Case as a trigger for reanalysis - Some arguments from the processing of double case ungrammaticalities in German[*]

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Abstract

In the recent literature there is a hypothesis that the human parser uses number and case information in different ways to resolve an initially incorrect case assignment. This paper investigates what role morphological case information plays during the parser's detection of an ungrammaticality or its recognition that a reanalysis is necessary. First, we compare double nominative with double accusative ungrammaticalities in a word by word, speeded grammaticality task and in this way show that only double nominatives lead to a so-called "illusion of grammaticality" (a low rate of ungrammaticality detection). This illusion was found to disappear when the second argument was realized by a pronoun rather than by a full definite determiner phrase, i.e. when the saliency of the second argument was increased. Thus, the accuracy in recognizing an ungrammaticality induced by the case feature of the second argument is dependent on the type of this argument. Furthermore, we found that the accuracy in detecting such case ungrammaticalities is distance sensitive insofar as a shorter distance leads to a higher accuracy. The results are taken as support for an "expectation-driven" parse strategy in which the way the parser uses the information of a current input item depends on the expectation resulting from the parse carried out so far. By contrast, "input-driven" parse strategies, such as the diagnosis model (Fodor & Inoue, 1999) are unable to explain the data presented here.

1. Introduction

In the recent discussion on mechanisms of reanalysis there is a dispute about the relative influence of different syntactic features, such as number and case. German appears to be particularly well suited to examining this question as it allows disambiguation by case as well as by number information. Thus, it is possible to investigate the specific contribution of each of these features to the resolution of an ambiguity. The following sentences illustrate the different means of disambiguation.

      (1a)   Die Botschafterin besuchte der Minister.

               The ambassador$_{amb}$ visited the minister$_{nom}$

               'The minister visited the ambassador.'

      (1b)   Die Botschafterin besuchten die Minister.

               The ambassador$_{sg}$ visited$_{pl}$ the minister$_{pl}$

               'The ministers visited the ambassador.'

In (1), the initial determiner phrase (the functional projection including determiner and noun phrase; DP) *die Botschafterin* is ambiguous with regard to case and grammatical function. As specified by the German inflection paradigm, the DP could be a nominative subject or an accusative object of the clause. In (1a), the grammatical function and, consequently, the case of the initial element will become clear as soon as the second, morphologically specified DP is processed. By contrast, in (1b) the ambiguity is resolved by way of the obligatory number agreement between main verb and subject in German.

Following parsing principles such as the Syntactic Prediction Locality Theory (Gibson 1998) or the Active Filler Hypothesis (Clifton & Frazier 1989), we propose that the initial, ambiguous DP *die Botschafterin* will be analyzed as the subject of the sentence. Assuming that this false interpretation of (or preference for) the first phrase leads to an experimentally detectable reanalysis effect, we expect conspicuous changes in reading times, ERP-patterns or acceptability ratings when the second case marked DP in (1a) is encountered or

when the number mismatch between the main verb and the first DP in (1b) forces an object reading of the initial phrase.

The theoretically motivated subject preference for an initial case ambiguous phrase was confirmed by a number of experiments (Hemforth et al. 1994, Schriefers et al 1994., Friederici et al. 1996, Meng 1997, Schlesewsky et al. 1996, Schlesewsky et al. 1999a). All these studies show that German native speakers do indeed follow such subject-first strategies.

Various experimental techniques have shown reliable subject-first advantages for sentences disambiguated via number mismatch (Kühn 1994, Schriefers et al. 1994, Schlesewsky et al. 1999a, Schlesewsky et al. 1998a, Meng 1997). When taken together, these studies also provide evidence for the structural independence of the number mismatch effect. The following examples exemplify some of the sentence constructions that this effect has been demonstrated for.

(2a)   relative clauses

Das ist die Botschafterin, die   die Professorinnen besucht hat/haben.

This is the ambassador, $who_{amb;sg}$ the $professor_{pl}$ visited   has/have

'This is the ambassador who visited the professors.'

'This is the ambassador whom the professors visited.'

(2b)   verb second interrogatives

Welche Botschafterin   besuchte/besuchten die Professorinnen?

Which $ambassador_{amb;sg}$ $visited_{sg}$ / $visited_{pl}$ the $professor_{pl}$

'Which ambassador visited the professors?'

'Which ambassador did the professors visit?'

(2c)   indirect questions

Es war klar, welche Botschafterin   die Professorinnen besucht hat/haben.

It was clear, which $ambassador_{amb;sg}$ the $professor_{pl}$ visited has/have

'It was clear which ambassador has visited the professors.'

'It was clear which ambassador the professors have visited.'

By contrast, Meng (1997) and Schlesewsky et al. (1999a) reported no or only a weak cost of reanalysis for constructions such as (3), in which the ambiguity is

resolved via the case information of the second DP.

(3a)   verb second interrogatives

Welche Botschafterin   besuchte der / den   Professor.

which $ambassador_{amb}$ visited the_{nom} / the_{acc} professor

'Which ambassador visited the professor?'

'Which ambassador did the professor visit?'

(3b)   long wh-movement

Welche Botschafterin   glaubst Du besuchte der / den   Professor.

which $ambassador_{amb}$ believe you visited the_{nom} / the_{acc} professor

''Which ambassador do you believe visited the professor?'

'Which ambassador do you believe the professor visited?''

The absence of a reanalysis cost for OS clauses compared to their SO counterparts was observable in reading times (Meng 1997, Schlesewsky et al. 1999a), ERP events (Schlesewsky et al 1998a) or in performance data of grammaticality judgements (Meng & Bader 1997).

