Bridging the gap between processing preferences and typological distributions: Initial evidence from the online comprehension of control constructions in Hindi

Ina Bornkessel-Schlesewsky[†], Kamal Kumar Choudhary[†],
Alena Witzlack-Makarevich[‡] & Balthasar Bickel[‡*]
[†]*Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig*
[‡]*University of Leipzig*

Abstract

Previous empirical results have revealed an interesting correspondence between online language comprehension strategies and typological distributions, namely a preference for accusative {S,A} alignment over ergative {S,O} alignment. In the processing domain, this preference is reflected in the preferred analysis of an initial ambiguous argument. In the typological domain, it can be seen in the higher tendency for language change to proceed from an {S,O} to an {S,A} alignment rather than vice versa. A correlation between these two observations would clearly be of interest for theoretical models of alignment patterns. However, before the assumption of such a correspondence is warranted, two problems need to be solved: (a) the time sensitivity of online processing data vs. the time insensitivity of typological distributions; and (b) the domain of application of the {S,A} preference in processing (identification of roles) and typology (roles being treated in the same way by some syntactic phenomenon). The present study, in which we examined the {S,A} preference in the processing of control constructions in Hindi, provides initial evidence that both of these problems can be overcome. On the basis of these empirical findings, we formulate a hypothesis about the correspondence between processing and typology and outline how it can be tested in future research.

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1. Introduction

The most fundamental goal of linguistic research is to identify the underlying characteristics of language, i.e. to determine why human languages are organised in the way that they are. The particular approach adopted in order to address this question differs between the various linguistic subdisciplines: grammatical theories seek to explain which utterances occur in the languages of the world and how these serve to mediate between form and meaning; language typology is concerned with cross-linguistic generalisations and distributions and the question of what explains these distributions; psycholinguistic theories attempt to account for the way in which linguistic utterances are produced and comprehended in real time. In spite of the fact that all of these fields approach language from fundamentally different perspectives, they (and the additional linguistic subdisciplines not mentioned here, e.g. sociolinguistics) all engage in the common endeavour of uncovering the hidden "pressures" that serve to shape languages. Arguably, the strongest conclusions as to what these pressures might be can be drawn when there is converging evidence from several different domains. In this paper, we present initial evidence for one such apparent convergence between language typology and psycholinguistics.

The remainder of the paper is organised as follows. We first introduce the phenomenon of interest, the "subject-preference" in language comprehension, before going on to describe its typological parallels. In the fourth section of the paper, we develop a hypothesis about the relationship between this processing strategy and typological distributions, which is then tested in an experiment on Hindi in section five. Finally, section six discusses the experimental findings and their theoretical consequences, before section seven presents an outlook.

2. The "subject preference" as a strategy for online language comprehension

In order to meet the demands of efficient communication, language must be produced and understood in real time. This means, for example, that the human language processing system cannot "wait" until the end of a sentence is reached in order to begin comprehending it – if this were the case, natural dialogue would be virtually impossible. Rather, it is standardly assumed that interpretation is "incremental" in the sense that each incoming word is immediately integrated with the representations already established and interpreted as fully as possible (e.g. Marslen-Wilson, 1973; Crocker, 1994; Stabler, 1994). Consequently, interpretive choices must often be made in the absence of complete and unambiguous information. Consider, for example, the following German sentence fragments:

(1)	a.	Welche Studentin	besuchte …
		[which student]:NOM/ACC.SG	visited.3SG …
	b.	Welche Studentin	besuchten …
		[which student]:NOM/ACC.SG	visited.3PL …

Both (1a) and (1b) begin with the wh-phrase *welche Studentin* ('which student'), which is morphologically ambiguous between nominative and accusative case marking and, thereby, between a subject and an object reading. When it encounters *welche Studentin*, the language comprehension system therefore cannot be sure which of these two potential readings will turn out to be correct. A subject reading is subsequently ruled out when a plural verb is encountered in a sentence such as (1b), due to the absence of obligatory subject-verb agreement. This type of disambiguation towards an object reading has been shown to lead to increased processing costs in a wide range of psycholinguistic and neurolinguistic experiments. For sentences such as (1), for example, a comparison between *besuchten* in (1b) and *besuchen* in (1a) has been shown to yield increased reading times (Schlesewsky, Fanselow, Kliegl, & Krems, 2000) and increased neural activity in terms of event-related brain potentials (beim Graben, Schlesewsky, Saddy, & Kurths, 2000; Knoeferle, Habets, Crocker, & Münte, 2008). Observations such as these serve to illustrate the "subject preference": the tendency to analyse an ambiguous first argument as the subject of the sentence. The subject preference has been observed in a range of languages including Dutch (Frazier, 1987), Italian (de Vincenzi, 1991), Spanish (Casado, Martín-Loeches, Muñoz, & Fernández-Frías, 2005) and English (Lee, 2004). It thus appears to constitute a rather robust strategy of online language comprehension.

In the psycholinguistic literature, the subject preference is most commonly explained in structural terms. For example, it has been assumed that a subject analysis of an initial argument serves to minimise the distance between filler and gap (Frazier & Flores d'Arcais, 1989; Crocker, 1994) or, under certain circumstances, avoids the need to postulate a movement chain altogether (de Vincenzi, 1991). An alternative hypothesis that needs to be considered is that a subject-initial reading is simply the most frequent in the languages in question (see, for example, MacDonald & Christiansen, 2002, for a possible experience-based account).

These competing explanations have recently been subjected to empirical scrutiny by means of systematic investigations in typologically varied languages. For example, Demiral, Schlesewsky, and Bornkessel-Schlesewsky (2008) observed a subject preference for initial case ambiguous arguments in Turkish, a subject-object-verb language allowing (or even favouring) subject drop. In Turkish, an initial ambiguous argument is compatible with two alternative analyses that do not involve filler-gap relations: a subject reading and an object reading in a sentence with a dropped subject. The finding of a subject preference in this language thus cannot be explained by a filler-gap-based account. Furthermore, the fact that Demiral et al. (2008) observed an equally strong subject preference for animate and inanimate arguments (in terms of event-related brain potential measures; ERPs) is not easily reconciled with a frequency-based account: corpus analyses suggest that the likelihood of an object reading is much higher for initial case-ambiguous inanimate arguments than for their animate counterparts. Further findings from Japanese, which is very similar to Turkish in structural terms but does not have subject-verb agreement, suggest that the subject preference also cannot be reduced to the processing system's endeavour to saturate agreement as quickly as possible (Wolff, Schlesewsky, & Bornkessel-Schlesewsky, 2007).

The overall pattern of cross-linguistic findings was recently rendered even more intriguing by the observation of a subject preference in Mandarin Chinese (Wang, Schlesewsky, Bickel, & Bornkessel-Schlesewsky, in press).[1] Whereas all of the languages referred to above (German, English, Dutch, Italian, Spanish, Turkish, Japanese) show relatively robust evidence for a "subject" category, the subject-object distinction has proved much more controversial in Chinese (see, for example, LaPolla, 1993; Bisang, 2006, and the references cited therein). This suggests that the subject preference can affect the time course of comprehension even in a language where the notion of subject plays only an extremely limited role in syntax.

[1]Note that the subject preference reported by Wang et al. (in press) was again observable for inanimate arguments, thereby ruling out explanations in terms of semantic properties like natural agency

The cross-linguistic observations about the subject preference suggest that it is difficult to establish a particular trigger for this preference that might be cross-linguistically applicable. In this way, the subject preference could tentatively be classified as a primitive of language processing, i.e. as a strategy that is universally applied in the first stages of analysing an initial (ambiguous) NP. But is it not a contradiction in terms to assume that a "subject"-preference applies even in languages which provide only little or no evidence for a subject category? This can be avoided if the subject preference hypothesis is reformulated in somewhat more theory neutral terms. Following Bickel (in press), grammatical relations are "equivalence sets of arguments, treated the same way by some construction in a language, e.g. being assigned the same case in a language, or triggering the same kind of agreement". In terms of this definition, the traditional category of "subject" corresponds to an equivalence of S-arguments and A-arguments, i.e. to the set {S,A}. Note that, here and in the following, we use the labels S, A, and O for generalised argument roles in the spirit of Comrie (1978) and Dixon (1994). S is the sole argument of intransitives; A and O are the two arguments of monotransitives. They are differentiated from each other by their semantic entailments in terms of volition, causation, sentience, motion, and independent existence in the sense of Dowty (1991) or by an equivalent framework of role semantics (e.g. Van Valin, 2005). In this way, the subject preference hypothesis can be reformulated as in (2):

(2) *The subject preference hypothesis*[2]
For the initial analysis of an ambiguous first argument, the language comprehension system universally prefers an {S,A} reading.

Within a recent cross-linguistic neurocognitive model of sentence comprehension, the extended Argument Dependency Model (eADM; Bornkessel & Schlesewsky, 2006; Bornkessel-Schlesewsky & Schlesewsky, in press; Bornkessel-Schlesewsky & Schlesewsky, to appear), the subject preference as defined in (2) is attributed to a comprehension principle termed "Distinctness", which states that arguments should be as distinguishable from one another as possible. The simplest way for an

[2]The examples discussed above all provided evidence that the comprehension system prefers an A-reading over a O-reading. For evidence for an S-preference, see Bornkessel-Schlesewsky and Schlesewsky (to appear).

argument to be distinct is for it to be the only argument, i.e. an S. When an S reading is ruled out, an A reading is preferred because it serves to maximise the defining properties of the argument and, at the same time, to minimise dependencies. This perspective is based on Primus' (1999) modification of Dowty's (1991) proto-role approach, according to which only A arguments have "true" prototypical role properties (e.g. control, sentience, causation), whereas the defining characteristic of an O argument is its semantic dependency on an A argument (i.e. O arguments are controlled, the target of sentience, causally affected). By positing an A reading, the processing system can therefore maximise the distinguishing features of the ambiguous argument and also avoid the postulation of the additional dependencies that would be required in the case of an O argument. In this way, the "subject preference" is considered an epiphenomenon of a more general processing requirement.

