The syntax of DP-coordination: Combining evidence from reading time studies and agrammatic comprehension[*]

Ilona Steiner

Seminar für Sprachwissenschaft – University of Tübingen, Germany

`steiner@sfs.uni-tuebingen.de`

1   Introduction

The syntactic analysis of coordination is discussed controversially in the literature. There are, broadly speaking, three different types of proposals for the analysis of DP-coordination. One approach involves the coordination of full clauses, smaller conjuncts (e.g., a coordinated DP) are derived via a deletion mechanism ("conjunction reduction", originally proposed by Chomsky (1957), for recent work on this approach see Wilder (1994), Schwarz (1998)). We will call this approach the "deletion analysis". In a second approach, coordinate phrases of any size are base-generated directly by phrase structure rules (see Dougherty (1970), Kayne (1994), Munn (2000)). This approach will be called the "phrasal analysis". The third kind of analysis allows for three-dimensional syntactic structure with single nodes being shared by more than one phrase marker (e.g., Moltmann (1992), Wilder (1999)). We will refer to this approach as the "node sharing analysis".

The aim of this paper is to show how different types of data sources can be combined in order to decide between these analyses and to gain a deeper understanding about the structure of DP-coordination. We present results from two comprehension studies in agrammatism that provide evidence against a deletion approach for DP-coordination. Results from reading time studies with normals then provide evidence for the node sharing analysis of DP-coordination and therefore distinguish between the remaining two analyses.

2 Evidence from Agrammatic Comprehension

Agrammatics are in general assumed to have a selective syntactic deficit, which makes it interesting for linguists to investigate this syndrome (see Menn and Obler (1990) for a definition). Theories on agrammatism are normally formulated with respect to a linguistic model specifying which component has broken down. Using data from agrammatics, on the one hand, allows us to validate these deficit theories. On the other hand, they allow us to support the underlying linguistic model thereby distinguishing between competing linguistic theories.

Theories on agrammatism make different assumptions about the nature of the agrammatic deficit and make different predictions for the comprehension of DP-coordination. We therefore conducted two experiments with (the same) German agrammatics.[1] In the first experiment we investigated the comprehension of DP-coordination in three different sentence types: as the subject of an intransitive verb (1a), the subject of a transitive verb (1b), and the object of a transitive verb (1c). The condition "sentence type" was crossed with three conjunction types: *und* ('and'), *sowohl..als auch* ('both..and'), *weder..noch* ('neither..nor').

(1) a. *Das Mädchen und der Junge tauchen.*
       ('The girl and the boy are diving.')

   b. *Die Frau und der Mann gießen die Blumen.*
       ('The woman and the man are watering the flowers.')

   c. *Der Mann trägt die Leiter und den Eimer.*
       ('The man is carrying the ladder and the bucket.')

The results showed that agrammatics did not have problems to interpret DP-coordination. This is interesting because the same patients were not able to understand wh-questions (subject and object questions) in the second experiment. The results of both experiments together provide evidence for the deficit theory by Ouhalla (1993), which is based on Chomsky's Principles and Parameters framework of the late 80s (see, e.g., Chomsky (1986), Abney (1987)). Ouhalla's theory assumes that agrammatics are not able to build functional projections. Since agrammatics did not have problems to interpret DP-coordination[2], we conclude that DP- (or NP-) coordination can be interpreted without functional projections. If Ouhalla's theory is correct, we can rule out the deletion analysis for DP-coordination and those phrasal analyses that involve functional projections for the coordinate DP, i.e. for example, the analyses by Munn (2000) and Kayne (1994).

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[1]The reader interested in the details is referred to Steiner (1999).

[2]Agrammatics of course will not build up a complete DP phrase structure. Ouhalla assumes that instead only an NP phrase structure will be constructed. This does not affect the understanding of the test sentences, since the determiners are not relevant for the interpretation of our sentences.

