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The Influence of Animacy and Context on Word Order Processing: Neurophysiological Evidence from Mandarin Chinese

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genehmigte

DISSERTATION

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Prof. Dr. Kaoru Horie

For my mother tongue,
one of the many languages in this world.

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Abbreviations

1.SG, 2.SG, 3.SG	first, second, third person singular
ACC	accusative
ASP	aspect
CL	classifier
COM	comment
CPF	completive focus
CTF	contrastive focus
DAT	dative
DEF	definite
DT	discourse topic
EEG	electroencephalography
ERP	event-related potencial
FOC	focus
FT	focus topic
GR	grammatical relation
GRO	ground
GSR	general semantic role
INDEF	indefinite
LOC	location
LS	logical structure
MAS	masculine
NEU	neuter
NOM	nominative
PL	plural
POSS	possesive
PST	past
QP	question particle
RC	relative clause
TOP	topic

Contents

Introduction

Language comprises a dynamic set of visual, auditory, or tactile symbols of communication, which is considered to be exclusive to humans. How to model the relation between the human brain and languages has long been studied in the field of psycholinguistics and neurolinguistics over last twenty years. The fact that the human brain processes languages that differ considerably may lead one to ask whether the language processing architecture – or at least certain aspects of it – can be considered to be universal, i.e. whether all languages are processed on the basis of a certain set of cross-linguistically applicable mechanisms or strategies. If this is indeed the case, we should be able to identify similar processing strategies across structurally and typologically varied languages. A promising candidate for such a potentially "universal" strategy is the so-called "subject-preference", which refers to the processing system tending to analyse the initial ambiguous argument as the subject of the sentence. This word order preference has been widely observed in a number of languages.

The present thesis aims to investigate whether or not the subject-preference can be observed in Mandarin Chinese by means of event-related potentials (ERPs). In contrast to the previously examined languages in which grammatical relations such as "subject" are well established, the status of the subject category in Mandarin Chinese is rather controversial. Hence, whether such a language exhibits a subject-preference or not becomes crucial for testing the assumption of a universal language processing mechanism. Furthermore, as Mandarin Chinese lacks overt grammatical devices such as case marking and verb agreement, semantic/pragmatic information such as animacy and context could be more strongly responsible for the processing differences – if there are any – between Chinese and previously examined languages. Thus, the present thesis also examines how animacy and context influence word order processing in this language.

The present thesis comprises three parts. Chapters 1 to 4 provide the theoretical background and the introduction to the methodology used in the present study. Chapter 1 addresses a cross-linguistically applicable property of sentence comprehension, "incrementality", and previous behavioural studies

on the subject-preference as well as the influence of two information types, animacy and context. Chapter 2 introduces the methodology of EEG and ERPs employed in the present study, and three language-related ERP components. Chapter 3 introduces a cross-linguistically motivated language-processing model, namely the *extended Argument Dependency Model* (the eADM), and previous ERP studies on subject-preference as well as the aforemetnitioned two influencing information types. Chaper 4 describes relevant features of Mandarin Chinese and word order variations in this language. The empirical findings of the presented study are reported in the second part. Chapter 5 presents three experiments examing the subject-preference in Chinese NP-V constructions, with the third one examining the influence of a topic context on the subject-preference. In accordance with the findings in the preceding chapter, Chapter 6 examines the influence of animacy on processing Chinese NP1-NP2-V constructions. In the third part, Chapter 7 provides a summary and a discussion of the overall experimental findings, and outlines their implications for accounts of language comprehension.

Part I

Theoretical and Empirical Background

Chapter 1

Language Processing

There are almost 7000 languages spoken in the world today, differing with respect to a wide range of characteristics (e.g. phonological, morphological, syntactic). Even within one single language, there are various types of constructions. However, despite this striking diversity across languages/constructions, the human brain should be able to uniformly process them at an astonishing high speed. Take language comprehension as an example[1]; when we hear or read a sentence, we first recognise the incoming acoustic or visual signals as words, which are made up of individual phonemes and morphemes, then connect words to lexical-semantic and syntactic features. Based on morphosyntactic information such as word category, case marking and verbal inflection, a syntactic structure is built up, which combines individual word meanings to form a semantic interpretation. Furthermore, the context or discourse in which a sentence is uttered also steps in to help determine the whole message conveyed by that sentence. Nevertheless, all these tasks are accomplished by our brains in such a short time that we don't experience any conscious effort.

It is worth considering how the human brain is able to complete such complicated linguistic tasks so efficiently. It is well known that ambiguity exists pervasively in natural languages, as a word or phrase often has more than one meaning, and a sentence often receives several possible structures and interpretations. Consequently, local ambiguities must be resolved at a certain point while the sentence unfolds over time and the brain seems to do a good job of resolving these ambiguities under such time pressure. In this

1 Although the field of "language processing" traditionally includes language comprehension and language production, language processing here focuses on the former because there have not been as many neurocognitive studies involving language production at the sentence level as those involving language comprehension. In the present thesis, unless otherwise noted, language processing refers to language comprehension at the sentence level rather than word level.

regard, the order of incoming constituents in a sentence – word order – provides a good testing ground for investigating how ambiguity is resolved during online sentence comprehension. Furthermore, psycholinguistic theories most generally vary on whether the ambiguity resolution initially proceeds in a modular or in an interactive manner (cf. Section 1.3). Therefore, investigating online ambiguity resolution during word order processing can shed light on the underlying architecture of language comprehension.

This chapter introduces a cross-linguistically applicable property of sentence comprehension, "incrementality", and then turns to the phenomenon of word order variations, with focus on the so-called "subject preference" and two factors that may influence it, namely animacy and context.

1.1 Incrementality

In spite of typological differences, the processing of different languages always involves the property of incrementality, i.e. the processing system integrates each new incoming constituent as quickly as possible with the input already processed and the representation built up so far (e.g. Marslen-Wilson 1973; Crocker 2005; Stabler 1994). This presumably universal property of language comprehension is required for effective real time communication. This rapid structuring of linguistic input is thought, for example, to decrease memory demands because it avoids the need to hold long lists of unstructured items in working memory (cf. Frazier & Fodor 1978). It is also beneficial for efficient real time communication (e.g. in dialogue, Pickering & Garrod 2004). Almost all the proposed models of sentence comprehension, no matter how they differ in detail with regard to their assumptions, agree on incrementality (Crocker 1994, 2005; Stabler 1994).

An initial illustration of this incremental processing could be obtained from a verb-final language/construction, in which the verb comes at the end of a sentence. The verb has long been considered the most pivotal constituent in a sentence because it not only bears syntactic features such as tense and aspect, but also semantic features which are relevant to the processing of its arguments in two important respects: one is to decide how many arguments are involved in an event and the other is to assign semantic (or thematic) roles

to these arguments. For example, the intransitive verb "run" takes only one argument, the runner, as an agent to perform the action of running. The transitive verb "employ" usually requires two arguments, the employee and the employer as the agent and the patient, respectively. A ditransitive verb such as "give" calls for three arguments, namely the agent who is giver, the recipient who is given to, and the theme that is being given. However, if information on the verb is so determinative for sentence comprehension, it appears logical to conclude that the sentence must be comprehended more slowly in a verb-final language/construction than in one which is not verb-final since the processing system needs to wait until the end of a sentence in order to begin interpreting it. Clearly, this is not true. At least, native speakers of languages whose grammar require or permits the verb to come last such as Japanese, Turkish, German and Dutch do not seem to understand a sentence with any delay (for empirical evidence, cf. Bornkessel-Schlesewsky & Schlesewsky 2009c). Furthermore, this also conflicts with the observation that Subject-Object-Verb (SOV) is the most common order among natural languages with a dominant word order (Crystal 1997; Dryer 2005)[2]. Clearly, "waiting" during processing would tax working memory, leading to processing inefficiency. A more efficient way is to process a sentence incrementally even though the verb information is not yet available.

Beyond the intuition from verb-final languages/constructions, there is indeed a large body of psycholinguistic evidence supporting incremental processing such as online syntactic ambiguity resolution where the processing system has been shown to make decisions even in the absence of complete and certain information. For example, a sentence such as "*John said the man died yesterday*" is ambiguous between one reading that "the man died yesterday" and another reading that "John said yesterday", depending on which verb the adverb attaches to. Kimball (1973) found that a processing cost resulted when the adverb had to be attached to the main verb ("said")

2 In a sample of 1228 language, Dryer (2005) found all six logically possible orders of the three elements S, O, and V. The six types and their frequency are: SOV (497), SVO (436), VSO (85), VOS (26), OVS (9) and OSV (4). There are also 171 languages that lack a dominant word order. His results show that SOV is the most common type followed by SVO, which is also consistent with Crystal (1997) finding that these two types account for more than 75% of natural languages with a dominant order.

compared with when it was attached to the embedded verb ("died"). This result thus suggests that the processing system already builds up an interpretation for the ongoing linguistic input before the adverb. When the adverb is encountered, the need to switch from one reading to another leads to a reanalysis cost.

Furthermore, ambiguity can be of varying degrees of complexity, some of which lead to the so-called "garden path effects", where the processing system fails to resolve the ambiguity. A well-known garden path sentence is "*The horse raced past the barn fell*" (Bever 1970). In this case, the processing system initially interprets the sentence as ungrammatical when the verb "fell" is encountered. To reanalyse it as a grammatical relative clause, "The horse (which was) raced past the barn fell", needs great effort. This example nicely shows that the processing system processes incrementally (i.e. it has already chosen one reading) so that a conflict results at the point where disambiguation to a non-preferred reading occurs.

In fact, besides the aforementioned syntactic ambiguities such as attachment ambiguity or the ambiguity between a main clause reading and a relative clause reading, there are also syntactic ambiguities between grammatical functions, for example, subject-object-ambiguities (there are also studies focusing on object-object-ambiguities, e.g. Hopf, Bayer, Bader & Meng 1998).

To understand the message that a sentence conveys such as "who did what to whom" in an event involving two participants, one needs to map from the syntactic representation of the sentence to a semantic representation. The latter is contributed by the so-called "semantic roles" (SRs), also known as "thematic roles". These SRs are determined by the meaning of the verb, which results in a large number of verb-specific SRs (e.g. agent, patient, experiencer, theme and so on). There are theoretical proposals that merge these SRs systematically into a small set of generalised concepts such as "macroroles" (Foley & Van Valin 1984; Van Valin & LaPolla 1997; Van Valin 2005) or "protoroles"(Dowty 1991; Primus 1999). In the language comprehension model called "the extended Argument Dependency Model (eADM)" (Bornkessel & Schlesewsky 2006a; cf. Chapter 3), two "generalised semantic roles" (GSRs) are assumed, Actor and Undergoer. Furthermore, the undergoer is hierarchically dependent on the actor (Primus 1999). Different from the notion of Actor and

Undergoer, “grammatical relations” (GRs) or “grammatical functions” such as subject and object are traditionally defined by the way in which arguments are integrated syntactically into a clause (Bickel in press). Although GRs and GSRs do not always directly match each other (e.g. the subject in the active sentence is the actor while in a passive sentence, it is the undergoer), they are indirectly related to each other via verb agreement or case marking, by which one can indentify GRs and consequently interpret its GSRs.

Psycholinguists have long been interested in the resolution of subject-object-ambiguities. These ambiguities exist, for example, in German, where an argument has an ambiguous case marking, or in English, where an argument is ambiguous between a subject-extracted relative clause reading and an object-extracted relative clause reading (cf. Section 1.2.1). Nevertheless, the language processing system has to assign a certain role to the ambiguous argument to fulfil the requirement of incrementality, i.e. maximise the form-to-meaning mapping. Thus, to examine how GRs (Subject/Object) and GSRs (Actor/Undergoer) are assigned to an ambiguous argument as the sentence unfolds over time can provide insights to understand the underlying mechanism of the language processing system.

1.2 Word Order Variations

The phenomenon of word order variations not only provides an important feature to distinguish typologically different languages, but also provides an interesting ground for examining the resolution of subject-object-ambiguities.

Steele (1978) classified languages with respect to whether they allow word order variation and found that about 70% of languages exhibit significant word order variation. This means that the majority of languages allow various possible linearizations of the words within a sentence. In languages with a strict word order such as English, a sentence like “*John killed Mary*” can typically only mean that John is the killer and Mary is being killed. If we change the word order into “*Mary killed John*”, then it becomes a sentence with the completely opposite meaning. In languages with relatively free word order such as German, Japanese, and Turkish, these two sentences would not have differed greatly despite their word order. “Mary” could precede “John” as long

as there is an overt case marker or a verb agreement indicating "who is doing what to whom". Therefore, the word order is not as important as in English.

The examples above thus show that languages with strict word order have a direct mapping between a linear order and a GR as well as GSR: in an active sentence, the first argument is mapping onto subject/actor and the second argument maps object/undergoer; languages with relatively flexible word order, by contrast, fail to show such a direct mapping. Therefore, to examine how different word orders are processed in different languages is important for exploring possible universal processing mechanisms or strategies and for distinguishing between language-universal and language-specific processing aspects.

The following subsections provide a promising candidate for a potentially *universal* processing strategy, the so-called "subject preference", and two possible influencing factors in word order processing, animacy and context. Notably, in order to introduce prominent theoretical accounts for word order processing, studies addressed here are those which previously examined word order processing in Indo-European languages (but in different constructions) using behavioural measures (acceptability judgements, self-paced reading, eye-tracking). A more cross-linguistic approach and relevant neurophysiological findings will be outlined in Chapter 3.

Before we move to the subject-preference, it is worthy to clarify the notion "subject" used here. The grammatical relations such as subject and object defined in a traditional sense (Dixon 1979) confuse syntactic and semantic transitivity to the extent that these notions become very difficult to apply to languages like Chinese (cf. Chapter 4 for details). In order to compare typologically different languages, grammatical relations in the present thesis are defined in a strictly semantic sense, following Bickel (in press) and Role and Reference Grammar (RRG; Van Valin & LaPolla 1997; Van Valin 2005). Here, S refers to the sole argument of an intransitive relation (e.g. *Peter* in *Peter is sleeping or* in *Peter died*); A refers to the more Agent-like argument of a transitive relation (e.g. *Peter* in *Peter was washing the dogs*); O refers to the more Patient-like argument of a transitive relation (e.g. *the dogs* in *Peter was washing the dogs*). In terms of this definition, the tranditional/syntactic category "subject" corresponds to the {S, A}-relation distinct from {O}. Notably, in a transitive relation, the subject-object distinction defined as above matches the

Actor-Undergoer/Agent-Patient distinction. Hence, in a sentence disambiguated into a transitive relation, we only use S or O for the argument disambiguated to a Subject/Actor/Agent reading or an Object/Undergoer/Patient reading. However, we distinguish syntactic notions (subject-object) and semantic notions (Actor-Undegoer/Agent-Patient) when we discuss different processing accounts, for example, the syntactically based accounts vs. the semantically/thematically based accounts for the subject-preference (cf. Sections 3.2.1 and 3.2.2 in Chapter 3, respectively).

1.2.1 The Subject-preference

The subject-preference refers to the processing system's tendency to: (a) analyse ambiguous initial arguments as subjects, and (b) prefer subject-extractions over object-extractions in relative clauses.

This preference is well established in a number of Indo-European languages such as Dutch (Frazier & Flores d'Arcais 1989), English (King & Just 1991; Lee 2004), French (Holmes & O'Regan 1981), German (Bader & Meng 1999; Schriefers, Friederici, & Kühn 1995), Italian (de Vincenzi 1991; Penolazzi, de Vincenzi, Angrilli & Job 2005) and Spanish (Casado, Martín-Loeches, Muñoz & Fernández-Frías 2005). It has recently also been reported for Turkish, an Altaic language (Demiral, Schlesewsky & Bornkessel-Schlesewsky 2008). To date, the subject-preference has been considered to be a promising candidate for a potentially *universal* processing strategy applicable across structurally and typologically varied languages. Accounts of this preference, however, vary considerably in psycholinguistic theories. Out of a large body of literature on subject-preference, we will only discuss some of the studies that revealed subject-preferences in different languages/constructions by using different behavioural measures. Furthermore, prominent accounts for deriving such preferences will also be addressed.

As a first illustration of the subject-preference in *ambiguous initial arguments*, consider the following Example 1.1 from German in Gorrell (1996).

(1.1) Example of German declarative sentence from Gorrell (1996)

a. SO:	Die Frau	sah	den Mann.
	[the woman]$_{NOM/ACC}$	saw	[the man]$_{ACC}$

'The woman saw the man.'

b. OS: Die Frau sah der Mann.
[the woman]$_{NOM/ACC}$ saw [the man]$_{NOM}$
'The man saw the woman.'

Examples in (1.1) are declarative main sentences in which the first arguments are ambiguous with respect to their grammatical functions, i.e. it could be either a subject marked for nominative case or an object marked for accusative case. Furthermore, word order in German is assumed to be SOV-dominant, which typically refers to the verb-final (the finite or non-finite verb) order in subordinate clause, where the order of preverbal constituents is free (cf. German scrambling in Section 1.2.3). In main clauses such as (1.1), however, German requires the finite verb to directly follow the first constituent (cf. "Vorfeld" in Example 1.11) to fulfil the so-called "verb-second" principle. Because it is ungrammatical for one sentence to have two nominative or two accusative case-marked arguments in German (cf. "double case violation" in Section 3.2.2), in both cases, the case marker of the second argument disambiguates the initial argument to a subject-initial order as in (1.1a) or object-initial order as in (1.1b). In a reading time study, Hemforth (1993) found that sentences disambiguated to object-initial order were processed significantly slower than sentences disambiguated to subject-initial order. In (1.1), it means that (b) is more difficult to process than (a). In a similar vein to the *Minimal Attachment* principle proposed by Frazier and Fodor (1978), Gorrell proposes the principles of *Simplicity* (Gorrell 1996) or *Minimal structure building* (Gorrell 2000), which attributes the subject-preference to the different structural positions of a subject and an object, i.e. the subject-initial order is associated with a simpler phrase structure than object-initial order. Clearly, this group of accounts derives subject-preference from a purely phrase structural perspective. However, whether such structural analyses can account for all circumstances remains controversial (cf. Schwartz & Vikner 1996; Gärtner & Steinbach 2003a,b).

Apart from simple declarative sentences as shown in (1.1), another construction that was used in initial tests of the subject-preference is the *wh*-questions, which was first examined in Dutch by Frazier and Flores d'Arcais

(1989). Example 1.2 is adopted from their study, which used grammaticality judgement tasks.

