in the dialogue context. A non-contrastive focus may *imply* an alternative, and indeed it is probably always possible to construct some alternative set for all foci.

Another example of a contrastive focus is *F3*:

- (4) G1: Where are you in relation to the top of the page just now? [HCRC q2nc3]
 F1: About four inches
 G2: Four inches?
 F2: Yeah
 G3: Where are you from the left-hand side?
 F3: **About two**

“(About) two” in $F3$ contrasts with “(About) four” in $F1$.

The elliptical utterances seen so far have consisted of just the focus. An elliptical utterance may also consist of the focus together with a partial ground. An example is the following substitute for $F3$ in (4):

- (5) $F3'$: **About two inches**

“About two inches” in (5) is a syntactic unit that I will call a *focus phrase*, see Drubig (1994). This means that the pragmatic focus in (4) consists of less than the focus phrase. Another example of an elliptical utterance consisting of the focus and a partial ground is C 's utterance in (6):

- (6) TA: And going where? [Amex tape 3 call 1]
 C: **Going to Los Angeles**

The focus phrase here is “to Los Angeles”, with the partial ground “going” being outside of the focus phrase, in contrast with $F3'$ in (5).

3 Corpus study: the context of elliptical utterances

The view I present here of the context of elliptical utterances involves seeing the ground as corresponding to a contextually constructed *embedding question*. This question can be construed as a function which when applied to the compositional content of the elliptical utterance, gives the contextual content. The embedding question can be seen as a retrospectively constructed question indicating the information structure of an utterance, in the manner of the quaestio of Umbach (2001). As an example, the embedding question of $F3$ in (4) can be seen as something like “How many inches are you from the left-hand side?” Umbach uses the quaestio as a “diagnostic tool” whereas in my approach the embedding question has a definite role in the modelling of the context in that it is needed for the integration of the focus in a dialogue participant’s model of the context, the dialogue participant’s *information state*.

I therefore connect the quaestio to a variant of the QUD structures of Roberts (1996) and Ginzburg (1996). The QUD is a collection of questions that are under discussion at a particular point in the dialogue. Whether it is to be seen as a stack as in Roberts’ account or a partially ordered set as in Ginzburg’s framework need not concern us here. Although a number of different issues may be open to discussion at the same time, only one issue is locally attended to by the dialogue participants. I call this the *primary* question under discussion, and it corresponds to the immediate and maximal question under discussion of Roberts and Ginzburg, respectively.

Now, connecting the embedding question to the QUD gives the following: an elliptical utterance indicates that the speaker of the utterance considers the corresponding embedding question to be the primary question under discussion for the hearer, either because the question already is the primary one or because the hearer can make it so, through accommodation (accommodation in the sense of Lewis (1979), and see also Roberts (1996)). I make no claim that human speakers actually have clearly formulated questions in this way. Rather, the embedding question as the primary question under discussion is to be seen as capturing the part of the context that is needed for the contextual content of the elliptical utterance, and is useful for formalisation and implementation.

I assume that each dialogue participant has her own model of the context, her own information state, and that this model is divided into one part that is participant internal, and one part that is the participant's view of what is shared knowledge between the dialogue participants. The contextual model for elliptical utterances that I investigate here is concerned with the shared part of the information state.

One important informational component for elliptical utterances is QUD, the structure of questions that are under discussion. The embedding question can be equivalent to the primary question under discussion that is explicitly introduced in the dialogue. An example of this is (2). The embedding question can also in other ways be related to an explicitly introduced question that is under discussion. An example is the following:

- (7) G: Have you got stones at the top left-hand point of your page? [HCRC q2nc3]
F: **Rock fall**

The embedding question corresponding to the ground for *F*'s utterance in (7) can be paraphrased as "What have you got at the top left-hand point of your page?", that is, a question that is obtained by abstracting over "stones" in *G*'s explicitly introduced question. Similar cases involve alternative questions.

Questions no longer under discussion are also used for ellipsis, and irrespective of whether the question was answered or not. An example is (3) where question *F1* has been answered and removed from QUD, but is used to determine the embedding question of the elliptical *F2*.

Besides questions, utterances functioning as answers are also used to give embedding questions:

- (8) C1: Is it non stop or? [Amex tape 13 call 1]
TA1: No all of these are going to be connecting flights
C2: **Through Pittsburgh?**

TA1 is an answer to the preceding *C1*. The contextual content of *C2* can be paraphrased as "Do they connect through Pittsburgh?", with the embedding question for *C2* being constructed from *TA1*.

A number of ellipsis examples make use of part of some preceding utterance in the dialogue together with material that can be inferred on the basis of the elliptical utterance or the context. A special case is elliptical utterances that use more than one preceding turn in the dialogue, as *F3* in (4).

In addition to different parts of the dialogue history, the embedding question for an elliptical utterance can be formed out of domain and situational knowledge. One example is elliptical questions or requests occurring as the opening of dialogues. The following examples are the opening turns in two dialogues in the OTG tourist information domain:

- (9) C: **Le programme des films** [OTG 1AP0228]
eng. The film programme
- (10) C: **La rue Stendhal** [OTG 1SB0223]
eng. Stendhal Street

The less an elliptical utterance makes use of a specific utterance in the dialogue for its contextual content, the more indeterminacy there is regarding the embedding question. This is a natural aspect of elliptical utterances, and is part of a view of meaning in dialogue as not being absolute but rather relative to dialogue participants. The embedding question of *C*'s utterance in (9) might be represented as something like “(Can you) Give me ___?”, whereas the embedding question for *C*'s utterance in (10) might be “(Can you) Tell me where ___ is?” The semantic class of the compositional content of the elliptical utterances, given a particular domain, clearly constrain possible embedding questions.

4 Corpus study: constraints on elliptical utterances

From the point of view of generating elliptical utterances, constraints on the content and the form of the utterance can be discussed in terms of three different sets of constraints. The first set of constraints involves the determination of the information structure of (the contextual content of) the utterance to be generated. Here, the definitions of the informational primitives naturally play a role: a ground is equivalent to some part of the context, a focus is informative in relation to the ground (one aspect of this is matching semantic classes and the focus being a suitable argument to the embedding question that corresponds to the ground), a contrastive focus has an alternative in a parallel structure from which the ground is determined.

Another important factor in the determination of information structure is distance or salience: elliptical utterances require the ground to be salient in the context. For utterances making use of domain or situational knowledge, such as (9) and (10) above, this knowledge has to be salient. For utterances making use of dialogue history, (2)-(4) and (6)-(8), my corpus study shows that the distance between the elliptical utterance and the utterance from which the ground is constructed, is short. Many examples make use of material in the immediately preceding turn. In terms of questions under discussion, the ground comes from the primary question under discussion (e.g., (2)), or from an answer or a question in relation to a previous question under discussion (e.g., (3)). For previous questions under discussion, these seem to be distanced from the current primary question under discussion by at most a short sequence, typically two turns, involving clarification or a request for more information (example (4)).

The second set of constraints involve the determination of which informational primitives, once determined, are to be realised. All utterances, whether elliptical or not, must minimally contain the focus. If ground is contextually available, the default is to realise

just the focus. However, appropriate generation of elliptical utterances involves not only being able to produce elliptical utterances but also knowing when *not* to use ellipsis. Constraints on when more than just the focus needs to be realised include: communication difficulties (anticipated or having occurred), politeness, formality, need for explicitness, and, illustrated in (11), *interference* (v. Givón (1983)):

- (11) A: Folksam och Trygghansa kan jag få numret till dom? [GSLC A8102181]
eng. Folksam and Trygghansa can I get their numbers?
 G: *Folksam har telefonnummer trettio noll tre noll noll och Trygghansa nitiotvå åttio noll noll*
eng. *Folksam has the telephone number thirty zero three zero zero and Trygghansa ninety-two eighty zero zero*

For the telephone numbers given as focus information by *G*, there are two possible grounds: “Folksam has the telephone number ____” and “Trygghansa has the telephone number ____”. These two grounds interfere, and to indicate which telephone number, which focus, goes with which ground, the ground can be explicitly included in the utterance, that is, be part of the compositional content. The first conjunct uttered by *G* in (11) contains a full ground and focus, whereas the second conjunct contains a focus together with a partial ground.

The third set of constraints on elliptical utterances concern the determination of the actual realisation. Syntactic agreement constraints such as number, gender, and case need to be adhered to. The utterance needs an appropriate phonological realisation, such as nuclear stress being assigned to the focus and, more specifically, the contrastive element in the case of a contrastive focus. Ground material may also need to be included for syntactic reasons:

- (12) A: What does Eavan think about books?
 B: ?? **Likes** B': *She likes them*

In (12) it seems that ground material is clearly available to *B*'s utterance through the primary question under discussion, but English does not allow the verb on its own in this kind of example.

5 Formalisation and implementation

I formalise the representation of the contextual and compositional content of the utterance using the HPSG sign, which allows the representation of semantic, syntactic, phonological, and pragmatic information – all of which are needed for elliptical utterances. Information structure is incorporated using an adaptation of Engdahl and Vallduví (1996) in which I assign information structure to pieces of semantic content through structure sharing.

The context is formalised as an information state as in the information state approach to dialogue modelling, Cooper, Larsson, Matheson, Poesio and Traum (1999). The shared part of my information state includes a QUD structure and a dialogue history as a queue of recent turns (move type and content) organised around previous questions under dis-

cussion.

The constraints on elliptical utterances are formalised as Optimality Theoretic constraints. The input is the information state together with a HPSG sign corresponding to the contextual content of the utterance to be generated, and containing only the CAT and CONT values, see the sample HPSG sign below (content given in the form of lambda expressions). The constraint hierarchy determines the information structure of the whole sign, and the phonological realisation of the utterance to be produced. In the example figure below, the primary question in the information state corresponds to *Who smiles?* The utterance to be generated is an answer utterance conveying that Virginia smiles. The OT constraints determines *virginia* as the focus and $\lambda x.smile(x)$ as the ground, the latter being co-indexed with the question under discussion in the information state. The phonological realisation here corresponds to the realisation of just the focus. Interference is handled using bidirectionality, that is, by also taking the hearer perspective into account.

$$\left[\begin{array}{l} \text{PHON } VIRGINIA \\ \text{CAT } S \\ \text{CONT } \boxed{2} @ \boxed{1} = smile(virginia) \\ \text{CONX } | \text{ I-S } \left[\begin{array}{ll} \text{F} & n\text{-contr}\boxed{1} \\ \text{GR} & \boxed{2} \end{array} \right] \end{array} \right]$$

$$\left[\begin{array}{l} \text{PHON } VIRGINIA \\ \text{CAT } \text{NP}_{[sing]} \\ \text{CONT } \boxed{1} virginia \\ \text{CONX } | \text{ I-S } | \text{ F } n\text{-contr}\boxed{1} \end{array} \right] \quad \left[\begin{array}{l} \text{PHON} \\ \text{CAT } \text{VP}_{[3p,sing]} \\ \text{CONT } \boxed{2} \\ \text{CONX } | \text{ I-S } | \text{ GR } \boxed{2} \end{array} \right]$$

$$[\text{INFO-STATE } | \text{ SHARED } | \text{ QUD: ? } \boxed{2} \lambda x.smile(x)]$$

The formalisation is currently being implemented in the information state based dialogue system GoDiS, see Larsson (2002). The utterance representations are implemented using existing system-external software for the encoding of HPSG signs. The information state is an extension of the present information state, and the system also includes a module of domain knowledge. Insights from the Optimality Theoretic analysis give the specifications of the update rules – which update the information state and determine what the system is going to say – and the order in which they are applied.

The full corpus analysis, as well as the formalisation using HPSG and OT, and the implementation, are all given in Ericsson (to appear).

6 Conclusion

My corpus study has shown that an elliptical utterance has a compositional content consisting of a focus or a focus together with a partial ground. The focus can either be identical with or less than the focus phrase, and the material making up the partial ground

may either be part of the focus phrase or not. A focus can be either contrastive or non-contrastive. The components that need to be included in a model of the context include dialogue history with special attention paid to the primary question under discussion, and domain and situational knowledge. The constraints on the generation of elliptical utterances concern the determination of the information structure of the contextual content, the determination of which informational primitives to realise, and the determination of the actual realisation. The utterance representation is formalised using the HPSG sign, the context is formalised as an information state, and the constraints as OT constraints. A dialogue system implementation is currently being developed.

References

- Cooper, R., Larsson, S., Matheson, C., Poesio, M. and Traum, D.: 1999, Coding instructional dialogue for information states, *Deliverable D1.1*, TRINDI.
- Dalrymple, M., Shieber, S. and Pereira, F.: 1991, Ellipsis and higher-order unification, *Linguistics and Philosophy* **14**(4), 399–452.
- Drubig, H. B.: 1994, Island constraints and the syntactic nature of focus and association with focus, *Arbeitspapiere des Sonderforschungsbereichs 340: Sprachtheoretische Grundlagen für die Computerlinguistik*. Bericht Nr.51.
- Engdahl, E. and Vallduví, E.: 1996, Information packaging in hpsg, in C. Grover and E. Vallduví (eds), *Edinburgh Working Papers in Cognitive Science*, pp. 1–32. Vol. 123: Studies in HPSG.
- Ericsson, S.: to appear, *Information Enriched Constituents in Dialogue*, Dissertation, Göteborg University.
- Ginzburg, J.: 1996, Interrogatives: Questions, facts and dialogue, *The Handbook of Contemporary Semantic Theory*, Blackwell, Oxford.
- Givón, T.: 1983, Topic continuity in discourse: An introduction, in T. Givón (ed.), *Topic Continuity in Discourse: A quantitative cross-language study*, John Benjamins.
- Larsson, S.: 2002, *Issue-based Dialogue Management*, PhD thesis, Göteborg University.
- Lewis, D.: 1979, Scorekeeping in a language game, *Journal of Philosophical Logic* **8**, 339–359.
- Pulman, S.: 1997, Higher order unification and the interpretation of focus, *Linguistics and Philosophy* **20**, 73–115.
- Roberts, C.: 1996, Information structure in discourse: Towards an integrated formal theory of pragmatics, in J.-H. Yoon and A. Kathol (eds), *OSU Working Papers in Linguistics, Vol 49: Papers in Semantics*.
- Umbach, C.: 2001, Contrast and contrastive topic, *Proceedings of the ESSLLI 2001 Workshop on Information Structure, Discourse Structure and Discourse Semantics*.
- Vallduví, E.: 1992, *The Informational Component*, Garland.

A TYPE-THEORETICAL APPROACH TO ELLIPSIS RESOLUTION IN DIALOGUE

Raquel Fernández
Department of Computer Science
King's College London
raquel@dcs.kcl.ac.uk

Abstract

This paper sketches an analysis of some types of non-sentential utterances (NSUs) in dialogue using Type Theory with Records (TTR), a version of Martin-Löf's constructive type theory with records and record types. We argue that a formulation in terms of TTR allows us to spell out both the principles by means of which NSUs get assigned a conventional import, and the mechanisms of context change that make available the entities by means of which ellipsis gets resolved.

1 Introduction

As elliptical constructions, non-sentential utterances (NSUs) require the presence of some information in context in order to resolve their fully specified sentential content. Recent approaches to NSUs in dialogue (Ginzburg and Sag 2001, Schlangen 2003) share the by now accepted idea that the contextual information required for an adequate account of their resolution must come from different sources of information, including at least both syntax *and* semantics. (Schlangen 2003) regards the content of an elliptical utterance as containing an unknown anaphoric propositional relation, which is then enriched using contextual inference. (Ginzburg and Sag 2001) analyse NSUs by means of two contextual features in their HPSG grammar: MAX-QUD (maximal question under discussion) and SAL-UTT (salient utterance): the content of elliptical utterances is specified in terms of constraints on these features, by identifying the propositional content of the NSU with that of MAX-QUD and the referential index of the fragment itself with that of SAL-UTT, which is also constraint to be syntactically parallel to it.