3 Evidence from Reading Time Studies

In order to distinguish between the remaining analyses (phrasal analysis without functional projections vs. node sharing analysis) we looked at sentence processing data in normals. In reading time studies a structural parallelism effect has been observed for coordinate structures, i.e., the second conjunct is read faster when it is structurally similar to the first one (see Frazier et al. (1984); Frazier, Munn, and Clifton (2000)).

(2) a. *Terry wrote [$_{DP}$ a long novel] and [$_{DP}$ **a short poem**].*
   b. *Terry wrote [$_{DP}$ a novel] and [$_{DP}$ **a short poem**].*

The determiner phrase [*a short poem*] is processed faster in (2a) than in (2b), since the two conjoined DPs in (2a) are structurally identical, which does not hold for the sentence in (2b). However, the parallel-structure effect does not occur in every case a phrase with a particular shape is repeated and therefore cannot be reduced to a structural priming effect. The parallelism effect seems to be specific to coordinate structures (see Frazier et al. (2000)).

Current models of sentence processing (Frazier and Clifton, 1996; Schneider, 1999) usually build up the same structure again for the second conjunct of a parallel coordinate structure (corresponding to a phrasal analysis) thereby providing no means to explain its more rapid processing (which is based on the assumption that building more structure requires more processing time). One proposal for the explanation of the parallel-structure effect is the *Copy* α model by Frazier and Clifton (2001). This model, however, predicts a facilitation effect only for a limited number of coordinate constructions, i.e., only in cases where the syntactic scope of the conjunction is clearly marked (e.g. in *either..or*). The parallel-structure effect in (2) therefore cannot be explained.

We propose the *iteration model*, a general parsing model for the processing of coordinate structures, which exploits the structural redundancy in the conjuncts (see also Steiner (2003)). The idea is that the parser, when encountering a conjunction, jumps back to the beginning of the current phrase and reuses the structure already built for the first conjunct. The redundant syntactic nodes are shared, the non-redundant parts have to be built up. This way the iteration model is able to account for the parallel-structure effect. In cases where the conjuncts are structurally identical (2a), the processing of the second conjunct reduces to attaching the words to the existing structure. In cases where the structure of the conjuncts differ (2b), the non-redundant parts (the adjectival phrase structure) have to be built in addition to that. In (2a) the parser has to build up less structure for the second conjunct than in (2b), which explains its more rapid processing. The data structures that naturally follow from the proposed iteration mechanism are three-dimensional trees in which redundant nodes are shared by the conjuncts. We

argue this to support a syntactic analysis which allows for three-dimensional syntactic structure as proposed, e.g., by Moltmann (1992) or Wilder (1999).

4 Combining both types of evidence

We presented results from two comprehension studies in agrammatism that provide evidence against a deletion approach for DP-coordination and against those phrasal analyses that involve functional projections for the coordinated DP. Results from modeling the parallel-structure effect found in reading time studies provide evidence for the node sharing analysis of DP-coordination and distinguish between a phrasal analysis and the node sharing analysis. Combining both kinds of results[3], we are able to decide between three competing types of analyses and finally get linguistic evidence for the node sharing analysis of DP-coordination. Since the results from the agrammatic data alone do not allow us to differentiate between the phrasal and the node sharing analysis of DP-coordination, the additional data from the reading time studies are needed. On the other hand, it is unclear if these reading time data alone would allow us to rule out the deletion analysis. It is therefore the combination of both kinds of results that provides unambigous evidence.

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[3]Note that the presented agrammatic data are from German patients, whereas the parallel-structure effect has been observed for English and has not been tested for German so far. Nonetheless, we assume that both types of results are not language specific. Ouhalla's theory on agrammatism, which we found evidence for, is also supported by English data. And it is assumed that the iteration mechanism, which successfully models the parallel-structure effect, is a general parsing mechanism for coordination, which does also hold for German. Therefore we think that it is justified to combine these two kinds of evidence.

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