(1.2) Example stimuli of Dutch *wh*-question from Frazier & Flores d'Arcais (1989)

a. SO: Welke arbeiders prijzen de voorman?
[which workers]$_{NOM/ACC.PL}$ praise$_{PL}$ [the foreman]$_{SG}$
'Which workers praise the foreman?'

b. OS: Welke arbeiders prijst de voorman?
[which workers]$_{NOM/ACC.PL}$ praise$_{SG}$ [the foreman]$_{SG}$
'Which workers (did) the foreman praise?'

c. SO-aux: Welke arbeiders hebben de voorman geprezen?
[which workers]$_{NOM/ACC.PL}$ have$_{PL}$ [the foreman]$_{SG}$
'Which workers have praised the foreman?'

d. OS-aux: Welke arbeiders heeft de voorman geprezen?
[which workers]$_{NOM/ACC.PL}$ has$_{SG}$ [the foreman]$_{SG}$
'Which workers have the foreman praised?'

Similar to German simple declarative sentences in (1.1), the word order of *wh*-questions in Dutch also obeys the verb-second principle such that the finite verb ("prijzen" and "prijst") or auxiliary ("hebben" and "heeft") should occupy the second position. Unlike (1.1), however, both locally ambiguous initial *wh*-phrases in (1.2) are disambiguated via number marking on the verb. Because number marking on the verb always agrees with the subject in this language, the plural verb form in (1.2a) and (1.2c) disambiguates the initial *wh*-phrase to a subject-initial order. By contrast, the single verb form in (1.2b) and (1.2d) disambiguates the initial *wh*-phrase to an object-initial order. In this study, Frazier and her colleague observed that Dutch *wh*-questions were processed more quickly and accurately when they were disambiguated to a subject-initial order compared with an object-initial order. Furthermore, there was no interaction of the presence or absence of an auxiliary with subject-/object-initial order.

The results thus support the existence of a subject-preference and speak in favour of the *Active Filler Strategy* (AFS) proposed by Frazier and her colleague. To explain this strategy, (1.3) presents a simplified structural representation of

subject-/object-initial *wh*-questions in Dutch. A rather standard structural analysis assumes that the *wh*-phrase moves to the position in front of the verb and leaves its base position as an empty category. The empty categories (subject and object positions) are indicated by "e" for short. The auxiliary and the verb are indicated by "Aux" and "V", respectively. The subscript S stands for "sentence".

(1.3) Simplified structural representation of subject-/object-initial *wh*-question in Dutch

a. SO: Welke arbeiders prijzen [*e* [de voorman *V*]$_{VP}$]$_S$]?

b. OS: Welke arbeiders prijst [de voorman [*e V*]$_{VP}$]$_S$?

c. SO-aux: Welke arbeiders habben [*e* [de voorman Aux geprezen]$_{VP}$]$_S$?

d. OS-aux: Welke arbeiders heeft [de voorman [*e* Aux geprezen]$_{VP}$]$_S$?

The relationship between a moved constituent and its corresponding empty category is known as a filler-gap dependency. Filler-gap theories all agree that the filler must be assigned to the gap during sentence processing, however they differ with respect to whether gap filling is filler-driven or gap-driven. The AFS, as a filler-driven account of gap filling in a top-down manner, predicts that once a moved constituent is identified as a filler, it will be assigned to the first (leftmost) possible gap position without "waiting" until the gap is reached. According to this view, the first potential gap for the initial filler ("Welke arbeiders") is a subject, thus a subject-preference observed in all cases regardless the presence or absence of the auxiliary. By contrast, the gap-driven accounts (Fodor 1978, 1979) such as *Gap-as-second-resort strategy* assume that gap filling takes place in a bottom-up manner, i.e. gap filling is initiated only when the gap is detected. From this perspective, (1.3b) is more difficult to process than (1.3d) because it is difficult to detect a gap in an entire VP phrase containing only empty categories. If this is the case, we should observe an interaction between word order and the auxiliary. That is, the subject preference should be stronger when comparing (1.3b) with (1.3a) than when comparing (1.3d) with (1.3c). However, no such observation was obtained, thereby supporting the AFS and speaking against gap-driven accounts in the sense that gap filling is not delayed until the gap is detected.

However, as pointed out by Schlesewsky, Fanselow, Kliegl and Krems (2000), the gap filling appeared to be carried out even earlier than assumed by the AFS. Schlesewsky et al. (2000) applied a similar experimental design to German *wh*-questions and observed an increased reading time at the position of the singular verb form compared with the plural verb form (e.g. Example 1.2: b vs. a). According to the AFS, the subject-preference should not arise until the first possible gap is reached, i.e. *after* the verb (cf. Example 1.3a). However, Schlesewsky et al. (2000) suggests that subject-preference must be already established even *before* the verb, otherwise they would not have been able to see the processing disadvantage for an object-initial *at* the verb. Similar results were also reported by beim Graben, Saddy, Schlesewsky and Kurths (2000). Schlesewsky and his colleagues thus argued that these results support incremental processing, which means the processing system starts to assign a subject reading as soon as the initial *wh*-phrase is encountered. Such incremental processing is also reflected by a reformulated version of the AFS, namely *active trace strategy* (ATS) proposed by Crocker (1994). When applied to the Dutch example 1.2, the ATS assumes that, once the initial *wh*-phrase has been identified as a filler, it starts to be assigned to a subject gap and leads to a subject interpretation. When the subsequent singular verb form is encountered, this interpretation cannot be upheld and the reanalysis to an object interpretation leads to an increase in reading time at the following verb.

As shown for Example 1.2, both the AFS and the ATS actually derive the subject-preference on the basis of the distance between a filler and a gap: when there are two different possible gap positions, the shortest distance between the filler and the gap (i.e. between filler and the leftmost gap) will be chosen. The debate between the AFS and the ATS within filler-driven accounts, or more generally the debate between filler-driven and gap-driven accounts all centres on the question of *when* gap filling takes place under the premise that there *is* a filler. However, the ambiguity need not necessarily arise in filler-gap distance but rather between a filler and a non-filler analysis. This type of situation was first explored by de Vincenzi (1991), using Italian sentences such as (1.4).

(1.4) Example stimuli of Italian declarative sentence from de Vincenzi (1991)
a. Ieri pomeriggio ha richiamato il venditore per chiedere uno sconto …

Yesterday afternoon called-back the seller [to ask for a discount]$_{PP}$

b. Ieri pomeriggio ha richiamato il venditore per offrire uno sconto …

Yesterday afternoon called-back the seller [to offer a discount]$_{PP}$

Italian is a language with a basic SVO order and no case marking. It further allows subject-drop and post-verbal subjects. Thus, sentences such as (1.4a/b) are locally ambiguous between a subject-drop reading ("someone called back the seller") and a post-verbal subject reading ("the seller called back"). Disambiguation was effected via the (plausibility of the) infinitival clause ("to ask for/offer a discount"). De Vincenzi observed a clear processing advantage for the subject-drop analysis, as reflected in increased reading times at the position of the PP for (1.4b) vs. (1.4a). She interpreted this finding as evidence for the Minimal Chain Principle (MCP), which is given in (1.5).

(1.5) Minimal Chain Principle (de Vincenzi 1991)

Avoid postulating unnecessary chain members at S-structure, but do not delay postulating required chain members.

The MCP states that, under conditions of local ambiguity, the processing system prefers a base-generated structure over a structure-involving movement. Thus, a subject-drop analysis of sentences such as (1.4a) is preferred, as it allows for a base-generated analysis of *pro* (the non-overtly realised subject pronoun). In addition, the MCP states that, when a filler has been unambiguously identified, it is associated with the closest gap site. Therefore, the MCP can account for all the findings explained by the aforementioned filler-gap distance[3].

So far, we have reviewed studies on the subject-preference for an initial ambiguous argument in different languages/constructions as well as prominent accounts for deriving this preference. As mentioned in the very beginning of this section, relative clauses (RCs) have also been examined

3 Note that MCP cannot be tested straightforwardly in declarative main clauses in German, because it is generally assumed that arguments in the initial position of such clauses, the "prefield", are not base generated there.

extensively with regard to the subject-preference [4]. Many studies have demonstrated that, for example, subject-extracted relative clauses (SRCs) like (1.6a) are easier to process than their counterparts, object-extracted relative clauses (ORCs) in (1.6b), using a variety of experimental methods.

(1.6) a. SRC: The reporter [that attacked the senator]$_{RC}$ disliked the editor.
b. ORC: The reporter [that the senator attacked]$_{RC}$ disliked the editor.

The preference for (1.6a) over (1.6b) has also been observed in other languages such as French (Frauenfelder, Segui & Mehler 1980; Holmes & O' Regan 1981), German (Mecklinger, Schriefers, Steinhauer & Friederici 1995) and Dutch (Brown, Hagoort & Vonk 2000; Frazier 1987; Vonk, Brown & Hagoort 2000). From the perspective of filler-gap theories, the processing advantage for subject gaps over object gaps can be explained by either linear distance (Gibson 1998, 2000) or structural distance (O'Grady 1997) between filler and gap. Both are shorter in an SRC than in an ORC. This scenario is visualised in (1.7). As is apparent in (1.7), "the reporter" (the filler) is linearly closer to the subject-gap than to the object-gap; structurally, it is also embedded higher in the SRC than in the ORC[5].

4 There is one factor that should not be ignored when testing the subject-preference in RCs. As demonstrated by Schlesewsky (1996), a head noun case marked for nominative, i.e. when the head noun is the subject in the main clause, will also lead to a preference for SRCs over ORCs. Therefore, to obtain a pure subject-preference one needs to control the relation between the roles of the head noun both in the main clause and in the RC. See also *perspective shift* in MacWhinney (1977, 1982) and *Parallel Function Hypothesis* in Sheldon (1974).

5 In language with head-initial RCs (the head noun precedes the RC) such as English, German, Dutch, linear distance and structural distance cannot be easily dissociated because the two properties are always correlates with one another as shown in (1.7). By contrast, in languages with head-final RCs (the head noun follows the RC) such as Japanese, Korean and Chinese, these two accounts conflict with each other: the former predicts an object-preference due to the shorter distance between the head noun (the filler) and the object-gap; the latter, by contrast, consistently predicts a subject-preference as the head noun is still embedded higher in the SRC than in the ORC. Recent studies on Japanese (Miyamoto & Nakamura 2003; Ishizuka, Nakatani & Gibson 2006; Ueno & Garnsey 2007) and Korean (Kwon, Polinsky & Kluender 2006; Lee & Stromswold 2007) revealed a subject-preference and thus speak in favour of structural distance.

(1.7) a. SRC: The reporter [that *e* [attacked the senator]$_{VP}$]$_{S}$ disliked the editor.
b. ORC: The reporter [[that the senator attacked *e*]$_{VP}$]$_{S}$ disliked the editor.

Apart from the filler-gap-based accounts, another group of accounts based on working memory limitations could also derive such subject-preference. The working memory accounts have been explicitly proposed by Gibson in a form of the *syntactic prediction locality theory* (SPLT: Gibson 1998) and *dependency locality theory* (DLT: Gibson 1998, 2000). Both theories assume that sentence processing and computational resources are constrained by a limited memory capacity. Furthermore, the computational resources consist of a memory cost component and an integration cost component, and both of them are influenced by *distance* and *locality*. In view of the SPLT/DLT, the processing difficulty for the ORC in (1.7b) is due to its longer distance integrations than the SRC in (1.7a). The integrations at the embedded verb ("attacked") involve connecting the object position of the verb to the filler ("the reporter"), an integration that crosses the subject noun phrase ("the senator"). By contrast, the integration at the verb "attack" is more local, and is thus assumed to consume fewer computational resources. In theories of filler-gap dependency, the SPLT/DLT could be described as a linear distance account.

Note that the SPLT/DLT can also derive subject-preference for initial ambiguous arguments such as (1.2). According to Gibson, the more categories that are required for the completion of a grammatical sentence as predicted, the higher the memory costs. In (1.2), when "Welke arbeiders" is encountered, only one (intransitive) verb is predicted for a subject-initial interpretation, while three categories should be predicted – a verb, an object gap and the subject – for an object-initial interpretation[6]. Hence, the subject-preference results from the lower number of the predictions, which is less taxing on working memory. Therefore, working memory-based theories provide an alternative account of the subject-preference to filler-gap-based theories.

However, findings from Chinese contradict: results have provided evidence for a subject-preference (Lin & Bever 2006; Kuo & Vasishth 2007) and for an object-preference (Hsiao & Gibson 2003).

6 Assuming that the prefield ("Vorfeld") is generally filled via movement, a subject gap would need to be predicted as well.

In summary, the empirical evidence suggests that the subject-preference is a stable phenomenon that is not only observed in different construction such as declarative sentences, *wh*-questions and RCs but also in different languages. These languages may differ with respect to their basic word order (e.g. English vs. Dutch/German), or differ with respect to whether a subject needs to be realised overtly or not (e.g. English/German/Dutch vs. Italian).

With regard to the derivation of the subject-preference, previous studies either attribute it to purely phrase-structure configurations (e.g. *Simplicity/Minimal structure building* in Gorrell 1996, 2000), filler-gap dependencies (e.g. *AFS* in Frazier & Flores d'Arcais 1989; *MCP* in de Vincenzi 1991; *ATS* in Crocker 1994), or working memory limitations (e.g. *SPLT/DLT* in Gibson 1998, 2000). However, as pointed out by Bornkessel and Schlesewsky (2006a), in spite of their underlying differences of detail, the first two accounts face difficulties in deriving the subject-preference in languages such as Turkish. The basic word order in this Turkish is SOV, however, OV is also very common because this language does not require an overt realization of the subject (i.e. allow subject-drop). Hence, unlike the aforementioned languages that are either not verb-final (Italian, English) or do not allow subject-drop (Dutch, German, English), the initial ambiguous argument in Turkish could naturally function as either the subject or the object (via subject-drop). This means that the initial subject/object in Turkish is in its base position, which does not involve moved arguments or empty categories. Furthermore, all these accounts make crucial reference to the existence of a "subject" category in the languages under examination. From a cross-linguistic perspective, however, the assumption of a universal "subject" category is rather controversial (e.g. Bickel in press; Croft 2001; Comrie 1989; Farrell 2005). Mandarin Chinese is a case in point (cf. Chapter 4). Thereby, in their model (cf. Chapter 3), Bornkessel and Schlesewsky (2006a) proposed to account for the subject-preference in a completely different manner, namely by deriving the subject-preference from the endeavour of the processing system to construct minimal dependencies, which is independent of the concept of "subject" itself and thus independent of any structural position. This account is outlined in Section 3.2.1 in more details.

1.2.2 Animacy

The animacy of an argument is an important factor that may influence word order processing. In linguistic typology, animacy is posited as one important feature of an argument that can be used to assess how prototypical the subject/actor it is, or how natural/prototypical a transitive sentence is. For example, if both arguments are definite and marked for nominative, an animate argument is a more typical subject/actor rather than an inanimate one. This tendency has been observed cross-linguistically and can be derived from the animacy hierarchy.

(1.8) Animacy Hierarchy adopted from Comrie (1989, p. 185)
Human > Animate > Inanimate

The above mentioned relation between animacy and grammatical relations can be typically observed in a transitive sentence, which is used to express a certain type of activity that is transferred to or carried over several participants and thus involves arguments which can either be more angent-like or more patient-like. Based on his cross-linguistic observation, Comrie claimed that the most natural/prototypical flow of information in transitive sentence should be the one where the agent is high in animacy and definiteness, and the patient is lower in animacy and definiteness.

Although these observations have not yet been investigated systematically across languages in psycholinguistics, animacy has long been considered to be semantic information that interacts with other information types, such as definiteness and case marking, to influence the interpretation of an argument in a sentence (cf. Section 3.2.2 for neurolinguistic evidence). This can be tested by crossing word order (subject-initial order vs. object-initial order) with animacy (animate vs. inanimate) in a transitive sentence. As most previous behavioural studies examine the animacy effect in RCs, here, we will only focus on animacy effect found in English and Dutch RCs, which is helpful for predicting the role of animacy in *ambiguous initial arguments in simple sentences*.

As discussed in the last section, ORCs are known to be more difficult to process than SRCs (cf. Example 1.6). However, this was the case where both the head noun (HN) and the RC noun did not differ with respect to animacy. In

their eye-tracking experiments on English RCs, Traxler, Morris and Seely (2002) manipulated the animacy of the HN and the RC noun as shown in (1.9) and found longer reading times for ORCs with animate objects than for corresponding SRCs with animate subjects (1.9b vs. 1.9a), whereas this difference disappeared in a comparison of ORCs with inanimate objects as opposed to corresponding SRCs with inanimate subjects (1.9d vs. 1.9c).

(1.9) Example stimuli of English RCs from Traxler et al. (2002)

a. SRC with animate subject
   The director [that watched the movie] received a prize at the film festival.
b. ORC with animate object
   The director [that the movie pleased] received a prize at the film festival.
c. SRC with inanimate subject
   The movie [that pleased the director] received a prize at the film festival.
d. ORC with inanimate object
   The movie [that the director watched] received a prize at the film festival.

These results thus suggest that the processing difficulty associated with the ORC was greatly reduced when the object in the RC was inanimate. In a subsequent experiment, Traxler, Williams, Blozis and Morris (2005) replicated these results and further found that such reduction could not be due to the lexical properties of specific verbs. Another piece of evidence which supports the influence of animacy on the prediction of RCs types was from Dutch. After manipulating the animacy of nouns in a reading time study on Dutch RCs, Mak, Vonk and Schriefers (2002, 2006) found there is no subject preference for RCs with an animate subject and an inanimate object. In terms of the English examples above, it means that there is no clear processing advantage for (1.9a) in comparison to (1.9d).

In general, the pattern of data from English and Dutch can be schematised as in (1.10). ">" means "was read faster than". The two capitalised characters indicate the grammatical roles of the HN and the RC noun. The smaller characters indicate animacy. Taking English as an example, the condition encoded by "S(an)-O(in)" refers to an SRC with an animate HN followed by an inanimate RC noun.

(1.10) S(an)-O(in)/O(in)-S(an) > S(in)-O(an) > O(an)-S(in)

The data pattern summarised in (1.10) implies that animacy information *does* influence the subject-preference because the ORC is processed as easily as SRC when it is supported by animacy information (S(an)-O(in)/O(in)-S(an)). On the other hand, the results show that animacy information is *not* strong enough to override the subject preference because even when there is no animacy support, the SRC still shows a processing advantage over the ORC (S(in)-O(an) > O(an)-S(in)).