In the following section, we show that an {S,A} preference can also be motivated on the basis of typological evidence.

3. Typological evidence

As first noted by Nichols (1993), ergative alignment of case marking, i.e. equivalent marking of S and O as opposed to A, is a recessive feature in the languages of the world, i.e. a feature that is prone to be lost in diachronic development and strongly intermixing with accusative patterns . This can be shown by the two kinds of typological analyses of the dataset discussed by Bickel & Witzlack-Makarevich (2008) in this volume. The dataset contains 492 alignment patterns worldwide; each language can contribute as many alignment sets as it has, e.g. if they are split across tense forms or referential categories.

First, we applied the genealogical sampling algorithm proposed by Bickel (2008). This algorithm extracts all genealogical units ('families') at any given taxonomic level that are either isolates not known to be diachronically related to any other system or, if they are not isolates, likely to be independent of their known ancestor, i.e. to represent results of language change. The likelihood of diachronic independence is assessed by whether or not there is a trend towards a uniform type within each unit: if there is one, it is likely that it is caused by diachronic dependency; if not, this is unlikely. The result of applying this algorithm shows that there are only 20% (39 out of 194) genealogical units with ergative case alignment (defined as treating A unlike S, and therefore including also systems that treat A and O alike or that treat all three roles differently). All other units show alignments of A with S (and possibly also O). (This proportion is significant under an exact binomial test, p<.001.) Of the units skewed towards A≠S, only 43% (17 out of 39) are at the highest known taxonomic node ('stocks' and stock-level isolates like Siuslan, Trans-Fly, Mirndi, or Basque), all others are at shallower levels. Of the units skewed towards A=S, by contrast, 89% (136 out of 155) are at the stock level (e.g Austroasiatic, Muskogean, Uralic etc). This difference between the proportion of stock levels with A≠S vs. A=S skewing is significant under a Fisher Exact Test (p=.027). This suggests that even at the largest known time depths, families tend to exhibit strong skewings towards S=A alignments and that S≠A aligments tend survive as strong trends only at shallower time depths, in short: families tend to 'change away' from S≠A.

In the second type of analyses, we concentrate on non-singleton families with at least five known members (in our database, this is $N = 57$) and measured the odds for each highest-level family (stocks) to have A=S as opposed to A≠S alignments.[3] The mean odds for A=S across stocks is 3.52 (SD=2.84, range=[.2,29]), meaning that on average, stocks are 3.5 times more likely to prefer skewings towards A=S rather than A≠S alignments. The difference from μ=1, which represents equiprobable trends, is significant under an exact permutation t-test (p<.001). Thus, under this approach, we observe again a strong trend towards A=S alignments within genealogical units. Since these are domains of language change, this suggests that overall, there must have been many more diachronic events leading to A=S than diachronic events leading to A≠S alignments.

In fact, recent work by Maslova & Nikitina (2007) finds the same distributional pattern by applying yet another method of assessing diachronic change probabilities.

This typological finding is unexpected given what is known about discourse patterns, which is one plausible factor affecting diachronic change. As has been shown for many languages worldwide, there is a very strong cross-linguistic trend towards reserving overt lexical NPs to S and O

[3]For statistical purposes, we took the natural logarithm of this and added a constant of .5 to each count for avoiding division by zero, i.e.

$$\text{logit}\,(S = A) = \log\left(\frac{N\,(\text{S} = \text{A}) + .5}{N\,(S \neq A) + .5}\right).$$

We report the plain odds, i.e. the exponentiated logits.

functions (DuBois, 1987; DuBois, 2003). If these are the most common NPs, Zipfian considerations would lead one to expect that, across language, they are unmarked, i.e. assigned a morphologically zero absolutive. Yet, this seemingly natural pattern is diachronically recessive, and so we need to turn to other possible factors affecting language change.

4. Linking processing and typology

In the preceding sections, we showed that findings from online language comprehension and language typology provide converging support for an {S,A} preference. This overlapping observation in very different types of data might therefore be a potential candidate for the type of cross-fertilisation across linguistic subdisciplines to which we alluded in the introduction. In order to determine whether this is indeed the case, however, we need to ascertain whether there is a systematic correlation between the {S,A} preference in processing and typology/language change. This goal is challenging for at least two reasons:

(a) *Time sensitivity*. Processing findings are time sensitive, i.e. they reflect the interpretive choices made as a sentence unfolds over time, typically in the face of incomplete information. By contrast, typological findings are time insensitive, i.e. they reflect the distribution of particular structures/constructions over the languages of the world.

(b) *Domain of the {S,A} preference*. The {S,A} preference in processing has thus far been observed in relation to role identification ("Is an argument S, A or O?") in single sentences. By contrast, typological observations with respect to the {S, A} preference make reference to alignment patterns, i.e. to S and A arguments being treated the same way by some grammatical construction (including case marking or agreement).

In order to assess possible correlations between the {S,A} preferences in processing and typology we thus first need to reconcile these diverging viewpoints with respect to time sensitivity and the domain of the {S,A} preference.

With respect to the issue of time sensitivity, we would like to pursue the conjecture that the relationship between the subject preference as a mechanism of initial processing choice and final sentence interpretation could be explained by the way in which the subject preference is modulated over the time course of the comprehension process (Wang et al., in press). Crucially, while the subject preference applies as soon as the brain processes a first NP (cf., for example, beim Graben et al., 2000; Knoeferle et al., 2008), it can be overridden by information encountered further down the track. The ease or difficulty of the reanalysis towards a O-reading is determined by the strength of the evidence against an {S,A} reading. This can be illustrated on the basis of the Turkish examples in (3) (from Demiral et al., 2008).

(3)	a.	Dün	adam	gör-dü-m.
		Yesterday	man[NOM]	see-PST-1SG
		'I saw (a) man yesterday.'		
	b.	Dün	taş	gör-dü-m.
		Yesterday	stone[NOM]	see-PST-1SG
		'I saw (a) stone yesterday.'		

Both (3a) and (3b) involve a reanalysis towards an O reading of the initial argument, as evidenced by direct measures of neural activity (event-related brain potentials, ERPs) at the critical clause-final verb (Demiral et al., 2008). At this position, both (3a) and (3b) engendered an early parietal positivity (200-600 ms post verb onset) in comparison to unambiguous controls (like 3a/b, but with an unambiguously case marked object). As already mentioned briefly in section 2, the ERP responses did not differ between (3a) and (3b), thereby suggesting that the initial processing conflict that is induced by the disambiguation towards an O reading is similar in both cases. Crucially, however, the two sentence types differ in terms of acceptability: whereas both give rise to an acceptability drop in comparison to unambiguous controls when judgements are given under time pressure, this drop is considerably more pronounced for the sentences with animate ambiguous arguments (judged to be acceptable in 76% of all cases as opposed to 98% for the comparable unambiguous control sentence) than for those with inanimate ambiguous arguments (acceptability of 87% vs. 99% for comparable unambiguous controls).[4] These findings suggest that – while

[4]As shown by an additional questionnaire study, sentences with ambiguous inanimate arguments (3b) are judged to be even more acceptable when judgements are given without time

the initial processing conflict is comparable for (3a) and (3b) – the final interpretation of an initial ambiguous argument as an O (rather than S or A) is facilitated when the argument lacks prototypical A-properties (e.g. volition or sentience in the case of an inanimate). Hence, even though both (3a) and (3b) involve a reanalysis of an initial {S,A} preference, the visibility of this reanalysis (from the perspective of surface measures like acceptability judgements) can vary considerably. Thus, final interpretation preferences do not always reflect initial processing choices.

This view of the subject preference as an initial and violable online processing preference allows us to reconcile the assumption that this preference is universal with the overt existence of A≠S=O, S≠A=O, and S=A=O alignment patterns in the languages of the world. For example, it could explain why Chinese grammaticalizes S=A alignments only to a very limited extent, in spite of the fact that it shows a subject preference for an initial NP during online sentence comprehension. Unlike languages like Italian or Modern Greek, Chinese allows dropping of arguments ('pro-drop') equally well for S, A and O, i.e. shows S=A=O alignment, so that, given an appropriate pragmatic context, an expression like *chi-le* [eat-PFV] 'he/she/it/someone ate it/something' can be a full sentence referring to a specific (or non-specific) person having eaten a specific (or non-specific) piece of food. In line with this, Chinese has not grammaticalized any construction of the kind corresponding to what is called 'conjunction reduction' in English. Therefore, there are no constraints on argument coreference in examples like the following (LaPolla, 1993):

(4)

Nei ge	ren	ba	xigua	diao	zai	dishang,
that CL	person	BA	watermelon	drop	LOC	ground

sui	le.
broke-to-pieces	ASP

'That man dropped the watermelon on the ground, (and it) burst.'

This example brings us to the second challenge raised above, namely to the domain of application of the {S,A} preference. If we are correct in assuming a correlation between the {S,A} preference as a (possibly) universal mechanism of initial choice during sentence processing and the {S,A} preference identified in language typology, the processing preference should extend beyond role identification and also be observable for the

pressure. Under these circumstances, the acceptability difference between sentences such as (3b) and their unambiguous counterparts is no longer fully reliable statistically.

processing of grammatical relation (GR) identifying constructions in the sense of Bickel (in press). GR-identifying constructions are syntactic phenomena that treat subsets of argument roles in the same way (see Section 3). From this perspective, an {S,A} preference would involve S and A arguments being assigned the same case marking, bearing the same agreement, or underlying the same restrictions in raising, relativisation, conjunction reduction etc. To the extent that this type of {S,A} preference has been shown in previous studies of language processing, it has always overlapped with role identification preferences of the type described above.

In view of these considerations, the present study aimed to provide initial empirical evidence for the existence of an {S,A} preference in the processing of GR-identifying constructions. Furthermore, we aimed to investigate whether the temporal dimensions of the {S,A} preference in online role identification (see above) also extend to the processing of features such as agreement, i.e. whether an initial {S,A} preference can be weakened by the presence of additional features or constructions that do not treat S and A alike.