Our analysis of ellipsis draws extensively on (Ginzburg and Sag 2001)'s approach. We reformulate their approach in terms of Type Theory with Records (TTR), an extension of constructive type theory with *records* and *record types* due to (Betarte and Tasistro 1998), and put forward as a linguistic tool in recent work by Robin Cooper (see e.g. (Cooper 2000, Cooper 2005)). As (Cooper and Ginzburg 2002) point out, TTR have several advantages over HPSG, like the availability of function types. Amongst other things, function types can be used to provide a characterisation of the dynamics of utterances that spells out the mechanisms of context change that make available the entities by means of which the content of NSUs gets resolved. This means that our reformulation of (Ginzburg and Sag 2001)'s account in terms of TTR is not just a nice technical exercise but, we believe, it offers interesting new possibilities where the interaction of context-dependence and dynamics is concerned.

2 Basics of TTR

The most fundamental idea in any type theory is that objects can be classified as being of different types. In the version of type theory we use here typing judgements are of the form $x : T$, where x is a variable that stands for an object of type T . Record types are sequences of typing judgements represented graphically as a matrix, where each judgement is a *field* in the record type. In a technical sense fields are pairs $\langle l, v \rangle$ where l is a label and v its value.

The inhabitants of record types are *records*. Records are sequences of fields which are pairs of labels and *objects*. A record r is of type RT if all the typing constraints imposed by RT are satisfied by r . More precisely,

$$\text{record } r =_{\text{def}} \begin{bmatrix} l_1 & = & a_1 \\ \dots & & \\ l_n & = & a_n \end{bmatrix} \text{ is of type } RT =_{\text{def}} \begin{bmatrix} l_1 & : & T_1 \\ \dots & & \\ l_n & : & T_n \end{bmatrix} \text{ iff } a_1 : T_1, \dots, a_n : T_n.$$

Note that according to this definition of typehood, record r could have additional fields and still be of type RT . This allows us to define a subtyping relation \sqsubseteq between types as follows: $T_1 \sqsubseteq T_2 \leftrightarrow$ if $a : T_1$ then $a : T_2$. In words, type T_1 is a subtype of type T_2 just in case any object of type T_1 is also of type T_2 . All records are of the empty record type $[\]$, the type which imposes no constraints. Hence it follows that all record types are subtypes of $[\]$.

Crucially the types in a record type can depend on the values of the preceding fields. For instance, consider the record type in (1-left):

$$(1) \quad \begin{bmatrix} x : \text{Ind} \\ y : \text{Ind} \\ c : \text{loves}(x, y) \end{bmatrix} \quad \begin{bmatrix} x = a \\ y = b \\ c = \text{loves}(a, b) \end{bmatrix}$$

Here labels x and y appear in fields whose values are required to be of type Ind (ividual). Label c should be regarded as a *constraint* or in the original formulation of Martin-Löf type theory as a type of proof (a proof of the truth of the proposition in a model for instance). What makes this record type *dependent* is that the type of the value of c depends on the choice of individuals made. A record of this type would be a record like the one in (1-right), where a, b are of type Ind and c is a proof of ‘ $\text{loves}(a, b)$ ’.

Record types can be nested, i.e. values in a record type can be record types themselves. We will use the notation $r.l$ to denote the value of label l in record r . To refer to values in nested records we will use sequences of labels or paths $r.l_1.l_2.\dots.l_n$.

The following are some type constructors that will be used in this paper. More technical details can be found in (Cooper 2005).

- **Function types** If T_1, T_2 are types, then so is $(T_1 \rightarrow T_2)$, the type of functions whose domain is $\{a \mid a : T_1\}$ and whose range is a subset of $\{a \mid a : T_2\}$.
- **The singleton type** If T is a type and $x : T$, then T_x is a singleton type of x , such that $a : T_x$ iff $a = x$. We will use $[l = a : T]$ to denote $[l : T_a]$.

- **The type of lists** If T is a type, then so is $\langle T \rangle$, where $\langle T \rangle$ is the type of lists of elements $a : T$. $L : \langle T \rangle$ iff L is a list and if $a \in L$ then $a : T$.

3 Context and Ellipsis

As noted by (Cooper and Ginzburg 2002) in their analysis of clarification ellipsis, one of the advantages of TTR is that, like feature structures in HPSG, record types can be used to represent syntactic and phonological information as well as semantics. Another is that, unlike unification-based formalisms, TTR is equipped with the tools from the lambda calculus, and therefore allows us to express, for example, the notion of meaning introduced by Montague and Kaplan as a function from context to content in a straightforward way.

In TTR this can be expressed by a function $\lambda r : T_1(T_2(r))$ of type $(Record \rightarrow RecType)$, which maps records r of type T_1 to record type T_2 (dependent on r). T_1 represents the type of context required to interpret the utterance, and T_2 constitutes the type of the utterance content (resulting from application to the context).

Consider for instance the utterance ‘Silvia runs’. Such an utterance can be represented by the function in (2).

$$(2) \lambda r : \left[\begin{array}{l} x : \text{Ind} \\ c_1 : \text{named}(x, \text{Silvia}) \\ t_{\text{ut}} : \text{Time} \\ t_{\text{ev}} : \text{Time} \\ c_2 : \text{includes}(t_{\text{ev}}, t_{\text{ut}}) \end{array} \right] \left(\left[\begin{array}{l} \text{phon} : \text{silvia runs} \\ \text{cat} : \text{S} \\ \text{cont} = \text{Run}(r.x, r.t_{\text{ev}}) : \text{ProofType} \end{array} \right] \right)$$

The type of context required to interpret this utterance (specified by the domain of the function) includes fields for all those parameters that require values to be found in context: the individual denoted by the proper name ‘Silvia’, the utterance and the event times, and the constraints that ‘x’ is named ‘Silvia’ and that the event time includes the utterance time. The type in the range of the function specifies the type of the utterance resulting from the instantiation of the context type with the current context. Note that the type of the content (the value of label ‘cont’) is dependent on the choice of objects made in r .

Although we will not give a full specification of this here, we assume that these representations are built up compositionally by the grammar. Generally speaking, the type of context encodes the presuppositions of an expression built up compositionally from their sub-components. Thus the NP ‘Silvia’ inherits the presupposition of existence of a suitable referent introduced by the proper noun. And the sentence amalgamates the presuppositions conveyed by both the NP and the VP.

In the theory of context in dialogue developed by (Ginzburg 1996, Ginzburg forthcoming), the resolution of fragmentary utterances like short answers to queries is tied to the presence of a suitable question under discussion (QUD) in context. In Ginzburg’s account questions are taken to be propositional abstracts—in TTR functions from records into propositions. Polar questions are formalised using vacuous abstractions, which in TTR corresponds to functions whose domain is the empty record type. Here we will use a simplified representation of such entities, representing the content of *wh*-questions as the

lambda abstract in (3-a), and the content of a polar question as the lambda abstract in (3-b).¹

- (3) a. Who runs? $\rightsquigarrow \lambda x. \text{Leave}(x)$
 b. Does Silvia run? $\rightsquigarrow \lambda []. \text{Leave}(\text{Elies})$

In the HPSG account of (Ginzburg and Sag 2001) a short answer like B’s response in the dialogue below would be analysed as an instance of the construction type *declarative fragment clause*.

- (4) A: Who runs?
 B: Silvia.

This clausal type has as its only daughter a phrase—an NP—whose content is revamped to a full propositional content via combination with the content of the maximal question under discussion (here the fist question in the ‘qud’ list). The function in (5) is a (simplified) TTR version of this construction type (where ‘hd_dtr’ is short for ‘head daughter’):

$$(5) \quad \lambda r : \left[\begin{array}{l} \text{max_qud} : \langle q_1 \mid \text{Question} \rangle \\ \text{sal_utt} : \langle \left[\begin{array}{l} \text{cat} : \text{Cat} \\ \text{cont} : \text{Ind} \end{array} \right] \rangle \end{array} \right] \left(\left[\begin{array}{l} \text{cat} : \text{S} \\ \text{hd_dtr} : \left[\begin{array}{l} \text{cat} = r.\text{sal_utt}.\text{cat} : \text{Cat} \\ \text{cont} = r.\text{sal_utt}.\text{cont} : \text{Ind} \end{array} \right] \\ \text{cont} = r.\text{qud}.q_1 @ \text{hd_dtr}.\text{cont} : \text{Prop} \end{array} \right] \right)$$

We use @ to represent functional application. The propositional content of the answer arises by application of the function denoted by the maximal QUD to the individual denoted by the NP. The syntactic specification of the NP (labeled as ‘cat’) is also context-dependent: It depends on the category of some salient utterance present in context. Thus short answers can be viewed as anaphors/presupposition triggers requiring particular QUDs and SAL-UTTs available in context.

4 The dynamics of utterances

How do contextual resources become available? To answer this question the context-dependent dimension of utterances has to be complemented by the dynamic semantics

¹The abbreviation in (3-a) should not be confused with the denotation of a VP. It is a short hand for the following propositional abstract:

$$\lambda r : \left[\begin{array}{l} x : \text{Ind} \\ c : \text{person}(x) \end{array} \right] \left(\left[\begin{array}{l} \text{sit} : r_1 \\ \text{sit_type} : [c_1 : \text{Leave}(r.x)] \end{array} \right] \right)$$

Propositions are defined using notions from Situation Semantics. Situations are formalised as records, while infons (situation types) are taken to be record types. A proposition is true just in case the situation record is of the type specified by the situation type.

insight that utterances not only depend on context but also *change* it. In a dialogue setting, adding dynamics to the Montague-Kaplan notion of meaning amounts to providing a characterisation of how the information states of the dialogue participants change on the basis of utterances. With this dynamic perspective in mind, our approach will be to view utterances as mappings between information state configurations.

Following Ginzburg’s dialogue gameboard (Ginzburg 1996, Ginzburg forthcoming), we assume information states of the following type:

$$IS =_{def} \left[\begin{array}{ll} \text{bg} & : \text{RecType} \\ \text{qud} & : \langle \text{Question} \rangle \\ \text{sal_utt} & : \langle \text{Sign} \rangle \\ \text{utt} & : \text{Sign} \end{array} \right]$$

Thus a record of type IS will include, at least, a label ‘bg’ (for background), whose value will be a record type representing the propositional content taken for granted or agreed upon by the dialogue participants; a list of elements of type Question , labelled as ‘qud’ (questions under discussion); a label ‘sal_utt’ (for salient utterance), whose value is a list of elements of type Sign^2 representing the list of salient utterances of the questions in ‘qud’; and a label ‘utt’ (for utterance), that will take as value the linguistic sign representing the last utterance made.

We take both the context with respect to which utterances are interpreted and the context resulting from the updates brought about by utterances to be subtypes of IS . Recall that the actual information states of the dialogue participants, which in our TTR account correspond to records, could have additional information and still be of type IS .

As the static representations above, dynamic utterance functions are of type $(\text{Rec} \rightarrow \text{RecType})$. They are functions utt mapping records r of type T_1 to record types T_2 , where T_1 and T_2 are required to be subtypes of type IS . Type T_1 specifies the type of the current context. More precisely, it specifies the contextual parameters of the utterance as part of the current information state. The dynamic import of the utterance (i.e. its contextual updates) is then a record type representing the type of the updated information state such that $utt(r) = T_2$. Note that, for simplicity’s sake, in the representation of the utterance functions below we will ignore those fields of the information state that are not relevant for current purposes.

The distinction between definite and indefinite NPs provides a simple example of what can be expressed by dynamic utterance functions. A definite NP like the one in (6) can be grounded if the current information state contains as background information a suitable referent. If this is the case, the sign denoting that individual is integrated into the new information state. On the other hand, indefinite NPs like (7) do not impose restrictions on the current context. Instead they denote existentially quantified individuals that are *introduced* into the updated background.

$$(6) \quad \lambda r : \left[\text{bg} : \left[\begin{array}{ll} \text{x} & : \text{Ind} \\ \text{c} & : \text{bike}(\text{x}) \\ \text{c}_1 & : \text{unique}(\text{x}) \end{array} \right] \right] \left(\left[\text{utt} : \left[\begin{array}{ll} \text{phon} & : \text{the bike} \\ \text{cat} & : \text{NP} \\ \text{cont} & = r.\text{x} : \text{Ind} \end{array} \right] \right] \right)$$

²The type Sign should be understood as the record type counterpart of feature structure signs in HPSG.

$$(7) \quad \lambda r : \left[\begin{array}{l} \text{utt} : \left[\begin{array}{l} \text{phon} : \text{a bike} \\ \text{cat} : \text{NP} \\ \text{cont} : \text{Ind} \end{array} \right] \\ \text{bg} : \left[\begin{array}{l} \text{x} = \text{utt.cont} : \text{Ind} \\ \text{c} : \text{bike}(\text{x}) \end{array} \right] \end{array} \right]$$

We can now use dynamic utterance functions to spell out how the contextual resources by means of which elliptical utterances get resolved become available in context.

QUDs can arise by different processes, like accommodation (see e.g. (Larsson 2002)) and coercion operations (Ginzburg and Cooper 2004). However probably the most trivial way of raising QUDs is by actually uttering questions. The perhaps obvious intuition that questions introduce QUDs in the dialogue model can be made explicit by representing the update brought about by interrogative clauses as the projection of their content into ‘qud’. The following function is a representation of the type *interrogative clause*:

$$(8) \quad \lambda r : \left[\text{qud} : \langle \text{Question} \rangle \right] \left(\left[\begin{array}{l} \text{utt} : \left[\begin{array}{l} \text{cat} : \text{S} \\ \text{cont} : \text{Question} \end{array} \right] \\ \text{qud} = \langle \text{utt.cont} \mid r.\text{qud} \rangle : \text{QuestionList} \end{array} \right] \right)$$

The constraint in (8) specifies that interrogative clauses (clauses whose content is of type ‘Question’) update the dialogue context by introducing their content at the head of the current ‘qud’ list.

Wh-phrases are salient sub-utterances of questions. This can be expressed by representing they update import as an update of ‘sal_utt’. The function in (9) is the lexical entry of the wh-word *who*. Following (Ginzburg forthcoming), the content of the wh-word is associated with the field ‘func_d’ (functional domain) to indicate that it will be associated with an argument that is abstracted over—it will be associated with the domain of a function.

$$(9) \quad \lambda r : \left[\begin{array}{l} \text{utt} : \left[\begin{array}{l} \text{phon} : \text{who} \\ \text{cont} : \left[\begin{array}{l} \text{x} : \text{Ind} \\ \text{c} : \text{person}(\text{x}) \end{array} \right] \\ \text{func_d} : \langle \text{cont} \rangle \end{array} \right] \\ \text{sal_utt} : \langle \text{utt} \rangle \end{array} \right]$$

The combination of the constraints in (8) and (9), which exemplify a grammar-driven notion of update, explicates the availability of the contextual entities required for the resolution of short answers to wh-questions.

5 Conclusions

In this paper we have explored an approach to the resolution of elliptical utterances in dialogue using TTR, a type theoretical framework that has the advantage of being able to mimic type feature structures, while being equipped with all the tools from the lambda calculus. We have proposed a dynamic representation of utterances that views them as mappings between information state configurations. Utterances and sub-utterances can

specify their context-dependence and their update import in a uniform fashion. This allows us to express both the contextual requirements of elliptical utterances, as well as the mechanisms of context change that make available the entities by means of which ellipsis gets resolved.