According to the aforementioned theories of RC processing such as those based on filler-gap dependency (AFS) and working memory limitation (SPLT), there should be a subject-preference when the relative pronoun is encountered. A reanalysis is required in the ORC irrespective of the animacy of the ORC. In other words, the animacy of the object of the RC does not influence the subject-preference at the relative pronoun. Clearly, both theories are inconsistent with the above data, which show an animay effect in the ORC with an inanimate object. However, one could argue that there might be a potential preference for the SRC in the ambiguous region, and that reanalysis takes place at any point in the ambiguous region when processing the ORC with an inanimate object.

Since animacy does influence the choice for an analysis of the RC, then how does it applies? Mak et al. (2002) argued that there are two possibilities. The first one assumes that the animacy information directly guides the choice of RC type when the relative pronoun is encountered. This means that once the processing system recognises an RC, it immediately assigns an animate head noun (HN) to an SRC reading while it assigns an inanimate HN to an ORC reading. According to this view, no processing difficulty is expected in ORCs with inanimate HN. The second one assumes that there is no clear choice between SRC and ORC when the relative pronoun is encountered (which has a similar view with the AFS and the SPLT in the sense that they all predict no animacy influence at this point) but only when the RC noun is encountered. At that position, two nouns compete for the role of subject and object of the RC. If the HN and the RC noun differ in animacy, the animate one will be chosen as a subject of the RC. From this perspective, no difference between SRC and ORC will be expected when the subject is animate and the object is inanimate.

From above, it is clear that both approaches could predict no processing difference between SRC and ORC if they are supported by animacy information. However, they differ with respect to *how* animacy information starts to influence the choice of RC types. The first assumes that an animacy effect emerges at the position of the relative pronoun, i.e. only one argument (the HN). By contrast, the second assumes that the animacy information is not used at the position of the first argument but the second argument (the RC noun). In short, these two approaches are distinct with respect to whether animacy influences the processing of the first argument: the first one answers yes while the second one answers no.

1.2.3 Context

Context has long been claimed to be a disambiguating factor in cases where syntax alone is not sufficient to resolve an ambiguity. For example, a sentence like "someone shot the servant of the actress who was on the balcony" is ambiguous between the reading in which the RC attached to "the servant" or "the actress". However, an appropriately biased context has been shown to influence the choices between these two readings (e.g. Papadopoulou & Clahsen 2003). Apart from using context to resolve structural ambiguities as above, recent studies also examine how context or information structure influences the sentence-internal realization of word order, for example, how prosodic, given-new, topic-focus and contrast information constrain word order processing (e.g. Carlson, Dickey, Frazier & Clifton 2009). However, there haven't been any studies examining the role of context on the processing *initial ambiguous arguments in simple sentences*, which is another topic of the present study. A relevant study was from German scrambling, which examined the role of context on the processing of *unambiguously case-marked initial arguments in simple sentence*.

As mentioned in Example 1.1, in German, the word order in declarative main clauses is verb-second, while in subordinate clause it is verb-final. More precisely, the verb-second principle requires a finite verb or auxiliary verb to appear in the second position. Thus the finite verb divides the clause into two parts: one in front of the finite verb (*Vorfeld*, 'prefield') and one between the finite verb and non-finite verb (*Mittelfeld*, 'middlefield'), as schematised below.

(1.11) VF V-finite MF V-non-finite

Furthermore, any syntactic constituent (e.g. a noun phrase, an adverb) can occupy the prefield while word order in the middlefield is rather flexible. Thereby both regions allow subject-/object-initial orders. In the generative literature, the subject-initial order in subordinate clauses (i.e. SO in the middlefield) is considered to be the basic word order from which the main clause is derived by movement (e.g. Haider 1993). Other deviating orders, for example, the object-initial order in the subordinate clause (i.e. OS in the middlefield), are known as "scrambling" in German (e.g. Haider & Rosengren 2003)[7]. In order to distinguish between the processing advantage of subject-initiality in unambiguous case (scrambling sentence) from that in ambiguous case (initial ambiguous argument), below, we use "SO preference" for the former but reserve "subject-preference" for the latter.

A number of factors have been claimed to influence scrambling orders, including case marking, pronominalization, intonation, definiteness, information structure and so on. Among these factors, information structure has been viewed as a dominant factor in the accounts of Choi (1996), Jacobs (1988), Müller (1999), and Uszkoreit (1987). For example, information structure requires a non-focused constituent to precede a focused constituent (cf. *weighted constraints:* Uszkoreit 1987), which means a non-focused argument is generally licensed to scramble in German. This assumption has been attested in an acceptability judgement study by Keller (2000). In this study, one group of participants was asked to judge the acceptability of the subject-/object-initial sentences in contexts which either have focused subject, e.g. (1.12a), or have focused object, e.g. (1.12b). Another group of participants, by contrast, judged the acceptability of the same set of sentences but in the absence of any contextual information.

7 Different from the original definition of scrambling in Ross (1967), "scrambling" in the present study is only used to describe a permutated word order rather than subscribe to the transformational definition. Further, scrambling in German is defined as a word order permutation in the middlefield rather than word order permutations in general.

(1.12) Example context for subject-/object-initial sentences from Keller (2000)

a. Subject Focus: Wer kauft den Wagen?
'Who will buy the car?'

b. Object Focus: Was kauft der Vater?
'What will the father buy?'

(1.13) Example subject-/object-initial target sentences from Keller (2000)

a. SO:	Maria	glaubt,	dass	der Vater	den Wagen	kauft.
	Maria	believes	that	[the father]$_{NOM}$	[the car]$_{ACC.FOC}$	buys
b. OS:	Maria	glaubt,	dass	den Wagen	der Vater	kauft.
	Maria	believes	that	[the car]$_{ACC}$	[the father]$_{NOM.FOC}$	buys

'Maria believes that the father will buy the car.'

Without context information, SO order was clearly more acceptable than OS order. In the conditions with context information, OS order was more acceptable in the supporting context (i.e. subject-focus context) than non-supporting context (i.e. object-focus context). However, OS order was less acceptable than SO order in both contexts. The findings thus indicate that the focus context *can* influence the acceptability of OS order but it *cannot* override the general SO preference.

Parallel to those for animacy, here we can make similar predictions on *when* the context information influence word order processing, i.e. whether or not the context influences the processing of the first argument. It is worthy to note that the answer might be different according to the "strength" of a context. For example, within the focus domain, Choi (1997) distinguished contrastive focus from completive focus such as *wh*-questions in (1.12), following Dik, Hoffmann, de Long, Djiang, Stroomer and Devries (1981). Choi observed sentence (1.14) adopted from Moltmann (1990) is acceptable even though the object ("the book") is scrambled, because the object is contrastively focused. Thereby Choi argued that the "*focus constraint does not hold any more if the scrambled phrase is contrastively focused*."

(1.14) Examples of contrastive focus from Moltmann (1990)

weil	Hans	das Buch	dem Mann	gegeben	hat
becuase	Hans	[the book]$_{ACC.\ FOC}$	[the man]$_{NOM}$	given	has

(Nicht die Zeitung)
not [the newspaper]$_{ACC}$

Based on Choi's statement, OS order is more acceptable in a contrastive focus context than in a completive focus context. The SO preference could be more affected, or even overridden by a contrastive focus context rather by a complete focus context as obtained in Keller's study. Accordingly, a context could be strong enough to override the subject-preference at the position of the initial ambiguous argument (for an empirical evidence against this view, cf. Section 3.2.3 in Chapter 3).

1.3 General Discussion

Previous behavioural studies show that the subject-preference as a stable word order preference can be observed in typologically diverse languages. Furthermore, animacy and context factors were outlined as two potential influencing factors to this preference. Although previous studies examine animacy and context in RCs or scrambling sentences, they are insightful for deriving predictions for processing the initial (subject/object) ambiguous argument. Clearly, animacy and context do influence the preference for subject-initiality; however, with respect to the question of *when* their influence applies, i.e. *whether* they influence the initial argument processing, different theories have different views.

According to whether they answer yes or no, theories can be subsumed under two distinct types of language comprehension models. Modular (or "two-stage") models (e.g. Frazier & Fodor 1978; Frazier & Rayner 1982; Frazier & Clifton 1996; Friederici 1995, 1999, 2002) assume that linguistic information from syntax, semantics and pragmatics are independent of each other and are processed in a hierarchical manner. In the initial stage of processing, only syntactic information, for example word category or a small set of structural preference is drawn upon. Non-syntactic information such as animacy and context only influences processing choices at a second stage. Interactive models (e.g. MacDonald, Pearlmutter & Seidenberg 1994; Trueswell, Tanenhaus & Garnsey 1994), by contrast, assume that different information types interact with each other from the first stage of processing. Interpretative

aspects are assumed to be analysed simultaneously as soon as the information is available. The model further allows a free communication and interaction between different information types during the comprehension process. Obviously, both classes of models agree on the point that syntactic, semantic/pragmatic information types are integrated during sentence comprehension to achieve understanding; the debate on modular or interactive fashion boils down to the question of *when* different information types interact: modular models assume the interaction takes place at a later stage of processing, while interactive models assume an early interaction (cf. Friederici 2002 for discussion). To date, the debate between these two classes of models has not yet been solved.

Consider when the language processing system encounters one single argument such as "the movie" in a simple sentence. According to modular models, "the movie" is immediately assigned to a formal analysis such as "subject" or to a subject position and no more information such as animacy and context should be taken into account. On the other hand, interactive models assume that animacy and context can influence the subject interpretation as soon as "the movie" is encountered. Recall the aforementioned two approaches to the subject-preference in RCs in Mak et al. (2002). The first can be classified to the interactive models in the sense that it assume that an inanimate initial noun directly lead to an object interpretation. However, experimental findings that animacy did not affect the subject-preference at the position of the initial ambiguous argument speak against this view (cf. Schlesewsky et al. 2000 for German *wh*-questions by self-paced reading; cf. Demiral et al. 2008, for Turkish declarative sentence by ERP). Rather, a number of experimental findings speak in favour of the second approach, i.e. animacy plays a role when processing two arguments but not one single argument (Bornkessel-Schlesewsky & Schlesewsky 2009b). As for the role of context, previous experimental findings from German show that a contrastive focus does not necessary signal an object-initial order in unambiguously case-marked sentence (Bornkessel, Schlesewsky & Friederici 2003, cf. Section 3.2.3). Thereby, the view of a contrastive context can be strong enough to override the subject-preference at the position of the initial ambiguous argument itself may also be difficult to hold. Electrophysiological

evidence for no influence of animacy and context on processing the first argument will be presented in Section 3.2.2 and Section 3.2.3, respectively.

Notably, most of the modular models and interactive models are based on the English data but make general predictions concerning language processing for all languages. However, whether animacy and context influence the processing of the ambiguous initial argument may also depend on *how strong* they are in a particular language/construction (e.g. Bornkessel-Schlesewsky & Schlesewsky 2009b,c). For example, in Awtuw (de Swart 2007, p.90), a transitive sentence in which neither of the arguments is case marked like "woman pig bit." (English translation of Awtuw original) could only be interpreted as "the woman bit the pig." To express the opposite meaning, "the pig bit the woman", an additional accusative marking on the "woman" is required. Thus, in contrast with English where argument interpretation is primarily determined by the word order, in this language, argument interpretation is entirely determined by the animacy hierarchy and thus is independent of the word order in the default case. Another example is Chinese. Chinese has the same SVO order as English but it allows verb-final orders as long as they are supported by animacy and/or context. For example, a transitive sentence such as "medicine John took." has no problem to be interpreted as "John has taken the medicine." even there is no overt verb agreement and case marking to indicate the subject and the object. As the verb requires an animate argument to be the subject and the inanimate argument is the topic in the context, it is unlikely to interpret the sentence as "the medicine has taken John". Thereby, compared with the basic SVO sentence, the verb-final constructions in Chinese is more likely to be influenced by animacy and context (cf. Section 4.3.3 for details).

Though the processing counterpart of this typological observation has not yet been established, these examples suggest that the role of animacy and context may vary in different languages/constructions. Importantly, such typological observations pose an interesting challenge of the traditional disassociation between the function of syntactic information and the function of semantic/pragmatic information. The former, such as case marking, has long been considered to be relevant for the identification of an argument's role, while the latter, such as animacy has been considered to be only responsible for role prototypicality. However, from a cross-linguistic

perspective, there is no clear cut-off line between the function of syntactic information and the function of semantic/pragmatic information, because semantic/pragmatic information may have different "strength" (i.e. to what degree animacy and context can determine the argument interpretation) in different languages/constructions (cf. *the competition model* in Bates, McNew, MacWhinney, Devescovi & Smith 1982; MacWhinney & Bate 1989).

Driven by cross-linguistic considerations and based on electrophysiological evidence, Bornkessel (2002), Bornkessel and Schlesewsky (2006a) proposed a language comprehension model – the extended Argument Dependency Model (the eADM), which captures the subject-preference and the influence of animacy as well as context in a different manner from the existing models. First, the eADM derive the subject-preference from the minimal-dependencies account, which is subsumed under a more general principle called "Distinctness". This principle is independent of structural differences, thus it is considered to be applicable for all the languages. Secondly, the eADM posits animacy as functionally equivalent to information types typically considered syntactic, such as linear order and case marking from the perspective of "the (syntax-semantics) interface". All these information types serve to render an argument more or less "prominent" and thus influence both role prototypicality and role identification. Finally, although the influence of context during word order processing is still a work in progress in the eADM, according to its current version, the model predicts an earlier influence of animacy than of context.

Before we move to the architecture of the eADM and relevant electrophysiological evidence in Chapter 3, preliminary knowledge about the methodology – event-related potentials (ERPs) – will be first introduced in Chapter 2. As the difficulty engendered by a certain type of word order typically reflects in a form of increased processing effect, ERPs could provide much information about such processing effect during online language processing.

Chapter 2

The EEG and ERP Methodology

The electroencephalogram (EEG) and event-related potential (ERP) methodology provides multi-dimensional information and a high temporal resolution for the examination of online language processing. It is thus suitable and widely used for examining the precise time-course and strength of an incoming information source during language processing.

The EEG signal represents the sum of oscillations that consist of different frequency bands depending on the biological, pathological and psychological status. The German psychiatrist Hans Berger (1873-1941) was the first to record the EEG and to describe the different waves or rhythms that were present in the normal and abnormal brain, such as the alpha rhythm (also known as "Berger's wave", prominent oscillations in the range of approx. 8-12 Hz). Importantly, he noticed that there was a correlation between changes in EEG signals and psychological status: the alpha rhythm decreases during problem solving (e.g. mental arithmetic) and increases again during relaxed wakefulness (Berger 1929). This critical finding thus enables EEG not only to be used to diagnose certain mental problems, but also to be used in the fields of experimental psychology and cognitive neuroscience (cf. Rösler 2005 for a more detailed historical overview).

This chapter gives an introduction to EEG measurement. Subsequently, ERP components that are related to the present study such as LAN, N400 and P600 are also addressed in turn.

2.1 EEG

The EEG reflects electrical changes in voltage (or potential) over time that can be measured non-invasively by electrodes applied to the surface of the scalp (e.g. Rugg & Coles 1996). What is often referred to as "brain activity" actually means the neural communication comprised of current flow. Suppose information transfers from neuron A to neuron B; A first creates action

potentials, which are discrete electrical signals. These electrical signals travel down axons and between A's membranes of pre-synapse and B's membranes of post-synapse, which result in small changes in current flow. Such small changes in current flow around synapses cause small changes in voltage, which can be detected by nearby recording electrodes. Notably, in reality, the voltage changes that are recorded on the scalp do not reflect the activity of a single target neuron such as neuron B, but reflect the activity of a large number of neighbouring neurons, estimated at 1,000 to 10,000 for the smallest EEG signals recorded. Recording the EEG takes advantage of the organization of the cortical pyramidal cells, which are the largest and most numerous type of neuron. As the cortical pyramidal cells are parallelly oriented perpendicular to the surface of the scalp, the small voltage changes generated by each active synapse can be compiled. The changes in current flow of the various synapses on neighbouring neurons are recorded outside of the head, non-invasively from electrodes placed on the scalp. This recorded voltage change over time is the EEG[8].

It is also important to note that any recording of the EEG is relative. This means that the record consists of the difference between one electrode relative to another electrode which is used as a reference. Typically, the reference electrode is placed at locations that are somewhat more insulated from brain activity such as on the thick bones behind the ears (mastoid reference), although other reference points are possible. As the polarity and spatial distribution of the EEG across the head depends on which reference point is chosen, one should pay special attention to the reference point when looking at the results of the recording.

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8 Concerning the relationship between language and the brain, another technique that provides direct, non-invasive measurements of brain activity is the magnetoencephalogram (MEG) which is based upon changes in the brain's magnetic fields produced by electrical activity in the brain. Other techniques such as positron emission tomography (PET) and functional Magnetic Resonance Imaging (fMRI), which are based on haemodynamic changes in the brain, are indirect measurements of brain activity (Otten & Rugg 2004). PET and fMRI can be considered complements to EEG in the sense that they provide high spatial resolution of brain activity (e.g. underlying brain region of interest) but poor temporal resolution (>1 second) while EEG exhibits high temporal resolution (only tens and hundreds of milliseconds) but low spatial resolution.

Compared to other alternative methods, EEGs can provide multi-dimensional information and high temporal resolutions. In contrast to uni-dimensional behavioural methods such as reading times and acceptability judgement, the product of EEG – ERP components, as will be introduced in the next section in more details, can be used to interpret qualitatively different effects. For example, the same type of analysis may engender different types of components. Their different amplitudes can quantitatively distinguish qualitatively similar effects. When studying sentence comprehension with EEG, the brain activities directly evoked by the stimulus sentences are continuously recorded over time. The response to the word of interest in the middle of the sentence can be observed once its position is time-locked in the stream of EEG signals. As the EEG provides a high temporal resolution, which is in the order of tens and hundreds of milliseconds, the brain responses are thought to be observed almost without delay.

However, this does not mean that EEG recording has no limitations. For instance, the first is the so-called "inverse problem". As mentioned earlier, the surface EEG signals reflect the activity of a large number of neurons, which may be located in various regions in the brain. Since we cannot exclude the possibility that the signal could be generated elsewhere, there are always multiple solutions for the surface change in EEG signal. Another point is the possibility that activity may, under certain circumstances, be "invisible" to surface recordings. This is the case, for example, when voltage changes in different cortical layers cancel each other out, so that there is not a measurable deflection at the surface of the scalp. Similarly, this situation results when the neuron assemblies yielding the activity are not oriented perpendicularly to the surface of the scalp.

A typical placement of the electrodes (the so-called "extended 10-20 system") is shown in Figure 2.1.