Furthermore, Meng & Bader (1997) observed that there exists a correlation between the processing behavior for case ungrammatical and case ambiguous sentences[1], as shown in examples (4) /(5) and Table 1.

(4a)   ambiguous

Jemand   fragte, welche Studentin   die Männer besucht haben.

someone asked which $student_{amb}$ the men   visited   have

'Someone asked which student the men have visited.'

(4b)   unambiguous

Jemand   fragte, welchen Studenten die Männer besucht haben.

someone asked $which_{acc}$ student   the men   visited have

(4c)   ungrammatical

*Jemand   fragte, welcher Student   die Männer besucht haben.

someone asked $which_{nom}$ student   the men   visited   have

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[1] In addition, Meng (1997) showed an analogous dependency with regard to the corresponding reading times. The decisive implication of this will be discussed in the context of the experiments presented.

(5a) ambiguous

Welche Studentin glaubst du, besuchte der   Mann?

which   student$_{amb}$ believe you visited   the$_{nom}$ man

'Which student do you believe the man visited?'

(5b) unambiguous

Welchen Studenten glaubst du, besuchte der   Mann?

which$_{acc}$ student   believe you visited   the$_{nom}$ man

(5c) ungrammatical

*Welcher Student glaubst du, besuchte der   Mann?

which$_{nom}$ student believe you visited   the$_{nom}$ man

As in example (1b), the ambiguity in (4) is resolved via number congruence. By contrast, the ambiguity resolution in (5) takes place via the case morphology of the second DP.

As Table 1 shows, a good performance in detecting that an utterance is ungrammatical correlates with a poor performance for the corresponding ambiguous construction.

Table 1. Percentages of correct answers for sentences disambiguated by agreement or by case (Meng & Bader 1997).

Condition	Agreement	Case
ambiguous	64 (4a)	90 (5a)
unambiguous	85 (4b)	93 (5b)
ungrammatical	84 (4c)	56 (5c)

Meng & Bader (1997) argue that these dependencies reflect a general strategy of the human parser, which is driven by the saliency of an unexpected event (e.g. an ungrammaticality or a false preference).

Mismatch Effect: The more salient a temporary ungrammaticality is, the stronger the resulting garden-path effect will be (Meng & Bader 1997).

While the *Mismatch Effect* is a descriptive characterization of the surface phenomenon, Fodor & Inoue's *Diagnosis Model* (Fodor & Inoue 1994, 1998, 1999; henceforth F&I) seeks to provide an explanation of the underlying mechanisms involved.

F&I argue that relative differences in garden path strength are not dependent on the difficulty of the repair process required, but rather reflect the transparency of diagnosis, i.e. to what extent the input item indicating that something is wrong also indicates where in the parsing process the wrong choice was made.

F&I assume that when the parser encounters a word that it cannot sensibly attach into the current phrase marker (the symptom of the garden path), it follows a principle which they call *Attach Anyway*. This principle states that in a situation where no acceptable attachment can be made, the parser should simply undertake the "least unacceptable attachment". As a consequence, the structure already built must be made to fit the current input and not vice versa, i.e. once *Attach Anyway* has applied, the grammar must determine what is wrong with the tree as it stands so that the parser can apply changes to it that will hopefully render it acceptable.

The Diagnosis Model thus focuses not on structural rebuilding processes, but on how the parsing error is diagnosed. The authors argue that different restructuring operations are not associated with differing costs. Rather, it is the transparency or opacity of the symptom which determines how easy or difficult recovery from a garden path will be. This means that if the symptom is able to provide the parser with a clear indication of where the error took place, recovery from the garden path will be relatively problem-free. On the other hand, if it is not possible at all to decide where the problem lies on the basis of the symptom, the parser will be forced to proceed virtually by trial and error in attempting to effect a satisfactory alteration of the tree. Thus, it will either require

considerably more effort to recover from the garden path or no recovery will be possible at all, seeing that the right path to follow may not even occur to the parser as a feasible option.

F&I attempt to account for the findings of Meng & Bader in terms of the diagnosis model in the following way: They argue that number information (e.g. in 4) is "negative" evidence because it is non-specific. This is due to the fact that a number mismatch only signals to the parser that the initial subject preference is incorrect, without giving any hint at what the correct analysis could look like, i.e. it does not specify which is the correct attachment site for the DP initially taken to be the subject of the clause. The case information in (5), by contrast, is "positive" evidence because it does not only show that the initial preference was incorrect, but also specifies the correct interpretation. This is because case is directly connected to structural position whereas number is not. Therefore, in the ambiguous constructions, the parser not only knows that its initial assumption (i.e. that the ambiguous DP is nominative) is wrong, but also what the correct structural position for this DP must be, namely the position of the direct object. In short, case information helps to find the structural alternative whereas number does not.

As far as the ungrammatical sentences are concerned, F&I are able to explain why ungrammaticalities based on number information (6) are much easier to detect than ungrammaticalities based on case information (7).

(6)   *..., welcher   Politiker die Minister   getroffen haben.
      ..., which$_{nom;sg}$ politician the ministers$_{amb;pl}$ met   have
      '... which politician the ministers have met.'

(7)   *Welcher Politiker glaubst Du, traf der   Minister?
      which$_{nom}$ politician believe you met the$_{nom}$ minister
      'Which politician do you believe the minister met?'