5. The present study: Testing the {S,A} preference for agreement in control constructions in Hindi

As described in the preceding section, the aim of the present study was to test whether the {S,A} preference in online language comprehension extends to GR-identifying constructions (specifically: agreement) and whether it is subject to a similar temporal modulation as the {S,A} preference in role identification. To this end, we examined the processing of agreement in control constructions in Hindi, using event-related brain potentials (ERPs) as a dependent measure. ERPs are small changes in the spontaneous electrical activity of the brain that occur in response to sensory or cognitive stimuli. On account of their excellent temporal resolution (in the range of milliseconds), they are extremely well suited to revealing online processing preferences as a sentence unfolds. For an introduction to the ERP methodology and its application to language processing, see Kutas, Van Petten, and Kluender (2006) and Bornkessel-Schlesewsky and Schlesewsky (forthcoming).

Control constructions in Hindi are optimally suited to examining the hypothesis that the strength of the {S,A} preference for an initial argument

– and the distance over which it is maintained – should correlate with the number of {S,A} oriented constructions with which the initial ambiguous NP is compatible. As will be explained in more detail in the following subsection, these constructions offer no less than three positions at which a possible {S,A} preference can be manipulated via agreement-related properties: NP1, the infinitive and the control verb. This will be explained in further detail in the following.

5.1. Experimental design and hypotheses

The critical sentence conditions for the present study (see Table 1) involve a manipulation of the following factors: the case marking of the matrix subject (nominative vs. ergative), the agreement properties of the infinitival verb (masculine vs. feminine) and the agreement properties of the control verb (masculine vs. feminine). Before motivating the choice of each of these factors in turn, we will briefly describe the relevant details of the Hindi agreement system.

Condition	Examples	Acceptability Judgement		Comprehension question	
		Accept ability (%)	RT (ms)	Accuracy (%)	RT (ms)
A – NMM	Raam$_i$ [ø$_i$ saikal calaa-naa] caah-taa hai. R.(M)[NOM] [NOM cycle(F)[NOM] ride-INF.M] want-IPFV.M AUX 'Raam wants to ride a bicycle.'	95 (4)	496 (195)	89 (6)	1981 (402)
B – NFM	Raam$_i$ [ø$_i$ saikal calaa-nii] caah-taa hai. R.(M)[NOM] [ERG cycle(F)[NOM] ride-INF.F] want-IPFV.M AUX 'Raam wants to ride a bicycle.'	67(29)	601 (232)	88 (6)	2082 (432)
C – NFF	*Raam$_i$ [ø$_i$ saikal calaa-nii] caah-tii hai. R.(M)[NOM] [ERG cycle(F)[NOM] ride-INF.F] want-IPFV.F AUX 'Raam wants to ride a bicycle.'	15 (16)	565 (243)	83 (12)	2077 (382)
D – EMM	Raam-ne$_i$ [ø$_i$ saikal calaa-naa] caah-aa hai. R.(M)-ERG [NOM cycle(F)[NOM] ride-INF.M] want-IPFV.M AUX 'Raam wanted to ride a bicycle.'	78 (24)	607 (258)	89 (7)	2073 (418)
E – EFM	*Raam-ne$_i$ [ø$_i$ saikal calaa-nii] caah-aa hai. R.(M)-ERG [ERG cycle(F)[NOM] ride-INF.F] want-IPFV.M AUX 'Raam wanted to ride a bicycle.'.	27 (25)	709 (253)	83 (9)	2215 (450)
F – EFF	Raam-ne$_i$ [ø$_i$ saikal calaa-nii] caah-ii hai. R.(M)-ERG [ERG cycle(F)[NOM] ride-INF.F] want-IPFV.F AUX 'Raam wanted to ride a bicycle.'.	88 (8)	558 (207)	87 (6)	2033 (425)

Table 1: Overview of the six critical conditions in the present study and summary of the behavioural results (by-participant means, with standard deviations given in parentheses).

In Hindi, verbs agree with the highest-ranking nominative argument in terms of number, gender and person (Mohanan, 1994). Thus, when there is a nominative S or A argument, it triggers verb agreement (cf. the agreement between the matrix subject *Raam* and the verb *caahtaa* in conditions A/B in Table 1 and the ungrammaticality of condition C). By contrast, when the A argument bears non-nominative case marking (e.g. ergative or dative), agreement is with the nominative O argument. When there is no nominative argument in the clause, the verb typically bears default (3rd person, masculine, singular) agreement (cf. condition D). Under certain circumstances, however, it may also agree with an argument in an embedded infinitival clause (Mahajan, 1990; Butt, 1995). This type of "long distance agreement" is illustrated by condition F in Table 1: here, the matrix verb (*caahii*) agrees with the feminine object in the control clause (*saikal*). However, while both default and long distance agreement are possible when the matrix subject bears ergative case marking, there must be a correspondence between whatever agreement it bears and the agreement of the infinitival verb. Hence, conditions D and F are possible, while condition E is ungrammatical. Finally, for embedded infinitival clauses with a shared argument, Hindi allows either a nominative or an ergative agreement pattern. As is apparent from Table 1, the infinitival verb in the control clause either agrees with the shared (and covert) argument (when it bears masculine agreement features; conditions A/D) or with the object in the control clause (when it bears feminine agreement features; conditions B/C/E/F). In the first of these patterns, the shared argument is associated with nominative case. In the second, it is identified as ergative-bearing via the object agreement pattern (see Bickel & Yadava, 2000).

With this background in mind, we can now turn to a closer description of the experimental design of the present study, focusing on the three critical manipulations related to a possible {S,A} preference: case marking of NP1, agreement of the infinitive, and agreement of the control verb.

Case marking of the first NP. As described above, only nominative arguments agree with the verb in Hindi. Hence, whereas both nominative and ergative first NPs are compatible with an {S,A} preference in terms of role identification, only nominative also allows for such a preference to be upheld in a GR-identifying construction, namely agreement. A nominative matrix subject should therefore set up an {S,A} preference with respect to agreement, whereas an ergative matrix subject should not.

Agreement properties of the infinitive. Depending on the agreement features of the infinitival verb, the embedded clause either shows a nominative or an ergative agreement pattern. It therefore either strengthens the {S,A} preference for the matrix subject (by introducing an additional {S,A} agreement relation for the shared argument) or counteracts it (via agreement with the O-argument in the control clause). If we are correct in assuming that the {S,A} preference for GR-identifying constructions can be strengthened or weakened by supporting or contradictory evidence in other constructions, the agreement pattern in the embedded clause should influence the resolution of the agreement relation in the matrix clause.

Agreement properties of the control verb. The control verb constitutes the critical position of interest in the present study. Its agreement properties can be used as a diagnostic tool for the strength of the {S,A} preference in the processing of agreement: if the preference is still operative once the control verb is reached, the absence of gender agreement between the initial NP and the verb should lead to a measurable increase in processing costs. By contrast, if the preference has been counteracted by other information since the processing of NP1, the effects of the agreement mismatch at the control verb should be measurably weaker. Specifically, we do not expect to observe costs of a gender mismatch in the ergative conditions, because here the case marking prevented an {S,A} agreement preference from being established in the first place. For the nominative conditions, by contrast, we expect the strength of the gender mismatch to be modulated by the agreement properties of the control clause as described above.

In order to examine these issues empirically, we analysed the ERPs at the position of the control verb in terms of two factors: case marking of the matrix subject (CASE: nominative vs. ergative) and gender agreement of both the infinitive and the control verb (GENDER: masculine infinitive – masculine control verb: MM; feminine infinitive – masculine control verb: FM; feminine infinitive – feminine control verb: FF). If we are correct in assuming that both the case marking of the matrix subject and the agreement properties of the infinitive serve to modulate the {S,A} preference for agreement in the matrix clause, we can expect to observe an interaction between CASE and GENDER at the position of the control verb. The expectation for masculine agreement (i.e. agreement with the matrix subject, the first NP affected by the {S,A} preference) should be strongest when the matrix subject is nominative-marked and when the infinitival agreement is also masculine (thereby strengthening the preference).

5.2. Materials and Methods

Participants
Twenty-four native speakers of Hindi participated in the experiment (5 women; mean age 27.58 years, range 23-39). All were right-handed as assessed by an adapted Hindi version of the Edinburgh handedness inventory (Oldfield, 1971). At the time of their participation in the experiment, all participants were residing in Berlin, Germany. All participants had learned Hindi before the age of six, but most also spoke one or more other Indian languages. A further four participants were excluded from the final data analysis due to excessive EEG artefacts.

Materials
Eighty sets of the six sentence conditions shown in Table 1 were constructed. The matrix subject was always a masculine proper name and the argument in the infinitival clause was always an inanimate argument of feminine gender. The 480 sentences thus resulting were subdivided into two lists, each containing forty sentences per critical condition (240 in total) and 3 sentences with similar lexical materials. Each list was combined with 160 additional filler sentences. The fillers were acceptable and unacceptable simple main clauses, thereby serving to ensure that participants would not invariably expect to encounter an embedded control clause in every sentence presented to them. List presentation was counterbalanced across participants.

Procedure
Sentences were presented visually in the centre of a computer screen in a word-by-word manner (nouns and case markers were presented together). Each word was presented for 650 ms, followed by an inter-stimulus-interval (ISI) of 100 ms. Each trial began with the presentation of an asterisk (1000 ms plus 200 ms ISI) and ended with a 1000 ms pause, after which participants completed two behavioural tasks. Firstly, they judged whether the sentence that they had just heard was an acceptable sentence of Hindi or not. As a cue for the judgement task, three question marks appeared in the centre of the computer screen. After a participant's response or after the maximal response time of 3000 ms had expired, a comprehension question appeared in the centre of the screen (see 5 for an example). Participants were required to judge whether this question was correct with respect to the preceding sentence or not.

(5) kya mohan saikal
Q Mohan(MASC)[NOM] bicycle(FEM)[NOM]
calaa-naa caah-taa hai ?
ride-INF.MASC want-IPFV.PTCP AUX.
'Does Mohan want to ride a bicycle?'