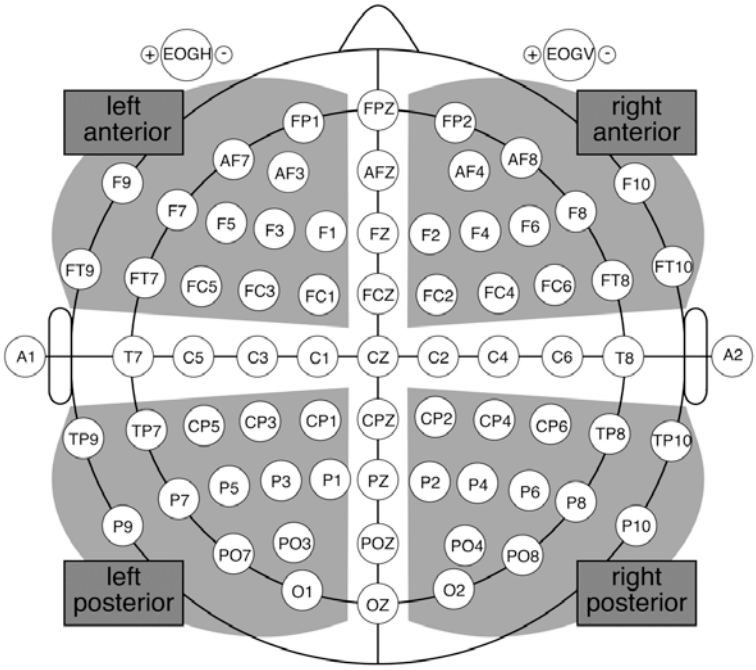

Figure 2.1: A top view of the scalp (up=forward; left=left). Electrodes are named with reference to brain regions: F=frontal, C=central, T=temporal, P=parietal, O =occipital. The numbers refer to the distance from the vertex and are odd on the left and even on the right. Electrodes at the midline between nasion and inion are referred to with an additional Z. The shaded areas indicate the typical nomenclature for the topographical characteristics of an ERP effect and also sample regions of interest (ROI) for statistical analysis. ERP effects can be characterised as anterior (or frontal), posterior (or parietal), or may also be central. Additional electrodes labelled as "EOGH" and "EOGV" refer to the electrodes that record the horizontal and vertical electro-oculogram, respectively. As the electrical signals caused by eye movements (saccades and blinks) lead to artefacts in the EEG, they must either be excluded from the data analysis or corrected. The electrode labels "A1" and "A2" refer to electrodes positioned at the left and right mastoid bones, respectively. They are often used as reference electrodes in language-related EEG experiments (cf. Handy 2004). Either A1 or A2 is chosen as a reference during the EEG recording but the average signal of both mastoids is typically used to re-reference the signal off-line to avoid distortion in terms of lateralisation (adopted from Bornkessel-Schlesewsky & Schlesewsky 2009c).

2.2 ERP

The term "Event-related potentials (ERPs)" refers to the potential changes in the EEG that are time-locked to sensory or cognitive events. Using this, we can examine the brain's response to those stimuli of particular interest (e.g. words or sentences) (cf. Rugg & Coles 1996). The procedure for observing ERPs from the raw EEGs is shown in Figure 2.2.

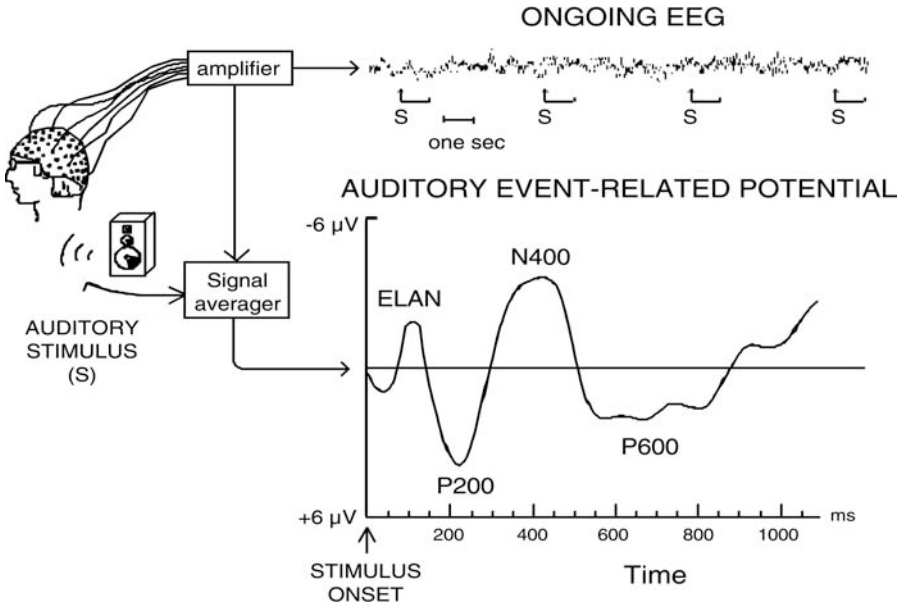

Figure 2.2: Schematic depiction of the setup of an ERP experiment on language processing (adopted from Coles & Rugg 1995).

As can be seen in Figure 2.2, the small changes in the EEG evoked by auditory (or visual) stimuli are recorded from the scalp. The changes evoked by stimuli are very small (between approx. 2-8 μV for language at the scalp) in comparison to the spontaneous (background) electrical activity of the brain (approx. 10-100 μV). This means the signal-to-noise ratio is very low, which in turn requires a high number of trials in each condition (i.e. the same type of stimuli). ERPs are extracted from this background activity by an averaging procedure according to the statistic assumption that when the same stimulus is repeated several times, similar electrocortical activity occurs during which

the noise is distributed randomly (Birbaumer & Schmidt 1996; Bösel 1996). To meet this requirement, approximately 30-40 items of each relevant stimulus type must be presented and more than 20 participants' ERPs are necessary. For the same reason, single participant ERPs typically cannot be interpreted with respect to psycholinguistic manipulations (though strong effects are sometimes visible in single participant averages). Rather, once averaging has been accomplished for each participant, a "grand average" is computed from these individual averages. The resulting ERPs exhibit less noise in the grand average and consist of a series of components, which provide the basis for a functional interpretation.

ERP components can be characterised in regards to four different dimensions: polarity (negative vs. positive), topography (which electrode sites exhibit a visible effect), latency (the time at which the effect is visible relative to the onset of a critical stimulus), and amplitude (the strength of an effect). In this way, ERPs are regarded as a highly sensitive, multidimensional measure of language processing.

The x-axis in Figure 2.2 depicts time in milliseconds or seconds from critical stimulus onset, which occurs at the vertical bar, while the y-axis depicts voltage in microvolts. Note that negativity is conventionally plotted upwards (Kutas & van Petten 1994). ERP components are typically named according to their polarity (N for negativity vs. P for positivity) and latency. For example, an N400 indicates negativity with a peak latency of approximately 400 ms relative to the critical stimulus onset.

In addition, it should always be kept in mind that the ERP methodology only provides relative measure, that is, an effect can only be interpreted from the comparison of a critical condition with a control condition, but never with respect to the coordinate system (i.e. in absolute terms). For example, an N400 effect is defined as a more negative waveform in comparison to the control condition at approximately 400 ms post critical stimulus onset. However, the absolute voltage could be positive or negative for a number of reasons, for example, due to other neural processes that are independent of the manipulation of interest (e.g. simply the state of being vigilant). The following sections will introduce three classical language-related components.

2.3 Language-Related Components

A number of ERP components have been reported to reflect the brain's response to linguistic stimuli. Within the scope of all kinds of language-related components, here, three ERP components are considered to be well-known and relevant to the present study; they are LAN, N400, and P600. A classical preliminary interpretation will be introduced first, then a revised interpretation based on recent observations that are difficult to reconcile with the classical functional interpretations will follow. Note that throughout the present thesis, the critical word for comparing ERP responses is underlined and the ERP effects are noted in parentheses after the examples.

2.3.1 LAN

The left anterior negativity (LAN) is usually observable between approximately 300 and 500 ms post onset of the critical word[9]. This effect is a component that typically occurs in combination with P600s (cf. Section 2.3.3) and is often found

9 In the psycholinguistic/neurolinguistic literature, there is a left negative anterior negativity that has been reported as early as 100 ms, namely "Early Left Anterior Negativity (ELAN)". The ELAN shares a number of similarities with LAN: it often persists in the 300-500 ms latency window, is also distributed in the left anterior sites, and is also found in relation to syntactic anomalies rather than in response to semantic processing demands. However, some scholars have proposed to functionally distinguish these two left anterior negativities. For example, in modular models such as the "syntax-first" model in Friederici (2002), the ELAN (150-200 ms) is interpreted to reflect the violation of phrase structure construction based on word category information in the initial processing stage. The LAN (300-500 ms), by contrast, is at the subsequent processing stage as the N400, because it is hypothesised to reflect the difficulties in integrating morphosyntactic information (person, number, gender, case feature) with semantic information devoted to thematic role assignment. This distinction of these two stages is supported by the finding that the ELAN as a response to phrase structure violation can block the N400 (typically reflects the semantic violation), but not vice versa (cf. Hahne & Friederici 2002; cf. Van Den Brink & Hagoort 2004 for a different view).

in correlation with morphosyntactic mismatches such as violations in person, number and gender agreements[10].

Kutas and Hillyard (1983) first found that sentences with violation of subject-verb agreement such as "**some shells is even soft.*" engendered a LAN. By contrast, the sentences with semantic violations gave rise to an N400 (see below). The LAN shared approximately the same latency window with the N400 but it was distributed on different sites.

It has been further revealed that the occurrence of the LAN is not only restricted to subject-verb agreement but exhibits a more general agreement relation. Gunter, Friederici and Schriefers (2000) used German sentences with the violation of gender agreement as shown in (2.1). They found these sentences consistently elicited a LAN no matter whether the verb and the object nouns were semantically associated or not. Rather, the semantic variable (high-cloze vs. low-cloze) was reflected in the N400, which was not influenced by gender (dis)agreement. The interaction of these two variables was reflected in the form of the P600 component (see below) because sentences with high-cloze nouns such as (2.1a) engendered an additional P600 while sentences with low-cloze nouns such as (2.1b) did not. Based on these findings, Gunter et al. (2000) argued for a modular processing model, in which syntactic and semantic processes are autonomous during an early processing stage and interact during a later processing stage.

(2.1) Example stimuli from Gunter et al. (2000)

*a. Sie	bereist	den Land	auf	einem	kräftigen	Kamel.	(LAN, P600)
she	travels	$[the]_{MAS}[land]_{NEU}$	on	a	strong	camel	
*b. Sie	befährt	den Land	mit	einem	alten	Warburg.	(LAN)
she	drives	$[the]_{MAS}[land]_{NEU}$	with	an	old	Warburg	car

The LAN has been replicated for agreement mismatches in many languages such as Dutch (Gunter, Stowe & Mulder 1997), Spanish (Barber &

10 Gender agreement could also engender an N400. Schmitt, Lamers and Münte (2002) examined the biological (semantic) and syntactic agreement between the pronoun and its reference in German. They observed an N400 for the pronoun disagreeing with a non-diminutive noun (i.e. the noun whose biological and syntactic agreements overlap, e.g. "der $Bub_{[MASC]}$").

Carreiras 2005) and Italian (Angrilli et al. 2002; de Vincenzi et al. 2003). Furthermore, it also occurs in morphological errors (Penke et al. 1997; Weyerts, Penke, Dohrn, Clahsen & Münter 1997). However, it should be noted that the violation of subject-verb agreement does not always give rise to a LAN. Nevins, Dillon, Malhotra and Phillips (2007) used Hindi sentences that mismatched the correct agreement on different domains (gender, number, gender and number, person and gender) and found that all of these agreement violations elicited P600s but not any LANs. From Nevins and his colleagues' perspective, the lack of a LAN implies that the LAN may reflect only certain sets of agreement violations under certain conditions.

In contrast to the view that attributes the LAN to a specific response resulting from a mophosyntactic violation as above, a second view explains the LAN in terms of general verbal working memory process. This view is particularly based on the presence of the LAN in fully grammatical sentences (e.g. Kluender & Kutas 1993). For example, Münte, Schiltz and Kutas (1998) found that sentences such as "*Before the scientist submitted the paper, the journal changed its policy*." elicited a sustained LAN as opposed to sentences such as "*After the scientist submitted the paper, the journal changed its policy*." The LAN started 300 ms after the onset of the first word but occurred over the course of the whole sentence. They attributed this effect to the fact that the temporarily later event occurs earlier in the sentence and thus needs to be held in working memory in order for the sentence to be interpreted. However, as King and Kutas (1995) observed, there are differences between negativities related to morphosyntactic processes and working memory with respect to latency and duration. The LAN effects in the former occur more locally after the violation occurred, while those in the latter are visible throughout the whole sentence.

The LAN has also been observed in grammatical sentences that involve a mismatch of prominence scales. Bornkessel, McElree, Schlesewsky and Friederici (2004b) examined subject-object ambiguity with a reanalysis of dative-initial order in German, as shown in (2.2).

(2.2) Example stimuli from Bornkessel et al. (2004b)

a. NOM-SO: … dass Maria Sängerinnen gefällt. (LAN)
that [Maria]$_{\text{NOM/ACC/DAT. SG}}$ [singers]$_{\text{NOM/ACC/DAT.PL}}$ please$_{\text{SG}}$
'…that Maria is appealing to singers.'

b. DAV-OS: … dass Maria Sängerinnen gefallen. (N400)
that [Maria]$_{NOM/ACC/DAT.\ SG}$ [singers]$_{NOM/ACC/DAT.PL}$ please$_{PL}$
'…that singers are appealing to Maria.'

In (2.2), the clause-final verb – dative object-experiencer verb – disambiguated the initial argument to a nominative subject-initial order (2.2a) or dative object-initial order (2.2b) via number marking. ERP time locked to the verb revealed that the sentence disambiguated into a dative object-initial order elicited an N400 (cf. Section 2.3.2) as opposed to nominative subject-initial order (2.2b vs. 2.2a). Additionally, there was a second ERP effect – a LAN for the latter as opposed to the former (2.2a vs. 2.2b). The authors interpreted the N400 as a reflection of the grammatical function reanalysis for an object-initial reading, and the LAN was interpreted as a reflection of a mismatch of the thematic hierarchy and case hierarchy (cf. prominence scales (3.1) in Chapter 3): the case hierarchy requires nominative before dative order (NOM > DAV), whereas the thematic hierarchy requires experiencer before theme order (Experiencer (Actor) > Theme (Undergoer)), two orders conflict in the case of nominative subject-initial sentence (2.2a).

In general, the LAN can be viewed as a component that typically correlates with syntactic anomalies independent of any semantic manipulation. It can also associate with general verbal working memory process and mismatch of the prominence scales in grammatical sentences.

2.3.2 N400

The N400 is a centro-parietal negativity with a peak latency of approximately 400 ms post-onset of a critical word. Besides its sensitivity for lexical-semantic manipulations such as word frequency (Kutas & Federmeier 2000) and word repetition (van Petten, Kutas, Kluender, Mitchiner & McIsaac 1991), it has widely been associated with the processing of semantic violations or implausibilities (Kutas & Hillyard 1980a, b), and the integration of a word into a meaningful context (Chwilla, Brown & Hagoort 1995; Friderici 1995).

Kutas and Hillyard (1980a) first observed this component in semantically incorrect sentences such as "**He spread the warm bread with socks*." compared to correct counterparts. In order to test whether the N400 reflects a general effect

of surprise due to a mismatch or is actually related to language processing, Kutas and Hillyard (1980b) presented both semantically anomalous sentences and sentences containing a physically deviating word (words printed in larger type). The physical deviation led to a P560 but not to an N400, thus supporting the assumption that the N400 is indeed related to language processing.

Although problems with the integration of a word into a preceding context generally give rise to an N400, the amplitude of the N400 varies with respect to the degree of lexical-semantic relatedness and unexpectedness. For example, Federmeier and Kutas (1999) used sentences like "*They wanted to make the hotel look more like a tropical resort, so along the driveway they planted rows of ….*" and completed the sentence with either "palms/pines/tulips". They found that although both the sentences that ended with "pines" and "tulips" elicited an N400 compared with "palms", sentences that ended with "pines" elicited a slightly smaller amplitude than "tulips". These results thus suggest that the N400 can be modulated by the degree of the association with the expected continuation. The amplitude is smaller in violations that used a semantically closer word than a semantically more distant word. Furthermore, Kutas and Hillyard (1984) found that the N400 became more pronounced with a higher degree of unexpectedness (i.e. a lower cloze probability) for the critical word, which suggested that not only semantic violations or anomalies, but also unexpectedness can lead to varying amplitudes of the N400 in a meaningful sentence.

The classical interpretations of N400 which have been reviewed so far might lead readers to conclude that the N400 is purely caused by aspects of semantic processing. The following studies, however, will show that the N400 may also appear under some syntactic circumstances such as grammatical function reanalysis. Hopf et al. (1998) used German sentences with initial case-ambiguous objects. The clause-final verbs served to disambiguate the initial objects to either accusative case or dative case. Compared with unambiguously (accusative/dative) case-marked conditions, Hopf et al. (1998) found that at the position of the disambiguating verb only the dative-initial conditions elicited an N400 but not the accusative-initial conditions. Unlike such object-object (accusative vs. dative) ambiguities examined by Hopf et al. (1998), in a visual experiment, Bornkessel et al. (2004b) examined German complement sentence with subject-object (nominative vs. accusative/dative)

ambiguities, in which the ambiguous object-initial conditions are illustrated in (2.3).

(2.3) Example stimuli from Bornkessel et al. (2004b)

Alle wussten, …

everyone knew …

a. ACC-OS: …	dass	Friedrich	Gönnerinnen	lieben, …	(P600)
	that	$\text{Friedrich}_{[SG]}$	$\text{patrons}_{[PL]}$	$\text{love}_{[PL]}$	
	'… that patrons love Friedrich.'				
b. DAV-OS: …	dass	Friedrich	Gönnerinnen	zuwinken, …	(N400)
	that	$\text{Friedrich}_{[SG]}$	$\text{patrons}_{[PL]}$	$\text{wave.to}_{[PL]}$	
	'… that patrons wave to Friedrich.'				

Bornkessel et al. (2004b) contrasted ambiguous object-initial conditions (OS) with the ambiguous nominative-initial control conditions (SO). They found that at the position of the disambiguating verb, the accusative-initial conditions elicited a P600, while the dative-initial conditions elicited an N400. The P600 was expected because it is typically associated with structural reanalysis (cf. Section 2.3.3). However, the occurrence of an N400 here was unexpected according to the previously mentioned semantic interpretation. Furthermore, this N400 should not be due to a dative assignment because in contrast to Hopf et al. (1998) the nominative-initial control conditions for the dative reanalysis also involved a disambiguation to dative object in this experiment.