In (6), the parser is faced with a number mismatch between both DPs and the final auxiliary. Due to the opacity of the symptom, there is no series of steps

that the parser might undertake in order to save the structure. Thus, the ungrammaticality of the sentence is reliably detected. In (7), by contrast, the second DP is attached by the parser to the structural position of a subject, seeing that the morphological case information unequivocally associates the DP with this position. With regard to the question of what then happens to the first DP (which is also unambiguously specified for nominative case), F&I (1999) propose that the parser does not have the case of this DP available. Rather, it is assumed that this case feature has been "overlooked" and that the case of the first DP was thus assigned *per default*. As a consequence of this default assignment, the case feature of the initial DP may be reassigned unproblematically. In this way, the Diagnosis Model accounts for the mismatch effect, i.e. for the acceptability differences between case and number-induced ungrammaticalities as well as the (in)visibility of a reanalysis in the corresponding ambiguous structures.

Note, however, that F&I's argumentation with regard to the case effects is exclusively based on structures with a linear order of first argument-verb-second argument. Thus, the ambiguous argument (or the trace in long movement constructions) is always followed by a verb. The second argument then disambiguates the structure or makes it ungrammatical. If the whole range of German constructions is considered, however, the above generalization of case-induced reanalysis effects, i.e. that they are weak or even invisible, cannot be maintained.

First evidence for a costly reanalysis via Case was reported by Schlesewsky et al. (1995) Brück (1996) and Macketanz (1996). These studies reported higher reading times for the nominative specified determiner of the second DP in sentences where the initial wh-phrase is extracted from a that-clause, as illustrated in (8).

(8a)   Welche Botschafterin   glaubst Du daß der   Richter besuchte?
         which   ambassador$_{amb}$ believe you that the$_{nom}$ judge   visited
         'Which ambassador do you believe the judge to have visited?'

(8b)   Welche Botschafterin   glaubst Du daß den   Richter besuchte?

      which   ambassador$_{amb}$ believe you that the$_{acc}$ judge   visited

      'Which ambassador do you believe to have visited the judge?'

Further evidence for a costly case-induced reanalysis was presented by Fanselow & Schlesewsky (1998) and Schlesewsky et al. (1999a). For embedded whether-clauses (9) and embedded wh-questions (10), several self paced reading studies showed a reanalysis effect from the point of processing the second DP to the end of the clause.

(9)   Die Sekretärin wusste nicht,...

      The secretary didn't know

(9a)   ...ob wahrscheinlich unglücklicherweise die Ärztin   den Staatssekretär belog.

        if probably   unfortunately   the doctor$_{amb}$ the$_{acc}$ secretary   lied

      ' ... if the doctor probably unfortunately lied to the secretary.'

(9b)   ...ob wahrscheinlich unglücklicherweise die Ärztin   der Staatssekretär belog.

        if probably   unfortunately   the doctor$_{amb}$ the$_{nom}$ secretary   lied

      ' ... if the secretary probably unfortunately lied to the doctor.'

(10)   Die Sekretärin wusste nicht,...

      The secretary didn't know

(10a)   ...welche Frau   wahrscheinlich unglücklicherweise den Staatssekretär belog.

        which woman$_{amb}$ probably   unfortunately   the$_{acc}$ secretary   lied

      ' ... which woman probably unfortunately lied to the secretary'

(10b)   ...welche Frau   wahrscheinlich unglücklicherweise der Staatssekretär belog.

        which woman$_{amb}$ probably   unfortunately   the$_{nom}$ secretary   lied

      ' ... which woman the secretary probably unfortunately lied to.'

As in the sentences used by Brück (1996) and Macketanz (1996), the embedded verb appears after the arguments have been processed. Therefore, the case information of the second DP is the first available disambiguating information.

      The following example, which was reported by Schlesewsky (1997), illustrates the problems that must be addressed by a potential explanation of case-induced disambiguation in an especially illuminating way. In sentences

such as (11), an initial ambiguous declarative DP is modified by a restrictive relative clause. Within this clause a morphologically underspecified relative pronoun confronts the parser with a second ambiguity. While the relative clause is disambiguated via number, the ambiguity in the main clause is resolved by the case marking of the second DP.

(11a)   Die Botschafterin,   die   die Minister   besucht hat, sah den   Reporter.
        the ambassador$_{amb}$ who$_{amb;sg}$ the minister$_{amb;pl}$ visited has saw the$_{acc}$ reporter
        'The ambassador who has visited the ministers saw the reporter."

(11b)   Die Botschafterin,   die   die Minister   besucht hat, sah der   Reporter.
        the ambassador$_{amb}$ who$_{amb;sg}$ the minister$_{amb;pl}$ visited has saw the$_{nom}$ reporter
        'The reporter saw the ambassador who has visited the ministers.'

(11c)   Die Botschafterin,   die   die Minister   besucht haben, sah den Reporter.
        the ambassador$_{amb}$ who$_{amb;sg}$ the minister$_{amb;pl}$ visited have saw the$_{acc}$ reporter
        'The ambassador whom the ministers have visited saw the reporter.'

(11d)   Die Botschafterin,   die   die Minister   besucht haben, sah der Reporter.
        the ambassador$_{amb}$ who$_{amb;sg}$ the minister$_{amb;pl}$ visited have saw the$_{nom}$ reporter
        'The reporter saw the ambassador whom the ministers have visited.'

In a self paced reading study, the reading time for the sentence-final nominative DP is higher than that for its accusative counterpart only in sentences with an object reading of the relative pronoun (11c vs. 11d), i.e. where the initial preference for a subject interpretation of the relative pronoun must be revised. In the constructions where no reanalysis takes place within the relative clause, there are no reading time differences between the sentence-final nominative and accusative DPs (11a vs. 11b).