References

- Betarte, G. and Tasistro, A.: 1998, Extension of Martin Löf type theory with record types and subtyping, *in* G. Sambin and J. Smith (eds), *25 years of constructive type theory*, Oxford University Press.
- Cooper, R.: 2000, Information states, attitudes and dependent record types, *in* L.Cavedon, P. Blackburn, N. Braisby and A. Shimojima (eds), *Logic, Language and Computation*, Vol. 3, CSLI Publications.
- Cooper, R.: 2005, Austinian truth, attitudes and type theory, *Research on Language and Computation*. To appear.
- Cooper, R. and Ginzburg, J.: 2002, Using dependent record types in clarification ellipsis, *Proceedings of the sixth workshop on the semantics and pragmatics of dialogue (Edilog)*, Edinburgh University, pp. 45–52.
- Ginzburg, J.: 1996, Interrogatives: Questions, facts, and dialogue, *in* S. Lappin (ed.), *Handbook of Contemporary Semantic Theory*, Blackwell, Oxford.
- Ginzburg, J.: forthcoming, *Semantics and Interaction in Dialogue*, CSLI Publications and University of Chicago Press, Stanford: California. Draft chapters available from <http://www.dcs.kcl.ac.uk/staff/ginzburg>.
- Ginzburg, J. and Cooper, R.: 2004, Clarification, ellipsis, and the nature of contextual updates, *Linguistics and Philosophy* **27**(3), 297–366.
- Ginzburg, J. and Sag, I.: 2001, *Interrogative Investigations*, CSLI Publications, Stanford, California.
- Larsson, S.: 2002, *Issue based Dialogue Management*, PhD thesis, Gothenburg University.
- Schlangen, D.: 2003, *A Coherence-Based Approach to the Interpretation of Non-Sentential Utterances in Dialogue*, PhD thesis, University of Edinburgh, Scotland.

ELLIPSIS INTERPRETATION AND MINIMAL INFERENCE

Dan Hardt
Department of Computational Linguistics
Copenhagen Business School
dh@id.cbs.dk

WHY BE SILENT?

SOME FUNCTIONS OF ELLIPSIS IN NATURAL LANGUAGE*

Petra Hendriks & Jennifer Spenader
University of Groningen; Stockholm University
p.hendriks@rug.nl; j.spenader@gmail.com;

Abstract

Although ellipsis is a highly pervasive phenomenon in natural language, its function has largely remained a mystery. While the use of ellipsis can make a sentence more difficult to understand, sometimes the reverse is true. Using ellipsis sometimes is the best way, or even the only way, to express a given meaning. Ellipsis can restrict possible readings, express otherwise ineffable meanings, clarify discourse structure, and establish rapport between speaker and hearer. All these functions motivate a closer look at the possibilities of integrating a treatment of ellipsis in natural language applications.

1 Ellipsis

Ellipsis is the non-expression of sentence elements whose meaning can be retrieved by the hearer. This is a highly pervasive, but at the same time ill-understood phenomenon in natural language. The presence of ellipsis is commonly believed to be one of the main reasons why natural language is so ambiguous. If sentence elements are left unpronounced, a hearer must rely on other parts of the sentence as well as intonation or extra-sentential information, to recover the unpronounced material. For this reason, an elided utterance could have several meanings. But why would a speaker intentionally choose to make a sentence more ambiguous? And why do speakers make this choice so frequently? For example, Alcántara and Bertomeu (this volume) found that 7.5% of the 6922 events found in their 50,000 word corpus were elided. The standard explanation for ellipsis is in terms of speaker's economy (or 'least effort'). By not expressing sentence elements whose presence is not essential for the meaning of the sentence, the speaker can communicate more with fewer words.

However, in this paper we will argue that ellipsis has more functions than merely meeting the speaker's wish to reduce his or her efforts. In the following sections, we discuss a number of other functions, that suggest that the elided form contributes different meanings than their full form counterparts. Ellipsis can restrict possible interpretations, allow us to say things with that are otherwise ineffable, disambiguate

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discourse structure, and serve as a rapport-creating device that could be relevant to automatic dialogue systems.

2 Speaker's economy

The notion of speaker's economy as a driving force behind ellipsis can already be found in the work of Zipf (1949). Zipf identified a systematic interaction between two opposing forces, the first one being the force of unification, or speaker's economy. If this force were to apply unboundedly, however, the result would be a vocabulary of just one word (presumably *uh*) which refers to all the distinct meanings of the language. Because this never happens, there must be another force at work which has the opposite effect of promoting a distinct meaning for every word. This force is called the force of diversification, or hearer's economy. In the neo-Gricean pragmatics framework of conversational implicature, these forces have been reformulated in terms of the hearer-oriented Q principle and the speaker-oriented R principle (e.g., Horn, 1993). According to the Q principle, the speaker should say as much as she can, given the Gricean maxim of Quality and the R principle. According to the R principle, the speaker should say no more than she must, given the Q principle.

These two principles are not merely in opposition, but interact in such a way that the one principle constrains the other. With respect to ellipsis, the interaction between the Q principle and the R principle results in ellipsis only being possible if the hearer is able to recover the missing material. In addition, the interaction gives rise to what Horn terms the division of pragmatic labor. According to Horn's division of pragmatic labor, the more specialized or lexicalized form of two expressions with more or less the same meaning will tend to become associated with the unmarked, stereotypical meaning, while the use of the more complex and less lexicalized expression will tend to be restricted to all other cases. This is illustrated by the following example, taken from Horn (1993):

- (1) a. He wants him to win.
- b. He wants PRO to win.

As Horn argues, the selection of a full pronoun in (1a) over a null PRO signals the absence of the co-referential reading associated with the reduced syntax. Under Horn's view, the reduced sentence (1b) thus is the unmarked form, which carries the unmarked, co-referential, reading. Using a full form is the marked case, whereas using a reduced form is the unmarked case. This contrasts with the standard view on ellipsis, according to which the full utterance is the default case and ellipsis is the special case.

However, speaker's economy by itself is not sufficient to explain the presence of ellipsis. Even if we assume ellipsis to be restricted to those cases where the elided material is recoverable by the hearer because some identical element is present in the sentence, this does not yield an explanation for all instances of ellipsis. In contrast, and in line with Horn, we will argue instead that one function of ellipsis is to restrict the meaning to a subset of the meanings expressed by the corresponding full form.

3 Removing readings

Although ellipsis often introduces potential ambiguity, it sometimes removes ambiguity that would otherwise occur. A well-known example is the following (the b-example is taken from Partee & Rooth, 1983: ex. 23):

- (2) a. A fish walked and a fish talked.
- b. A fish walked and – talked.

The a-example is ambiguous between a reading according to which one fish walked and another fish talked, and a reading according to which the same fish walked and talked. The b-example, in which the subject of the second conjunct has been omitted, only allows for the second reading. Because of the mismatch between the two meanings of (2a) and the single meaning of (2b), many analyses of coordination assume that (2b) is not an elided sentence derived from (2a). Rather, (2b) is assumed to be base-generated as VP coordination. The consensus towards this example and similar ones is that the meaning effects in these sentences typically occur as the result of the quantified expression *a fish*.

However, ellipsis can also remove ambiguities in sentences without a quantified expression. Consider the following sentences (Levin & Prince, 1986):

- (3) a. Sue became upset and Nan became downright angry.
- b. Sue became upset and Nan - downright angry.

Sentence (3a) has two readings, a symmetric and an asymmetric one. According to the symmetric reading, the two events expressed by the two conjuncts are understood as independent. According to the asymmetric reading, the first event is interpreted as the cause of the second event. That is, because Sue became upset, Nan became angry. In sentence (1b), the finite verb *became* has been omitted from the second conjunct, an operation which is known as gapping. In contrast to sentence (3a), elided sentence (3b) only has the symmetric reading. This is why sentence (3b) is impossible in the context in (4), which favors an asymmetric reading:

- (4) Susan's histrionics in public have always gotten on Nan's nerves, but it's getting worse. Yesterday, when she couldn't have her daily Egg McMuffin because they were all out, Sue became upset and Nan became downright angry.

The disappearance of the asymmetric reading when the finite verb in the second conjunct is not pronounced suggests that the ellipsis itself sometimes signals important information to the hearer. In this case, gapping provides the hearer with clues that the coherence relation between the two conjuncts should be interpreted as a contrast relation rather than a causal or temporal relation (Kehler, 2000), and the two subjects as contrastive topics (Hendriks, 2004). Similarly, in sentence (2b) omission of the subject of the second conjunct indicates to the hearer that the conjuncts share the same subject. An explanation of ellipsis in terms of speaker's economy (or 'least effort') is not able to account for this effect of ellipsis. Rather, this effect is in line with the view, put forward in the previous section, that ellipsis signals a restricted meaning. On the production side,

this effect has been incorporated in the natural language generation system proposed by Hielkema, Theune and Hendriks (this volume). But ellipsis not only restricts meaning. It also allows us to express meanings that are otherwise inexpressible.

4 Conveying non-expressible aspects of meaning

Surprisingly, even if ellipsis is the non-expression of sentence elements, these do not necessarily have to be elements that are normally expressible. In this section, we list several examples where ellipsis is the only way to express a certain meaning, because the full form violates syntactic or semantic constraints. Consider the following comparative, which lacks an overt *than*-clause or *than*-phrase:

(5) Wolves get bigger - as you go north from here.

In example (5), originating from Carlson (1977) and discussed by Zwarts, Hendriks, and de Hoop (2005) under the name of ‘reflexive comparatives’, it is impossible to add a *than*-clause or *than*-phrase without changing the meaning:

(6) Wolves get bigger than ??? as you go north from here.

As Carlson already observed, the intended reading of (5) is not that a wolf grows in size when you put it in your car and drive north with it, but that spatial parts (‘stages’) of the wolf population differ in size. Observe that the meaning expressed by the elided sentence (5) cannot be expressed in an explicit way through a non-elided version of the sentence; there is no way to explicitly add that the size of wolves correlates with latitude.

Zwarts, Hendriks, and de Hoop (2005) argue that the impossibility of such a non-elided version lies in the unacceptability of sentences expressing a relation of comparison between two identical referents if this relation is not explicitly marked as being reflexive (for example by using a reflexive form). Consider (7):

(7) Jane smokes more than Jacky, but Jacky drinks more.

Resolving the elided compared element in the *but*-clause to *than Jane* is fine, but resolving this elided element to *than Jacky* is awkward because there seems to be a restriction on comparative relations between the same referent (Zwarts, Hendriks, & de Hoop, 2005). The same constraints seem to play a role in (5). Eliding the comparative clause allows for a comparison between two referents that are as identical as possible, while at the same time avoiding having to use a reflexive form. The missing compared element is preferably retrieved from the same sentence. However, taking the subject of the matrix clause, *wolves*, as the antecedent of the missing compared element results in a reflexive reading which is not marked as such. By adding ‘intensional’ indices to the arguments of the comparative (in the example in (5) these indices are provided by the domain of space, but temporal or other indices are possible as well), which allow for a mapping from spatial positions to different wolves, the hearer is able to establish a comparison between two almost identical, yet not completely identical, referents, namely wolves at position x and wolves at position y. By comparing these wolves on a

scale of size, the reading is obtained that the size of wolves correlates with latitude. As in the cases we discussed in the previous two sections, the meaning of the elided sentence is more restricted than the meaning of its non-elided counterpart, if this latter sentence were acceptable. In particular, ‘wolves at position x’ has a more specific reference than just ‘wolves’.

Another example where the non-elided version is ungrammatical is found in sluicing (from Merchant, to appear: ex. 8a):

- (8) They want to hire someone who speaks a Balkan language but I don’t remember which. (*Balkan language they want to hire someone who speaks.)

Because expression of the full subordinate clause would result in the violation of an island constraint (wh-extraction out of a relative clause island), ellipsis is the only possible way to express the above meaning. The meaning of the sluicing clause is more restricted than the meaning of the full subordinate clause would have been: in (8), *which* can only have wide scope, whereas a full clause *they wanted to hire someone who speaks a Balkan language* is ambiguous between a narrow scope reading and a wide scope reading for *a Balkan language*. So also in situations where the non-elided version is ungrammatical, the elided version has a meaning which is a subset of the meaning that a non-elided version would have had, if the sentence could have been formulated into a surface form.

5 Establishing discourse coherence

A well-known function of ellipsis, and anaphoric relations in general, is to establish discourse coherence. For example, by using a pronoun rather than repeating the full name, a speaker signals to the hearer that the referent is already familiar and should be found in the preceding discourse context. For this reason, (9b) is better than (9a). By omitting the noun phrase in its entirety, as in (9c), the speaker again signals that the referent is familiar, but, moreover, indicates that the missing subject must have the same reference as the subject of the first conjunct.

- (9) a. John walked. John talked.
b. John walked. He talked.
c. John walked and talked.

Although the *he* in (9b) could also refer to someone else than John, this is not possible for the missing subject in (9c). So an elided subject has a more restricted meaning than a pronominal subject.

6 Establishing a positive relationship with the hearer

Ellipsis is also generally recognized as a positive politeness strategy (Brown & Levinsons, 1987; Morand & Ocker, 2003). By omitting part of the message, one establishes a relationship with the addressee and this helps soften the Face Threatening Act (FTA) made. Consider the following examples:

- (10) a. (Do you) Mind if I join you? (Morand & Ocker, 2003)
 b. (Have you) Got any gum?
 c. If your husband routinely comes home late with lipstick on his collar,
 (then he must be having an affair)

The elided utterances express the same meaning as their full counterparts, but in addition they are specified with respect to the attitude towards the hearer. In this sense, then, the elided utterances express a subset of the meanings of their full counterparts.

7 Not a function of ellipsis: Introducing ambiguity

One of the well-known side-effects of ellipsis is that it can introduce ambiguities, such as stripping in (11) and VP-ellipsis in (12):

- (11) Mary likes John, and Bill too.
 (12) John loves his wife and Bill does too.

Interestingly, in an appropriate context this ambiguity seldom creates problems. This observation is not surprising from a communicative perspective. Since a speaker knows what meaning she wants to convey, her task is to select the form for that meaning. Only when the form is selected do alternative meanings become available. The lack of ambiguity in ellipsis is supported by the fact that VP-ellipsis has been suggested as a test to distinguish ambiguity from vagueness by Zwicky and Sag (1975). If one meaning of an ambiguous expression is used in the source clause, the same meaning must be used in the elided clause ((14b) is from Barker, to appear).

- (13) Jane bought a bat and Jack did too.
 (14) a. Bill waved and the flag waved too.
 b. ?? Bill waved and the flag did too.

Thus in (13) both Jane and Jack must have either bought a winged rodent, or baseball equipment. In (14a), each use of *waved* has a different, though related, sense, that of greeting and that of moving in the wind. In (14b) we can see that eliding the second verb leads to awkwardness because even at the level of senses, the elided version must have the same interpretation as the source clause. This is again a case where the elided version restricts the potential interpretation of lexical expression.

However there are some situations in which speakers intentionally introduce ambiguity. Puns are a well-known example. In these cases the purpose of the speaker or writer obviously is not to leave the reader in uncertainty as to the meaning to be expressed. Because the addressee has to put in some effort to decode the message, when he or she succeeds the result is a positive attitude towards the speaker. Puns are used frequently in advertising because the same positive attitude often carries over to the product being advertised (van Mulken, van Enschoot-van Dijk, & Hoeken, 2005). The give as an example an add for a flashlight that ended with: *The gift that leaves you beaming!* makes people feel positive towards the flashlight. That's why interpreting an

elided utterance can sometimes have a similar effect as solving a riddle or a crossword puzzle. Even an example similar to (14b) can be perceived as witty with the right content. Consider (15):

- (15) Dictator Dave suffered a heart attack. Immediately after, he collapsed, and his evil empire did too.

Example (15) plays on the ambiguity between the two senses of *collapse* and creates a clever effect. Thus purposeful introduction of ambiguity by means of ellipsis does exist, but its function can be grouped under the function of ellipsis discussed in the previous section, namely to contribute to a positive rapport with the addressee.

8 Conclusion

In this paper, we argued that speaker's economy by itself is not sufficient to explain the presence of ellipsis in natural language. We listed several examples illustrating that ellipsis can have many other functions than merely meeting the speaker's wish to reduce his or her efforts: ellipsis can remove ambiguity, ellipsis can convey non-expressible aspects of meaning, ellipsis can establish discourse coherence, and ellipsis can contribute to a positive rapport with the hearer. The paper discussed several cases where ellipsis does not increase but rather decreases ambiguity. In these cases, ellipsis appears to signal a restricted meaning which is a subset of the meanings expressed by the corresponding full form. As a consequence, the full forms take over the remaining meanings. Elided forms thus appear to be unmarked forms giving rise to unmarked meanings, in accordance with Horn's division of pragmatic labor.