To shed further light on this reanalysis N400, Haupt, Schlesewsky, Roehm, Friederici and Bornkessel-Schlesewsky (2008) conducted a subsequent auditory ERP study using similar complement sentences with the subject-object ambiguity as shown in (2.4). In order to minimise all task-related influences[11], they embedded these critical sentences within short stories, asking participants to answer questions for general story comprehension.

11 There is empirical evidence showing that both an N400 and late positivity can be modulated by the effects of a task, experimental environment, and individual processing strategy (Roehm, Bornkessel-Schlesewsky, Rösler & Schlesewsky 2007a).

(2.4) Example stimuli from Haupt et al. (2008)

a. ACC-OS: … dass Bertram Surferinnen geärgert haben.
(N400-late POS)
that Bertram$_{[SG]}$ surfers$_{[PL]}$ annoyed$_{[PL]}$ have$_{[PL]}$
'… that surfers annoyed Bertram.'

b. DAV-OS: … dass Bertram Surferinnen gratuliert haben.
(N400-late POS)
that Bertram$_{[SG]}$ surfers$_{[PL]}$ congratulated$_{[PL]}$ have$_{[PL]}$
'… that surfers congratulated Bertram.'

The sentences in (2.4) are not disambiguated via the main verb (dative/accusative) but rather via the auxiliary after the main verb. Haupt and her colleagues again observed an N400, which was followed by a late positivity, at the position of the auxiliary where the sentence was disambiguated to an object-initial order compared to their subject-initial counterparts. These results suggested that the subject preference was already established before the disambiguating auxiliary, i.e. at the position when the verb clearly requires the dative or accusative case (for similar results, see also Schlesewsky & Bornkessel 2006). One new finding in their study was that the reanalysis N400 was accompanied by a late positivity component, forming a biphasic N400-late positivity[12] pattern in the terminology of the Extended Argument Dependency Model (the eADM, Bornkessel & Schlesewsky 2006a, cf. Chapter 3). As this pattern did not differ between dative and accusative conditions, the reanalysis to an object-initial order is thus reflected in an N400 effect independent of the type of object case (accusative/dative). Based on the observation above, Haupt et al. (2008) suggested that the reanalysis-related N400 and the standard N400 – the one associated with the lexical-semantic processing – have one aspect in common: both of them are related to interpretative problems. Thus, these two types of N400s could belong to a greater "N400 family".

12 The late positivity which is considered to be a part of a biphasic pattern (in which reanalysis properly correlates with the N400) is interpreted by Schlesewsky and Bornkessel (2006) to reflect the processes related to an evaluation of *Well-formedness* (cf. Fig. 3.1 in Chap. 3).

In fact, the N400 can result not only from the grammatical functions reanalysis as in (2.3) and (2.4), but also from the animacy influence interacted with the case marking. As will be shown in Chapter 3, an N400 results when the processing system expects an animate subject after the initial object but actually encounters an inanimate subject (Frisch & Schlesewsky 2001; Roehm et al. 2004). Furthermore, an N400 also occurs in an ungrammatical sentence in which the second argument is marked with the same case as the first argument (cf. the so-called "double case violation" in Section 3.2.2).

To summarise, an N400 occurs not only during the processing of semantically anomalous sentences, but also under more general reanalysis circumstances such as grammatical function reanalysis, animacy influence and case violation. The findings of the reanalysis N400 are essential because they challenge the classical interpretation by revealing that the N400 should not be associated with one single functional domain[13].

2.3.3 P600

A centro-parietal positivity that occurs between 600-1000 ms after the critical word onset is a late positivity that has also been termed P600 (Osterhout & Holcomb 1992, 1993) or syntactic positive shift (SPS; Hagoort, Brown & Groothusen 1993).

P600 effects occur not only in ungrammatical sentences (cf. Example 2.1a, also cf. Hagoort et al. 1993), but also in grammatical sentences with a non-preferred syntactic structure. Osterhout and Holcomb (1992, 1993) first reported a P600 in the disambiguating region of garden path sentences such as "*The broker persuaded to sell the stock was sent to jail.*" In this sentence, the verb "persuaded" is ambiguous between a main verb and a reduced relative clause interpretation. As a number of studies have demonstrated that the processing system strongly prefers for the former reading (e.g. Ferreira & Clifton 1986; Frazier & Rayner 1982; Rayner, Carlson & Frazier 1983), a difficulty in

13 Note that the critical words in this section on N400 happened to be the last words in the sentences, which seems to give an impression that only the end of the sentences engenders such effects. In fact, as was apparent in other examples here, critical words can be located at any position in the sentences and may elicit any of the various ERP effects (e.g. Kutas & Hillyard 1983).

processing reflected by the P600 is observable when the appearance of the word "to" disambiguates the sentence to the non-preferred reading. The findings thus support the P600 as a language-related component in correlation with reanalysis in sentences with structural ambiguities.

Subsequent studies further revealed that P600 effects can also be engendered by syntactic complex sentences. For example, Kaan, Harris, Gibson and Holcomb (2000) used sentence stimuli as illustrated in (2.5).

(2.5) Example stimuli from Kaan et al. (2000)
a. Emily wondered *which* the star the performer in the concert had imitated … (P600)
b. Emily wondered *who* the performer in the concert had imitated … (P600)
c. Emily wondered *whether* the performer in the concert had imitated ...

In this study, they found a P600 at the embedded participle verb ("imitated") for the *which*- and the *who*- conditions as opposed to the *whether*-condition. Furthermore, a somewhat more pronounced P600 was found for the *which*-condition in comparison to the *who*-condition. Kaan and colleagues assumed that this difference results from additional discourse-related processes. As *which*-questions trigger the inference of a set of entities in the discourse, *who*-questions do not. The *which*-questions may have required greater processing resources – the integration cost in terms of Gibson (1998) – than *who*-questions at the point of the embedded verb. Based on the correspondence between the amplitude of the ERP effect and the degree of integration cost, Kaan and colleagues proposed that the P600 is a more general marker of syntactic integration. In fact, elaborations on P600s by Friederici, Hahne, and Saddy (2002) as well as Kaan and Swaab (2003) further revealed that the P600 is not a unitary component because the reanalysis-related and complex-related P600s could be distinguished from each other with respect to their different topographical distributions: centro-parietal in the former vs. fronto-central in the latter.

Furthermore, Frisch, Schlesewsky, Saddy and Alpermann (2002) observed a broadly distributed P600 in response to syntactic ambiguity. In a visual ERP experiment, they used declarative main clauses in German and found that at the position of the initial argument the (subject-object) ambiguous argument

engendered a broadly distributed P600 as opposed to unambiguously case-marked arguments. At the position of the second argument, where the ambiguous sentences were disambiguated toward either an object-initial order or a subject-initial order, a second P600, whose distribution was similar to the first one, was observable for the non-preferred object-initial order in comparison to the subject-initial order. The second P600 (object-initial vs. subject-initial) replicates the previous studies in which the P600 is reported as a correlate for the revision from the subject-initial reading to a non-preferred object-initial reading (beim Graben et al. 2000; Mecklinger et al. 1995). The finding of the P600 (ambiguous vs. unambiguous) observed at the initial locally ambiguous argument is new. Frisch and colleagues argue that this P600 does not reflect the revision since there is no preceding interpretation to be revised at this position. For the same reason, it is also difficult to attribute this P600 to the syntactic integration as proposed in Gibson (1998). Instead of integration cost, one may argue that the structural prediction costs can be minimised by assuming a subject analysis of the ambiguous argument. In this way, one needs to extend the interpretation of the P600 in that it not only reflects the structural revision but also reflects the complexity of structural predictions possible at one item. Thus, Frisch and colleagues argue that the P600 reflects both the recognition of an ambiguity (at the ambiguous initial argument) and its resolution (at the disambiguating second argument) and thereby should be taken as an indicator of syntactic processing cost in general.

In summary, the findings that we have seen so far suggest a close association between the P600 and syntactic processing difficulty including reanalysis, integration in complex structures and ambiguity. Therefore, the P600 is conventionally used to diagnose aspects of syntactic processing. However, as will become clear in the following, the P600 is not exclusively syntactic in nature.

Recall that Gunter, Friederici and Schriefers (2000) found an interaction of semantic expectancy and grammatical gender in their experiment by using German sentences with high and low cloze probable object nouns. As shown in Example 2.1, (*Sie bereist* <u>*das Land*</u>..., 'She travels the land …' vs. *Sie befährt* <u>*das Land*</u>..., 'She drives the land…'), the ERPs were measured based on the object noun which was either in agreement or disagreement with its article. The P600 was only observable at the high-cloze nouns but not at the low-cloze nouns.

Hence, Gunter et al. (2000) suggested that this component should not be due to a purely syntactic processing; rather, it implies the interaction of the semantic cloze-probability and syntactic gender violation. This non-syntactic aspect of the P600 was further demonstrated in Roehm, Bornkessel-Schesewsky, Rösler, and Schlesewsky (2007a) by using sentences such as "*The opposite of black is nice*.", in which there is no syntactic processing problems but only a semantic violation. Roehm and his colleagues observed a biphasic N400-late positivity[14] pattern at the position of the last word. They propose that the late positivity might correlate to a global evaluation of the proper formation of sentence or it could also be interpreted as a result of repetition and semantic priming (Camblin, Gordon & Swaab 2007)

Beyond the syntax-semantics interaction observed above, a bigger challenge of the classical interpretation of the P600 effects seems to stem from the so-called "semantic P600", which has triggered an intensive debate in recent literature for its seemingly semantic nature. As the initial illustration of the semantic P600, consider sentences adopted from Kim and Osterhout (2005).

(2.6) Example stimuli from Kim & Osterhout (2005)

a. Sentence with a semantic attraction violation
   The hearty meal was devouring … (P600)
b. Sentence without a semantic attraction violation
   The dusty tabletops were devouring … (N400)

The sentences in (2.6) contain animacy violations with (a) and without semantic "attraction violations" (b). Kim and Osterhout found a P600 effect for (2.6a) in comparison to both active and passive control sentences. By contrast, (2.6b) engendered an N400 effect. These results suggest that the semantic attraction between "meal" and "devouring" is so strong that it leads the

14 Based on phenomenological grounds, a nomenclature is proposed for the dissociation between the P600 and the late positivity: in the case of a monophasic ERP deflection, the effect will be referred to as a P600, whereas it will be termed a late positivity if it occurs as part of a biphasic pattern. Note that this denotation does not imply theoretical differences. This nomenclature will be justified when discussing the neurocognitive models in Chap. 3 and it will be employed throughout the remainder of this thesis.

processing system to analyse this as a syntactically ill-formed sentence, the well-formed counterpart of which is "*The hearty meal was devoured …*". Kim and Osterhout (2005) thus argued that this P600 results from a syntactic mismatch between the present participle form encountered by the processing system and the semantically based expectation for a past participle. Furthermore, if the evidence is compelling enough, semantic analysis can override syntactic analysis even in unambiguous sentences.

In contrast to Kim and Osterhout (2005), Kolk and his colleagues (Kolk, Chwilla, van Herten & Oor 2003; van Herten, Kolk & Chwilla 2005; Vissers, Chwilla & Kolk 2006) interpret the P600 as a domain-general correlation of "conflict monitoring". In their study, van Herten et al. (2005) compared verb-final sentences in Dutch such as (2.7).

(2.7) Example stimuli from van Herten et al. (2005)

a. De vos die op de stropers joeg sloop door het bos. (P600)
   the fox$_{[SG]}$ that at the poachers$_{[PL]}$hunted$_{[SG]}$stalked through the woods
   'The fox that hunted the poachers stalked through the woods.'

b. De vos die op de stropers joeg sloop door het bos. (P600)
   the fox$_{[SG]}$ that at the poachers$_{[SG]}$hunted$_{[SG]}$stalked through the woods
   'The fox that hunted the poacher stalked through the woods.'

Both of the sentences are implausible because the syntactic structure requires a reversal interpretation, that is, normally, it is the poacher(s) that hunts the fox but not the other way around. The poachers should be expected to be the subject based on this plausibility heuristic. According to Kim's and Osterhout's (2005) syntactic mismatch view that a P600 results from a semantic/plausibility-based computation of the relation between arguments and the verb, which can override the syntactic analysis, (2.7a) should lead to a P600 in comparison to (2.7b). In the former, two arguments differ in number and the plural verb agrees with the more plausible subject. By contrast, no such mismatch arises in the latter case as both arguments are singular and thus call for the same verb form. However, van Herten and colleagues found a P600 in both cases, thus speaking against the syntactic mismatch account for the P600. Therefore, they argue that semantic P600s result from the conflict when the output of the plausibility contradicts the syntactic analysis. Further

evidence for this conflict-related P600 have also been provided in other domains such as orthographical errors (Vissers et al. 2006).

Finally, semantic P600 effects have also been related to problems in thematic processing, such as animacy violations. Kuperberg and colleagues (2007) observed a P600 but not an N400 for sentences such as "*For breakfast the eggs would bury…*" In this sentence, there is no close semantic relation between *eggs* and *bury*; thus, the aforementioned "semantic attraction" does not play a role here. However, there is obviously an animacy violation because the verb, *bury*, calls for an animate agent. Therefore, they attribute the occurrence of a P600 rather than an N400 effect to aspects of thematic processing since animacy violation in their critical sentences can be considered a thematic violation (an alternative interpretation for this result was provided by Bornkessel-Schlesewsky & Schlesewsky 2008). Hoeks and his colleagues (2004) proposed a similar account based on their Dutch experiments, using sentences as in (2.8).

(2.8) Example stimuli from Hoeks et al. (2004)

De speer	heeft	de atleten	geworpen.	(P600)
the javelin$_{[SG]}$	has$_{[SG]}$	the athletes$_{[PL]}$	thrown	

'The javelin has thrown the athletes.'

According to Hoeks' and his colleagues' view, the sentence-final verb disambiguates the inanimate noun to a subject via verb agreement and thereby to an implausible reading. The presence of an inanimate subject leads to an underspecification of the "message-level" representation (the representation of the sentence meaning combining lexicon-semantic and syntactic constrains) being constructed, which consequently leads to the absence of an N400 at the sentence-final verb ("thrown") while the P600 observed at this position reflects a correlation of increased thematic processing effort.

Given all the accounts available, it should be always kept in mind that the P600 effects discussed here are only from a small subset of studies because the occurrence of the P600 is not restricted to an association with linguistic motivations, but also associated with experiment environments such as the proportion of grammatical to ungrammatical sentences in an experimental

block (Coulson, King & Kutas 1998; Hahne & Friederici 1999). As the P600 can result from such a variety of sources, to simply handle it as an index of syntax processing as the classical view is clearly not logical.

Altogether, morphosyntactic processing, semantic processing and syntactic processing were traditionally separated as indexed by anterior negativities, N400 and P600 effects, respectively. However, recent ERP-data revealed that N400 effects can be observed for certain types of grammatical function reanalysis (Example 2.3, 2.4), animacy influence and case violation, whereas P600 effects can be elicited in response to semantic integration costs (Examples 2.6-2.8). These findings challenged the conventional classification in the sense that the one-to-one mapping – to map N400 on semantic processing and to map P600 on syntactic processing does not appear to hold well. As Schlesewsky and Bornkessel (2006) pointed out, it is better to capture N400s and P600s within a multiplicity of environments, rather than to tie them down to one particular functional domain of linguistic processing. Importantly, it should be noted that to create a one-to-one mapping does not mean that the syntactic and semantic processes do not differ; it only implies that these processes may not be reflected in the ERP components in the sense of a strict dichotomy. Furthermore, the failure to map these does not mean that the ERP components are uninformative either, because ERP components can still reveal qualitative distinctions between different kinds of processing patterns even if these patterns cannot be interpreted in absolute terms.

Chapter 3

The eADM and Neurophysiological Evidences

In Chapter 1, we reviewed previous behavioural studies on the subject-preference and two information types, animacy and context, which possibly influence it. Furthermore, depending on *when* different information types interact, language comprehension models can be mainly divided into two distinct classes, i.e. modular models vs. interactive models. Though the debate between these two has not reached a conclusion, as discussed at the end of the Chapter 1, most of the existing models are mainly based on the behavioural findings from English (SVO). Hence, it is difficult to derive predictions with respect to ERPs for other, typologically different, languages. In this chapter, we introduce the architecture of "the extended Argument Dependency Model (the eADM)", which is based on cross-linguistic neurocognitive data. To this end, relevant neurophysiological findings of word order processing as well as how to derive these findings from the eADM are outlined. Finally, the motivation of the present thesis is addressed, i.e. Chinese, as a language that is typologically different from all the language previously examined, seems to pose a challege to a universal subject-preference.

3.1 The eADM

The eADM is a language comprehension model proposed by Bornkessel and Schlesewsky (2006a), which is a fundamentally extended version of a model that was first introduced in Bornkessel (2002). The latest version of this model is shown in Figure 3.1 (Bornkessel-Schlesewsky & Schlesewsky 2009b).

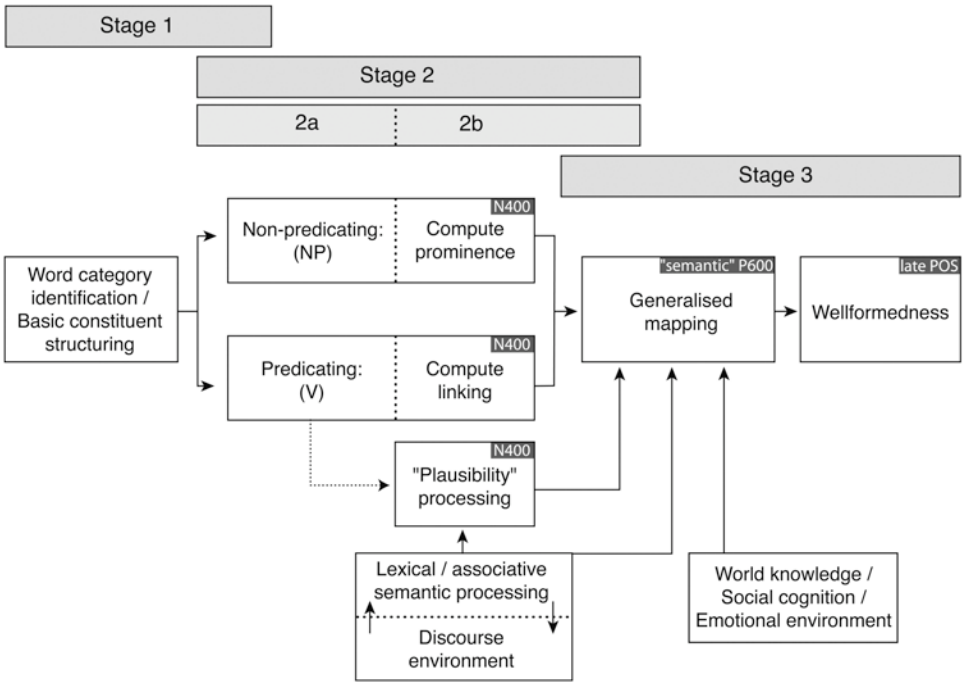

Figure 3.1: The architecture of the extended Argument Dependency Model (eADM; Bornkessel-Schlesewsky & Schlesewsky 2009b).