     Thus, we are faced with a peculiar visibility condition for case-induced reanalyses (or diagnoses), namely that a reanalysis is visible and not weak if an unexpected event (an earlier reanalysis in our case) occurs before the disambiguating second argument appears. Otherwise a reanalysis appears, but it is invisible. How the Diagnosis Model could explain this is not at all clear.

     A further problem arises with the assumption that the case of the first DP in an ungrammatical double nominative construction is "overlooked". It is not

really clear what "overlooked" means in this context and how this default assignment is supposed to work. There are at least the following two possibilities:

(I) The parser overlooks the case marking of the first DP upon first encountering it. Consequently, the initial assignment of the grammatical function of subject to this DP is effected via a default rule (e.g. Active Filler Hypothesis). If this were the case, there should be no difference in processing measures between unambiguous nominative and accusative sentence-initial DPs, e.g. "der/welcher Mann" vs. "den/welchen Mann" which is clearly not the case (cf. Friederici et al. (1998), Schlesewky et al. (1999a), Rösler et al. (1998)). Secondly, we would predict that in sentences with two accusative marked DPs such as (12),

(12) * Welchen Politiker glaubst Du traf den   Minister?
         which$_{acc}$ politician believe you met the$_{acc}$ minister

an accusative marked second DP should *confirm* a default subject reading of the first DP. Therefore, we would expect subjects to judge sentences such as (12) as highly acceptable, that is, subjects should perform *below* chance in a grammaticality judgement task. This prediction will be tested in Experiment 1.

(II) The case of the first DP is not overlooked *initially*, but it is no longer available to the parser when the second DP is encountered. Thus, the parser attaches the second DP to the structural position of subject and *then* assigns the first DP to the object position (assignment of default object case [+Acc]; Gorrell 1996). In this way, the empirical findings of processing differences between nominative vs. accusative marked initial DPs in German may be accounted for. Furthermore, it would predict –in contrast to possibility (I)- that there should not be any difference between double nominatives such as (7) and double accusatives such as (12), seeing that it should be equally easy to find the default case that has to be assigned to the first DP. The prediction that subjects should

judge double nominatives and double accusatives with similar accuracies is also tested in Experiment 1 of the present study.

2. Experiment 1

As we have shown in the introduction, we cannot hope to truly understand how case information is processed by considering only constructions which are disambiguated or rendered ungrammatical by an DP specified for nominative, for in this way we will never be able to decide whether the results obtained are a consequence of the specific "positive" properties of structural case (as suggested by F&I) or whether they rather reflect the special status of nominative case (default case; cf. Bittner & Hale 1996).

In our first experiment we will therefore compare ungrammatical double nominative constructions with ungrammatical double accusatives. We will not use ambiguous structures, as Meng and Bader (1997) did, seeing that it makes no sense to compare an ungrammatical double accusative clause with an ambiguous sentence that contains a final accusative phrase, e.g. *welche Lehrerin traf den Rektor- which teacher met the principal*. The latter follows the normal word order and meets the expectations of the preferred reading induced by the interpretation of the initial ambiguous phrase. Thus we cannot expect an influence of reanalysis costs, since there is no reanalysis.

In order to avoid an uncontrolled influence of word order variation and morphological specification, we will test the ungrammatical constructions against their unambiguous counterparts.

The following sentences exemplify the entire set of conditions used in the first experiment.

(13a) SO unambiguous

Welcher Botschafter besuchte den Richter ?

which$_{nom}$ ambassador visited   the$_{acc}$ judge

'Which ambassador visited the judge?'

(13b) OS unambiguous

Welchen Botschafter besuchte der   Richter ?

which$_{acc}$ ambassador visited   the$_{nom}$ judge

'Which ambassador did the judge visit?'

(13c) double nominative ungrammatical

*Welcher Botschafter besuchte der   Richter ?

which$_{nom}$ ambassador visited   the$_{nom}$ judge

(13d) double accusative ungrammatical

*Welchen Botschafter besuchte den   Richter ?

which$_{acc}$ ambassador visited   the$_{acc}$ judge

If F&I's approach is correct, we would expect double accusatives to be judged with an accuracy rate that is equal to (prediction II) or lower than (prediction I) that found for double nominatives. However, there is also a number of theoretical and experimental arguments for a higher complexity of object initial structures in comparison to their subject initial counterparts (Travis 1984, Gibson 1998, King & Just 1991, Schlesewsky et al. 1998b), which might influence the saliency of the ungrammaticality in accusative initial constructions.

2.1 Method

2.1.1 Participants Twenty-four native German speakers from the Potsdam University participated, for 10 DM each.

2.1.2 Materials Seventy-two data blocks each containing the four different forms exemplified in the sentences presented in (13) were constructed. All experimental sentences contained an initial DP (ambiguous or morphologically specified) followed by a transitive verb and an additional DP that was

morphologically marked for nominative or accusative case. Probands decided upon the grammaticality of the sentence or the validity of the initial preference at the position of the determiner of the second DP. In order to avoid influence from additional case information we controlled the degree of inflection of the second noun. This is possible insofar as the inflection paradigm of German shows different patterns for nominative and accusative Case, for example *Richter- Richter* (judge Nom-Acc) versus *Junge-Jungen* (boy Nom- Acc). The actual stimuli are available upon request.

48 experimental items (12 sentences per condition) were combined with 168 fillers. The fillers consisted of approximately the same number of phrases and were counterbalanced concerning the degree of ungrammaticality and the number of topicalized phrases in analogy to the experimental material. A chance function chose 12 sentences per condition and constructed a list only as the participant started the experimental program. After six subjects all experimental sentences had been presented in a counterbalanced way and a new trial was started automatically.