References

- Alcántara M. & N. Bertomeu: 2005, Ellipsis in Spontaneous Spoken Language, this volume
- Barker, C.: to appear, Vagueness. Encyclopedia article. *Encyclopedia of Language and Linguistics*, 2nd edition. Elsevier
- Brown, P., and S. Levinson: 1987, *Politeness*. Cambridge, Cambridge University Press
- Carlson, G.: 1977, *Reference to Kinds in English*, PhD Dissertation, University of Massachusetts, Amherst
- Hendriks, P.: 2004, Coherence Relations, Ellipsis, and Contrastive Topics, *Journal of Semantics* **21**, 133-153
- Hielkema, F., M. Theune, & P. Hendriks: 2005, Generating Ellipsis Using Discourse Structures, this volume
- Horn, L.R.: 1993, Economy and Redundancy in a Dualistic Model of Natural Language, in: S. Shore & M. Vilkkuna, eds., SKY 1993: *1993 Yearbook of the Linguistic Association of Finland*, 33-72

- Kehler, A.: 2000, Coherence and the Resolution of Ellipsis, *Linguistics and Philosophy* **23**, 533-575
- Levin, N.S., & E.F. Prince: 1986, Gapping and Causal Implicature, *Papers in Linguistics* **19**, 351-64
- Merchant, J.: to appear, Variable island repair under ellipsis. In Johnson, K. (ed.), *Topics in ellipsis*, Cambridge University Press, Cambridge
- Morand, D., & R.J. Ocker: 2003, Politeness Theory and Computer-Mediated Communication: A Sociolinguistic Approach to Analyzing Relational Messages, *Proceedings of the 36th Hawaii International Conference on System Sciences (HICSS'03)*
- Partee, B., & M. Rooth: 1983, Generalized Conjunction and Type Ambiguity, in R. Bauerle, C. Schwarze, & A. von Stechow (eds.), *Meaning, Use and Interpretation of Language*, Walter de Gruyter, Berlin, 361-383
- Van Mulken, M., R. van Enschot-van Dijk, & H. Hoeken: 2005, Puns, Relevance and Appreciation in Advertisements, *Journal of Pragmatics* **37**, 707-721
- Zipf, G.K.: 1949, *Human Behavior and the Principle of Least Effort*, Addison-Wesley, Cambridge, MA
- Zwarts, J., P. Hendriks, & H. de Hoop: 2005, Comparative Paths to an Optimal Interpretation, *Proceedings of Sinn und Bedeutung* **9**, 553-563
- Zwicky, A.M., & J.M. Sadock: 1975, Ambiguity Tests and How to Fail Them. In: Kimball, John P. (ed.), *Syntax and Semantics* **4**, 1-36

GENERATING ELLIPSIS USING DISCOURSE STRUCTURES

Feikje Hielkema, Mariët Theune & Petra Hendriks
University of Groningen; University of Twente

Feikje@ai.rug.nl, M.Theune@ewi.utwente.nl, P.Hendriks@let.rug.nl

Abstract

This article describes an effort to generate elliptic sentences, using Dependency Trees connected by Discourse Relations as input. We contend that the process of syntactic aggregation should be performed in the Surface Realization stage of the language generation process, and that Dependency Trees with Rhetorical Relations are excellent input for a generation system that has to generate ellipsis. We also propose a taxonomy of the most common Dutch cue words, grouped according to the kind of discourse relations they signal.

1 Introduction

Ellipsis and co-ordination are key features of natural language. For a Natural Language Generation system to produce fluent, coherent texts, it must be able to generate co-ordinated and elliptic sentences. This article describes an effort to implement syntactic aggregation in the Virtual Storyteller, a Java-based story generation system. The focus lies on the generation of co-ordinated and elliptic structures for the Dutch language.

In this abstract, syntactic aggregation is defined as the process of combining two clauses at the surface level using any kind of syntactic structure, for instance ellipsis, co-ordination or a subordinate clause. We make two important claims:

- The process of syntactic aggregation belongs in the Surface Realizer module of a natural language generation system
- The combination of dependency trees and discourse structures constitutes excellent input to the Surface Realizer

Cue phrases are a natural language's resources to signal different rhetorical relations, and as such are a vital part of syntactic aggregation. They have great influence on the syntactic structure of an aggregated sentence. Therefore we have designed a taxonomy of the most common Dutch cue words, to use in the aggregation process.

The Virtual Storyteller is a multi-agent NLG-system that creates and narrates fairy tales. At the time of writing, the generated tales feature only two characters, but have different events and endings. The plot is created by so-called Actor agents, autonomous computer programs that represent the characters in the story, each with its own personality and goals. They are able to reason logically and are affected by emotions. These emotions, when felt strongly, cause the agent to adopt a new goal that overrides its original goal.

The Narrator Agent transforms the plot into text. The initial version of the Narrator only presented the bare facts of the story, mapping the events from the plot to simple, fixed

sentences. This resulted in a very monotone, uninteresting narrative. Syntactic aggregation should help enormously to improve the liveliness of the generated narratives. The goal of our project was to make the Narrator produce at least the following structures:

- Paratactic constructions: *Diana left the desert and Brutus entered the forest*
- Hypotactic constructions: *Diana left the desert, because she saw Brutus*
- Conjunction Reduction: *Diana entered the desert and saw Brutus*
- Right Node Raising: *Diana entered and Brutus left the desert*
- Gapping: *Diana entered the desert and Brutus the forest*
- Stripping: *Diana entered the desert and Brutus too*

Different cue words should be available, to improve the variety and to signal different rhetorical relations. Although our work aims in the first place at improving the texts produced by our story generation system, we believe that our approach to syntactic aggregation and ellipsis is sufficiently general to be relevant for all kinds of language generation systems. In addition, we will argue that our approach is largely language-independent.

The rest of this paper is structured as follows. In section 2 we describe the design of the Narrator, and argue that syntactic aggregation should be located within the last stage of the language generation process. In section 3, we present the cue word taxonomy that we developed for use in the aggregation process, and we discuss how we perform aggregation in our system, using this taxonomy. We end with a brief discussion and conclusions.

2 Design

2.1 The Narrator

The design of the Narrator agent is based on the three stage pipe-line structure described by Reiter & Dale (2000). The Content (Document) Planner receives as input a list of propositions representing the events that make up the plot, plus related background material (typically, characters' actions and their causes). It removes superfluous information and adds rhetorical relations between the propositions (see section 3.2.2). The Sentence Planner (Microplanner) maps the propositions to Dependency Trees (see section 3.2.1), while maintaining the rhetorical relations between them. Finally, the Surface Realizer performs syntactic aggregation and generates the surface form.

Although Reiter & Dale (2000) see aggregation as a Microplanning task, we have decided to situate syntactic aggregation in the Surface Realizer module instead. The RAGS-project (Cahill & Reape, 1999) showed a lack of consensus on the location of the aggregation process in the NLG pipe-line; instead the situation varied widely over different NLG-systems. This divergence is partly caused by the fact that many, quite different processes are gathered under 'aggregation' (see Reape & Mellish, 1999). Our project only dealt with syntactic aggregation. As syntactic aggregation deals with grammatical processes (co-ordinating sentences and deciding which elements can be

deleted without rendering the sentence ungrammatical), in our view it should be situated with the other grammatical processes, in the Surface Realizer.

2.2 The Surface Realizer

The Surface Realizer receives as input a ‘Rhetorical Dependency Graph’: a graph specifying the rhetorical relations between sentences, represented as *Dependency Trees*. Dependency Trees are a prominent feature of Meaning-Text theory (Mel’cuk, 1988). They are constructed on the basis of predicates and arguments. There is no dependency on linear word order, and no limit on the amount of children a node can have. This means the trees are able to handle variation in word order easily, so that they translate well over different languages. In fact, Dependency Trees have been used with success in Machine Translation (Lavoie et al., 1999). This means that a generation system using Dependency Trees can be adjusted to another language quite easily; only the rules specific to the generated language have to be replaced, the generation algorithm remains intact.

The independence of word order, and the dependency labels that specify which role a node performs in its parent syntactic category, cause Dependency Trees to be easy to manipulate, especially for the purpose of generating ellipsis. In our project, we follow the Alpino format for Dependency Trees (Bouma et al., 2001), with some minor changes. A tag for morphology has been added, and the tags that indicate the position of a word or syntactic category in the Surface Form are left out.

The discourse structure graphs, of which the Dependency Trees form the nodes, were inspired by Rhetorical Structure Theory (Mann & Thompson, 1987). This theory was originally developed as a descriptive framework for the analysis of text structure, but it is also used in several NLG applications (for an overview, see Hovy, 1993). Among other things, rhetorical relations influence the syntactic structure of a co-ordinated and elliptic sentence. Shaw (2002) uses discourse structures to determine the syntactic structure that should be used to combine two propositions. Hendriks (2004) showed that rhetorical relations do hold as well for certain elliptic structures, such as gapping: a gapped sentence can only have a Resemblance relation between its clauses.

As well as Dependency Trees, rhetorical relations are language independent, as is illustrated by the fact that Rhetorical Structure Theory has been applied successfully to various languages including English, Dutch, German, and Portuguese. This means that rhetorical structures can be passed on to the Surface Realizer, to be used for the selection of a correct and fitting co-ordinating syntactic and/or elliptic structure, when combining two Dependency Trees. The rhetorical relations that we currently distinguish are Cause, Contrast, Purpose, Temporal and Additive. These were judged to be most important for storytelling. The number of relations can be easily expanded if necessary.

Because the Narrator is closely connected to the rest of the multi-agent system, it can access the reasoning, plans and emotions of the Actor agents, and use this information to determine which rhetorical relations to include in the Rhetorical Dependency Graph. For instance, an agent makes a plan to reach a certain goal (Purpose), or can have two conflicting goals (Contrast).

3 Cue Phrase Taxonomy

Sanders & Noordman (2000) show that coherence (rhetorical) relations play an important part in human text processing, and that linguistic markers (cue phrases) cause faster processing of coherence relations between two segments. As a useful linguistic feature in text processing, cue phrases should certainly be included in text generation.

3.1 Related work: Taxonomies for English and Dutch cue phrases

Knott & Dale (1993) use cue phrases as an objective measure to determine a set of rhetorical relations that is based on linguistic evidence. They classified a corpus of cue phrases according to their function in discourse, using a substitutability test. Put simply, this test is used to determine whether two cue phrases signal (partly) the same features, by checking whether one can be substituted by the other in a particular context.

On this basis a taxonomy of cue phrases was created. This taxonomy was hierarchical, as some cue phrases signal more features than others. Knott & Sanders (1998) have created a similar taxonomy for Dutch cue phrases, using the cognitive primitives that were proposed by Sanders et al. (1992) to differentiate between the classes. However, this taxonomy is rather complex and will presumably be hard to implement. Moreover, Knott & Sanders admit that their taxonomy was created using only those cue phrases that were easiest to classify; other cue words will be even harder to classify and cause the taxonomy to be even more of a labyrinth. For these reasons we have decided to create a less convoluted taxonomy for our own purposes.

3.2 Cue Word Taxonomy for syntactic aggregation

For the purpose of syntactic aggregation in our storytelling system, a small taxonomy charting only the most prevalent cue words in Dutch, has been constructed using a variant of the substitutability test described by Knott & Dale (1993). Because the taxonomy, given in figure 1, is meant to be used by the Surface Realizer *before* the words are ordered to produce the surface form (linearization), unlike Knott and Dale we paid no attention to any changes a cue word might make in the word order in the clauses. The clause order could be changed as well, if this did not influence the meaning of the sentence. In short, we only looked at substitutability with respect to meaning, regardless of surface form.

The test was used on two types of data: sentences taken from a fairy tale book (Andersen, 1975), and sentences based on the output of the story generating system. The tested cue words all had a frequency of over a hundred in a representative sample from the Spoken Dutch Corpus (Wouden et al., 2003), to exclude rare cue words. Only cue words that seemed appropriate for narrating a story (not too difficult, because the target group are children) were included.

When grouping the cue words, it turned out that rhetorical relations such as Cause, Purpose and Contrast were not enough to distinguish the classes; extra variables needed to be introduced. We selected features which are in principle available to the story generating system, such as volitionality and the chronological ordering of events.

relation has several cue words by which it can be expressed, and as these cue words do not all have the same relation, they are expressed by different syntactic structures as well. The program generates hypotactic and paratactic sentences, and can add modifiers to individual trees as well. If the input consists of two simple trees (figure 2 shows the input of the Surface Realizer, and the output of the Elliptor) and a Contrast relation between them, the initial version would have produced: 'Diana is bang. Diana wil Brutus doden' (Diana is scared. Diana wants to kill Brutus). The current system can produce paratactic and hypotactic constructions, or add a modifier to one of the clauses. These constructions can be produced with several different cue words as well. This causes a variety of sentences far greater than the boring sequence of fixed, simple sentences that were generated before.

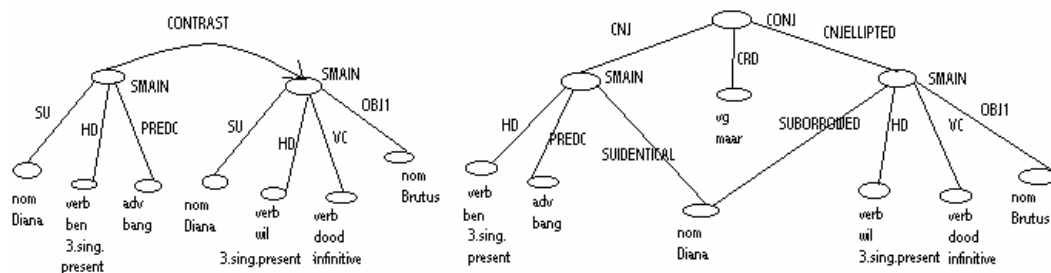


Figure 2: input of the Surface Realizer, output of the Elliptor

If the Conjunction algorithm has generated a paratactic structure, such as 'Diana is bang, maar Diana wil Brutus doden' (Diana is afraid, but Diana wants to kill Brutus), the Elliptor finds a suitable elliptic structure. In this example that is Conjunction-Reduction, resulting in 'Diana is bang, maar wil Brutus doden'. We were able to produce all the desired forms of ellipsis (see section 1), including combinations of different structures, such as gapping and conjunction reduction simultaneously (Diana wants to hug the prince but maim Brutus).

5 General Discussion

5.1 Syntactic Aggregation in the Surface Realizer

As we discussed above, one of the findings of the RAGS-project was that there is no consensus on the right location for aggregation to take place. This is at least partly caused by the use of different definitions of aggregation, which comprise processes quite different in level. Syntactic aggregation deals with grammatical processes, and so the Surface Realizer, the module where linearization is performed using grammatical rules, is the logical place to situate it.

There is evidence that ellipsis is language-dependent. Not all forms of ellipsis are permissible in all languages. Some forms depend on word order, so it seems that ellipsis is influenced by the same grammatical rules that perform linearization. The Surface Realizer already has access to these rules, an extra argument to perform syntactic aggregation (and the generation of ellipsis) in the Surface Realizer.

Discourse structures do not seem to be affected by which language is used. Because rhetorical relations are neutral, they can be processed at the latest stage, after lexicalisation, in the Surface Realizer. This also puts less strain on the component that

has to create the Dependency Trees. The trees only represent simple facts ('Diana is scared', 'Diana flees'), so the trees are uncomplicated.

5.2 Dependency Trees

Is the Dependency Tree language-independent? Mel'cuk (1988) designed Dependency Trees to be free of word order to allow for languages where the word order is vastly different from English. But is it only word order that makes languages differ from one another? In Latin, it is not necessary to mention the subject of a sentence – and that certainly shows in a Dependency Tree. And all languages have some concepts that do not translate well, though these might not crop up often in the telling of a simple fairy tale. Still, even if the Dependency Trees that the Surface Realizer gets as input are not totally language-independent, the methods to process them and turn them into Surface Forms *are*. Substituting the cue words and grammatical rules should be sufficient to enable the Surface Realizer to process Dependency Trees lexicalised to a different language. For this reason alone, we think Dependency Trees are excellent input for a Surface Realizer that tries not to commit itself to one language. Another advantage of using Dependency Trees in syntactic aggregation is that they can easily be manipulated, because the role a word or a constituent plays in a sentence is given by a label (subject-deletion is realized by deleting the node labeled 'subject').