The architecture of the eADM is based on the neurocoginitive data from different languages/constructions, thus one can derive predictions not only for differences and similarities across languages, but also for different constructions within a single language. As apparent in Figure 3.1, the eADM assumes that that incremental argument interpretation proceeds in three hierarchically organised stages. In the following, we introduce each stage of the eADM in more details.

Stage 1 encompasses *Basic constituent structing*, which is exclusively based on word category information. The processing system constructs basic constituents by selecting and combining syntactic templates akin to those employed in RRG (Van Valin & LaPolla 1997; Van Valin 2005). Crucially, the basic constituent structuring in this sense only takes word category information into account. This stage is important because it differs from traditional "syntax-first" accounts of language comprehension (e.g. Frazier &

Fodor 1978; Frazier & Rayner 1982) in that it does not determine sentence-level interpretive relations such as GRs (subject/object). The word category based syntactic template building is indepent of the relational information for the argument interpretation. This enables the model to capture word order variations without movement or empty categories (regardless of language structural differences) and is thus cross-linguistically applicable, e.g. the syntactic templates can also to a language in which there is no direct correspondence between argument position and its interpretation as well as to a language in which there is a direct correspondence like English. The argument interpretation takes place exclusively in Stage 2, where the language-specific differences in word order processing emerge as different laguages have different ways to accomplish the sentence-level interpretive relation (e.g. via case marking, aniamcy, definiteness).

Stage 2 is the most central part of the eADM. In this stage, form-to-meaning mapping at the sentence-level – the interpretive relations between the arguments themselves and between the argument and the verb – are established. This stage is composed of two substages: Stage 2a concerns the word category information that is relevant for relational processing, whereas Stage 2b reflects how the relational processing takes place. According to the word category information, two routes are assumed: *Compute prominence* for non-predicating constituents (mainly NPs) to assign [±dep] features (see Section 3.2.1 below) or *Compute linking* for predicating constituents (mainly Verbs) to finish verb-argument linking.

According to this model, the incremental argument interpretation for a verb-final sentence with the word-by-word English translation "I an apple ate" involves the assignment of GSRs. In this case, to assign "I" to the Actor and "an apple" to the Undegoer, is determined by the syntax-semantic interface with reference to cross-linguistically motivated, hierarchically ordered information types termed "prominence scales" as shown in (3.1). The existence of prominence scales is considered universal whereas the applicability of the individual hierarchies is language specific.

(3.1) Prominence scales relevant to the syntax-semantics interface for the incremental argument interpretation from Bornkessel-Schlesewsky & Schlesewsky (2009b)

a. morphological case marking (nominative > accusative / ergative > nominative)
b. argument order (argument 1 > argument 2)
c. animacy (animate > inanimate)
d. definiteness/specificity (definite/specific > indefinite/ unspecific)
e. person (1st/2nd person > 3rd person)

The representations assigned to the arguments by computing prominence are mapped onto the lexical entry of the verb as soon as this constituent is encountered. The eADM assumes that the verb-specific restrictions on this linking process are encoded in a decomposed lexical representation, the "logic structure" (LS), which is adopted from RRG (Van Valin 2005). When applied to this case, the LS of a verb such as "eat" is "do' (x, [eat' (x, y)]) & BECOME eaten' (y)", thereby encoding both the number of arguments (x and y) and their relation to one another (x is ranked higher than y in the Actor-Undergoer hierarchy (cf. Van Valin 2005). Just as "ate" provides rich predictive information about the upcoming argument in languages/constructions ordered as "I ate …" (cf. Altmann & Kamide 1999), the previous prominence-based argument interpretation also constrains predictions about upcoming verbs in verb-final languages/constructions in that it ideally asks for a two-argument verb which can link "I" to the Actor and "an apple" to the Undergoer.

In parallel to Stage 2, other interpretively relevant information types such as plausibility, discourse and world knowledge are also processed. These two streams of processing integrate with one another in the *Generalised Mapping* in Stage 3 (cf. Bornkessel-Schlesewsky & Schlesewsky 2008 for details), where an evaluation of *Well-formedness* is finally taken into account. It should be noted that in this model the term well-formedness is not meant as a direct opposition to ill-formedness or ungrammaticality. Rather, it refers to a gradient mechanism that evaluates a structure's acceptability by taking several factors (e.g. discourse) into account.

Taken together, the eADM assumes that incremental argument processing starts from word category information, then goes on to the interpretive relations between constituents, and ends with well-formedness check. To render itself cross-logistically applicable, the eADM differs substantially from previous models on the processing of word category based syntactic template

construction (Stage 1) and interpretative relations among constituents (Stage 2). Below, we review neurophysiological studies on word order processing with reference to the approaches within the eADM.

3.2 The Effects of Word Order Variations

As outlined in Chapter 1, word order variations have been studied by using different kinds of behavioural measures. Here, more fine-grained neurocognitive investigations by means of the ERP method are introduced. In line with Chapter 1, we review the neurophysiological studies for subject-preference, animacy and context. Relevant theoretical accounts for these effects and how to model these effects within the eADM are discussed as well.

3.2.1 Subject-preference Effects

Most of the ERP studies, similar to the behavioural studies outlined in Chapter 1, observe subject-preference within complex sentences such as RCs with the basic idea of testing whether a locally ambiguous relative pronoun is preferentially analysed as a subject or an object. However, as pointed out by Schlesewsky (1996), since complex sentences may not provide a good testing ground for a "pure" subject-preference (cf. Footnote 4 in Chapter 1), only studies employing on subject-object ambiguity at the initial argument in a simple sentence are discussed here.

Previous ERP studies on subject-object-ambiguity in German simple sentences revealed that the subject-preference can be well observed in both middle field and prefield. For the middlefield, Friederici and Mecklinger (1996) and Friederici, Mecklinger, Spencer, Steinhauer & Donchin (2001) observed a P600 for the initial ambiguous argument disambiguated to an object reading in comparison to a subject reading in complement clauses. For the prefield, a similar P600 was also observed in *wh*-clauses by beim Graben et al. (2000) and in declarative main clauses by Knoeferle, Habets, Crocker & Münte (2008). Apart from the P600, N400 for this type of reanalysis have also been reported in Bornkessel et al. (2004b) and Haupt et al. (2008) (cf. Examples 2.3 and 2.4 in Chapter 2). The findings from German, as well as the findings from Turkish

below, suggested that there are several ERP correlates of subject-object reanalysis according to the language and construction type under examination. As the Turkish example is crucially relevant to the discussion on a cross-linguistic derivation of the subject-preference, we take a close look of the subject-preference in Turkish below.

Demiral et al (2008) conducted a visual ERP study on Turkish simple sentences with the initial arguments ambiguous with subject or object reading. They compared the object-initial conditions, as illustrated in (3.2), with their subject-initial control conditions.

(3.2) Example stimuli from Demiral et al. (2008)

a. Dün adam gördüm. (early POS)
yesterday man see-PST-1.SG
'I saw (a) man yesterday.'

b. Dün taş gördüm. (early POS)
yesterday stone see-PST-1.SG
'I saw (a) stone yesterday.'

Like German, Turkish has morphological case marking and flexible word order. However, unlike German, it is consistently verb-final (SOV) and it allows the subject to be dropped even without special contextual requirements for sentences with first or second person subjects. Thus, object-initial orders (OV) in (3.2) do not deviate from the normal word order pattern and are common in this language. A dropped first person subject ("I") can be indicated by the agreement marker at the final verb and no first person pronoun is present. The first arguments "adam" ('man') and "taş" ('stone') are locally ambiguous between a subject (in an SOV or and SV) and an object (unmarked OV with a dropped subject) reading. This ambiguity is resolved to the object reading via the first person agreement marker at the position of the verb.

Nevertheless, Demiral and his colleagues observed that object-initial conditions engendered a processing cost in the form of an early positivity (between approx. 200 and 600 ms) at the position of the disambiguating verb in comparison to unambiguous case-marked control conditions (with objects that were clearly marked for accusative case). This result thus serves to illustrate

the subject-preference: the tendency to analyse an initial ambiguous argument as the subject of the sentence.

Furthermore, the early positivity associated with the non-preferred disambiguation did not differ between sentences with animate (3.2a) and inanimate (3.2b) ambiguous arguments, suggesting that the subject-preference cannot be reduced to semantic factors (e.g. a preference for an Actor-interpretation of the first argument). The animacy-independent subject-preference has also been reported for German (cf. Scheepers, Hemforth & Konieczny 2000 for complement clauses in eye-tracking; cf. Schlesewsky et al. 2000 for *wh*-questions in self-paced reading).

To date, there has been a large amount of behavioural and neurophysiological evidence to support the subject-preference as a universal processing strategy. However, these studies differ considerably with regard to the derivation of the subject-preference. As outlined in Section 1.2.1, previous approaches for deriving the subject-preference either from purely phrase-structure configurations (e.g. *Simplicity/Minimal structure building* in Gorrell 1996, 2000), filler-gap dependencies (e.g. *AFS* in Frazier & Flores d'Arcais 1989; *MCP* in de Vincenzi 1991; *ATS* in Crocker 1994), or working memory limitations (e.g. *SPLT/DLT* in Gibson 1998, 2000). However, the first two accounts face difficulties in deriving the subject-preference in languages such as Turkish, as the initial subject/object in this language is in its base position and thus does not involve moved argument and empty category. While de Vincenzi's MCP provides a view of how to resolve local ambiguity without movement, it only predicts that the processing system prefers a base-generated structure over a structure involving movement without making any further predictions on which analysis the processing system prefers when both a subject and an object analysis of an initial argument are compatible with a base-generated structure, as in the case of Turkish.

In fact, the first two accounts also face difficulties in explaining the findings on the SO preference in Japanese. In a recent auditory ERP study, Wolff, Schlesewsky, Hirotani and Bornkessel-Schlesewsky (2008) compared unambiguously case marked object-initial order, i.e. a clause with a scrambled object, with its counterpart subject-initial order, as shown in (3.3). Assuming the initial argument followed by a prosodic boundary should lead the processing system to adopt a scrambling order in this language, they

manipulated, in addition to the word order, the NP1 to occur with or without the prosodic boundary.

(3.3) Example stimuli of Japanese sentences from Wolff et al. (2008)

a. OS: 二週間前、 判事を 大臣が 招きました。(NP1: ScramNEG)
nisyuukanmae hanzi-o daizin-ga manekimasita
two weeks ago [judge]$_{ACC}$ [minister]$_{NOM}$ invited
'Two weeks ago, the judge invited the minister.'

b. SO: 二週間前、 判事が 大臣を 招きました。(NP2: N400)
nisyuukanmae hanzi-ga daizin-o manekimasita
two weeks ago [judge]$_{NOM}$ [minister]$_{ACC}$ invited
'Two weeks ago, the minister invited the judge.'

At NP1, Wolff and colleagues found an increased processing cost in the form of scrambling negativity for (3.3a) vs. (3.3b) (cf. scrambling negativity in Section 3.2.3 in this chapter) when there was a prosodic boundary after the NP1. By contrast, they did not observe such effect for the same comparison without a prosodic boundary. They thus argue that the scrambling negativity does not only result from processing an object itself (e.g. case marking) but also results from the relational aspects of word order processing: the presence of the prosodic boundary after the NP1 signals an upcoming argument while the absence of the prosodic boundary does not necessarily lead to the expectation of a second argument since an initial object with a dropped subject is very common in this language. This argumentation is supported by the findings at NP2, where they observed an N400 for (3.3b) vs. (3.3a), i.e. a canonical subject-before-object order vs. object-before-subject order, because a second argument was not expected after a nominative NP1. The overall ERP pattern replicated the previous findings from German *wh*-questions (Bornkessel, Fiebach, & Friederici 2004a). For the German data, one could argue that there is a syntactic dependency between an object and a subject, thus the scrambling negativity at NP1 either results from an increased distance between a filler (an object) and its associated gap in the structure, or from an extra effort to maintain a dependent argument in working memory. Also, because German requires an obligatory overt subject, an initial object thus leads to expecting an upcoming subject via the object-subject dependency, which results in no

processing cost at NP2. However, such a scenario is difficult to apply to Japanese as this language has an unmarked OV order with a dropped subject like Turkish, thus an initial object does not necessarily lead to the expectation of an upcoming subject unless there is a prosodic boundary after it. Hence, the findings on NP2 in Japanese suggested that the SO preference cannot be due to a purely syntactic reason, but is relational in nature. As the subject-preference in Turkish, the processing advantage of subject-initiality should be derived from a more general source.

In contrast to the first two accounts, Gibson's working memory account argues that the subject-initial order gives rise to fewer predictions for the completion of a grammatical sentence, which in turn results in lower cost in memory; thus this account can derive the processing advantage of subject-initiality in general. However, the working memory theories and the first two accounts have in common that they make crucial reference to the subject category in the language under examination. Therefore, they all face the difficulty of making predictions for languages such as Chinese, where the existence of a subject category is controversial. In this sense, all these aforementioned accounts can be referred to as syntactically based accounts.

Different from the syntactically based accounts, the eADM proposes that the subject preference is attributable to a cross-linguistic, phrase-structurally independent preference for constructing minimal dependencies in argument interpretation. This minimal-dependencies account was first proposed in the form of the "Minimality" principle [15] within the eADM (Bornkessel & Schlesewsky 2006a), as in (3.4).

(3.4) Minimality (Bornkessel & Schlesewsky 2006a, p. 790),

In the absence of explicit information to the contrary, the human language processing system assigns minimal structures. This entails that only required dependencies and relations are created.

15 In the latest version of the eADM, Minimality is subsumed under the vacuous "Distinctness", which constrains the processing system by requiring that "*The participants in an event should be as distinct as possible from one another in terms of all available dimensions of prominence*" (Bornkessel-Schlesewsky & Schlesewsky 2009c). Minimality is subsumed by Distinctness in the sense that the easiest way to be distinct an intransitive structure from a more complex transitive structures is to be the sole argument of the sentence.

Note that the Minimality principle carries two assumptions: (1) an ambiguous argument is preferentially interpreted as the sole argument in an intransitive relation and thus it is an S; (2) if the intransitivity assumption cannot be upheld, i.e. when the sentence is disambiguated to a transitive relation, the argument is interpreted as an A rather than an O. Both assumptions can be captured via the assignment of the feature [-dep] during Stage 2 of processing – argument interpretation – in the eADM (i.e. -dependent, cf. Bornkessel 2002; Schlesewsky & Bornkessel 2004). In an intransitive relation, a [-dep] argument need not be responsible for the state of affairs (i.e. it could be an O, as in *John died*): it is independent by virtue of the fact that there is no second argument. In a transitive relation, by contrast, the assignment of [-dep] amounts to an A, whereas [+dep] signals an O. Since it has been proposed that O is semantically dependent on A (cf. Primus 1999), assigning a subject reading again avoids the need to establish unnecessary dependencies.

Indeed, the findings from Turkish and Japanese are more compatible with the minimal-dependencies account. According to this account, it is costly not only when an intransitive relation [-dep] needs to be reanalysed as a transitive relation [+dep], but also when the intransitive relation [-dep] needs to be reanalysed as an O [+dep] rather than an A [-dep]. Hence, a processing cost is still observable for the initial ambiguous argument disambiguated to an object as opposed to a subject in Turkish, even though the object is in its base position in this language. For the same reason, a processing cost was observed for the accusative vs. nominative at NP1 in Japanese when there was a prosodic boundary after the NP1, as the accusative NP1 suggested a transitive relation and the prosodic boundary signaled an upcoming subject. Furthermore, the finding at the NP2 nicely supports the idea that change from an intransitive relation [-dep] to a more complex transitive relation [+ dep] is costly: an initial nominative is preferably analysed as the sole argument of an intransitive relation, and thus there is no prediction for a second argument. An initial accusative, by contrast, unambiguously calls for a transitive interpretation and, thereby, for a second argument. Hence, the processing cost results when the second argument is encountered in the nominative-initial sentence (3.3b) as compared to the accusative-initial sentence (3.3a), even though this language does not require an obligatory overt subject.

In summary, the subject-preference has been reported in different languages in a number of studies, most of which attribute the subject-preference via syntactically based accounts, e.g. purely phrase-structure configurations, filler-gap, or working memory limitations. However, such accounts face the difficulty of deriving the preference for a subject-initial order in Turkish and Japanese, and the difficulty of predicting for languages in which the existence of the subject category is controversial. In contrast to the syntactically based accounts, the eADM posits the subject-preference as an epiphenomenon of a more general processing preference for minimising dependencies. In this way, the eADM derives a universal subject-preference independent of subject category itself, and thus independent of any structural position.

3.2.2 Animacy Effects

Animacy is traditionally defined as an important semantic feature of one argument. The status of animacy has long been used to distinguish different processing models by asking *when* semantic information and syntactic information interacts (cf. Section 1.3 in Chapter 1). Extending on what we have discussed in Section 1.2.2, neurophysiological evidence about the influence of animacy will be presented here.

As a first illustration, we take a look at findings on animacy effects in English. In their study, Weckerly and Kutas (1999) manipulated NP1 with different animacy as shown in (3.4) and found that (3.4a) elicited an N400 effect as opposed to (3.4b).