2.1.3 Procedure The sentences were presented word by word in a speeded grammaticality task. Every word appeared for 250 ms in the middle of a computer screen. The ISI was 100 ms. In order to fix the eyes in the center of the screen an asterisk was presented before the presentation of the first word of a sentence. After the last word a question mark appeared as a prompt for the probands to decide on the grammaticality of the analyzed clause as quickly as possible.

2.2 Results

The percentages of correct answers and the mean reaction times (for correct answers only) for each experimental condition are given in Table 2.

Table 2. Percentages of correct answers (in %) and mean reaction times (in ms) for correct answers in Experiment 1 (wh-DP-V-DP); corresponding examples are given in parentheses.

Condition	Subject-Object	Object-Subject
unambiguous	97/ 635 (13a)	95/ 618 (13b)
ungrammatical	64/ 863 (13c)	77/ 694 (13d)

All data with reaction times greater than 4000 ms were excluded from the analysis; these made up about 1% of the data in the experiment and were evenly distributed over all conditions. In addition, we used only the data with correct responses for the reaction times analysis[2].

An analysis of variance was performed on the means of correct responses and the means of reaction times, with both subjects, F_1, and items, F_2, as random variables.

For correct responses, the MANOVA revealed that there was a main effect of Grammaticality [$F_1(1,23)= 67.17$, $p<.01$, $F_2(1,71)= 172.14$, $p<.01$]. The main effect of Word order was marginally significant in the subject analysis, but significant in the item analysis [$F_1(1,23)= 3.42$, $p<.08$, $F_2(1,71)= 6.00$, $p<.02$].The interaction Word order by Grammaticality was significant in the subject analysis as well as in the item analysis[$F_1(1,23)= 6.11$, $p<.05$, $F_2(1,71)= 13.38$, $p<.01$].

Furthermore, the MANOVA gave the following results for the observed reaction time data: a significant main effect was found for Grammaticality [$F_1(1,23)= 11.02$, $p<.01$, $F_2(1,71)= 26.76$, $p<.01$] and for Word order [$F_1(1,23)= 12.83$, $p<.01$, $F_2(1,71)= 5.73$, $p<.05$]. The interaction Word order by Grammaticality was also significant in the subject as well as in the item analysis [$F_1(1,23)= 5.61$, $p<.05$, $F_2(1,71)= 10.07$, $p<.01$]. In addition, a single comparison showed that there is a significant difference between the double nominative and the double accusative ungrammaticalities with respect to correct

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[2] Incorrect responses are not taken into account seeing that it is not possible to ascertain why a sentence is judged incorrectly, neither with regard to the processing taking place nor with regard to the source of such a judgement.

responses [$F_1(1,23)= 4.85$, $p<.05$, $F_2(1,71)= 11.09$, $p<.01$] as well as reaction times [$F_1(1,23)= 12.49$, $p<.01$, $F_2(1,71)= 11.25$, $p<.01$]. There is no significant contrast between both grammatical conditions.

2.3 Discussion

The results of Experiment 1 show an unequivocal distinction between the ungrammatical conditions. Subjects tend to judge double nominative sentences as more grammatical than their accusative counterparts. The judgements for the grammatical sentences show that the contrast between the ungrammatical conditions is not caused by word order or by differences in the recognition of the morphological specification. The former showed that the higher accuracy in double accusatives is not due to a non-canonical word order of accusative initial structures in general[3].

Furthermore, the mean response time is significantly higher for the double nominative construction than for all other relevant conditions (see Table 2), i.e. subjects need additional time to decide on the grammaticality of this construction. This will be discussed in more detail below.

In sum, the judgement results as well as the response time data confirm the exceptional status of the nominative construction. They show that we need a more fine grained analysis in order to understand the mechanisms involved in the identification of a nominative marked argument. From the perspective of the Diagnosis Model, the present data are problematic insofar as they are incompatible with the assumption that the case feature of the first DP is "overlooked", however one may choose to interpret this.

3. Experiment 2

Given that the results of Experiment 1 exclude the possibility of attributing the poor judgement performance for double nominatives to the fact that the

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[3] Additional evidence that the case of the first DP does not affect the "visibility" of the case of the second argument is given in Schlesewsky & Fanselow (1998) and Schlesewsky et al. (1999).

morphological case information of the first DP is somehow overlooked, it seems plausible to assume that it might in fact be the processing of the second DP which causes the effect in question. Such an assumption is also supported by the various experimental studies discussed in the introduction. Recall that a case-induced reanalysis effect is visible in ambiguous structures only when the main verb does not intervene between both arguments, i.e. in those constructions where the second argument is the first possible disambiguating element. Thus, it seems that the visibility of a reanalysis effect depends upon the saliency of the information provided by the second argument.

In all the experiments reported above, the second DP was realized by a non-pronominal definite DP. Given that the properties of this definite DP and/or the circumstances under which it is processed are the reason for the observed phenomena, the simplest way to test this assumption is to change the properties of the final argument. Because we are unable to vary the morphological properties of the (nominative) case feature itself, we will use an indirect way of rendering the information provided by the second argument more salient. Following the studies of Kaan (1997), Osterhout & Mobley (1995) and Sanford et al. (1983), we will assume that pronouns differ from definite DPs with respect to saliency[4]. For example, pronouns refer to an entity that has already been introduced, whereas a definite DP may refer to a person in a previous context, but can also introduce a new entity into the discourse. Furthermore, definite DPs can refer to an entity that has not been explicitly mentioned in the preceding context, while pronouns cannot refer to such entities. This means that pronouns are used to refer to entities that have already been defined and that are explicitly mentioned (salient) in the discourse context. As Osterhout & Mobley (1995) showed, there is a strong demand to bind a pronoun to a possible antecedent even when the pronoun's gender information does not allow this[5].