The comprehension task required the answers 'yes' and 'no' equally often, with 'no' responses required in the case of an exchanged content word. The maximal response time for the comprehension task was 4500 ms. After both tasks had been completed, there was a 2000 ms pause before the beginning of the next trial.

The experimental session was subdivided into 10 blocks of 40 sentences each and lasted approximately 3 hours including electrode preparation.

EEG recording

The EEG was recorded by means of 25 AgAgCl-electrodes fixed at the scalp by means of an elastic cap (Electro Cap International, Eaton OH). AFZ served as the ground electrode. Recordings were referenced to the left mastoid, but rereferenced to linked mastoids offline. The electro-oculogram (EOG) was monitored by means of electrodes placed at the outer canthus of each eye for the horizontal EOG and above and below the participant's right eye for the vertical EOG. Electrode impedances were kept below 5 kOhm. All EEG and EOG channels were amplified using a Twente Medical Systems DC amplifier (Enschede, The Netherlands) and recorded with a digitization rate of 250 Hz.

In order to eliminate slow signal drifts, a 0.3-20 Hz band-pass filter was applied to the raw EEG data. Subsequently, average ERPs were calculated per condition per participant from the onset of the critical word to 1000 ms post onset, before grand-averages were computed over all participants. Trials for which the comprehension task was not performed correctly were excluded from the averaging procedure, as were trials containing ocular, amplifier-saturation or other artefacts (the EOG rejection criterion was 40μV).

Data Analysis

For the acceptability judgement task, mean acceptability ratings and reaction times were calculated for each condition. For the comprehension task, error rates and reaction times were calculated for each condition. Incorrectly answered trials were excluded from the reaction time analysis for the comprehension task. In all cases, we computed repeated-measures analyses of variance (ANOVAs) involving the condition factors CASE (unmarked first NP vs. ergative first NP), and GENDER (masculine infinitive – masculine control verb: MM; feminine infinitive – masculine control verb: FM; feminine infinitive – feminine control verb: FF) and the random factors participants (F_1) and items (F_2).

For the statistical analysis of the ERP data, repeated-measures ANOVAs were calculated for mean amplitude values per time window per condition in four regions of interest (ROIs). Lateral ROIs were defined as follows: *left-anterior* (F3, F7, FC1, FC5); *left-posterior* (CP1, CP5, P3, P7); *right-anterior* (F4, F8, FC2, FC6); *right-posterior* (CP2, CP6, P4, P8). For the midline electrodes, each electrode (FZ, FCZ, CZ, CPZ, PZ, POZ) was treated as a ROI of its own. When the analysis involved factors with more than one degree of freedom in the numerator, we applied the correction of Huynh and Feldt (1970) in order to avoid Type I errors due to violations of sphericity.

For both the behavioural and the ERP data, the alpha-levels for pairwise comparisons between the three leves of the factor GENDER were corrected for multiple comparisons according to a modified Bonferroni procedure (Keppel, 1991). Only effects that reached the corrected probability level of $p<0.033$ were considered significant (with $p<0.04$ amounting to a marginally significant effect). In the following, we report uncorrected probability levels for all effects meeting the significance criterion.

5.3. Results

5.3.1 Behavioural data

Table 1 shows mean acceptability ratings and reaction times for the acceptability judgement task and mean percentages of correct answers and reaction times for the comprehension task.

Acceptability judgement task

For the acceptability ratings, a repeated measures ANOVA revealed a main effect of GENDER ($F_1(2,46)=61.78$, $p<0.001$; $F_2(2,158)=351.38$, $p<0.001$), and an interaction of CASE x GENDER ($F_1(2,46)=136.56$, $p<0.001$; $F_2(2,158)=756.69$, $p<0.001$). The main effect of CASE only reached significance in the analysis by items ($F_1(1,23)=0.88$, $p<0.36$; $F_2(1,79)= 32.73$, $p<0.001$). Resolving the interaction CASE x GENDER by CASE revealed an effect of GENDER for sentences with a nominative matrix subject ($F_1(2,46)=119.49$, $p<0.001$; $F_2(2,158)=814.18$, p<0.001) and for sentences with an ergative matrix subject ($F_1(2,46)= 74.12$, $p<0.09$; $F_2(2,158)=357.74$, $p<0.001$). Pairwise comparisons between the three levels of the factor GENDER revealed significant differences between all three conditions for sentences with nominative subjects (all F_1s > 23.50, ps < 0.001; all F_2s > 192.50, ps < 0.001). For sentences with ergative subjects, the difference between MM and FF only reached marginal significance in the analysis by participants ($F_1(1,23)=3.42$, $p<0.08$), while all other comparisons were significant (all F_1s > 118.50, ps < 0.001; all F_2s > 9.40, ps < 0.01).

The reaction times for the acceptability judgement task showed main effects of CASE ($F_1(1,23)=13.19$, $p<0.001$; $F_2(1,79)=30.92$, $p<0.001$) and GENDER ($F_1(2,46)=14.16$, $p<0.001$; $F_2(2,158)=42.40$, $p<0.001$) as well as an interaction CASE x GENDER ($F_1(2,46)=6.15$, $p<0.004$; $F_2(2,158)=13.24$, $p<0.001$). Resolving the interaction by CASE showed main effects of GENDER for sentences with nominative matrix subjects ($F_1(2,46)=10.17$, $p<0.001$; $F_2(2,158)=18.30$, $p<0.001$) and for sentences with ergative matrix subjects ($F_1(2,46)=10.79$,p<0.001; $F_2(2,158)=35.30$, $p<0.001$). For sentences with a nominative subject, pairwise comparisons between conditions showed a significant difference between conditions MM and FF ($F_1(1,23)=7.59$, $p<0.01$; $F_2(1,79)=19.13$, $p<0.001$) and between conditions MM and FM ($F_1(1,23)=17.23$, $p<0.001$; $F_2(1,79)=31.27$, $p<0.001$), while the difference between conditions FF and FM only reached marginal significance in the analysis by items ($F_1(1,23)=3.11$, $p<0.09$; $F_2(1,79)=3.71$, $p<0.06$). For the pairwise comparisons between the conditions with ergative subjects, only the difference between conditions MM and FF failed to reach significance in the analysis by participants ($F1(1,23)=2.08$, $p<0.16$), while all other comparisons showed significant differences (all F_1s > 8.60, ps < 0.01; all F_2s > 8.20, ps < 0.01).

In summary, the acceptability judgement task revealed acceptability differences between all three conditions with nominative subjects and all three conditions with ergative subjects. Crucially, the precise nature of the acceptability pattern differed depending on the case marking of NP1 (nominative: MM > FM > FF; ergative: FF > MM > FM). The acceptability differences between conditions were mirrored by the reaction times. For sentences with nominative subjects, responses were significantly faster for condition MM than for the other two conditions, with an additional trend for FF to be faster than FM. For sentences with ergative subjects, condition FM gave rise to slower reaction times in comparison to both FF and MM, here with an additional trend for FF to be faster than MM.

Comprehension question

The statistical analysis of the error rates for the comprehension task showed a main effect of GENDER ($F_1(2,46)=6.55$, $p<.001$; $F_2(2,158)=3.16$, $p<0.05$) and an interaction of CASE x GENDER ($F_1(2,46)=6.28$, $p<.003$; $F_2(2,158)=3.16$, $p<0.04$). Separate analyses for the two levels of CASE revealed an effect of GENDER for sentences with nominative matrix subjects ($F_1(2,46)=5.77$, $p<0.006$; $F_2(2,158)=4.77$,$p<0.009$), while this effect was only significant in the analysis by participants for sentences with ergative matrix subjects ($F_1(2,46)=7.60$, $p<0.001$; $F_2(2,158)=2.13$,$p<0.12$). Pairwise comparisons for the nominative conditions showed a significant difference between FF and FM ($F_1(1,23)=5.08$, $p<0.03$; $F_2(1,79)= 4.85$, $p<0.03$) and between FF and MM ($F_1(1,23)=8.12$, $p<0.01$; $F_2(1,79)=9.75$, $p<0.01$), while conditions FM and MM did not differ from one another ($F_1/F_2 < 1$). For the ergative conditions, the difference between conditions MM and FM was significant ($F_1(1,23)=11.17$, $p<0.01$; $F_2(1,79)=3.82$, $p<0.05$), whereas the comparison between FF and FM only yielded a significant difference in the analysis by participants ($F_1(1,23)=7.60$, $p<0.01$; $F_2(1,79)=2.08$, $p<0.15$) and the comparison between MM and FF was not significant in either analysis ($F_1(1,23)=1.17$, $p<0.29$; $F_2 < 1$).

The reaction times for the comprehension task showed main effects of CASE ($F_1(1,23)=11.20$, $p<.002$; $F_2(1,79)=5.79$, $p<0.02$) and GENDER ($F_1(2,46)=11.88$, $p<.001$; $F_2(2,158)=10.47$, $p<0.001$) and an interaction CASE x GENDER ($F_1(2,46)=7.42$, $p<.001$; $F_2(2,158)=3.13$, $p<0.05$). Resolving the interaction by CASE showed main effects of GENDER for sentences with nominative matrix subjects ($F_1(2,46)=5.01$, $p<0.01$; $F_2(2,158)=3.52$, $p<0.03$) and for sentences with ergative matrix subjects ($F_1(2,46)=14.97$, $p<0.001$; $F_2(2,158)=8.09$, $p<0.001$). Pairwise comparisons for the nominative conditions revealed a significant difference between MM and FM ($F_1(1,23)=7.05$, $p<0.01$; $F_2(1,79)=5.94$, $p<0.02$) and between MM and FF ($F_1(1,23)=8.84$, $p<0.01$; $F_2(1,79)=5.39$, $p<0.02$), but not between FM and FF ($F_1/F_2 < 1$). For the ergative conditions, condition FM differed from MM ($F_1(1,23)= 14.24$, $p<0.001$; $F_2(1,79)=7.38$, $p<0.01$) and from FF ($F_1(1,23)=23.61$, $p<0.001$; $F_2(1,79)=19.67$, $p<0.001$), while there was no difference between MM and FF ($F_1(1,23)=1.87$, $p<0.18$; $F_2<1$).