(3.5) Example stimuli from Weckerly & Kutas (1999)
a. The movie that … (N400)
b. The novelist that …

To explain for the increased processing cost at NP1 in (3.5), the syntactically based accounts refer to the difficulty in interpreting an inanimate argument as a subject (cf. Frazier 1987). The semantically/thematically based account, by contrast, argues for an Actor-preference for the initial ambiguous argument when it is animate, and attributes processing costs to the fact that

an inanimate argument is not an ideal Actor (cf. *Agent-Action-Object strategy*: Bever 1974). If this is really the case, and not only restricted to English, we should observe a cross-linguistic processing disadvantage for the initial inanimate subject. However, findings from German (Scheepers et al., 2000; Schlesewsky et al., 2000) and Turkish (Demiral et al. 2008) speak against these accounts by showing that an initial inanimate nominative argument (i.e. an initial inanimate subject like in English) did not yield an N400 effect. In German, Schlesewsky et al (2000) found that there was no difference between an animate NP1 and an inanimate NP1 analysed as the subject of the clause. Similarly, Turkish showed a subject-preference independent of the animacy of NP1 (cf. Example 3.2). The absence of animacy effects at NP1 in German and Turkish suggested the animacy-related N400 is language-specific (in languages like English) rather than language-universal. Furthermore, in relation with the previous section, which showed that the subject-preference cannot be explained by the syntactically based accounts, here, the findings from German and Turkish further suggested that the subject-preference cannot be explained by a semantically based account either. Rather, these findings are most compatible with minimal-dependencies account, which claims that a sole argument can be either animate or inanimate.

Interestingly, in contrast to the absence of animacy-related N400 at NP1, findings from German showed that the animacy-related N400 emerged at NP2 in this language. For example, Roehm et al. (2004) used embedded *wh*-questions as shown in (3.6) and found that *wh*-questions with an initial animate accusative argument followed by an inanimate nominative argument yielded an N400 effect at NP2 as compared to an animate argument in the same position.

(3.6) Example stimuli from Roehm et al. (2004)

a. … welchen Arzt der Zweig gestreift hat. (N400)
[which doctor]$_{ACC}$ [the twig]$_{NOM}$ brushed has
'…which doctor the twig brushed.'

b. … welchen Arzt der Jäger gelobt hat.
[which doctor]$_{ACC}$ [the hunter]$_{NOM}$ praised has
'… which doctor the hunter praised.'

Converging evidence for animacy effects at NP2 has also been recently reported from Tamil (Muralikrishnan, Schlesewsky & Bornkessel-Schlesewsky 2008) and Chinese (Phillipp, Bornkessel-Schlesewsky, Bisang & Schlesewsky 2008). As the latter study is highly relevant to the present thesis with respect the influence of animacy in processing ambiguous verb-final sentences (NP1-NP2-V) in Chinese (cf. Chapter 6), we will address it in more details below. Phillipp et al. (2008) examined (subject-/object-) unambiguous verb-final constructions in Chinese by using coverbs *bǎ* and *bèi* (cf. Chapter 4, Section 4.3.2 for detailed introduction to bǎ-/bèi-constructions). The coverbs bǎ and bèi, which are positioned between NP1 and NP2, lead to an unambiguous subject-before-object and object-before-subject interpretation, respectively. In these two sentence types, Philipp et al. (2008) varied the animacy of both NP1 and NP2, which resulted in four types of sentences, as shown in (3.7). Here and after, Chinese examples are illustrated in an order of characters, Pinyin[16], word-for-word gloss and its translation. Note that Chinese "words" are separated from each other by space only for the convenience of reading. In fact, Chinese orthography does not give any clue to identify "words" as in English, because Chinese sentences are composed with strings of characters without boundaries to mark word borders.

(3.7) Example stimuli from Philipp et al. (2008)

a. O (an)- S (an):	王子	被	挑战者	刺死	了。
	wángzǐ	bèi	tiǎozhànzhe	cìsǐ	le
	Prince	BEI	contender	stab	ASP
	'The prince was stabbed by the contender.'				
b. O (an)- S (in):	王子	被	绳子	勒死	了。
	wángzǐ	bèi	shéngzi	lēisǐ	le
	Prince	BEI	cord	strangle	ASP
	'The prince was strangled by the cord.'				
c. S (an)- S (an):	王子	把	挑战者	刺死	了。
	wángzǐ	bǎ	tiǎozhànzhe	cìsǐ	le

16 Pīnyīn is the Romanisation system officially adopted by the government in Beijing. It represents the tones by means of diacritic marks above the nuclear vowel of the word. The diacritic mark for the high level tone is / ¯ /, for raising tone is / ´ /, for the curve tone is / ˇ /, for the falling tone is / ` /.

	Prince	BA	contender	stab	ASP
	'The prince stabbed the contender.'				
d. O (in)- S (an):	小刀	把	挑战者	刺死	了。
	xiǎodāo	bǎ	tiǎozhànzhe	cìsǐ	le
	Knife	BA	contender	stab	ASP
	'The knife stabbed the contender.'				

Philipp and his colleagues found no evidence to suggest that the interpretation of the NP1 is affected by animacy, i.e. there was no effect of animacy on NP1 and also no effects at the following coverb position which might have indicated a preference for a subject or an object reading based on the animacy of the NP1[17]. This finding is compatible with the minimal-dependencies account, which base the interpretation of the initial argument on the fact that it is the sole argument regardless of its animacy. At the position of the NP2, by contrast, they observed an N400 for sentences such as (3.7b) vs. (3.7a), i.e. for an inanimate subject following an object (independently of the animacy of the object). Importantly, as there was no effect of argument animacy at the position of the NP1, the N400 at the NP2 does not result from simple animacy differences at the single argument level. (Note that the choice of lexical items was balanced across lexical sets such that, over all trials, the same groups of animate and inanimate nouns were contrasted at NP1 and NP2 positions). Interestingly, Philipp and his colleagues only observed N400 effects for inanimate subject in *bèi*-sentences but not in *bǎ* sentences. These results suggest that the N400 for atypical subjects only occurs when the subject is encountered after an object, an interpretation which was corroborated by an additional experiment (Philipp et al. 2008, Experiment 2). This observation has been interpreted as evidence for predictive processing: since O is semantically dependent on S, the processing of an object leads to the prediction of a subject

17 Philipp et al. (2008) did observe an N400 effect for inanimate initial arguments followed by *bèi*. However, this effect appears to reflect specific pragmatic demands of the passive construction in Chinese. In contrast to passive constructions in Indo-European languages, passives with *bèi* in Chinese give rise to an adversity reading of the initial object (e.g. Chappell 1986; Bisang 2006b), i.e. the initial argument must be adversely affected by the event, which requires the affected object to be able to experience a psychological state and thereby be animate. When this requirement cannot be fulfilled, an animacy-related N400 results.

but not vice versa. Since prototypical subject properties entail animacy, the processing of an initial object leads the system to expect that any upcoming subject argument should be animate. Hence, an N400 results when an inanimate subject is encountered instead.

The findings from Chinese support the aforementioned findings from German and Tamil, which have shown that an inanimate subject following an object engender an N400 effect, whereas no such effect is observed for subject-initial sentences, and no animacy differences occur at the position of the initial argument.

Based on the cross-linguistic observation above, Bornkessel-Schlesewsky and Schlesewsky (2009b) argued that animacy-related N400 effects do not simply result from a mismatch between inanimacy and subjecthood itself, but rather from the processing cost of having to assign an inanimate subject on the basis of prominence information, which can be derived from *Compute prominence* in the eADM. In the eADM, animacy is assumed to in combination with other prominence information types while computing prominence of an argument to build up a thematic interpretation between arguments independent of the verb. These information types (e.g. linear position, case marking, animacy and definiteness) are weighed differently in different languages/constructions.

In languages such as English, prominence is primarily determined by linear position, and animacy plays a secondary role. In (3.5), when the determiner ("the") is encountered, the processing system endeavours to assign the upcoming argument a high prominent status, an animate actor, based on its initial position. When it actually encounters an inanimate actor, this effort fails, reflected in an N400. By contrast, in a free word order language such as German, the thematic interpretation processes primarily on the basis of morphological information, e.g. case marking rather than linear order. In (3.6), when the initial inanimate *wh*-phrase is interpreted as an object via its accusative case marker, the processing system starts to predict an upcoming ideal subject, an animate nominative actor. This prediction is on the basis of prominence scales because a more prominent actor should be animate and with the nominative case marker (recall Examples 3.1a and 3.1c). However, this requirement is not entirely fulfilled when the second argument is encountered. The assignment of a more prominent status (the nominative

case and the actor role) to an inanimate argument thus leads to a processing conflict expressed by an N400. As the prominence-based interpretation always performs between arguments (i.e. more than one argument), animacy must work in relation to the NP1. Therefore, the N400 does not occur for the initial inanimate argument, but only when the inanimate subject follows an object, i.e. at NP2. The relational feature of animacy is difficult to obtain from English because of the convergence between an argument position (i.e. linear order) and other prominence information types in this language. Thus, an N400 is observable even at NP1 in this language. The findings on processing unambiguous verb-final constructions in Chinese are more similar to German rather than to English.

The prominence-based interpretation can be justified itself via the so-called "double case violation" experiments in German. Frisch and Schlesewsky (2001, 2005) used embedded *wh*-questions as shown in (3.8) and (3.9). Sentences in (3.8a) and (3.9a) are ungrammatical because German does not allow one sentence to have two nominative case-marked arguments.

(3.8) AN-AN conditions in Frisch & Schlesewsky (2001)

*a. … welcher	Angler	der Jäger	gelobt	hat.	(N400, Late POS)
[which	angler]$_{NOM}$	[the hunter]$_{NOM}$	praised	has	
b. … welchen	Angler	der Jäger	gelobt	hat.	
[which	angler]$_{ACC}$	[the hunter]$_{NOM}$	praised	has	

(3.9) AN-IN conditions in Frisch & Schlesewsky (2001)

*a. … welchen	Förster	der Zweig	gestreift	hat.	(Late POS)
[which	forester]$_{NOM}$	[the twig]$_{NOM}$	brushed	has	
b. … welchen	Förster	der Zweig	gestreift	hat.	
[which	forester]$_{ACC}$	[the twig]$_{NOM}$	brushed	has	

The ERP response at NP2 showed that when both arguments were animate, the double case violation gave rise to a biphasic N400-late positivity pattern compared to its grammatical counterpart (Example 3.8: a vs. b); when the first argument was animate and the second was inanimate, the double case violation only elicited a late positivity as opposed to its grammatical counterpart (Example 3.9: a vs. b). In short, the late positivity was consistently

observable in conditions with double case violation; by contrast, N400 was observable only when both arguments were animate but not when the first argument was animate and the second was inanimate. The presence or absence of N400 thus confirmed the prominence-based interpretation in the sense that when two arguments are equally prominent in case and animacy, the processing system has difficulty in ranking them on the thematic hierarchy (i.e. determining which argument is Actor and which argument is Undergoer), thus an N400 emerges. While this difficulty was moved away when arguments differ in animacy, since animacy helps case maker to differentiate two arguments thematically, thus the N400 was absent in this case. The late positivity, by contrast, was elicited independently of the animacy manipulation, indicating a more syntactic-related process, as described in *Well-formedness* in the eADM.

To summarise, the influence of animacy does not come in at the initial argument but at the following argument. The absence of animacy effects at the initial argument (either unambiguously cased marked such as German example 3.6, or ambiguous with its case marking such as Turkish example 3.2) is not compatible with semantically based accounts since an animate initial argument does not necessarily lead to an Actor (otherwise there should be an increased processing cost for an inanimate initial argument in languages other than English). Rather, it is compatible with the minimal-dependencies account in that the interpretation of the initial argument is based on the fact that it is the sole argument of the sentence rather than animacy. The emergence of the animacy effect at the second argument (cf. German example 3.6, Chinese example 3.7) suggests that animacy serves as a relational information influencing the establishment of the thematic interpretation between arguments, which is captured within the eADM by positing animacy as one of several prominence information types while computing prominence of an argument to build up a thematic interpretation between arguments independently of the verb. However, the generality of the argument that different languages/constructions may weigh animacy differently in interpreting an argument needs to be tested (cf. *the competition model* in Bates et al. 1982; MacWhinney & Bate 1989; Bornkessel-Schlesewsky & Schlesewsky 2009c).

3.2.3 Context Effects

To investigate how context constrains sentence-internal word order processing is a new research tendency in psycholinguistic studies. However, there haven't been any ERP experiments directly designed to examine the interaction between a context and word order preference while processing an initial ambiguous argument, which is thus one of the topics of the present thesis. Nevertheless, as will be shown below, there are some insightful studies on processing unambiguously case-marked arguments. Furthermore, the eADM also provides explicit assumptions about the time course of contextual influences on word order processing, i.e. the influence of context should come in after prominence information such as animacy[18].

In Section 1.2.3, we observed an SO preference in German unambiguously case-marked sentence, i.e. an object scrambled sentence (OS) is more difficult to process than a subject initial sentence (SO). In a visual ERP study conducted by Schlesewsky, Bornkessel and Frisch (2003), the processing disadvantage of the object-initial sentence was reflected by the so-called "scrambling negativity". The example sentence is shown in (3.10).

(3.10) Example of a German sentence with initial object argument from Schlesewsky et al. (2003)

Dann hat den Schnuller der Vater dem Sohn gegeben.
(Scram NEG)
then has [the pacifier]$_{ACC}$ [the father]$_{NOM}$ [the son]$_{DAT}$ given
'Then the father gave the pacifier to the son.'

Compared with subject-initial control conditions (i.e. initial arguments that were clearly marked for nominative case), ERP responses time-locked to the initial object showed increased processing costs in the form of a focal negativity (approx. 300-500 ms). This effect has also been observed for object-

18 In the eADM, the influence of context (cf. "discourse environment" in Fig. 3.1) is often discussed in the debate about the "semantic P600", which is related with lexical/semantic processing (see Section 2.4.2). However, the influence of context is not necessarily restricted to the semantic P600, but is expected to show up after the prominence information more generally (i.e. *Generalised mapping* in Fig. 3.1).

initial arguments after a complementizer ("that") in subordinate clauses (Bornkessel, Schlesewsky & Friederici 2002b). This focal negativity was labelled as "scrambling negativity" by Schlesewsky et al. (2003) because it was distributed between a classical LAN (left-anterior) and a classical N400 (central-parietal)[19].

However, this scrambling negativity was obtained under the absence of context. One may argue that the scrambling negativity may not only be due to a local syntactic violation (dislocate an argument to a non-canonical position) but could also be due to the constraints of information structure, for example, a scrambled object should usually be given in the context (e.g. Lenerz 1977; Fanselow 2003; Haider & Rosengren 2003). From this perspective, the scrambling negativity can be reduced in a supporting context. To make it clear whether or not this is the case, Bornkessel et al. (2003) manipulated word order and context as shown in (3.11)-(3.13). Sentences are visually presented in a question-answer manner. Context questions in (3.11) answered by object-initial target sentences in (3.12).

(3.11) Example context questions for object-initial sentences from Bornkessl et al. (2003)

a. Neutral context

Klaus fragt sich, was am Sonntag passiert ist.

'Klaus asks himself what happened on Sunday.'

19 As for the scrambling negativity, Rösler, Pechmann, Streb, Röder & Hennighausen et al. (1998) reported a similar effect but classified it as a LAN. Further, they consider it as reflecting an increase of working memory load for holding the initial object that cannot be immediately assigned to a canonical position. However, in a later ERP study on German word order variations conducted by Schlesewsky et al. (2003), it was observed that in sentences with non-pronominal arguments, the determiner of a scrambled noun phrase elicited a broadly distributed negativity (OS vs. SO), but not in sentences with scrambled pronominal arguments, suggesting that the language processing system is sensitive to fine-grained syntactic regularity. Thus Schlesewsky et al. (2003) argue that the scrambling negativity reflects a local syntactic violation rather than a general cognitive problem (e.g. working memory limitation).

b. Biased context towards a subject-focus (object given by context)
Klaus fragt sich, wer am Sonntag den Gärtner besucht hat.
'Klaus asks himself who visited the gardener on Sunday.'

c. Biased context towards an object-focus (subject given by context)
Klaus fragt sich, wen der Lehrer am Sonntag besucht hat.
'Klaus asks himself whom the teacher visited on Sunday.'

(3.12) Example object-initial target sentence from Bornkessel et al. (2003)
Dann erfuhr er, dass den Gärtner der Lehrer besucht hat. (FosPOS)
then heard he that [the gardener]$_{ACC}$ [the teacher]$_{NOM}$ visited has
'Then he heard that the teacher visited the gardener.'

They found, however, that the scrambling negative was not reduced (i.e. *den Gärtner* in the context of 3.11b), though overall the object-initial sentence was judged more acceptable than setences without a context-given object in previous studies. By contrast, this scrambling negativity disappeared when the scrambled object was focused (i.e. *den Gärtner* in the context of 3.11c). Instead, the focused object gave rise to the so-called "focus positivity" (a parietal positivity between 280 and 480 ms) as opposed to when it was embedded in a neutral context (i.e. *den Gärtner* in the context of 3.11c vs. *den Gärtner* in the context of 3.11a).

Based on the absence of the scrambling negativity for a focused object, one might conclude that focus rather than givenness is a sufficient condition for removing the local cost of processing a scrambled object, since focus positivity seems to have cancelled the scrambling negativity completely in (3.12). However, things turn out to be more complex when examining (3.12) following the mismatched context questions as shown in (3.13).

(3.13) Example mismatched context questions from Bornkessel et al. (2003)
Klaus fragt sich, wer am Sonntag den Lehrer besucht hat.
'Klause asks himself who visited the teacher on Sunday.'

When the scrambled object introduced a new lexical item but did not match the case marker predicted by the context question (i.e. *den Gärtner* in 3.12 is accusative rather than nominative predicted by the wh-phrase in the context of 3.13), Bornkessel and colleagues observed a focus positivity co-occurring with a scrambling negativity but in an attenuated form, which indicates that there was a component overlap between a focus positivity and a scrambling negativity. This result thus suggests that previous observations of focus overriding the local cost of processing a scrambled object should be constrained, i.e., only when the target argument is focused and matches the case marker predicted by the context. In this sense, the focus positivity was interpreted to reflect an argument that fully matched the contextual predictions.