These differences with respect to discourse saliency should have consequences for the way definite DPs and pronouns are processed. Whereas a

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[4] Naturally, there is also a contrast to indefinite full DPs. We will not, however, consider such discourse relations in this paper, seeing that indefinites are in some ways similar to definites with respect to discourse properties.

[5] In the case of cataphoric pronouns or when the pronoun precedes its antecedent as the result

full definite DP fulfills the formal requirements of the second argument position (except the case information), a pronoun has additional needs of its own with respect to binding properties, i.e. the processing of pronouns should require additional cognitive cost. As a consequence, we assume that the saliency of the second argument may be stronger when this argument is realized by a pronoun than when it is realized by a full definite DP.

Experiment 2 used the same constructions as Experiment 1, save that the second argument was realized by a pronoun. As far as the results are concerned, there are essentially two possible outcomes. First, if the results of Experiment 2 show a similar pattern to that found in Experiment 1, this may be taken as an indication of the fact that the phenomenon under examination does not result from the saliency of the second argument. On the other hand, if the judgement data of Experiment 2 show similar accuracies for double nominative and double accusative sentences, we will be able to attribute the results of Experiment 1 to processing mechanisms of the second argument.

3.1 Method

3.1.1 Participants Twenty-four native German speakers from the Potsdam University participated, for 10 DM each.

3.1.2 Materials Seventy-two data sets with four different forms as in the sentences presented in (14) were constructed. Each sentence contained an initial DP (ambiguous or morphologically specified) followed by a transitive verb and a final pronoun that was morphologically distinctive between nominative and accusative case. As in Experiment 1, probands were asked to decide on the grammaticality at the position of the determiner of the second DP.

The 48 experimental sentences were combined with 168 fillers. The fillers consisted of approximately the same number of phrases and were counterbalanced concerning the degree of ungrammaticality and the number of

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of a movement operation, there appears to be the tendency to bind the pronoun in a default context. This explains why sentences with such pronouns are interpretable.

topicalized phrases in analogy to the experimental material. A chance function chose 12 sentences per condition and constructed a list only when the proband ran the experimental program. After six subjects all experimental sentences had been presented in a counterbalanced way and a new trial was started automatically.

3.1.3 Procedure The sentences were presented word by word in a speeded grammaticality task. Every word appeared for 250 ms in the middle of a computer screen. In order to fix the eyes in the center of the screen, an asterisk was presented before the first word of a sentence. The ISI was 100 ms. After the last word a question mark appeared which signaled to probands that they should decide on the grammaticality of the analyzed clause as quickly as possible.

(14a)   Welcher Botschafter besuchte ihn ?
        $which_{nom}$ ambassador visited   him
        'Which ambassador visited him?'
(14b)   Welchen Botschafter besuchte er ?
        $which_{acc}$ ambassador visited   he
        'Which ambassador did he visit?'
(14c) *Welcher Botschafter besuchte er ?
        $which_{nom}$ ambassador visited   he
(14d)* Welchen Botschafter besuchte ihn ?
        $which_{acc}$ ambassador visited   him

3.2 Results

The percentages of correct answers and the mean reaction times (for correct answers only) for each experimental condition are given in Table 3.

Table 3. Percentages of correct answers (in %) and mean reaction times (in ms) for correct answers in Experiment 2 (wh-DP-V-Pronoun); corresponding examples are given in parentheses.

Condition	Subject-Object	Object-Subject
unambiguous	91/ 527 (14a)	97/ 509 (14b)
ungrammatical	79/ 726 (14c)	82/ 729 (14d)

As in Experiment 1, the data with reaction times greater than 4000 ms were excluded from the analysis (< 1% with an even distribution across conditions).

For all data with correct responses, the MANOVA revealed that there was a main effect for Grammaticality [$F_1(1,23)= 34.10$, $p<.01$, $F_2(1,71)= 67.33$, $p<.01$]. The main effect of word order and the interaction word order by Grammaticality was not significant.

Furthermore, the MANOVA gave the following results for the observed reaction time data: a significant main effect was found for Grammaticality [$F_1(1,23)= 22.58$, $p<.01$, $F_2(1,71)= 70.90$, $p<.01$]. Neither the condition Word order nor the interaction Word order by Grammaticality reached a significant level .

3.3 Discussion

The data of Experiment 2 show that there is a significant difference between grammatical and ungrammatical sentences in responses as well as in judgement times. Subjects tends to judge grammatical sentences more accurately than ungrammatical ones and the time required to decide on the grammaticality of these sentences is shorter than that required for the ungrammatical expressions.

If we are willing to accept a zero result, we see that there exists a clear contrast between the results of Experiment 1 and Experiment 2. Both the contrast in accuracy and the contrast in decision times found in the former

disappear if the second argument is a pronoun. Thus it seems that a more salient second argument leads to a better performance with regard to the recognition of the case information of this element. As a consequence, subjects are able to analyze an ungrammaticality independent of the type of case violation.

4. Experiment 3

Taking the results of the first experiments together, we see that the ˈˈillusion of grammaticality˝ in double nominative constructions varies as a function of the type of the second argument. However, in order to ensure that the differences between full DPs and pronouns visible in these experiments do indeed reflect variations in the saliency of the case feature, we will run a final experiment combining the sentences used in Experiments 1 and 2.