5.3 Discourse Structures

Rhetorical relations can determine which cue words can be used. They are a suitable mechanism to carry a certain meaning across to the level when it is finally of use. And if the relations even influence the grammatical structure that an elliptic sentence can have, the Surface Realizer certainly should have access to them.

However, the relations that were used in this project were not the set that is given by Mann & Thompson (1987). Only a few relations were selected for the moment, those deemed of the most importance to the narrating of a fairy-tale. Cause and Contrast are very basic concepts, and Temporal relations are vital for any narrative. They were then divided into subclasses that correspond to groups of cue words, derived from the small cue word taxonomy that was created for this purpose. The properties that distinguish the subclasses are molded in terms of information that is available to the story generation system. This way, rhetorical relations can easily be added by the Content Planner, because the information is already there. The rhetorical relations that we currently distinguish were selected based on linguistic evidence, on the groups of cue words that were determined. In the future, our cue word grouping should be experimentally confirmed, and if it is not confirmed, the taxonomy should be adapted. Because, as Reape & Mellish (1999) have said, NLG systems should be based on linguistic theories and linguistic evidence to be truly successful.

6 Conclusion

In this article, we have worked toward the following conclusions:

- The most appropriate place for syntactic aggregation is at the level of the Surface Realizer

- The combination of Dependency Trees and rhetorical relations is excellent input for such a Surface Realizer, because Dependency Trees are easily manipulated and rhetorical relations can determine the syntactic constructions that can be used

The Surface Realizer that was created is capable of syntactical aggregation, and of generating several forms of ellipsis that are prevalent in Dutch.

References

- Andersen, Hans Christian; *Sprookjes en Vertellingen*; translated 1975 by W. van Eeden; Bussum, Van Holkema en Warendorf, 1975
- Bouma, Van Noord & Malouf; 2001; Alpino: Wide Coverage Computational Analysis of Dutch. In: *Computational Linguistics in the Netherlands CLIN 2000*
- Cahill, L. & Reape, M.; 1999; Component tasks in applied NLG Systems; Information Technology Research Institute Technical Report Series
- Hendriks, Petra; (2004); [Coherence Relations, Ellipsis, and Contrastive Topics](#); in *Journal of Semantics* 21:2, pp. 133-153.
- Hovy, E.; 1993; Automated Discourse Generation using Discourse Structure Relations; in *Artificial Intelligence*, pages 341-385
- Knott, A. & Sanders, T.; 1998; The Classification of Coherence Relations and their Linguistic Markers: An Exploration of Two Languages; In *Journal of Pragmatics*, Volume 30, pages 135-175
- Knott, A. & Dale, R.; 1993; Using Linguistic Phenomena to Motivate a Set of Rhetorical Relations; in *Discourse processes : a multidisciplinary journal*, vol. 18 (1994), afl. 1, pag. 35-62
- Lavoie, B., Kittredge, R., Korelsky, T., Rambow, O.; 2000; A Framework for MT and Multilingual NLG systems based on Uniform Lexico-structural Processing; In *Proceedings of ANLP/NAACL 2000*
- Mann, William C. and Sandra A. Thompson; 1987; *Rhetorical Structure Theory: A Theory of Text Organization*, ISI: Information Sciences Institute, Los Angeles, CA, ISI/RS-87-190, 1-81.
- Mel'cuk, Igor A. (1988); *Dependency Syntax: Theory and Practice*; State University of New York
- Reape, M. & Mellish, C.; 1999; Just What is Aggregation Anyway?; in *Proc. 7th European Workshop on Natural Language Generation*, 1999
- Reiter, Ehud & Dale, Robert (2000); *Building Natural Language Generation Systems*; Cambridge University Press
- Sanders, Ted J.M., Spooren, Wilbert P.M. & Noordman, Leo G.M.; 1992; Toward a Taxonomy of Coherence Relations; in *Discourse Processes* 15, pages 1-35, 1992
- Sanders, Ted J.M. & Noordman, Leo G.M.; 2000; The Role of Coherence Relations and their Linguistic Markers in Text Processing; in *Discourse Processes*, Volume 29(1), pages 37-60.
- Shaw, J.C.; 2002; *Clause Aggregation; an approach to generating Concise Text*; Phd thesis, Columbia University
- Wouden, T. van der, H. Hoekstra, M. Moortgat, B. Renmans & I. Schuurman; Syntactic Analysis in the Spoken Dutch Corpus. In *M. González Rodríguez & C. Paz Suárez Araujo, Proceedings of the third International Conference on Language Resources and Evaluation*. 768-773.

CUMULATIVE EFFECTS IN THE EVALUATION OF PSEUDO-GAPPING

Jack Hoeksema
University of Groningen
j.hoeksema@let.rug.nl

1 Pseudogapping

The phenomenon of pseudogapping (Levin 1980) has puzzled a great many linguists. Judgments on pseudogapping sentences are often insecure, because this type of ellipsis itself is often viewed as marginal (cf. e.g. Lasnik 1999) and informal, and in addition to this, shows a great deal of variation among speakers of English. The term pseudogapping suggests a relation to gapping, but several linguists have tried to assimilate it to VP-ellipsis instead (e.g. Kuno 1981, Jayaseelan 1990, Lasnik 1999). Compare:

- | | | | |
|-----|----|--|------------------|
| (1) | a. | That may not bother you, but it does me. | [pseudo-gapping] |
| | b. | Smoke bothers Fred, and loud music Fred's parents. | [gapping] |
| | c. | Smoke might have bothered Fred, but it didn't. | [VP-ellipsis] |

Like gapping, pseudogapping involves the ellipsis of a verb (plus additional elements), while nonverbal elements like direct objects may be left behind as remnants. Like VP-ellipsis, pseudogapping leaves behind an auxiliary verb. The morphosyntax of pseudogapping is largely that of VP-ellipsis, then, and languages that do not have VP-ellipsis, such as German and Dutch, also lack a parallel to English pseudogapping. However, the contextual requirements of pseudogapping resembles those of gapping: both types of ellipsis are most common in conjunctions and the conjunction-like environment of comparatives of inequality and equality. VP-deletion, however, shows no restriction of this kind. Arguably, this is due to the fact that both pseudogapping and regular gapping involve contrasting two (or more) constituents, and coordinations (regular, as well as asyndetic) and comparatives form perfect settings for making such a contrast.

2 Corpus Data

Based on a survey of speaker judgments and a small corpus study, I will present a perspective on pseudo-gapping which treats acceptability as gradient, and dependent on two main linguistic factors: (1) type of context; (2) type of elided element. Violations of preferences are argued to be cumulative, leading to ever-worse judgments. In addition, I will propose that differences in acceptability among speakers need not reflect different underlying grammars, but rather different threshold levels for binary responses in terms of acceptable/nonacceptable.

The possibility of interaction between type of context and type of elided element was already raised in Levin (1980: 79). She noted that in comparative contexts, remnants as well as elided material showed greater variation than in noncomparative contexts.

As regards elided material, it is clear from the examples below that the ellipsis of a transitive verb is better than the ellipsis of verb+preposition or ellipsis of verb+indirect object:

- (2) a. Mary never kissed her husband the way she did her lover.
- b. I would rather wait for the train than I would the bus.
- c. Fred gave as many people a compliment as he did a reprimand.

I will argue that the elided element is a transitive verb or a transitive verb phrase (TVP), to use a classical Montagovian notion (cf. Bach 1979, 1980). Other types of elided material lead to degraded sentences.

The contexts of pseudogapping are rather similar to those of gapping: coordination, comparative structures and (more rarely) a discourse context with the ellipsis site in a different sentence than the antecedent, cf.:

- (3) a. I will peel the oranges and you will the tangerines.
- b. I would rather peel oranges than I would tangerines.
- c. I won't kill the Pope. I will the President.

Corpus data suggest that among the contexts, the most prominent one is the comparative, following by coordination, and then discourse. These usage preferences are reflected in grammaticality judgments. [DATA TO BE ADDED]

Table 1 gives a comparison of English gapping and pseudogapping usage data, from a small corpus of naturally-occurring examples that I collected over the years. In the category *comparative* not only comparatives of equality and inequality were included, but also structure with *such as, the way* and *like*, which also involve some form of comparison, cf.:

- (4) a. Are you going to kill me the way you did the others?
- b. Are you going to kiss me like you did your wife?
- c. Are you going to kick me just as you did him?

This preference was already noted in Visser (1963: 513) and Levin (1980: 75).

Table 1: Contexts for gapping and pseudogapping (corpus data)

CONTEXT	GAPPING	%	PSEUDOGAPPING	%
Comparative	8	8	118	90
Coordination	92	89	4	3
Discourse	3	3	3	2
Other	0	0	6	5

Hoeksema (1991: 689-691), following a suggestion by David Dowty, notes a division among speakers of English as regards the acceptability of sentences such as:

- (5)
- a. %I consider her more interesting than I do attractive.
 - b. %They call him a fool more often than they do a genius.
 - c. %Billy wanted her out just as often as he did back.

Some reject such sentences, while others find them acceptable. However, when the context is changed from (quasi-)comparative to coordination or a discourse context, the results are bad even for people who have no general problems with noncomparative contexts in general:

- (6)
- a. *I don't consider her interesting, but I do attractive.
 - b. *They might call him a fool, but they wouldn't a genius.
 - c. *Billy wanted her out. He certainly didn't back.

The examples in (6) contrast with those in (7) where the post-auxiliary remnant is the direct object:

- (7)
- a. I don't consider HER interesting, but I do HIM.
 - b. They might call CLINTON a fool, but they didn't BUSH.
 - c. Billy wanted his WIFE out, but he didn't his BOOKIE.

In a tradition ultimately going back to Chomsky (1955), a number of authors such as Bach (1979, 1980) and Hoeksema (1991) have treated expressions such as *consider interesting* and *call a fool* as complex transitive verbs, or TVPs, which combine with direct objects by wrapping its material around it. When this transitive expression is deleted as a unit, as is the case in (7), the result is better than the result of deleting only part of the TVP, as in (5) and (6). The difference between (5) and (6), finally, is due to a cumulative effect: on top of the suboptimal ellipsis in (5), the sentences in (6) also have a dispreferred noncomparative context. The existence of cumulative effects on grammaticality judgments is not too surprising, given for instance the recent work on gradient grammaticality judgments for gapping (Keller 2000, cf. also Sorace and Keller 2005), where cumulative effects, albeit associated with different constraints, were likewise found.

[Note: judgment data are being collected at the moment.]

References

- Bach, E.: 1979, Control in Montague Grammar. *Linguistic Inquiry* 10-4, 515-531.
- Bach, E.: 1980, In Defense of Passive, *Linguistics and Philosophy* 3, 297-341.
- Chomsky, N.: 1955, *The Logical Structure of Linguistic Theory*. [Published 1975 by Plenum Press, New York]
- Hoeksema, J.: 1991, Complex predicates and liberation in Dutch and English, *Linguistics and Philosophy*, 14, 661-710.
- Jayaseelan, K.A.: 1990, Incomplete VP deletion and Gapping, *Linguistic Analysis* 20, 64-81.
- Keller, F.: 2000, *Gradience in Grammar: Experimental and Computational Aspects of Degrees of Grammaticality*. Doctoral dissertation, University of Edinburgh.
- Kuno, S.: 1981, The syntax of comparative clauses.' Proceedings of CLS 17, Chicago Linguistics Society, Chicago, 136-155.
- Lasnik, H.: 1995, A note on pseudogapping, *MITWPL* 27, 143-163.
- Lasnik, H.: 1999, Pseudogapping puzzles, in: S. Lappin and E. Benmamoun, *Fragments. Studies in Ellipsis and Gapping*. Oxford University Press, Oxford,
- Levin, N.: 1980, *Main Verb Ellipsis in Spoken English*. In: Arnold M. Zwicky, ed., *Clitics and Ellipsis*. OSU Working Papers in Linguistics, 65-165.
- Sorace, A. and F. Keller: 2005, Gradience in Linguistic Data., *Lingua* **115**:11, 1497-1524.
- Visser, F.Th.: 1963, *An historical syntax of the English language. Part one: Syntactical units with one verb*. Leiden: E.J. Brill.

INDEFINITES AND SLUICING. A TYPE LOGICAL APPROACH.*

Gerhard Jäger
Department of Linguistics and Literature
University of Bielefeld
gerhard.jaeger@uni-bielefeld.de

Abstract

Following Jäger (2001), we propose to extend the Lambek calculus with two additional implications, where the first one models anaphora and the second one indefiniteness. Both pronouns and indefinites are interpreted as (possibly partial) identity functions, but they give rise to different types and are thus subject to different interpretation strategies. The descriptive content of indefinites is interpreted as a domain restriction on the corresponding function. The resulting grammar of indefinites treats the scopal behavior of these NPs in an empirically adequate way. Furthermore it leads to a straightforward surface compositional analysis of Sluicing. The assumed division of labor between syntax and semantics in Sluicing is in accordance with the facts; Sluicing is correctly predicted to be insensitive to syntactic islands, but sensitive to morphological features of the antecedent.

1 The type logical treatment of anaphora

In Jäger (2001) a type logical version of Jacobson’s (1999) variable free grammar of anaphora is given and successfully applied to VP ellipsis. To this end, the associative Lambek calculus **L** is extended with a third implication “|”, where $A|B$ is the type of an anaphoric expression of type A which requires an antecedent of type B . Semantically this corresponds to a function from B -denotations to A -denotations. The behavior of the new implication is governed by the following sequent rules (we replace the rule of use from Jäger (2001) by a somewhat stronger version, but the difference is irrelevant for all practical purposes).

$$\frac{X \Rightarrow M : A \quad Y, x : A, Z, y : B, W \Rightarrow N : C}{Y, X, Z, w : B|A, W \Rightarrow N[M/x][wM/y] : C} \llbracket L \rrbracket$$
$$\frac{X, x : A, Y \Rightarrow M : B}{X, y : A|C, Y \Rightarrow \lambda z.M[yz/x] : B|C} \llbracket R \rrbracket$$

The first rule is responsible for anaphora resolution, while the second one ensures that anaphora slots can percolate up in larger syntactic structures. All relevant instances of

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Jacobson’s combinators **Z** and **G** are theorems of the resulting logic. If we adopt the Jacobsonian type assignment $np|np$ and meaning assignment λxx for anaphoric pronouns, her CCG-analysis of pronominal anaphora thus mainly carries over to this type logical system.¹ In (Jäger 2001) it is furthermore shown that we obtain a straightforward account of VP ellipsis if we assume that the stranded auxiliary *did* in constructions like (1) has type $(np \setminus s)|(np \setminus s)$ and denotes the identity function on properties.

- (1) John entered before Bill did.

2 A type logical grammar of indefinites

We propose that the semantics of indefinite NPs is similar to the one of anaphoric pronouns. Consider a simple minimal pair such as

- (2) a. It moved
b. Something moved

According to the analysis mentioned above, (2a) has the category $s|np$ (i.e. it is a clause containing one unresolved pronoun) and the meaning representation $\lambda x.MOVE'x$, i.e. it denotes the property of moving. The central claim of the present paper is that (2b) should be analyzed analogously; its meaning representation is also $\lambda x.MOVE'x$. The two sentences differ in truth conditions and in their semantic contribution to larger constructions because they belong to different syntactic categories. To implement this idea, we extend the Lambek calculus with another binary connective, \rightsquigarrow . The intuition here is that a sign of category $A \rightsquigarrow B$ is like a sign of category B except that it introduces a discourse referent of the type corresponding to category A . So an indefinite NP will receive the category $np \rightsquigarrow np$, and a sentence containing an indefinite has the category $np \rightsquigarrow s$. (In linguistic applications, A will always be instantiated with np .) A sign of category $A \rightsquigarrow B$ denotes a function from A -denotations to B -denotations, so

$$Dom(A \rightsquigarrow B) = Dom(B|A) = Dom(A \setminus B) = Dom(B/A) = Dom(B)^{Dom(A)}$$

A simple indefinite like *something*, having category $np \rightsquigarrow np$, thus denotes a Skolem function. This function is lexically specified to be the identity function λxx , so *something* comes out as synonymous with *it*.