To summarise the results for the comprehension task, participants made more errors for condition FF as opposed to conditions MM and FM in the nominative sentences; for the ergative sentences, condition FM yielded higher error rates than MM and (by participants) than FF. With regard to the reaction times, condition MM engendered faster responses than both FM and FF in the nominative conditions, whereas reaction times were slower for condition FM as opposed to MM and FF in the ergative sentences.

5.3.2 ERP data

Control verb

Grand average ERPs for the position of the control verb are shown in Figure 1. Visual inspection of the figure suggests that the ERP responses for the critical conditions differ between approximately 350 and 600 ms post onset of the control verb. The sentences with nominative matrix subjects appear to show a three-way distinction in this time window, with the masculine-masculine (MM) condition showing a positivity in comparison to the other two conditions, of which the feminine-masculine (FM) condition in turn shows a negativity in comparison to the feminine-feminine (FF) condition. By contrast, sentences with ergative matrix subjects only show a two-way distinction between conditions: here, a negativity is apparent for the FM condition in comparison to both the MM and the FF condition. Finally, the nominative subject FF condition appears to show an additional late positivity between approximately 700 and 900 ms post verb onset. In accordance with the visual inspection of the data, statistical analyses were performed in two time windows: 350-600 ms and 700-900 ms.

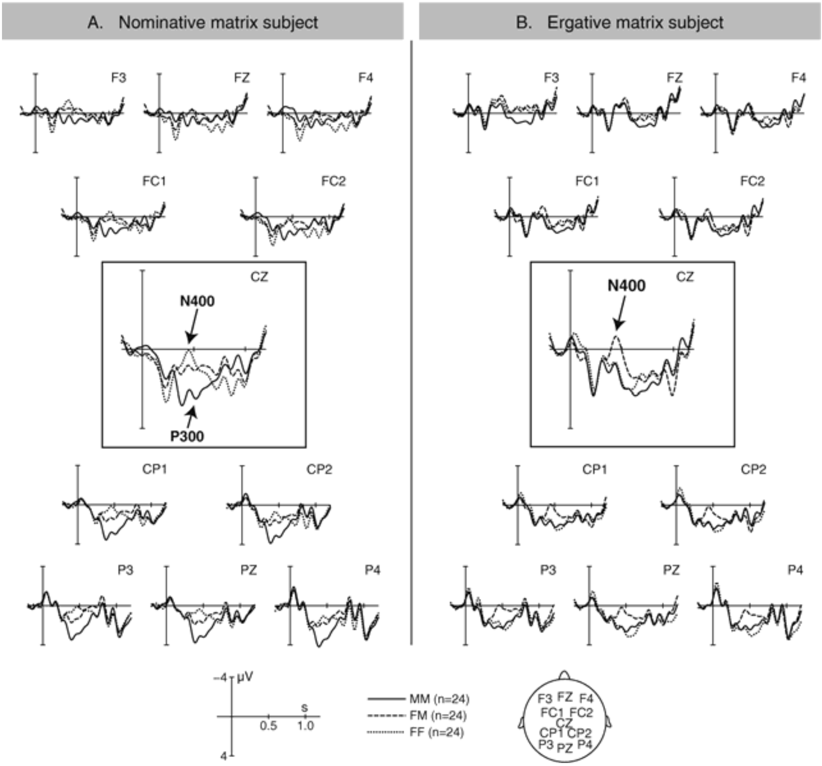

Figure 1: Grand average ERPs (N=24) at the position of the critical control verb (onset at the vertical bar). The figure compares conditions MM, FM and FF for sentences with a nominative matrix subject (Panel A) and sentences with an ergative matrix subject (Panel B). Negativity is plotted upwards.

In the earlier time window (350-600 ms), repeated measures ANOVAs revealed a main effect of GENDER (midline: $F(2,46)=8.03$, $p<0.002$; lateral: $F(2,46)=8.03, p<0.002$) as well as interactions ROI x CASE (midline: $F(4,115)=4.87$, $p<0.001$; lateral: $F(3,69)=3.03$, $p<0.05$), ROI x GENDER (midline: $F(8,184)=3.51$, $p<0.02$; lateral: $F(6,138)=6.99$, $p<0.001$), CASE x GENDER (midline: $F(2,46)=5.91$, $p<0.007$; lateral: $F(2,46)=6.91$, $p<0.003$) and ROI x CASE x GENDER (midline: $F(8,184)=9.85$, $p<0.001$; lateral: $F(6,138)=5.41$, $p<0.001$).

Separate analyses within each region of interest showed an interaction of CASE x GENDER at central and posterior midline sites (CZ: $F(2,46)=3.83$, $p<0.03$; CPZ: $F(2,46)=5.82$, $p<0.01$); PZ: $F(2,46)=10.68$, $p<0.001$; POZ: $F(2,46)=17.35$, $p<0.001$) and in both posterior lateral ROIs (left: $F(2,46)=11.87$, $p<0.001$; right: $F(2,46)=10.74$, $p<0.001$). When these interactions were resolved by CASE, all of the regions showing an interaction also showed an effect of GENDER both for sentences with nominative matrix subjects (all Fs≥7.77; all ps<0.001) and for sentences with ergative matrix subjects (all Fs≥4.30; all ps<0.02). Pairwise comparisons between the three levels of the factor GENDER are presented in Table 2A and Table 2B for sentences with nominative and ergative subjects, respectively. As is apparent from the table, for sentences with nominative subjects, condition MM engendered a centro-parietal positivity in comparison to both FM and FF, and FM elicited an additional left-posterior negativity in comparison to FF. Thus, the analysis confirmed the three-way distinction between these conditions that was indicated by visual inspection. Sentences with ergative subjects, by contrast, only showed a two-way distinction between conditions: here, FM engendered a negativity in comparison to both FF and MM.

A. NOMINATIVE matrix subject			
ROI	MM-FF	MM-FM	FM-FF
CZ	$F(1,23)=13.21$, $p<0.01$	$F(1,23)=8.38$, $p<0.01$	-
CPZ	$F(1,23)=19.39$, $p<0.001$	$F(1,23)=11.33$, $p<0.01$	-
PZ	$F(1,23)=26.38$, $p<0.001$	$F(1,23)=11.22$, $p<0.01$	-
POZ	$F(1,23)=26.06$, $p<0.001$	$F(1,23)=10.73$, $p<0.01$	-
Left-posterior	$F(1,23)=33.19$, $p<0.001$	$F(1,23)=15.05$, $p<0.001$	$F(1,23)=7.31$, $p<0.02$
Right-posterior	$F(1,23)=22.02$, $p<0.001$	$F(1,23)=13.41$, $p<0.01$	-
B. ERGATIVE matrix subject			
ROI	MM-FF	MM-FM	FM-FF
CZ	-	$F(1,23)=8.98$, $p<0.01$	$F(1,23)=5.57$, $p<0.03$
CPZ	-	$F(1,23)=7.54$, $p<0.02$	$F(1,23)=6.94$, $p<0.02$
PZ	-	$F(1,23)=10.15$, $p<0.01$	$F(1,23)=12.64$, $p<0.01$
POZ	-	$F(1,23)=14.46$, $p<0.001$	$F(1,23)=22.39$, $p<0.001$
Left-posterior	-	$F(1,23)=28.41$, $p<0.001$	$F(1,23)=9.65$, $p<0.01$
Right-posterior	-	$F(1,23)=11.10$, $p<0.01$	$F(1,23)=20.95$, $p<0.001$

Table 2: Pairwise comparisons between the three levels of the factor GENDER for sentences with nominative (A) and ergative matrix subjects (B). Comparisons are shown for all regions of interest (ROIs) that showed an interaction CASE x GENDER. All of these regions also showed effects of GENDER for both nominative and ergative conditions. For the pairwise comparisons, alpha-levels were corrected according to a modified Bonferroni procedure (Keppel, 1991), i.e. only effects that reached the corrected probability level of $p<0.033$ were considered significant (with $p<0.04$ amounting to a marginally significant effect). In the table, we report uncorrected probability levels for all effects meeting the significance criterion. Abbreviations: MM (masculine agreement on infinitive – masculine agreement on control verb); FM (feminine agreement on infinitive – masculine agreement on control verb); FF (feminine agreement on infinitive – feminine agreement on control verb).

In the second time window (700-900 ms), we observed an interaction of ROI x CASE (midline: $F(5,115)=3.51$, $p<0.06$; lateral: $F(3,69)=5.44$, $p<0.02$) and, for the lateral electrodes, an interaction of ROI x GENDER $F(6,138)=5.02$, $p<0.001$. The interaction ROI x CASE x GENDER reached significance for the midline electrodes ($F(8,184)=3.23$, $p<0.02$) and showed a trend towards significance at lateral sites ($F(6,138)=1.97$, $p=0.09$). Separate analyses in each ROI showed interactions of CASE x GENDER at FZ ($F(2,46)=3.37$, $p<0.05$) and in the right-anterior ROI ($F(2,46)=3.49$, $p<0.04$). Resolving these interactions by CASE showed a trend towards an effect of GENDER for nominative conditions at FZ ($F(2,46)=2.52$, $p=0.09$) and a significant effect of GENDER in the right-anterior ROI ($F(2,46)=4.79$, $p<0.02$), while neither of these regions showed an effect of GENDER for the ergative conditions. For the nominative conditions, pairwise comparisons between the three levels of GENDER for the regions showing a main effect revealed significant differences between FF and MM (right-anterior: $F(1,23)=13.47$, $p<0.001$; FZ: $F(1,23)=5.42$, $p<0.03$) and between FF and FM (right- anterior: $F(1,23)=5.58$, $p<0.03$). These differences were due to the fact that condition NFF showed a right frontal positivity in comparison to the other two conditions with nominative matrix subjects.