Furthermore, on the basis of the results obtained thus far, we cannot be sure that the effect is driven only by the processing of the second argument. Rather, there is an additional point that should be discussed in the context of the following experiment. In view of the results of Ferreira and Henderson (1991) who found that a longer ambiguous region leads to a stronger garden path effect, the linear proximity of the two DPs may be an additional factor potentially influencing the conflict resolution that must take place on the second argument. Thus, if the visibility of the first DP's case information does play a role (as suggested by F&I and by Meng & Bader 1997), increasing the distance between the two arguments should lead to a lower accuracy in all ungrammatical conditions.

The consequence for the experimental design is the inclusion of an additional phrase that intervenes between the arguments.

4.1 Method

4.1.1 Participants Twenty-four native German speakers from the Potsdam

University participated, for 10 DM each.

4.1.2 Materials The material and the total number of sentences were identical to those used in Experiments 1 and 2. In addition, we modified the first DP with a prepositional phrase in all conditions. The following sentences exemplify this extension for the double nominative condition.

(15) * Welcher Dichter aus der Vorstadt besuchte der   Gärtner
         which$_{nom}$ poet   from the suburbs visited   the$_{nom}$ gardener

(16) * Welcher Dichter aus der Vorstadt besuchte er
         which$_{nom}$ poet   from the suburbs visited   he

The conditions "word order" and "grammaticality" were specified as within-subject-factors whereas "type of second argument" (pronoun vs. non-nominal definite DP) was specified as a between-subject-factor.

4.1.3 Procedure The procedure was identical to Experiments 1 and 2.

4.2 Results

The percentages of and mean reaction times for correct answers for each experimental condition are given in Table 4.

Table 4. Percentages of correct answers (in %) and mean reaction times (in ms) for correct answers in Experiment 3 (DP vs. Pronoun).

Condition		Subject-Object	Object-Subject
unambiguous	DP	94/ 541 (15a)	92/ 533 (15b)
	Pron.	88/ 551 (16a)	91/ 553 (16b)
ungrammatical	DP	50/ 762 (15c)	70/ 680 (15d)
	Pron.	67/ 783 (16c)	69/ 809 (16d)

As in Experiments 1 and 2, all data with reaction times greater than 4000 ms were excluded from the analysis; these made up about 1% of the data in the experiment and were evenly distributed across all conditions. In addition, we used only the data for correct responses in the reaction times analysis.

An analysis of variance was performed on the means of correct responses and the means of reaction times, with both subjects, F_1, and items, F_2, as random variables

For correct responses, the MANOVA revealed that there was an overall effect of Word order [$F_1(1,47)= 6.80$, $p<.05$, $F_2(1,143)= 11.41$, $p<.01$], of Grammaticality [$F_1(1,47)= 120.88$, $p<.01$, $F_2(1,143)= 257.42$, $p<.01$], a significant interaction Word order by Grammaticality [$F_1(1,47)= 5.55$, $p<.05$, $F_2(1,143)= 11.32$, $p<.01$] and a significant interaction Type by Grammaticality [$F_1(1,47)= 11.02$, $p<.01$, $F_2(1,143)= 26.76$, $p<.01$]. In addition, there was a three way interaction Word order by Grammaticality by Type [$F_1(1,46)= 5.91$, $p<.05$, $F_2(1,143)= 11.32$, $p<.01$].
Separate analyses for the different types (pronoun, definite DP) show that the Word order effect as well as the interaction Word order by Grammaticality is caused by the differences in the definite DP condition [word order: $F_1(1,23)= 17.31$, $p<.01$, $F_2(1,71)= 19.59$, $p<.01$; word order by grammaticality: $F_1(1,23)= 6.55$, $p<.05$, $F_2(1,71)= 16.76$, $p<.01$]. In the pronoun condition neither Word order nor the interaction Word order by Grammaticality were significant. By contrast, both conditions show a significant effect of Grammaticality [non-pronominal definite DP: $F_1(1,23)= 99.72$, $p<.01$, $F_2(1,71)= 244.19$, $p<.01$; pronoun : $F_1(1,23)= 40.83$, $p<.01$, $F_2(1,71)= 74.22$, $p<.01$].

The comparison of the ungrammatical conditions shows a significant interaction Word order by Type: $F_1(1,46)= 5.04$, $p<.05$, $F_2(1,142)= 10.10$, $p<.01$]. As can be seen in Table 4, this result is based on the different responses in the double nominative condition with respect to the Type.

With respect to response time, there is a significant overall effect of Grammaticality [$F_1(1,47)= 34.05$, $p<.01$, $F_2(1,143)= 82.37$, $p<.01$].

4.3 Discussion

The results of Experiment 3 confirm our interpretation of the preceding experiments. We found that subjects judge grammatical sentences more accurately than ungrammatical ones independent of whether the argument is a pronoun or a full DP. The Word order effect visible in the response analysis is caused by the performance in the double nominative condition involving a full DP. In the grammatical conditions neither the full DP nor the pronoun condition shows a tendency for a Word order effect. As we expected, the accuracy for ungrammatical double nominative sentences is better if the second argument is realized as a pronoun. Thus, these data provide further evidence for the assumption that the peculiar accuracy pattern in ungrammatical double nominative sentences is caused by the analysis of the second argument.

5. General Discussion

In this paper we have presented three grammaticality judgement experiments. The first experiment shows that judgement accuracy is significantly lower for ungrammatical sentences than for their grammatical counterparts. In addition, and more interestingly, the judgements for double accusative ungrammaticalities are more accurate than those for double nominatives.

The second experiment, using a pronoun instead of a definite non-pronominal DP as the second argument, confirms the lower accuracy for ungrammatical sentences, while the differences between the ungrammatical conditions found in Experiment 1 disappeared.