The property of introducing a discourse referent can be inherited from sub-constituents to super-constituents. Formulated in type logical terms, this means that the deductive behavior of \rightsquigarrow is governed by the following rule, which is entirely analogous to the rule of proof of the anaphora slash.

$$\frac{X, x : A, Y \Rightarrow M : B}{X, y : C \rightsquigarrow A, Y \Rightarrow \lambda z.M[yz/x] : C \rightsquigarrow B} [\rightsquigarrow]$$

It is easy to see that this rule, as well as the two rules for the anaphora slash, have the subformula property. Furthermore, Lambek’s (1958) proof of Cut elimination smoothly

¹The main difference is that the type logical version predicts linear precedence to be the licensing structural configuration for anaphora where Jacobson assumes a version of c-command. The interested reader is referred to (?) for further discussion of this issue.

carries over to the extended Lambek calculus. The resulting system is thus guaranteed to be decidable and to have the finite reading property (i.e. there are only finitely many Cut free proofs for each theorem).

Indefinites are not anaphoric; the argument slot that is created by an indefinite can thus not be filled by anaphora resolution. In type logical terms, this means that the logic of \rightsquigarrow is solely determined by the rule $[\rightsquigarrow]$. There is not counterpart of the rule of use of the anaphora slash for \rightsquigarrow . (This can be regarded as a proof theoretic implementation of Heim's (1982) Novelty Condition.)

The syntactic derivation of (2b) is given in figure 1. If we plug in the lexical semantics λxx for *something* and MOVE' for *moved*, we obtain the sentence meaning $\lambda v.\text{MOVE}'v$ for (2b).

$$\frac{\frac{\frac{}{x : np \Rightarrow x : np} [id] \quad \frac{}{y : s \Rightarrow y : s} [id]}{z : np, w : np \backslash s \Rightarrow wz : s} [\backslash L]}{u : np \rightsquigarrow np, w : np \backslash s \Rightarrow \lambda v.w(uv) : np \rightsquigarrow s} [\rightsquigarrow]}$$

Figure 1: Derivation for (2b)

In the general case, indefinite descriptions come with a non-trivial descriptive content. We analyze the descriptive information as a restriction on the domain of the corresponding function. The denotation of the indefinite description *a cup*, for instance, would come out as the identity function on the set of cups. To express partial functions in the typed λ -calculus, we extend its syntax and semantics in the following way:

Definition 1

- If M and ϕ are terms of types σ and t respectively and v is a variable of type τ , then $\lambda v_\phi M$ is a term of type $\langle \tau, \sigma \rangle$.
- $\|\lambda v_\phi M\|_g = \{ \langle a, \|M\|_{g[v \rightarrow a]} \rangle : \|\phi\|_{g[v \rightarrow a]} = 1 \}$

The lexical entry for the indefinite article is given in (3b); its meaning is a function from a set to the identity function over this set. Given this, the sequent in (3c) is a theorem, and the meaning of the sentence (3a) is thus (3d), i.e. it denotes the partial truth-valued function that returns 1 for each cup that moved, 0 for each cup that didn't move, and that is undefined for all non-cups.

- (3)
- A cup moved
 - $a - \lambda P x_{P_x}.x : (np \rightsquigarrow np)/n$
 - $y : (np \rightsquigarrow np)/n, z : n, w : np \backslash s \Rightarrow \lambda u.w(yzu) : np \rightsquigarrow s$
 - $\lambda u.\text{MOVE}'((\lambda x_{\text{CUP}'_x}.x)u)$
($\equiv \lambda u_{\text{CUP}'_u}.\text{MOVE}'u$)

3 Truth and negation

Since sentence denotations need not be truth values in the present system but may be partial truth-valued function of any arity, truth has to be defined polymorphically, and it has

to be relativized to the syntactic category of the sentence in question. (This will ensure that (2a) and (b) will have different truth conditions despite their identical denotations.) Furthermore, we follow Dekker (2000) in relativizing truth to sequences of objects (that supply the referents of unbound pronouns). So truth is defined as a four place relation between a sentence denotation (expressed by the meta-variable α below), a syntactic category (where we use the meta-variable S), a model (which is suppressed in the notation below) and a sequence of individuals \vec{e} . ($c\vec{e}$ is the sequence that results if you add c as top element to the sequence \vec{e} .)

Definition 2 (Truth)

$$\begin{aligned} \vec{e} \models \alpha : s & \text{ iff } \alpha = 1 \\ c\vec{e} \models \alpha : S|np & \text{ iff } \vec{e} \models (\alpha c) : S \\ \vec{e} \models \alpha : np \rightsquigarrow S & \text{ iff } \vec{e} \models \left(\bigcup_{\alpha c \text{ is defined}} (\alpha c) \right) : S \end{aligned}$$

Intuitively, the argument slots originating from pronouns are filled by the elements of the sequence \vec{e} , while the slots coming from indefinites are existentially bound.

It is easy to see that the truth conditions of our examples come out as expected, i.e. (2) is true wrt. a sequence iff the first element of this sequence moved, (2b) is true if something moved, and (3a) if some cup moved.

As in Dynamic Predicate Logic or in Dekker’s Predicate Logic with Anaphora, negation is an operation that operates on the truth conditions of its operand rather than on its meaning directly. In the present system this means that negation is relativized to the syntactic category of its operand. As in the truth definitions above, argument slots originating from indefinites are existentially closed, while those coming from pronouns are passed further up.

Definition 3 (Negation)

$$\begin{aligned} \sim \alpha : s & = 1 - \alpha \\ \sim \alpha : S|A & = \lambda c. \sim (\alpha c) \\ \sim \alpha : A \rightsquigarrow S & = \sim \left(\bigcup_{c \in Dom(A)} \alpha c \right) \end{aligned}$$

We assume that the arguments of other propositional operators (like conjunctions or verbs of propositional attitudes) undergo a similar operation of existential closure as well.

4 Linguistic consequences

Consider the following construction:

- (4) If a cup moved, the ghost is present

Suppose that the particle *if* has the polymorphic category $S_1/S_1/S_2$ (where $S_{1/2}$ range over sentential categories) and the meaning representation $\lambda pq.(\neg p \vee q)$ (where \neg is the syntactic counterpart of the semantic negation operation defined above, and $\phi \vee \psi$ abbreviates $\neg(\neg\phi \wedge \neg\psi)$). To simplify the discussion, we ignore the internal structure of the main

clause *the ghost is present* and represent its meaning as GHOST_IS_PRESENT. Given this, (4) is predicted to be structurally ambiguous—depending on the stage in the derivation where the rule $[\sim]$ is applied—and to receive the following two semantic representations:

- (5) a. $\neg \lambda u_{\text{CUP}'_u} \text{MOVE}'u \vee \text{GHOST_IS_PRESENT}$
 b. $\lambda u_{\text{CUP}'_u} . \neg \text{MOVE}'u \vee \text{GHOST_IS_PRESENT}$

According to the truth definitions given above, (a) is true if either no cup moved or the ghost is present—i.e. the indefinite has narrow scope wrt. the conditional—and (b) is true if there is a certain cup u such that either u doesn't move or the ghost is present. This corresponds to the specific reading of the indefinite *a cup*.

This example illustrates the following noteworthy properties of the present analysis of indefinites:

A An indefinite can take scope over each clause it is contained in, and it scopally interacts with superordinate propositional operators like negation. However, the scoping mechanism for indefinites is entirely independent of the type logical scoping mechanism for genuine quantifiers (like Moortgat's (1996) *in situ* binder), and if quantifier scope is clause bounded or otherwise restricted, this has no implications for the scope of indefinites. So the unrestricted scope taking behavior of indefinites is expected.

B The present theory assumes that indefinites are interpreted *in situ*. Therefore the scope of indefinites is not subject to constraints on movement. Nonetheless the descriptive content of an indefinite—being interpreted as a domain restriction on a function—is inherited by its super-constituent after semantic composition. This ensures that the existential impact of an indefinite and its descriptive content are never unduly divorced.

C No particular problem arises if the extension of the descriptive content of an indefinite is empty. For instance, if there were no cups, both (3a) and (4) in the reading (5b) would denote the empty function and would therefore be false.

The second and third point pose problems for other *in situ* theories of indefinites like the choice function approach (see for instance the discussion in Geurts (2000)), and it has been argued that some kind of movement analysis is inevitable for these reasons. The present approach demonstrates that the empirical facts can be analyzed in a surface compositional way.

Last but not least it should be mentioned that Dekker's treatment of donkey anaphora can be incorporated into the present system without major problems by designing a polymorphic version of conjunction. Space prevents us from pursuing this issue further; the interested reader is referred to ?.

5 Sluicing

This grammar of indefinites, paired with the mentioned type logical treatment of anaphora, leads to a straightforward surface compositional analysis of Sluicing. This is a version of ellipsis where under certain contextual conditions, a bare *wh*-phrase stands proxy for an entire question. The source clause is typically a declarative clause which contains an indefinite NP. The target clause is interpreted as the question that is obtained if this indefinite is replaced by a *wh*-phrase. For example, the Sluicing construction in (6a) is interpreted as (6b).

- (6) a. A cup moved, and Bill wonders which cup
 b. A cup moved, and Bill wonders which cup moved

We assume that the *wh*-determiner *which* in an embedded question like in (6b) has the lexical entry given in (7a). (We adopt Moortgat’s 1988 gap operator “ \uparrow ”, i.e. $s \uparrow np$ is the type of a clause with an *np* gap. q is the type of embedded questions. The predicate Q^+ denotes the positive extension of the predicate Q . This means that $\|Q^+\|_c = 1$ iff $\|Q\|_c = 1$, and $\|Q^+\|_c = 0$ otherwise.) The question (7b) thus receives the semantic representation (7c).

- (7) a. which cup moved
 b. which – $q/(s \uparrow np)/n : \lambda PQ?x.Px \wedge Q^+x$
 c. $?x.CUP'x \wedge MOVE'x$

Now consider a Sluicing construction like (6a). The antecedent clause has the category $np \rightsquigarrow s$, i.e. it is a clause containing an indefinite. Its interpretation is $\lambda v_{CUP} \lambda v' MOVE'v$. We assume that the *wh*-word *which* has the same interpretation here as in the non-elliptical interpretation, but a different category. The second lexical entry for *which* is

- (8) which – $q|(np \rightsquigarrow s)/n : \lambda PQ?x.Px \wedge Q^+x$

So if we combine *which* with a common noun like *cup*, we get an item of type $q|(np \rightsquigarrow s)$, i.e. an anaphoric embedded question which needs an antecedent of type $np \rightsquigarrow s$, i.e. a clause containing an indefinite. Plugging in the meaning of the antecedent in the example (6a), the embedded question receives the resolved meaning $?xCUP'x \wedge (\lambda x_{CUP} \lambda v' MOVE'x)^+x$, which is equivalent to $?x.CUP'x \wedge MOVE'x$.

This analysis handles the essential empirical characteristics of Sluicing correctly:

A It follows from the type of the *wh*-phrase in Sluicing constructions that the antecedent clause has to contain an indefinite which corresponds to the *wh*-phrase in the elliptical clause. So the oddity of (9) is predicted.

- (9) *The cup moved, and Bill wonders which cup

B Sluicing is island insensitive. This means that Sluicing constructions are grammatical even if their non-elliptical counterparts are deviant due to an island violation. A typical example is (10) (taken from Chung and McCloskey (1995)), where the non-elliptical version involves a violation of the Complex NP Constraint.

- (10) a. The administration has issued a statement that it is willing to meet with one of the student groups, but I’m not sure which one
 b. *The administration has issued a statement that it is willing to meet with one of the student groups, but I’m not sure which one the administration has issued a statement that it is willing to meet with

Under the present approach this is predicted because the elliptical and the non-elliptical construction are not transformationally related. For the Sluicing construction to be grammatical, it is sufficient that the antecedent clause contains a wide scope indefinite, and the scope of indefinites is not subject to island constraints.

C The descriptive part of the antecedent indefinite is interpreted as an additional restriction on the interrogative operator in the ellipsis site. For example, the next two sentences are correctly predicted to be synonymous.

(11) John invited a philosopher, but I don't know {which philosopher/who}

D In case marking languages it can be observed that the indefinite in the source clause must have the same case as the corresponding *wh*-phrase in the target clause. The following German example (from Ross (1969)) illustrates this point:

(12) Er will jemandem schmeicheln, aber sie wissen nicht {wem / *wen}
 HE WANTS SOMEONE_{DAT} FLATTER BUT THEY KNOW NOT {WHO_{DAT} /
 WHO_{ACC}}
 'He wants to flatter someone, but they don't know whom'

This generalization can easily be covered if we represent morphological information in the syntactic categories. Let us say simplifyingly that a name in dative case has the category $np(dat)$. An indefinite in dative case would then receive the category $np(dat) \rightsquigarrow np(dat)$, and a clause containing such an indefinite has the category $np(dat) \rightsquigarrow s$. A sluiced *wh*-phrase in dative like *wem* above has the category $q|(np(dat) \rightsquigarrow s)$, i.e. it requires a clause containing an indefinite in dative as antecedent.

References

- Chung, S., W. L. and McCloskey, J.: 1995, Sluicing and logical form, *Natural Language Semantics* **3**, 239–282.
- Dekker, P.: 2000, Grounding dynamic semantics, University of Amsterdam.
- Geurts, B.: 2000, Indefinites and choice functions, *Linguistic Inquiry* **31**, 731–738.
- Heim, I.: 1982, *The Semantics of Definite and Indefinite Noun Phrases*, PhD thesis, University of Massachusetts, Amherst.
- Jacobson, P.: 1999, Towards a variable-free semantics, *Linguistics and Philosophy* **22**(2), 117–184.
- Jäger, G.: 2001, *Logical Aspects of Computational Linguistics, no. 2014 in Lecture Notes in Artificial Intelligence*, Springer, Berlin, Heidelberg, chapter Anaphora and quantification in categorial grammar, pp. 70–89.
- Lambek, J.: 1958, The mathematics of sentence structure, *American Mathematical Monthly* **65**, 154–170.
- Moortgat, M.: 1996, *Discontinuous Constituency*, De Gruyter, chapter Generalize quantification and discontinuous type constructors.
- Ross, J.: 1969, Guess who?, in G. M. G. R. I. Binnick, A. Davison and J. L. Morgan (eds), *Papers from the Fifth Regional Meeting of the Chicago Linguistic Society*, University of Chicago, pp. 252–286.

GENERAL BUT INESCAPABLE CONSTRAINTS ON VERB-PHRASE ELLIPSIS

Phillippe Kreutz
L'Université Libre de Bruxelles
pkreutz@ulb.ac.be

My paper intends to shed some new light on a well-studied phenomenon, namely infinitival Verb-Phrase ellipsis. I will mainly consider the (not so well-studied) French data but my general approach seem to hold for related English data. I won't address the issue of VP-ellipsis in terms of deletion process or (null) anaphora resolution. It remains an open question whether my approach favour a specific stance with respect to this issue. Anyway, the arguments put forward in [Busquets & Denis, 2001] for distinguishing between these two stances prove to be unfounded (for French at least). Therefore, I will stick to a more neutral (and, I hope, more fruitful) description of the phenomenon at stake. As [Larjavaara, 2000], I consider the so called 'VP-ellipsis' to instantiate an intransitive use of transitive verbs. Nevertheless, I will only cope with what is usually known as non-deictically controlled surface ellipsis (see [Sag & Hankamer, 1984]). Our approach relies on two main principles:

(I) VP ellipsis is mainly constrained by a general interpretative process attributing rationality to agents, namely the hypothesis of an internal (constitutive) relation between a type of behaviour (the one alluded to in the antecedent site but omitted in the ellipsis site) and a disposition to act in a certain way.(see [Shopen, 1972] and [Saebø, 1996] for the first steps towards this idea)

(II) Any (use of a) verb allowing VP-ellipsis should encode a conceptualization of action supporting this alluded link between a behaviour-type and the disposition it manifests.