6. Discussion

The present study aimed to provide initial empirical evidence for the hypothesis that the {S,A} preference in online language comprehension extends to the processing of other GR-identifying constructions. This was tested in control constructions in Hindi, which allow for a manipulation of the initial {S,A} preference at three different points: NP1, the infinitive and the control verb. At the position of the critical control verb, event-related potential (ERP) measures indeed revealed the predicted interaction between CASE and GENDER. For the conditions with a nominative subject, we observed a three-way distinction between conditions: in a time window from 350-600 ms, condition MM engendered a centro-parietal positivity (P300), whereas both FF and FM elicited a centro-parietal negativity (N400), which was larger for condition FF. In addition, FF elicited a late positivity. By contrast, the sentence conditions with an ergative subject only gave rise to a two-way ERP distinction, namely to an N400 effect (350-600 ms) for FM in comparison to FF and MM. These findings indicate that the establishment of an agreement relation at the position of the control verb is subject to modulation by information at all three of the critical positions described above.

6.1. The influence of the case marking of NP1

Firstly, and rather unsurprisingly, the pattern of ERPs at the control verb is influenced by the case marking of NP1. When this argument is nominative-marked, the system exhibits a clear preference for agreement between NP1 and the matrix verb. This is shown by the fact that the only condition that leads to a violation of this expectation, namely FF, differs from both MM and FM, engendering the largest N400 and a late positivity. When NP1 is ergative-marked, by contrast, the pattern at the control verb depends entirely on the agreement of the infinitive, i.e. there is a preference for the agreement in the matrix clause to match that of the infinitive. This is evidenced by the N400 distinction for FM vs. MM/FF, with no difference between the latter two conditions. These observations precisely reflect theoretical descriptions of the agreement system in Hindi (see section 5.1): agreement is always with the highest-ranked nominative argument; when there is no nominative argument in the sentence, the matrix verb either exhibits default agreement or long distance agreement. Whichever of the two options for a non-nominative subject is chosen, however, there must be a match between the agreement of the embedded verb and that of the matrix verb. Even though the behavioural results point to a final acceptability advantage for long distance agreement as opposed to default agreement, the ERP data suggest that both types of agreement are equally easy to process online.

This overall data pattern shows that agreement mismatches between NP1 and the control verb engender N400 effects in sentences of the type examined here.[5] Furthermore, it supports our assumption that an {S,A}

[5] In the ERP literature on sentence processing, agreement mismatches are typically associated with late positivities (P600 effects) and, under certain circumstances, with left-anterior negativities (LAN effects) (see Kutas et al., 2006). The observation of an N400 effect in the present study thus appears somewhat surprising. Possibly, the nature of this effect could be attributable to the manipulation of gender agreement. In an experiment on adjective-noun agreement in Spanish, Barber and Carreiras (2005) observed an N400 for gender agreement violations when the nouns and adjectives were presented as word pairs. Furthermore, in a previous ERP examination of subject-verb agreement in Hindi, Nevins, Dillon, Malhotra, and

preference for a particular construction is only set up when there is no morphological evidence to the contrary: with an ergative-marked NP1, the processing system does not expect an {S,A} agreement relation in the matrix clause.

6.2. The interplay between the agreement properties of the infinitive and the control verb

Crucially, the present findings also provide insights that go beyond what can be derived from grammatical descriptions of agreement in Hindi. Observations of this type are particularly informative with regard to online processing preferences and, thereby, for our hypothesis about the {S,A} preference. Consider the three conditions with a nominative matrix subject. In addition to the distinction between the ungrammatical condition FF and the other two conditions, which was already described above, we also observed a differential ERP response to conditions MM and FM: whereas MM engendered an early parietal positivity (P300), FM did not. The P300 is one of the best studied ERP components – or component families – in higher cognition (see Nieuwenhuis, Aston-Jones, & Cohen, 2005, for a recent review). The latency and topography of the effect observed in the present study suggests that it is an instance of a so-called "P3b", which has been associated with the processing of task-relevant target stimuli (Polich, 2004). In the domain of sentence processing, Roehm, Bornkessel-Schlesewsky, Rösler, and Schlesewsky (2007) observed a P300 at the position of the highly predictable target word *white* in sentences such as *The opposite of black is white*, but only when an assessment of the antonym relation was task-relevant. A similar line of argumentation can be applied to the nominative conditions in the present study: the masculine agreement feature of the control verb was not only highly predictable (given that this verb *must* agree with the nominative subject), but also relevant for the performance of the acceptability judgement task. Strikingly, however, a

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Phillips (2007) observed an effect which could be classified as an N400 for a combined person-gender violation. (While the authors themselves interpreted this effect as the beginning of a late positivity, visual inspection of their ERP figures suggests that it is in fact a negativity for the violation condition.) Thus, the finding of N400 effects for gender agreement violations is not unprecedented. However, the precise conditions under which agreement processing correlates with one or the other type of ERP component clearly requires further investigation in future research.

P300 was only elicited in condition MM and not in condition FM. The absence of a P300 in condition FM suggests that the prediction for masculine agreement in the main clause is diminished when the infinitival shows object agreement. This observation provides strong converging support for our assumptions about the {S,A} preference because it shows that preference for NP1 to form part of an {S,A}-oriented agreement relation in the matrix clause is weakened considerably when there is evidence against an {S,A} alignment in a different construction (i.e. agreement in the embedded clause).

Before concluding that this interpretation is indeed justified, however, we must rule out an alternative explanation. Recall from the analysis of the behavioural data that condition NFM was judged to be significantly less acceptable (67%) than condition NMM (95%) (see Table 1). These judgements are in line with the theoretical literature on Hindi, which has suggested that sentences of type NFM are more marked than sentences of type NMM and that the usage of these constructions is subject to dialectal variation (see Bickel & Yadava, 2000, and the references cited therein). Could it thus be the case that the processing system no longer sets up a prediction for the control verb once it recognises that the sentence is degraded in acceptability? In order to address this question, we examined the ERP responses elicited by the infinitival in the nominative conditions. This analysis revealed no difference between feminine (object) agreement as opposed to masculine (subject) agreement on the infinitival. Thus, the absence of a P300 at the position of the control verb in condition FM does not appear to be due to a general change in processing strategy that is triggered by a mismatch response at the position of the preceding infinitive. If this were the case, we should be able to observe a clear ERP correlate of the processing problem at the position of the infinitive, which is not the case.

However, since it appears somewhat counterintuitive that an acceptability drop should not be accompanied by some sort of ERP response, we undertook a closer examination of the acceptability ratings themselves. The relatively high standard deviation for the by-participant mean in condition NFM (29%) suggested that there might be some variation in the acceptability of this condition across participants. Indeed, individual acceptability ratings ranged from 8% to 95%.[6] In order to investigate the

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[6]At a first glance, this observation appears to support the assumption of dialectal differences in the usage and acceptability of this construction (see above). However, we did not

possible effects of this variation on the ERPs, we conducted a median split analysis of the ERP data at the position of the infinitive, i.e. participants were assigned to a "low acceptability" or a "high acceptability" group depending on whether their acceptability score for condition NFM was below or above the median for this condition. ERPs at the position of the infinitive are shown separately for the two groups in Figure 2.

find any systematic relationship between acceptability and our speakers' regions of origin. The source of the individual variation thus needs to be investigated further.

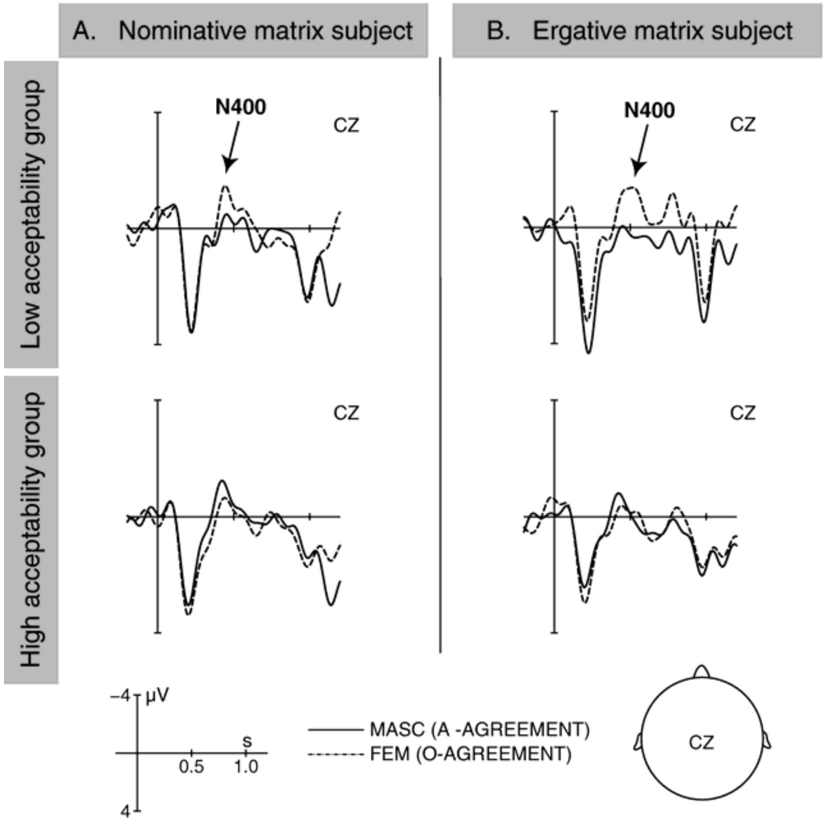

Figure 2: Grand average ERPs at the position of the infinitive within the control clause (onset at the vertical bar). The figure compares masculine (subject) and feminine (object) agreement in the embedded clauses for sentences with a nominative matrix subject (Panel A) and sentences with an ergative matrix subject (Panel B). ERPs for "high acceptability" (N=12) and "low acceptability" (N=12) participants are shown in the top and bottom halves of the figure, respectively. Groups were defined via a median split of acceptability ratings for condition NFM (see the text for further details). Negativity is plotted upwards.