The third and final experiment confirms the contrast induced by varying the type of the second argument. It makes clear that double nominative sentences involving a pronoun as their second argument are judged more accurately than double nominatives in which the second argument is realized by a non-pronominal definite DP. In addition, the general accuracy for ungrammatical sentences is lower in Experiment 3 than in the previous experiments. This may tentatively be taken as evidence for a linear distance effect.

In sum, in view of the data presented in this paper, the assumption that case is a trigger for a relatively costless reanalysis or a cue for a temporarily easy repair of a locally detected ungrammaticality, as stipulated by F&I, seems to be untenable.

Rather, the data are more compatible with a parsing strategy that may be termed "expectation-driven". What does this mean? If we recall in which sentences a reanalysis or an ungrammaticality can be detected, we can recognize two different types. In the first type (e.g. embedded sentences or indirect questions) the second argument is the first available disambiguating element. The second type contains an element (a pronoun) that requires additional processing cost and thereby increases the saliency of the inherent feature.

The first construction only differs from main clauses with the verb in second position, e.g. *Welche Richterin besuchte den Gärtner* (which ambassador visited the gardener), with regard to the position of the second, morphologically specified argument. Seeing that no verb intervenes between the initial ambiguous item and the disambiguating word, the first available information is the case marking on the second DP. Therefore this case information is taken to support or disconfirm the initial subject preference.

In the main clauses, the parse mechanism can be explained in the following way: on encountering the verb there is no information that contradicts the initial preference. Therefore the number agreement on the verb is taken as evidence in support of the subject preference analysis. Since there is apparent number support for the preferred parse, the case information of the second DP is not attended to. The advantage is the possibility of an early, immediate semantic interpretation. This interpretation of the data clearly predicts that in main clauses, subjects interpret an ambiguous OVS sentence as SVO. This is a strong claim which must be tested in further experiments.

The expectation-driven view presented above is supported by the sentences in (11), i.e. sentences where the visibility of the reanalysis is dependent on the existence of an earlier reanalysis. Our explanation for this effect is as follows: at first, the subject reads an initial ambiguous argument and

associates this element with a subject (nominative) reading. The second element (the relative pronoun) is also ambiguous and is therefore subject to the same preference as the first argument in the matrix clause. After the final auxiliary in the relative clause has been processed, the interpretation of the relative pronoun will be confirmed or it must be revised. In the latter case the parser takes this reanalysis in the relative clause as a signal against its preferred reading strategy. The verb following the relative clause does not resolve the ambiguity; the expectation at the point of the second argument is low with respect to an object, but high with respect to a disambiguating element. As a consequence, the case marked DP is able to give the information required to confirm or disconfirm the initial preference. In the other case, the strategy of assignment of a preferred case is successful up to the point of processing the main clause verb. In this case, which is similar to the simple wh-sentences that we presented here, there is no negative evidence for using the information of this verb. This early integration leads to an interpretable partial clause (which may be an intransitive expression). This step is an indirect confirmation of the initial preference. The final DP, independent of the type of case marking, fills the expected position. The interpretation is clearly more driven by this expectation than by the analysis of the information given by the final element.

Returning now to the ungrammatical structures that we are concerned with in this paper, we must ask what role is played by the pronominal information during an expectation driven parse. The appearance of a pronoun as the sentence final argument interrupts the automatically preferred parse described above. The saliency of this argument is now higher and thus the visibility of its case information is stronger than the expectation to find a transitive object. Consequently, double nominative constructions are recognized as ungrammatical much more accurately. While our experiments have shown that the saliency of the case information is higher for pronouns than for full definite DPs, we cannot be sure which factors this higher saliency is to be attributed to. As we argued above, it might result from the obligatory search for an antecedent (cf. Osterhout & Mobley, 1995; van Berkum et al., 1999). On the

other hand, a further plausible interpretation could be that the saliency simply results from a higher case cue validity for pronouns. In the case of a pronoun, the case information is carried by a single element, while for full definite DPs there are two elements of which only one contains the relevant information.

The view outlined above, however, cannot account for the finding of a linear distance effect in Experiment 3. Recall that this effect was observable for all ungrammatical conditions. In this way, it appears that the processing of the first DP is somehow relevant to the detection of the ungrammaticality, i.e. the longer the distance between the first and the second argument, the more difficult it is to reactivate the fieatures of the former. The contrast between double nominatives and double accusatives would then result from the fact that an accusative-initial structure is more marked from the point of processing the first argument onwards, thus rendering the case feature of this initial argument more salient. In the case of the second argument being realized by a pronoun, we must again take into account that pronouns must inevitably initiate a search for an antecedent (e.g. Osterhout & Mobley, 1995). During the course of this search, the sentence-initial DP is also scrutinized, thus leading to a reactivation of this DP's case feature and, consequently, to a more reliable detection of the ungrammaticality. While this approach may at first glance appear similar to F&I's proposed alteration of the first DP, there are fundamental differences between the two. Thus, the approach proposed here neither assumes that the case feature of the first DP is somehow "overlooked" nor that the invisibility of a reanalysis in certain contexts is due to a specific property of case and thereby a systematic alteration of the first DP's case feature. On the other hand, this proposal cannot explain the reading time data with regard to those structures in which the two arguments are separated by intervening information such as a relative clause or sentences in which the verb follows its arguments.

Finally, we are sure that the view presented here constitutes a new aspect in the discussion on the nature of reanalysis. Thus, the data strongly suggest that both expectations and input must be taken into account in this regard. To what

extent the two interreact and how their relationship to one another should be characterized, however, must be examined in further research.

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