(I) is in no way incompatible with a structural approach to discourse coherence ([Asher & Vieu, 2005]). Rhetorical coherence relations (such as Contrast, Parallelism and Explanation) between the antecedent clause and the elided clause are known to have a direct impact on VP-ellipsis (see [Gardent, 1993], [Kehler, 2000], [Hardt & Romero, 2004]). However, we need to examine in more details the relevant aspects of such relations with respect to the discourse phenomenon at stake. Without taking here any stance (realism Vs ascriptivism) towards dispositions, I will argue that VP-ellipsis cases (especially those relying on an Explanation relation) always involve a disposition construed as a reason to act. This disposition grounds and guarantees, for instance, the juridical or ethical status of a behavior which itself functions abductively as a clue for the existence of this disposition. Our approach of VP-ellipsis relies heavily on the Searlian theory of speech acts, rationality and action. According to [Searle, 2001], a reason to act is an internalized factitive entities which determines the conditions to be fulfilled in order for an agent to act according to such a reason. Our explanation also relies on the Aristotelian notion of Ethos (assuming responsibility to agents and dispositions to act in a certain way). Our data strongly suggest that the acceptable intransitive uses of transitive verbs necessarily also commit the interpreter to assign an ethical or juridical status to the agent himself of the implicit behaviour (such a move is

of course not only relevant to Explanation but also to Contrast and Parallelism). We could explain why *cesser* ('to cease') allows VP-ellipsis in (1a) but not in (1b) where Alice's behavior is clearly not a manifestation of her moral character (the kind of person she really is). As I have argued at length elsewhere, the aspectual properties of *cesser*, are not, pace [Saebø, 1996], so much relevant for VP-ellipsis. Likewise, (2a) is better than (2b) only because Pol is assigned the status of an 'authorized' person through (6a) but, in French, there is no corresponding status of 'permitted' person. A similar explanation holds for the contrast between (3a) and (3b).

- (1) a. «Allez, à quoi ça sert de pleurer comme ça! se dit Alice d'un ton plutôt cassant. Je te conseille de cesser immédiatement!» En règle générale, elle se donnait de très bons conseils [L. Carroll (transl.)]
 b. ?? Le produit s'est répandu sur le sol. Immédiatement, Alice s'est mise à pleurer abondamment. Elle a cessé le lendemain matin, lorsque son inflammation des muqueuses a pu être maîtrisée
- (2) a. Pol est venu. Son père l'a autorisé
 ('Pol came. His father allowed/authorized him')
 b. ?? Pol est venu. Son père lui a permis
 ('Pol came. His father permitted him')
- (3) a. J'ai fait la vaisselle parce qu'on m'a demandé
 ('I made the crockery because one asked me')
 b. ?? J'ai fait la vaisselle parce qu'on m'a ordonné
 ('I made the crockery because one ordered to me')

Principle (II) does not, of course, exempt us a careful (corpus-based) lexico-semantic analysis of the verbal expressions which do (or which do not) allow VP-ellipsis. Indeed, one need to explain not only why certain verbal expressions allow VP-ellipsis in some but not all contexts but also why, *ceteris paribus*, alleged synonyms behave so differently. For instance, (*avoir envie* (4a), *essayer* (5a), *oublier* (5b)) can be used intransitively while, by default, (*désirer* (4b), *tenter* (5a), *omettre* (6b)) cannot. Likewise, while all commissives support a close link between a reaction and the reasons it relies on, *consentir* is the only commissive to be reluctant to an intransitive use (7). To account for these data, we will put forward non ad-hoc (but all pertaining to Principle I) semantic properties of the verbs at stake. We will show that a purely lexically driven approach to VP-ellipsis (such as advocated in [Gyuris, 2000]) is not viable both for empirical and explanatory reasons.

- (4) a. J'ai pas répondu tout de suite parce que j'avais pas envie
 ('I did not answer immediately because I did not want')
 b. ?? J'ai pas répondu tout de suite parce que je désirais pas ('I did not answer immediately because I did not wish')
- (5) a. ... Il n'est pas en mesure de prendre des décisions parce qu'à chaque fois qu'il essaie, il fait l'objet de contestations devant les tribunaux. (Google)
 b. ??... Il n'est pas en mesure de prendre des décisions parce qu'à chaque fois qu'il tente, il fait l'objet de contestations devant les tribunaux. Je devais sortir les poubelles mais j'ai oublié.

- (6) a. Je devais sortir les poubelles mais j'ai oublié.
('I was to leave the dustbins but I forgot')
- b. ?? Je devais sortir les poubelles mais j'ai omis.
('I was to leave the dustbins but I omitted').
- (7) Quand on lui a demandé de nous aider, il a accepté/était d'accord /a refuse/
??consent'
('When on asked him to help us, he accepted/agreed/refused/??consent')
- (8) Il viendra. Il a le droit.
('He will come. He has the right')

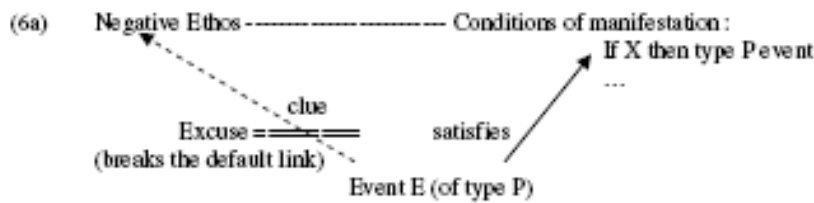
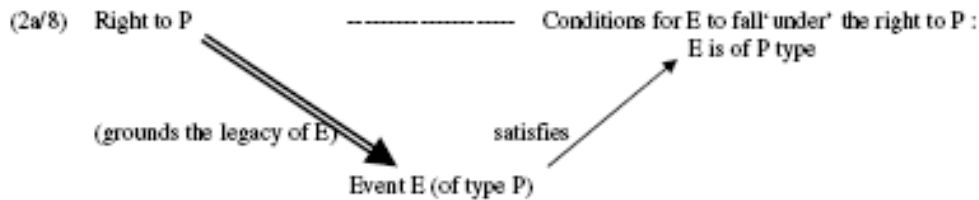
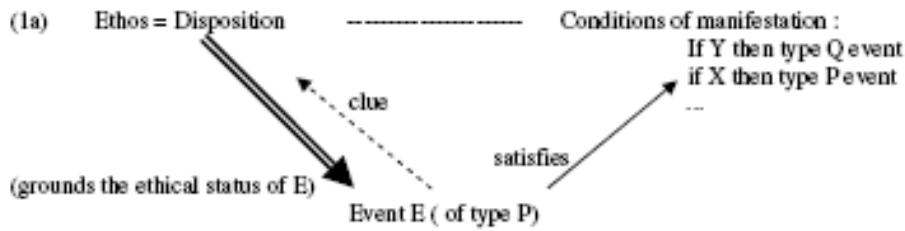
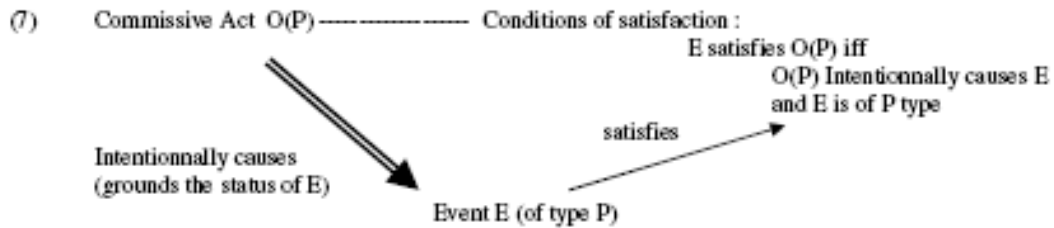
The behaviour of verbal expressions like *avoir le droit* (see 8) or *avoir l'occasion* will be also analysed. We will also re-consider the intransitive use of French modals verbs (*pouvoir, savoir, devoir, vouloir*) which, pace [Busquets & Denis, 2001], is not only restricted to the deontic meaning of these verbs. Of course, as already noted, deontic relations (as involved in directive and commissive speech acts) strongly support VP-ellipsis but the 'possibility' reading of *pouvoir* is not at all incompatible with VP-ellipsis in (8). Notice that an epistemic use of 'devoir' in (9) is unacceptable. Our approach can cope with these (otherwise unexplained) data. Indeed, potentiality, contrary to epistemic evidence, can be construed (retrospectively) as grounding action.

- (9) –Est-ce que tu as pu te reposer un peu? Oui, j'ai pu
- (10) –Est-ce que Pol est à la maison? ?? Oui, il doit

According to us, VP-ellipsis is just another illustration of the relevance in language of the privileged links between agents and the way we categorize them through the interpretive hypothesis of their grounded behaviour. For instance, the general interpretive process alluded in principle (I) is also at stake in the interpretation of a large range of conventionalized expressions in the 'conditional' mood, illustrated in (11).

- (11) a. On lui donnerait le bon Dieu sans confession
b. Il tuerait père et mère
c. Une chatte n'y retrouverait pas ses jeunes

The following schemas give a rough idea of the relevant kind of semantic relations involved in the some of the above examples.



Selected References

- Asher N. & L. Vieu: 2005, Subordinating and coordinating discourse relations, *Lingua* 115, pp. 591-610.
- Busquets, J. & P. Denis: 2001, L'ellipse modale : le cas de pouvoir et devoir, *Cahiers de Grammaire*, 26, pp.55-74.
- Cummins, S. & Y. Roberge: 2003, Null objects in French and English. *Linguistic Symposium on Romance Languages* 33, Indiana University, pp. 1-16
- Elugardo, R. & R. Stainton: 2004, Shorthand, Syntactic Ellipsis, and the Pragmatic Determinants of What Is Said, *Mind & Language*, vol. 19.4, pp. 442-471.
- Gardent, C.: 1993, A unification-based approach to multiple VP Ellipsis resolution, *ACL Proceedings. Sixth European Conference*, pp. 139-148.
- Gyuris, B.: 2003, Semantic Licensing of VP-Ellipsis, *Papers on the Mental Lexicon*, ed. Huba Bartos. Budapest: research Institute of Linguistics, Hungarian Academy of Sciences.
- Hardt, D.: 1999, Dynamic Interpretation of Verb Phrase Ellipsis, *Linguistics and Philosophy*, 22 (2), pp. 187-221.
- Hardt, D. & M. Romero: 2004, Ellipsis and the Structure of Discourse, *Journal of Semantics*, vol. 21. 4, pp. 375-414.
- Hobbs, R. J. & A. Kehler: 1997, Theory of Parallelism and the Case of VP Ellipsis, *Proceedings of the 35th Annual Meeting of the Association for Computational Linguistics and 8th Conference of the European Chapter of the Association for Computational Linguistics (ACL-97/EACL-97)*, pp. 394-401.
- Kehler, A.: 2000, Coherence and the Resolution of Ellipsis, *Linguistics and Philosophy*, 23 (6), pp. 533-575.
- Larjavaara, M.: 2000, *Présence ou absence de l'objet. Limites du possible en français contemporain*, Saarijärvi: Academica Scientiarum Fennica.
- Saebø, K.: 1996, Anaphoric presuppositions and zero anaphora, *Linguistics and Philosophy*, 19, pp. 187-209.
- Sag, I. A. & J. Hankamer: 1984, Towards a theory of anaphoric processing, *Linguistics and Philosophy*, 7, pp.325-345.
- Searle, J. R.: 1998, *La construction de la réalité sociale* (traduction de l'anglais par Claudine Tiercelin), Paris, Gallimard.
- Searle, J. R.: 2001, *Rationality in Action*, Cambridge (Massachusetts), MIT Press.

Shopen, T.: 1972, *A Generative Theory of Ellipsis : A Consideration of the Linguistic Use of Silence*, Bloomington, Indiana University Linguistic Club.

Webber, B.: 1979, *A Formal Approach to Discourse anaphora*. New York & London, Garland

Zribi-Hertz, A.: 1986, *Relations anaphoriques en français: esquisse d'une théorie generative raisonnée de la réflexivité et l'ellipse structurale*. Thèse de Doctorat d'Etat, Paris VIII.

THE DISCOURSE CHARACTERISTICS OF GAPPING: WHEN THE NEGATION TAKES WIDEST SCOPE

Sophie Repp
Humboldt Universität zu Berlin
sophie.repp@rz.hu-berlin.de

Abstract

In gapping sentences where a negative marker in the first conjunct takes wide scope over the whole coordination, the negation obligatorily operates on the level of the speech act rather than on the level of the proposition. In assertions, this is denial negation (e.g. van der Sandt 1991) and in questions, outer negation (e.g. Ladd 1981). This type of negation is an instantiation of the degree of strength that is associated with the sincerity conditions (Vanderveken 1990) of a speech act, which is a feature that it shares with VERUM focus and certain epistemic adverbs. Syntactically, this negation is situated higher than propositional negation, viz. in the CP of the clause. This suggests that gapping with wide scope negation is fundamentally different from 'ordinary' gapping which always involves propositional negation.

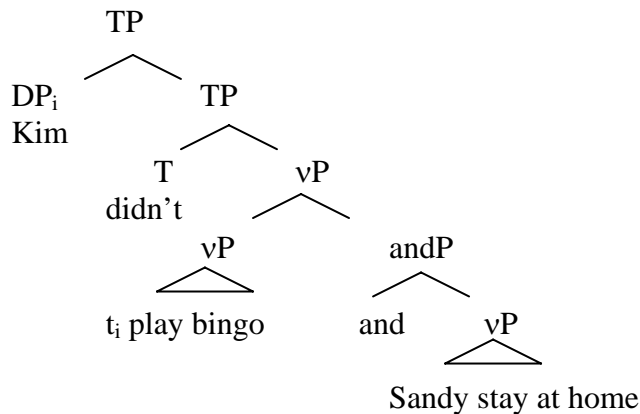
1 Introduction

When a gapping coordination contains a negative marker in the first conjunct which is elided in the second, the negation can take wide scope over both conjuncts (Johnson, 1996; Oehrle, 1987; Siegel, 1984, 1987; Winkler, 2003):

- (1) Oh no! John hasn't flown the coop and his wife simply enjoyed it! (Siegel, 1987: 56)
 $\neg (A \& B)$

This has given rise to an analysis of gapping and related ellipsis types (e.g. left peripheral deletion, pseudogapping), where the conjuncts are assumed to be vPs, VPs or TPs rather than CPs. The idea is that the negation is situated outside the coordination and thus can take scope over both conjuncts. To restore surface order, the subject of the first conjunct in these small-conjunct accounts is usually moved outside the coordination; material that is identical in both conjuncts moves across-the-board (see for instance Johnson, 1996; López & Winkler, 2003; Zoerner & Agbayani, 2000). A simplified example is given in (2), from Johnson (1996: 38).

- (2) Kim didn't play bingo and Sandy stay at home.



Such an analysis is not without problems. The application of this structure to those gapping sentences where the negation does not take wide but “distributed” scope ($\neg A$ & $\neg B$), requires a number of additional, rather complex assumptions. Furthermore, it seems that we must actually allow the coordination of CPs in the distributed readings:

- (3) a. Why did John go by train and why Mary by car?
 b. After lunch, there was a concert for the kids and in the evening, for the grown-ups.

Why-phrases as in (3a) have been suggested to be base-generated in Spec,CP (e.g. Hegarty, 1991; Rizzi, 1990). Topicalisation as in (3b) usually is assumed to be movement to Spec,CP (for a solution for the latter aspect, see López & Winkler, 2003). There are more problems, such as that the interpretation of the negation in the second conjunct is also dependent on semantic-pragmatic factors that come to play in the semantic contribution of various conjunctions that can be used in gapping (*but* vs. *and*, see Repp, 2005). Furthermore, gapping in a language like German, which in general is thought to disallow distributed-scope readings of the negation altogether, and therefore has been assumed to be the coordination of polarity phrases (Winkler, 2003), does actually allow distributed scope readings under specific conditions: if a negative polarity item like *nicht ausstehen können* ('cannot stand') as in (4) is elided, gapping of the negation becomes acceptable in German:

- (4) Max kann französische Filme nicht ausstehen und Maria spanische.
 'Max can't stand French films and Mary (can't stand) Spanish films.'