Figure 2 suggests that the low acceptability group shows an N400 for feminine vs. masculine agreement at the position of the infinitive, whereas no such difference is observable in the high acceptability group. Interestingly, the effect for the low acceptability group is not restricted to the nominative conditions, but is also observable for the ergative conditions. These impressions were confirmed by a statistical analysis involving the between-participants factor GROUP, which was conducted in a time window from 350-550 ms post onset of the infinitive. The analysis revealed interactions GROUP x GENDER (midline: $F(1,22)=9.32$, $p<0.01$; lateral: $F(1,22)=6.88$, $p<0.02$) and GROUP x ROI x CASE x GENDER (midline: $F(5,110)=7.37$, $p<0.01$; lateral: $F(3,66)=2.90$, $p<0.06$). Resolving these interactions by group showed a main effect of GENDER for the low acceptability group (midline: $F(1,11)=36.30$, $p<0.0001$; lateral: $F(1,11)=27.85$, $p<0.001$), which was due to a negativity for feminine vs. masculine agreement. The high acceptability group showed an interaction ROI x CASE x GENDER for the midline electrodes only ($F(5,55)=5.12$, $p<0.02$), but no significant interaction CASE x GENDER for any individual ROI.

In order to ascertain whether the group differences at the position of the infinitive correlated with a differential modulation of the ERPs at the position of the control verb, we recomputed the statistical analysis for the control verb including GROUP as a between-participants factor. This analysis revealed no interactions with the factor GROUP, thereby suggesting that the pattern of results reported for the control verb in section 5.3 holds for both the low acceptability and the high acceptability group. Hence, the ERP effects at the position of the control verb are independent of whether object agreement in the infinitival clause yields a measurable increase in processing effort (in the low acceptability group) or not (in the high acceptability group). The absence of a P300 at the control verb for condition NFM therefore does not appear to be reducible to an agreement mismatch at the preceding infinitive: the P300 is always absent, both for the participants who show an agreement effect in the embedded clause and for those who do not.

In summary, the analysis of the ERPs at the position of the infinitive and the group split point to a separability of the agreement relations in the embedded clause and in the matrix clause. Only those speakers for whom object agreement in an infinitival clause is degraded in acceptability show an agreement mismatch at the position of the embedded verb. By contrast, all speakers draw upon the agreement information from the embedded clause to adjust their predictions about the agreement properties of the upcoming matrix verb.

At this point, the attentive reader might wonder whether it is not a contradiction of our {S,A} preference hypothesis to assume that an {S,O}-oriented agreement relation in the embedded clause only engenders an ERP effect in a subset of participants. After all, one might expect the processing system to assume that the shared argument, via its coreference with the matrix subject, will trigger agreement in the embedded clause. In this regard, however, it is important to keep in mind the demands of incremental interpretation, i.e. the need to analyse and interpret each constituent as fully as possible as soon as it is encountered. Crucially, due to the head-finality of Hindi, our critical control constructions were indistinguishable from transitive main clauses until the infinitive was reached (and the inclusion of simple transitive filler sentences served to maintain this ambiguity throughout the course of the experiment) . Previous findings from Japanese suggest that, under such circumstances, a main clause reading is preferred (Kamide & Mitchell, 1999). Hence, it is only at the position of the infinitive that the processing system will establish an embedded clause, an agreement relation in that clause and a coreference relation between the shared argument and the matrix subject. Rather than confirming or disconfirming a presumed agreement relation for the nominative-marked initial NP, the infinitive therefore sets up an *additional* agreement relation. This serves to highlight the nature of the {S,A} preference as an *ambiguity resolution strategy*: it is not generally costly to establish an {S,O} correspondence in a particular construction; costs only arise when the assumption of an {S,A} correspondence that was set up in the presence of an ambiguity must be revised. For this reason, the processing of an unambiguously marked, initial accusative is not generally costly (e.g. Demiral et al., 2008; Wolff, Schlesewsky, Hirotani, & Bornkessel-Schlesewsky, in press), since the possibility of an {S,A} correspondence is immediately ruled out by the case marking. The assumption that the agreement relation in the embedded clause is initially established independently of the matrix subject is further supported by the observation that the low acceptability group showed an N400 for object agreement in the embedded clause for both the nominative and the ergative conditions. This shows that the N400 is not due to a violation of the expected agreement relation between the matrix subject and the first upcoming verb, but rather to the dispreferred status of infinitival object agreement for some speakers.[7] The consequences of this agreement relation for the {S,A} preference of the matrix subject then appear to be computed in a second step; this is compatible with the observation that reference is established in approximately the same time frame as agreement (cf. Burkhardt, 2006) and that the computation of sentence-internal relations takes priority over that of cross-sentential relations during online comprehension (Bornkessel & Schlesewsky, 2006).

6.3. Consequences of the present findings for the characterisation of the {S,A} preference

The present findings provide compelling evidence for the assumption that the {S,A} preference for an initial argument is influenced by the number of {S,A}-oriented GR-identifying constructions that converge on the first argument. In the strongest case, all possible sources of evidence converge, thereby leading to a high degree of expectation for an {S,A} orientation in all further constructions remaining to be disambiguated. In the present study, this prediction was reflected in a P300 at the position of the control verb in the NMM condition, reflecting the processing of the expected {S,A}-oriented agreement relation when both nominative case marking and the agreement relation within the embedded clause supported an {S,A} correspondence. At the opposite extreme, the {S,A} preference does not apply when it is immediately contradicted at the position of the first argument, e.g. by ergative case marking. This observation highlights the nature of the subject preference as an ambiguity resolution strategy, i.e. it only affects processing in the case of an ambiguity, but does not lead to increased costs in the presence of unambiguous information that is incompatible with the strategy.

These results suggest that the time course of the interaction between the different information types that serve to influence the {S,A} preference can be rather complex. Whereas the ease or difficulty of establishing an agreement relation within the embedded clause was initially independent of the {S,A} preference for the matrix subject, the agreement relation within

[7] We might speculate that this disadvantage for {S,O} agreement in an infinitival clause is due to the absence of a morphological cue that serves to override the {S,A} preference (i.e. to the absence of overt ergative case marking). However, this assumption still does not explain why this sensitivity for morphological marking is only shown by a subgroup of speakers.

the infinitival clause, once established, either strengthened the preference (in the case of condition NMM) or weakened it (in the case of condition NFM). This suggests that the interaction between different {S,A}-oriented constructions and their joint reinforcement (or weakening) of the {S,A} preference for the initial argument crucially depends on the establishment of shared reference between these constructions. In other words: it is not the case that the preference for the first argument to be an agreement trigger in an {S,A}-oriented agreement construction leads to a general preference for this argument to trigger agreement on whatever verb is encountered next. Rather, if the closest following verb is identified as belonging to a subordinate clause, the agreement relation for this verb is first established and shared reference between the two clauses is computed before the {S,A} preference for the initial argument is modified (strengthened or weakened). This interpretation of the present findings leads to two alternative testable predictions, namely (a) that influences on the {S,A} preference which depend on shared reference between clauses will generally lead to a slower time course of processing, or (b) that a slowdown will only take place when the need for shared reference is not immediately apparent (e.g. due to an ambiguity between a main and a subordinate clause). According to the second of these hypotheses, the way in which shared reference is signalled (e.g. indirectly, like in Hindi, or by explicit morphological cues such as reflexives, switch-reference, logophorics etc.) should be expected to have a measurable impact upon the {S,A} preference.

A further interesting question concerns the relationship between the {S,A} preference in online role identification and in the processing of GR-identifying constructions. As noted in the introduction, the former has been explained via the processing system's preference for the arguments of a sentence to be as distinct as possible from one another. Might this assumption also carry over to the processing of GR-identifying constructions? In other words: might the preference for all applicable GR-identifying constructions to converge upon the same argument (as shown by the present findings) also be related to the Distinctness requirement? From this perspective, two arguments would be maximally distinct from one another when one is picked out by all available GR-identifying constructions. By contrast, Distinctness would be violated if these constructions were divided between the two arguments (e.g. if case served to pick out one argument and agreement the other). These questions could be examined empirically by investigating whether the factors that have been shown to affect the {S,A} preference in role identification interact with the

{S,A} preference in the processing of GR-identifying constructions. For example, recall from the introduction that factors like animacy and definiteness/specificity impact upon the interpretation of arguments as A or O when the ambiguous region spans two arguments. Could these information types potentially influence the processing of GR-identifying constructions such as agreement? If this were the case, the {S,A} preference for the initial argument in the present study may have been strengthened by the fact that this argument was animate and the second argument was inanimate. By examining the relationship between the factors conditioning the {S,A} preference in role identification and the {S,A} preference in the processing of GR-identifying constructions, we should be able to shed further light on the question of whether both of these preferences can be attributed to a single underlying processing principle.

7. Future directions

The present findings from Hindi provide a first piece of empirical evidence that the {S,A} preference during online processing extends to GR-identifying constructions. They further suggest that, like the {S,A} preference in role identification, this preference can be modulated over the time course of processing by converging or conflicting information encountered in other constructions. Both of these observations bring us a considerable step closer to being able to assume a correspondence between the {S,A} preferences observed in language processing and linguistic typology. Future research will therefore need to establish the precise nature of the correlation between these two domains and the factors by which it is conditioned. In particular, if we wish to determine how the {S,A} preference in language typology might be related to the {S,A} preference in language processing, a natural next step would be to investigate how the ("time sensitive") processing properties of a language relate to its ("time insensitive") grammatical properties.

In this regard, we hypothesise that the way in which the {S,A} preference as a mechanism of initial processing choice is maintained over the course of a sentence is likely affected by the particular properties of the language and the construction currently being processed. We use the term 'subject preference interval (SPI)' as a label for the time interval between the processing of the first NP that can be affected by the {S,A} preference and the time at which this preference is cancelled or overwritten by counteracting factors and therefore no longer has an effect. The SPI approaches zero when the case marking of the first NP rules out the application of an {S,A} preference for a particular GR-identifying construction. For other constructions, we expect SPIs of various lengths, depending on the construction that identifies the relevant grammatical relation. For example, we expect a relatively short SPI for loosely grammaticalised constructions that do not impose a strict S=A correspondence, e.g. various kinds of conjunction reduction and anaphoric patterns. Here, the subject preference is likely to be overwritten by incoming semantic and pragmatic information after the processing of the first clause. For more tightly grammaticalised constructions, e.g. raising constructions with infinitival dependents, which impose a strict S=A correspondence, we expect a longer SPI, perhaps one that is maintained throughout the processing of the construction, and unaffected by semantic and pragmatic information.