This is unexpected in a theory that assumes German to be the coordination of polarity phrases.

In this paper, I will argue that the conclusion that all gapping coordinations should be analysed as small conjunct coordinations is premature and that gapping sentences where the negation takes wide scope over the whole coordination truly differ from gapping sentences where the negation takes distributed scope. They differ in an important aspect which relates to their discourse conditions: wide-scope reading gapping sentences can only be used as a speech act of denial, or, since questions can also receive a wide-scope reading, as a denial-like speech act (see below for clarification of what this means). Distributed-scope reading gapping sentences are subject to no such restrictions.

2 Declarative Gapping Sentences With a Wide Scope Reading Are Denials

A denial is a speech act that objects to a previous utterance. According to van der Sandt (1991), it removes (part of) previously introduced material from the common ground and performs a correction operation on contextual information. Evidence for the denial character of wide-scope readings comes from various sources.

First, we observe that wide-scope gapping sentences require strong contextual licensing (as indicated by the interjection and the exclamation mark in example (1) above). Upon closer examination, it turns out that this licensing context is one that elicits a denial.

Second, the intonational make-up of these structures also indicates that we are dealing with a denial:

- (5) [Leon CAN't eat CAVIAR and Anna BEANS] (Winkler, 2003: 327)
 (H*) H*+L H*+L H⁻ (H*) H*+L H%

Contrary to what we find normally in gapping, viz. a deaccentuation of the finite verb (Hartmann, 2000), the finite verb in this wide-scope reading example carries an H*+L accent. Such an accent is typically used to highlight the polarity of the sentence. Stress on the – negative or positive – polarity of a sentence can have different functions, amongst them the expression of VERUM focus (short: VERUM). The concept of VERUM was first introduced by Höhle (1988, 1992), who proposes that it is an illocutionary operator. The function of that operator is to signal that the speaker insists on the truth of the proposition, which essentially is the meaning of a (positive) denial (see Klein, 1998 for a different view, as well as Erb, 2001). As this definition is somewhat problematic, I shall use a concept proposed by Romero & Han (2004), viz. that VERUM is a conversational epistemic operator. It is used by the speaker to assert that s/he is certain that the proposition embedded by VERUM should be added to the common ground.

Third, in German, the negative marker in wide-scope gapping sentences takes a position that does not correspond to that of ordinary clausal negation:

- (6) a. *Max liest das Buch {nicht/ NICHT} und Maria die Zeitschrift.
 b. Max liest NICHT das Buch und Maria die Zeitschrift.
 'Max isn't reading the book and Mary the magazine'

In (6a), the negative marker takes its normal position for clausal negation. The definite DP has scrambled out of the VP and *nicht* occurs after it. This version is ungrammatical no matter whether the negative marker is stressed or not. The only option to produce a wide-scope reading for a coordination like (6a) is given in (6b), where the negative marker is placed before the definite DP. This is a position the negative marker also takes in corrective-*but*-coordinations if the whole clause is to be corrected:

- (7) Max liest nicht das BUCH, sondern er und sein kleiner Bruder spielen draußen Ball.
 'Max isn't reading the book but he and his little brother are outside playing ball.'

Corrective-*but*-coordinations are generally assumed to have an explicit or implicit element of denial (Jacobs, 1991; Drubig, 2000).

Finally, if modal verbs are used in the wide-scope readings, they can scope over the whole coordination only if they have an epistemic reading and if, in addition, the negation scopes over them (root modals require polarity focus on the negative marker, as do all other finite verbs):

- (8) Max kann doch nicht das Haus gekauft haben und Maria die Wohnung!
'It is not possible that Max has bought the house and Mary the apartment.'

Thus, the negation must take scope over elements that already contribute to the speaker's opinion on the truth of the proposition. This indicates that the negation has a very high position here, which, as we will see below, is essential in these constructions.

3 Outer Negation in Interrogative Gapping Sentences

Now, as I already indicated above, the negation in gapping sentences cannot only take wide scope in declaratives but also in interrogatives. Let us first look at polarity questions. Crucially, the negation in negative-polar questions can only take wide scope if these questions contain what Ladd (1981) called outer negation. (9a) is an example of outer negation; (9b) shows inner negation (from Romero & Han 2004):

- (9) a. A: Ok, now that Stephen has come, we are all here. Let's go!
S: Isn't Jane coming too? (outer negation)
b. Scenario: Pat and Jane are two phonologists who are supposed to be speaking in our workshop on optimality and acquisition.
A: Pat is not coming. So we don't have any phonologists on the programme.
S: Isn't Jane coming either? (inner negation)

In (9b), speaker S originally had assumed that Jane would be coming. From A's statement, however, S concluded that this is false. With the question, S checks that the original assumption indeed is false. What is being questioned is the inference $\neg p$. This is what Ladd calls inner negation. In (9a), in contrast, S checks that the proposition s/he believes to be true actually is true. What is being questioned is the speaker's belief p . This is Ladd's outer negation. To account for this difference between inner and outer negation, Romero & Han (2004) propose that VERUM scopes over inner negation and that outer negation scopes over VERUM. Informally, the meaning of a question with outer negation is given in the following:

- (10) outer negation: LF: [CP Q not [VERUM [IP X]]]
{ it is not for sure that we should add to CG that X;
it is (not not) for sure that we should add to CG that X }

What the questions asks then, is whether some material should be deleted from the common ground or not, which is the interrogative counterpart to a denial.

Inner and outer negation can be distinguished by morphosyntactic means. In German, for instance, where the negative marker usually fuses with the indefinite determiner if that is adjacent, such a fusion does not take place in the case of outer negation (Büring & Gunlogson, 2000). What we find in gapping is that the negative marker is not allowed to fuse in the wide-scope readings (note though that the argument is weakened by the fact that *kein* in general is bad in gapping if it is not repeated in the second conjunct):

- (11) a. Hat John nicht Wein getrunken und Maria Fisch gegessen? (outer)
 b. *Hat John keinen Wein getrunken und Maria Fisch gegessen? (inner)
 'Wasn't it the case that (John drank wine and Mary ate fish)?'

In English, similar observations obtain.

Another characteristic of outer negation, which also applies to denials, is that it allows positive polarity items to occur in its scope (also cf. the *too/either* distinction above). Interestingly, in ellipsis we find the following difference:

- (12) a. Hat Max nicht schon gestern dort angerufen und Maria vorgestern?
 'Didn't Max call there already yesterday and Mary the day before?'
 b. Hat Max dem Kellner keine müde Mark Trinkgeld gegeben und Maria dem Barkeeper?
 'Didn't Max give the waiter a penny in tips and Mary the barman?'

(12a) contains a positive polarity item (*schon*, 'already') and the wide scope reading is fine. (12b), which contains a negative polarity item (*keine müde Mark*, 'not a penny') can only be read with a distributed scope of the negation, which, importantly, requires an appropriate intonation contour, i.e. pitch accents on *Max* and *Kellner*, and on *Maria* and *Barkeeper*; the polarity item must be deaccented. Again, it seems, that wide scope reading gapping sentences only support outer negation. And again, the data are similar for English. Also note that the negative marker in negative polar questions also needs to take a "preposed" position (not illustrated here).

Wh-questions show a similar behaviour to polarity questions. In addition, they reveal a characteristic of the wide scope readings, which will be important in the syntactic analysis of these structures:

- (13) a. WHO didn't give MARY a BOOK and WHO JOHN a MAGAZINE?
 (= distributed scope reading)
 b. Who DIDN'T give Mary a book and (*who) John a magazine? (= wide scope)

Wh-phrases, which can occur in both conjuncts in the distributed readings, cannot do so in the wide scope readings.

4 Analysis

I assume that the negation that occurs in the wide-scope gapping sentences is itself a conversational epistemic operator and does not only scope over the operator VERUM. It

is the negative counterpart of VERUM, if you will (Romero & Han, 2004 only assume such an operator for declaratives). This operator, call it FALSUM, expresses that the speaker is not committed to adding the proposition to the common ground. This means that for interrogatives, the set of propositions will be {it is sure that we should not add p to CG / it is not sure that we should not add p to CG}¹ (as in Romero & Han, 2004).

VERUM and FALSUM essentially are epistemic speech act operators (as are for instance *wohl, surely*). I would like to argue that they refer to the degree of strength of the sincerity conditions of a speech act in the sense of Searle & Vanderveken (1985) and Vanderveken (1990). A sincerity condition determines the “psychological modes of the mental states that the speaker must have if he is sincerely performing a speech act with that force in a possible context of utterance” (Vanderveken 1990: 117). The sincerity condition for an assertion is that the speaker believes the truth of the proposition in question. The mental states that are relevant for a sincerity condition come in varying *degrees of strength*, e.g. how strongly committed is a speaker to the proposition uttered. Thus, the degree of strength is essentially a notion of epistemic modality on the level of the speech act. A speaker can be absolutely committed to the addition of a proposition to the common ground (VERUM), more or less committed (*wohl, surely*), or not committed at all (FALSUM).

To link this up with the syntax of gapping, note that it has been argued that the negation in denials – or ‘echo’ negation in general – differs syntactically from ordinary sentence negation (e.g. Cormack & Smith, 1998; Weiß, 2002; Zanuttini, 1997). More specifically, echo negation is often assumed to take a position higher than clausal negation, viz. in the C-domain, usually below Rizzi’s (1997) ForceP. Ordinary clausal negation, in contrast, is assumed to be situated in the T-domain. In addition, it has been proposed that the negation used in corrective-*but*-coordinations (see ex. (7)), also takes a high position in the C-domain (e.g. Drubig, 1994, 2000). This suggests a unified analysis of the two phenomena, which is also supported by the gapping data.

For the syntax of the wide-scope readings, I assume a Rizzi-style Split-CP (Rizzi, 1990). With what we said above about epistemic speech act operators that refer to degrees of strength, I suggest the following structure:

- (19) Max liest NICHT das Buch und Maria die Zeitschrift.
 [ForceP Decl [StrengthP FALSUM [&P Max liest das Buch und Maria liest die Zeitung]]]

This structure takes into account the facts that the denial negation scopes over the whole structure and that *wh*-words can only occur once in the structure (there is only one slot for Q because there is only one ForceP).

To summarise, I suggest that wide-scope gapping sentences indeed are coordinations of smaller conjuncts than CP, though of a different kind than was originally assumed because the negation is found much higher than in the T-domain of the clause. It is not

¹ One option to define FALSUM – which is very close to Romero & Han's formula - is given below, although there are other, perhaps more intuitive solutions (see Repp in prep. for details).

$[[\text{FALSUM}_i]]^{g_{x^i}} = \lambda p_{\langle s, t \rangle} \lambda w. \neg \forall w' \in \text{Epi}_x(w) [\forall w'' \in \text{Conv}_x(w') [p \in \text{CG}_{w''}]]$

the case that ordinary sentence negation needs to scope over the coordination because it is not actually involved in the wide scope readings. It is echo negation that scopes over the coordination. This means that the distributed-scope sentences are fundamentally different. They involve ordinary sentence negation, which is simply part of each conjunct. I am assuming a copying analysis for them (see Repp, in prep.).

References

- Büring, D. & C. Gunlogson (2000), Aren't positive and negative polar questions the same? Ms. available at semanticsarchive.net.
- Cormack, A. & N. Smith (1998), Negation, polarity and V positions in English, *UCL Working Papers in Linguistics* **10**, 285-322
- Drubig, H.-B. (1994), Island constraints and the syntactic nature of focus and association with focus, *Arbeitspapiere des SFB 340 Nr. 51*, Tübingen.
- Drubig, H.-B. (2000), Towards a typology of focus and focus constructions, Ms. Tübingen University.
- Erb, C. (2001), *Finite Auxiliaries in German*, Tilburg Dissertation in Language Studies.
- Hartmann, K. (2000), *Right Node Raising and Gapping. Interface Conditions on Prosodic Deletion*, Benjamins, Amsterdam.
- Hegarty, M. (1991), Adjunct extraction without traces, *Proceedings of West Coast Conference on Formal Linguistics* **10**, Linguistic Association Stanford, 209-222
- Höhle, T. (1988), VERUM-Fokus, *Sprache und Pragmatik* **5**, 2-7
- Höhle, T. (1992), Über Verum-Fokus in Deutschen, J. Jacobs (Ed.), *Informationsstruktur und Grammatik*, Linguistische Berichte Sonderheft 4/1991-1992, Westdeutscher Verlag, Opladen, 112-141
- Jacobs, J. (1991), Negation. A. v. Stechow & D. Wunderlich (Eds.), *Semantik. Ein internationales Handbuch zeitgenössischer Forschung*, de Gruyter, Berlin, 560-596
- Johnson, K. (1996), In search of the English middle field, Ms. University of Massachusetts, Amherst. Revised version from 2003 at http://people.umass.edu/kbj/homepage/Content/middle_field.pdf
- Klein, W. (1998), Assertion and finiteness, N. Dittmar & Z. Penner (Eds.), *Issues in the Theory of Language Acquisition. Essays in Honor of Jürgen Weissenborn*, Lang, Bern, 225-245
- Ladd, R. D. (1981), A first look at the semantics and pragmatics of negative questions and tag questions, *Papers from the 17th Regional Meeting of the CLS*, 164–171

- López, L. & S. Winkler (2003), Variation at the syntax-semantics interface: Evidence from gapping, K. Schwabe & S. Winkler (Eds.), *The Interfaces: Deriving and Interpreting Omitted Structures*, Benjamins, Amsterdam, 227-248
- Oehrle, R. T. (1987), Boolean properties in the analysis of gapping, G. J. Huck & A. E. Ojeda (Eds.), *Syntax and Semantics 20: Discontinuous Constituency*, Academic Press, San Diego, 203-240
- Repp, S. (2005), Negation, gapping and 'but', Paper presented at the Workshop "(In)determinacy of Meaning: Issues in Formal Pragmatics", 27th Annual Meeting of the DGfS Cologne.
- Repp, S. (in prep.), *Interpreting Ellipsis: The Changeable Presence of the Negation in Gapping*. PhD thesis. Humboldt Universität zu Berlin.
- Rizzi, L. (1990), *Relativized Minimality*, MIT Press, Cambridge.
- Rizzi, L. (1997), The fine structure of the left periphery, L. Haegeman (Ed.), *Elements of Grammar: Handbook in Generative Syntax*, Dordrecht, Kluwer, 169-337
- Romero, M. & C.-h. Han (2004), On negative yes/no questions, *Linguistics and Philosophy* **27**, 609-658
- Searle, J.R. & D. Vanderveken (1985), *Foundations of Illocutionary Logic*. CUP, Cambridge.
- Siegel, M.E.A. (1984), Gapping and interpretation, *Linguistic Inquiry* **15**, 523-530
- Siegel, M.E.A. (1987), Compositionality, case, and the scope of auxiliaries, *Linguistics and Philosophy* **10**, 53-76
- van der Sandt, R. (1991), Denial, *Papers from the 27th Regional Meeting of the CLS 2: The parasession on negation*, 331-344
- Vanderveken, D. (1990), *Meaning and Speech Acts*, CUP, Cambridge.
- Weiß, H. (2002), Three types of negation: A case study of Bavarian, S. Barbiers, L. Cornips & S. van der Kleij (Eds.), *Syntactic Microvariation*, www.meertens.knaw.nl/books/synmic, 305-332
- Winkler, S. (2003), *Ellipsis at the Interfaces*, Habilitation thesis, Univ. of Tübingen.
- Zanuttini, R. (1997), *Negation and Clausal Structure: A Comparative Study of Romance Languages*, OUP, Oxford.
- Zoerner, C.E. & B. Agbayani (2000), Unifying Left-Peripheral Deletion, Gapping and Pseudogapping. *CLS* **26**, The Main Session, 549-561