GR-identifying constructions vary typologically not only in the kind of GR they define, but also in their structural properties (Wang et al., in press), and this suggests the following general working hypothesis for a correlation between processing and typology:

(6) *The Subject Preference Interval (SPI) Hypothesis:*
The Subject Preference Interval correlates with typological variables of GR-identifying constructions.

The hypothesis is correlational, not causal, and therefore, it has two sides of special interest, one for processing research and one for typological research. On the processing side, we will need to identify the critical variables correlating with SPIs. Progress in this presupposes detailed typological research on these variables and their distribution. On the typology side, it will be important to identify the typological distributions that correlate with SPI length. Progress in this presupposes detailed psycholinguistic research on the actual relationship between SPI lengths and constructional properties. Should these research endeavours indeed support a close correlation between online processing preferences and typological distributions, they will likely bring us closer to understanding the nature of linguistic alignment patterns and grammatical relations.

References

Barber, H. & Carreiras, M. (2005). Grammatical gender and number agreement: An ERP comparison. *Journal of Cognitive Neuroscience*, *17*, 137-153.

beim Graben, P., Schlesewsky, M., Saddy, J. D., & Kurths, J. (2000). Symbolic dynamics of event-related brain potentials. *Physical Review E*, *62*, 5518-5541.

Bickel, B. (2008). A refined sampling procedure for genealogical control. *Sprachtypologie und Universalienforschung*, *61*, 221–233.

Bickel, B. (in press). Grammatical relations typology. In J. Jung Song (Ed.), *The Oxford handbook of language typolog*y. Oxford: Oxford University Press.

Bickel, B. & Witzlack-Makarevich, A. (2008). Referential scales and case alignment: reviewing the typological evidence. In M. Richards & A. L. Malchukov (eds.), *Scales*. Vol. 86 of Linguistische Arbeitsberichte. Universität Leipzig.

Bickel, B. & Yadava, Y. P. (2000). A fresh look at grammatical relations in Indo-Aryan. *Lingua*, *110*, 343-373.

Bisang, W. (2006). From meaning to syntax - semantic roles and beyond. In I. Bornkessel, M. Schlesewsky, B. Comrie, & A. D. Friederici (Eds.), *Semantic role universals and argument linking: Theoretical, typological and psycholinguistic perspectives*. (pp. 191-236). Berlin: Mouton de Gruyter.

Bornkessel-Schlesewsky, I. & Schlesewsky, M. (forthcoming). *Processing syntax and morphology: A neurocognitive perspective*. Oxford: Oxford University Press.

Bornkessel-Schlesewsky, I. & Schlesewsky, M. (in press). An alternative perspective on "semantic P600" effects in language comprehension. *Brain Research Reviews*.

Bornkessel-Schlesewsky, I. & Schlesewsky, M. (to appear). Minimality as vacuous distinctness: Evidence from cross-linguistic sentence comprehension. *Lingua*.

Bornkessel, I. & Schlesewsky, M. (2006). The Extended Argument Dependency Model: A neurocognitive approach to sentence comprehension across languages. *Psychological Review*, *113*, 787-821.

Burkhardt, P. (2006). Inferential bridging relations reveal distinct neural mechanisms: Evidence from event-related brain potentials. *Brain and Language*, *98*, 159-168.

Butt, M. (1995). *The structure of complex predicates in Urdu*. Stanford: CSLI Publications.

Casado, P., Martín-Loeches, M., Muñoz, F., & Fernández-Frías, C. (2005). Are semantic and syntactic cues inducing the same processes in the identification of word order? *Cognitive Brain Research*, *24*, 526-543.

Comrie, B. (1978). Ergativity. In W. P. Lehmann (Ed.), *Syntactic typology: Studies in the phenomenology of language*. Austin, TX: University of Texas Press.

Crocker, M. W. (1994). On the nature of the principle-based sentence processor. In C. Clifton, Jr., L. Frazier, & K. Rayner (Eds.), *Perspectives on sentence processing*. (pp. 245-266). Hillsdale: Erlbaum.

de Vincenzi, M. (1991). *Syntactic parsing strategies in Italian*. Dordrecht: Kluwer.

Demiral, Ş. B., Schlesewsky, M., & Bornkessel-Schlesewsky, I. (2008). On the universality of language comprehension strategies: Evidence from Turkish. *Cognition*, *106*, 484-500.

Dixon, R. M. W. (1994). *Ergativity* (2nd ed.). Cambridge: Cambridge University Press.

Dowty, D. (1991). Thematic proto-roles and argument selection. *Language*, *67*, 547-619.

DuBois, J. W. (1987). The discourse basis of ergativity. *Language*, *63*, 805-855.

DuBois, J. (2003). Discourse and grammar. In M. Tomasello (Ed.), *The new psychology of language, Vol. 2*. Mahwah, NJ: Erlbaum.

Frazier, L. (1987). Syntactic processing: Evidence from Dutch. *Natural Language and Linguistic Theory*, *5*, 519-559.

Frazier, L. & Flores d'Arcais, G. B. (1989). Filler-driven parsing: A study of gap filling in Dutch. *Journal of Memory and Language*, *28*, 331-344.

Huynh, H. & Feldt, L. S. (1970). Conditions under which the mean-square ratios in repeated measurement designs have exact F-distributions. *Journal of the American Statistical Association*, *65*, 1582-1589.

Kamide, Y. & Mitchell, D. C. (1999). Incremental pre-head attachment in Japanese parsing. *Language and Cognitive Processes*, *14*, 631-662.

Keppel, G. (1991). *Design and analysis* (3rd ed.). Englewood Cliffs, NJ: Prentice Hall.

Knoeferle, P., Habets, B., Crocker, M. W., & Münte, T. F. (2008). Visual scenes trigger immediate syntactic reanalysis: Evidence from ERPs during situated spoken comprehension. *Cerebral Cortex*, *18*, 789-795.

Kutas, M., Van Petten, C., & Kluender, R. (2006). Psycholinguistics electrified II (1994-2005). In M. Traxler & M. A. Gernsbacher (Eds.), *Handbook of Psycholinguistics*. (2nd ed., pp. 659-724). London: Elsevier.

LaPolla, R. (1993). Arguments against "subject" and "object" as viable concepts in Chinese. *Bulletin of the Institute of History and Philology, Academia Sinica*, *63*, 759-813.

Lee, M.-W. (2004). Another look at the role of empty categories in sentence processing (and grammar). *Journal of Psycholinguistic Research*, *33*, 51-73.

MacDonald, M. C. & Christiansen, M. H. (2002). Reassessing working memory: Comment on Just and Carpenter (1992) and Waters and Caplan (1996). *Psychological Review*, *109*, 35-54.

Mahajan, A. (1990). *The A/A' distinction and movement theory*. Unpublished doctoral dissertation, MIT.

Marslen-Wilson, W. (1973). Linguistic structure and speech shadowing at very short latencies. *Nature*, *244*, 522-533.

Maslova, E. & Nikitina, T. (2007). Stochastic universals and dynamics of cross-linguistic distributions: the case of alignment types. *Unpublished Manuscript, Stanford University*.

Mohanan, T. (1994). *Argument structure in Hindi*. Stanford, CA: CSLI Publications.

Nevins, A., Dillon, B., Malhotra, S., & Phillips, C. (2007). The role of feature-number and feature-type in processing Hindi verb agreement violations. *Brain Research*, *1164*, 81-94.

Nichols, J. (1993). Ergativity and linguistic geography. *Australian Journal of Linguistics*, *13*, 39-89.

Nieuwenhuis, S., Aston-Jones, G., & Cohen, J. D. (2005). Decision making, the P3, and the locus coerulus-norepinephrine system. *Psychological Bulletin*, *131*, 510-532.

Oldfield, R. C. (1971). The assessment and analysis of handedness: The Edinburgh inventory. *Neuropsychologia*, *9*, 97-113.

Polich, J. (2004). Neuropsychology of the P3a and P3b: A theoretical overview. In C. Moore & K. Arikan (Eds.), *Brainwaves and mind: Recent developments*. (pp. 15-29). Wheaton, IL: Kjelberg Inc.

Primus, B. (1999). *Cases and thematic roles.* Tübingen: Niemeyer.

Roehm, D., Bornkessel-Schlesewsky, I., Rösler, F., & Schlesewsky, M. (2007). To predict or not to predict: Influences of task and strategy on the processing of semantic relations. *Journal of Cognitive Neuroscience*, *19*, 1259-1274.

Schlesewsky, M., Fanselow, G., Kliegl, R., & Krems, J. (2000). The subject preference in the processing of locally ambiguous wh-questions in German. In B. Hemforth & L. Konieczny (Eds.), *German sentence processing*. (pp. 65-93). Dordrecht: Kluwer.

Stabler, E. (1994). The finite connectivity of linguistic structure. In C. Clifton, Jr., L. Frazier, & K. Rayner (Eds.), *Perspectives on sentence processing*. (pp. 303-336). Hillsdale: Erlbaum.

Van Valin, R. D., Jr. (2005). *Exploring the Syntax-Semantics Interface*. Cambridge: Cambridge University Press.

Wang, L., Schlesewsky, M., Bickel, B., & Bornkessel-Schlesewsky, I. (in press). Exploring the nature of the subject-preference: Evidence from the online comprehension of simple sentences in Mandarin Chinese. *Language and Cognitive Processes*.

Wolff, S., Schlesewsky, M., & Bornkessel-Schlesewsky, I. (2007). The interaction of universal and language-specific properties in the neurocognition of language comprehension: Evidence from the processing of word order permutations in Japanese. *Journal of Cognitive Neuroscience, Supplement.*

Wolff, S., Schlesewsky, M., Hirotani, M., & Bornkessel-Schlesewsky, I. (in press). The neural mechanisms of word order processing revisited: Electrophysiological evidence from Japanese. *Brain and Language*.