By now we have seen that in German, context information such as givenness can give rise to a higher acceptability of a scrambled word order, but can not lead to an attenuation of local processing difficulty at the scrambled object (i.e. (3.12) following (3.11b)). By contrast, this local processing difficulty can be overridden when the scrambled object is focused and has the case marker predicted by the context (i.e. (3.12) following (3.11c)), which is reflected in a form of focus positivity without scrambling negativity. Recall that, following Dik et al (1981), Choi (1997) refers to the focus realised by *wh*-question, such as *den Gärtner* in (3.12) which completes the *wh*-slot in the question in (3.11c), as "completive focus", and refers to the focus realised by a contrastive context as "contrastive focus" (cf. Section 1.2.3 and Section 1.3 for general discussion). According to Choi (1997), contrastive focus is more likely to licence a scrambling order than completive focus. From the perspective of sentence processing, this means that no scrambling negativity should be observable at the position of the scrambled object when it is embedded in a contrastive context. However, the findings of visual experiments in Bornkessel and Scheleswsky (2006b) speak against this view by showing that the findings on contrastive focus are rather more complicated. Bornkessel and Scheleswsky (2006b) examined the parallel (contrastive) focus (in terms of Dik et al. 1981). They employed a context which ended in a sentence with two references, such as "*... I don't know exactly who supervised Toralf and who supervised Dietmar*". This context was followed by the target sentence with each of the two references as initial scrambled object, i.e. "*I heard that Toralf was very much liked by the organic*

chemist, while Dietmar was found to be very talented by the environmental chemist.". They found a similar result to givenness: a global licensing of a scrambling word order. In a subsequent visual experiment, they studied contrastive focus, which is classified as corrective (contrastive) focus context in Dik et al. (1981). They presented a short story which was ended in a speculation such as "*I suspect that it was Toralf*". When this speculation was corrected by a target sentence such as "*I heard that it was Dietmar who was passed by a particular well meaning examiner*", no scrambling negativity was observed in this case. However, the absence of the scrambling negativity was accompanied by a global acceptability decrease, thereby suggesting that the corrective (contrastive) focus is not a possible local licenser for a scrambling order in German (otherwise we should also observe a global increase in acceptability later). Thus, Bornkessel and Scheleswsky (2006b) argued the scrambling negativity resulted from the violation of the SO preference and the absence of this effect was tentatively interpreted as a result of extra-grammatical licensing – communicative saliency, i.e. corrective (contrastive) focus calls for an effort against the previous speculation.

One study relevant to German corrective (contrastive) focus above is a visual ERP experiment on English *it*-clefts in Cowles, Kluender, Kutas and Polinsky (2007). In this experiment, Cowles and colleagues examined the violation of information structure, precisely, the violation of focus assignment in *it*-clefts when answering *wh*-questions as shown in (3.14).

(3.14) Example context from Cowles et al. (2007)

A priest, a farmer, and a labourer were sitting outside the church. Who did the priest pray for, the farmer or the labourer?

(3.15) Example target sentences from Cowles et al. (2007)

a. Congruent: It was the <u>farmer</u> that the priest prayed for. (early POS)

b. Incongruent: It was the <u>priest</u> that prayed for the farmer. (N400, early POS)

They found two types ERP response at the position of the clefted noun. First, a large positivity between 200 and 800 ms for both clefted nouns as opposed to all other word positions in the target sentence. They interpreted

these effects as such: "*Focused elements may trigger integration effects like those seen at sentence end*". Secondly, the focusing of an inappropriate referent elicited a smaller negativity effect between 200 and 800 ms for the incongruent focus as compared to congruent focus. In spite of its long latency and small amplitude, they interpreted this negativity as a kind of N400, which suggests that "*comprehenders use constraints based on prior context to form expectations about the information status of discourse referent in the answer*". These findings are in line with Bornkessel et al. (2003), showing that the focused arguments are associated with a positivity effect independently of other violations such as case maker in German. Furthermore, not only the communicative saliency such as corrective (contrastive) focus in German, but also strong sentence-internal considerations (i.e. unambiguous syntactic structure of focus) such as *It*-cleft can elicit such positivity. Finally, in addition to the positivity reflecting the fulfilment of a contextual expectation, it shows that information structural mismatches between context and target sentences are generally reflected in N400-like negativity.

In summary, all these studies show that context information can more or less influence the word order preference as we saw in German. However, as proposed within the eADM, to what degree context information influences the ordering of arguments may differ according to the strength of the context. For example, in German, a corrective (contrastive) focus can override the SO preference by its strong communicative saliency in the discourse. Furthermore, the contextual influence could also vary depending on the examined language/construction. For languages with the so-called "pragmatic word order" such as Chinese, the word order preference is more likely influenced by context manipulation.

3.3 Challenges from Chinese

The subject-preference as well as whether and how animacy or context influences such a word order preference have been mainly studied in Indo-European languages such as English, German and Dutch, in which the status of "subject" are well-established. However, from a cross-linguistic perspective, the assumption of a universal "subject" category is rather controversial (e.g. Bickel in press; Croft 2001; Comrie 1989; Farrell 2005). As will become clear in

the next chapter, Chinese is such a case in point. In contrast with the previously examined languages, most of which are "subject-prominent", Chinese is "topic-prominent" because topic-comment constructions rather than subject-predicate constructions have been argued as the basic sentence type in this language (Li & Thompson 1976). Furthermore, as this language lacks grammatical devices such as overt case marker and verb agreement to single out the subject, word order processing could rely more on semantic/pragmatic information in this language than in the subject-prominent languages previously examined.

If Chinese does not show the subject-preference, this would imply that subject-preference should be confined only to languages in which the status of the subject category are well-established and thus speaks against the assumption of a universal processing strategy; if, by contrast, Chinese shows a subject-preference, given the controversial status of the subject category, such a finding would certainly support the assumption of a language-universal processing strategy that engenders the subject-preference. As a third possibility, Chinese could show a subject-preference but differ from all other languages examined previously by allowing animacy and context to override this preference in certain circumstances. This would require a distinction between language-universal processing strategy and language-specific processing characteristics. To investigate these questions in Chinese can therefore not only help us to evaluate different accounts, but also shed light on the cross-linguistically universal language processing architecture.

Chapter 4

Mandarin Chinese

In language typology, Mandarin Chinese[20] is described as an "isolating" language in contrast to inflectional languages because its lack of overt grammatical devices such as noun declension and verb inflection. This means that most words[21] in Chinese have a bare and immutable form. Nouns are not case-marked for grammatical relations such as subject, direct object or indirect object, and verbs have no agreement to indicate such grammatical relations either. Furthermore, they do not change according to number, case, gender, tense, mood or any of the other inflectional categories as in an inflectional language, such as Indo-European languages.

For example, in Chinese, a noun or pronoun does not undergo any changes when it is a subject or an object. For instance, "我" (wǒ, 'I') stays "我" no matter whether it is a subject "I" or an object "me". A common noun like "小说" (xiǎoshuō, 'novel') could remain the same regardless of whether it is used as single or plural, definite or indefinite. Besides nouns, verbs like "读" (dú, 'to read') remain as they are, no matter if the action happened yesterday or happens today or will happen tomorrow. It also remains "读" regardless of whether its subject is the first person or the third person, plural or single[22]. Faced with such an economical language, it is no wonder for people to say that

20 Mandarin Chinese refers to the category of "普通话" (pǔtōnghuà, 'Standard Chinese'), which bases its phonology on Beijing dialect. It is spoken by most Chinese native speakers and serves as the official spoken language in China. For the sake of simplicity, throughout the remainder of this thesis, "Chinese" rather than "Mandarin Chinese" is used.

21 Even word categories are difficult to distinguish in Chinese. It has been proposed that older stages of Chinese lacked a verb-noun distinction (cf. Bisang 2008) and that the modern language still allows for a substantial degree of fluidity in this respect (with the same lexeme functioning as a noun or a verb depending on the sentence context).

22 There are only a small number of human nouns that can be suffixed by "们" (men) to express plural and definite meaning, such as "我们" (wǒmen, 'we/us'), 朋友们(péngyoumen, 'friends').

there are more ambiguities in Chinese than there are in any other languages. How, then, are these ambiguities cleared up to reach a precise interpretation of a sentence in Chinese? The answer is that lexical items, or simply world knowledge and discourse context could disambiguate it. For instance, "读" can be lexically modified by a temporal noun such as "昨天" (zuótiān, 'yesterday') to indicate that the action took place yesterday. It is also clear what is subject and what is object in natural discourse.

In Chinese, word order *can* but *not always* serve to disambiguate "who is doing what to whom". On the one hand, the canonical SVO order seems to be a promising cue for disambiguating the preverbal argument to a subject and the post-verbal argument to an object, much like English; on the other hand, word order is not as reliable as in English, since this language also allows SOV and OSV orders, in which the object is topicalised to a preverbal position. Hence, there is no particular position for the subject or for the object in this language. Moreover, pro-drop is very common in Chinese, which means that the subject and/or the object are not necessarily overt. Therefore, topicalisation and pro-drop vary the word order in Chinese. Moreover, in theoretical linguistics, these two features are often used to argue for the pragmatic nature of Chinese word order as opposed to the syntactic nature of word order in Indo-European languages, and also they provide potential challenges of the well-established subject-preference in psycholinguistics statements that are based on findings from mostly Indo-European languages. In this chapter, an introduction to topic and pro-drop is first provided. To this end, word orders in Chinese are addressed, with a focus on the canonical SVO order, and verb-final orders (SOV and OSV) with and without coverbs *bǎ/bèi*.

4.1 Topic and Subject

Typologically, Chinese has also been classified as a "topic-prominent" in contrast to a "subject-prominent" language. In Li and Thompson (1976), topic-comment rather than subject-predicate is assumed to be the basic sentence type (i.e. a sentence construction that cannot plausibly be derived from another) in Chinese. Taking this line of argumentation one step further, LaPolla (1993) argued forcefully that grammatical relations such as "subject" and "object" do not exist in Chinese and that their imposition essentially

derives from a "Euro-centric" perspective. In order to make clear why "topic" rather than "subject" is better to capture Chinese patterns, we need to take a look at the subject defined in Indo-European languages.

The grammatical relations subject and object are traditionally taken to specify the (morphosyntactic) relationship between an argument and a sentence. However, the precise definition of grammatical relations varies considerably across different theoretical approaches. In Chomskyan theories of grammar, the subject or object status of an argument is determined by its position in the syntactic structure (Chomsky 1981; cf. Ura 2000). In alternative approaches such as Lexical-Functional Grammar (Bresnan 2001), by contrast, grammatical relations are assumed to be syntactic primitives, which cannot be defined further. Finally, there are also grammatical theories (e.g. RRG), which do not assume grammatical relations in the traditional sense at all.

Abstracting away from these controversies within and between formal frameworks, grammatical relations can also be defined in a typological/descriptive way. 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*". We will briefly illustrate this on the basis of examples from English (cf. Example 4.1). As mentioned in Chapter 1, we use the notions defined in Bickel (in press) and RRG (Van Valin & LaPolla 1997, Van Valin 2005) to identify particular arguments: S (the sole argument of an intransitive relation; e.g. *Peter* in 4.1a/*the boys* in 4.1b); A (the more agent-like argument of a transitive relation; e.g. *Peter* in 4.1c/*The boys* in 4.1d); P (the more patient-like argument of a transitive relation; e.g. *the dogs* in 4.1c/d).

(4.1) a. Peter is sleeping.
b. The boys are sleeping.
c. Peter was washing the dogs.
d. The boys were washing the dogs.

Example 4.1 shows that, in English, the auxiliary agree with the argument left-adjacent to it in number (and person). This is the case in both intransitive (4.1a/b) and transitive (4.1c/d) sentences, thus showing that S and A arguments are systematically treated alike in English in terms of both position and

agreement (and also case marking if one were to use pronouns instead of non-pronominal noun phrases). Hence, it provides evidence for a grammatical relation {S, A}, i.e. "subject" in traditional terms. Notably, however, S is in contrast to A in the sense that the sole argument is semantically intransitive and is assigned with a patient role but not an agent role, thus the similar treatment of S and A arguments cannot be reduced to semantic/thematic factors borne by an argument[23]. The relevance of the notion "subject" for English is substantiated by further phenomena, e.g. anaphoric links as in (4.2).

(4.2) a. Peter_i greeted Bill_k and $\_\_{}_{i/*k}$ went home.
b. Peter went home and __ greeted Bill.
c. *Peter went home and Bill greeted __.

Example 4.2 shows that when two clauses are conjoined and an argument is omitted from the second clause, two grammatical restrictions must be fulfilled: the zero anaphor (i.e. the omitted argument) must be co-referent with the subject (S or A argument) of the first conjunct (cf. a), and be the subject (S or A argument) of the second conjunct (cp. b and c).

The preceding discussion served to summarise some of the arguments for the importance of the grammatical relation "subject" in English. Furthermore, it suggests that there exists a subject/object asymmetry in this language since it shows that it is the subject rather than the object that triggers the agreement and controls anaphoric links. A similar line of argumentation also holds for other languages in which a subject preference has been observed during online processing (e.g. German, Dutch, Italian, and Turkish). Hence, for all of these languages, the existence of a subject category is relatively uncontroversial.

In Chinese, by contrast, the status of the subject is controversial because many of the phenomena that can be explained with reference to grammatical relations such as subject in other languages (e.g. English) are rather derivable via the notion of "topic" in Chinese. The basic sentence form in Chinese is comprised of two parts, namely a "topic" and a "comment". The topic is "*what*

23 This is the exactly theoretical evidence for supporting the subject-preference should not be reduced to a semantically/thematically-based preference for analysing the initial ambiguous argument as an Actor (cf. Sec. 3.2.2, Chap. 3).

a sentence is about … [it] sets a spatial, temporal or individual framework within which the main predication holds" (Li & Thompson 1981, p. 86). Chinese fulfils Li and Thompson's criteria for a topic prominent language: (a) the topic, but not the subject is surface coded (the topic appears clause-initially); (b) passive constructions are rarely used/carry a special adversity meaning (cf. Footnote 17 and Section 4.3.2); (c) there are no "dummy" subjects; (d) there are "double topicalisation" constructions, and (e) the topic rather than the subject controls anaphoric links. Topic-comment constructions are very pervasive in this language, (4.3) is one of the examples showing that (a) the topic need not be in a selectional relation with the verb, (b) the possibility for "double topicalisation" constructions and (c) coreference between an anaphor and the topic. Chinese characters are added by the current author.

(4.3) Topic-comment construction from Li & Thompson (1976, p. 463)

那	棵	树$_i$	叶子	大	所以	我	不	喜欢	__$_i$。
nà	kē	shù	yèzi	dà	suǒyǐ	wǒ	bù	xǐhuān	

[that tree]$_{TOP1}$ [[leaves]$_{TOP2}$ [big]$_{COM2}$]$_{COM1}$ so [1.SG]$_{TOP}$ [not like]$_{COM}$

'That tree, the leaves are big, so I don't like (it/*them).'

The sentence in (4.3) is comprised of two clauses, each of which consists of a topic and a comment. The initial argument in the first clause is a topic rather than a subject because it is not in a selectional relation with the predicate (the predictative adjective "big") as in (4.1). Furthermore, the first clause is a "double topicalization" construction (Teng 1974, or "possessor ascension" in Fox 1981), in which the main topic ("that tree") is the possessor of the second topic ("leaves"), and the second topic combined with the following "big" makes up a whole comment to the main topic (cf. Tsao's 1987 for treating the *bǎ*-marked object as a second topic in Section 4.3.2). Obviously, the double topicalisation cannot be argued to be two subjects as it is ungrammatical to have two subjects in one sentence by the subject definition, while there could be more than one topic in a sentence, if there are two or more NPs in front of the verb (cf. LaPolla 1990, 1993). The anaphoric links occur but do not fulfil the aforementioned grammatical restrictions: the zero anaphor is neither co-referent with the subject of the first clause nor is the subject of the second clause. Rather, it is co-referent with the main topic of the first clause ("that tree"), which is a topicalised object of the second clause (i.e. "that tree, I like",

cf. OSV in Section 4.3.3). Therefore, the anaphoric links here is between a topic and a topic, and it is the topic rather than the subject that controls the anaphoric links.

Furthermore, as topic is a notion that is defined at the discourse-level, the topic-prominent feature is often used to emphasise the important role of semantic and pragmatic – as opposed to syntactic – information in Chinese. This appears highly relevant to the examination of the subject preference in the present study. Consider the following famous example:

(4.4) Anaphoric links from LaPolla (1993, p. 10)

a. 那 个 人 把 西瓜 掉 在 地上，
nà gè rén bǎ xīguā diào zài dìshàng
that CL person BA[24] watermelon drop LOC ground
____ 碎 了。
suì le
broke-to-pieces ASP
'That man dropped the watermelon on the ground, (and it) burst.'

b. 那 个 人 把 西瓜 掉 在 地上，
nà gè rén bǎ xīguā diào zài dìshàng
that CL person BA watermelon drop LOC ground
____ 慌 了。
huāng le
get-flustered ASP
'That man dropped the watermelon on the ground, (and he) got flustered.'

The sentences in (4.4) stand in stark contrast to the English examples in (4.2). They illustrate that there are no grammatical restrictions on anaphoric links in Chinese, i.e. the zero anaphor in the second clause can either be coreferent with the P argument (4.4a) or the A argument (4.4b) of the first clause. Hence, constituent reduction does not provide evidence for a distinction between "subjects" and "objects" in Chinese. Rather, it shows that anaphoric links in Chinese are based on semantic information (verb meaning) and pragmatic (world knowledge). Furthermore, since Chinese has neither case marking nor agreement, these phenomena also cannot serve to identify

24 See coverbs in Sec. 4.4.2.

subjects. Finally, since word order is considerably freer in Chinese than in English, a position-based definition of subjecthood is not feasible either. On the basis of these and further observations on Chinese, LaPolla (1993) concluded that there is no evidence for grammaticalised subject and object categories and accordingly, no subject/object asymmetries in Chinese. Other researchers have argued for somewhat less extreme positions, noting that subject/object asymmetries can in fact be observed in Chinese under certain conditions such as topic extraction out of relative clauses (cf. Huang & Li 1996; Xu & Langendoen 1985; Xu 1986; Bisang 2006a for discussion).

To summarise, theoretic linguistics varies on whether the category of subject exists in Chinese or not. From a strict view of grammatical relations, there is no such category in Chinese equivalent to the subject defined in Indo-European languages, while from a less strict view, there is subject in Chinese because some topics behaves like a subject. Nevertheless, it appears undisputable that the evidence for the subject is much thinner for Chinese as opposed to the languages in which a subject preference has been observed to date.

4.2 Pro-drop

The term “pro-drop language” (from “pronoun-dropping”) refers to a language where certain classes of pronouns (usually a subject or an object) need not be overtly expressed if they can be inferred from context or are non-emphasis. According to whether the null pronoun can be recovered by verbal morphology or not, the languages that allow pro-drop can be further classified into “agreement pro-drop” languages and “agreement-less/discourse pro-drop” languages. Based on these criteria, Chinese can be typologically described as a pro-drop language in contrast to the languages that require an obligatorily overt subject with agreement morphology such as English and German. Within the languages that allow pro-drop, Chinese can be further classified as an “agreement-less/discourse pro-drop” language like Japanese, as opposed to “agreement pro-drop” languages such as Italian and Turkish (Holmberg 2005).

Unlike Italian and Turkish, pro-drop languages in which a dropped subject can be recovered by the verb agreement, Chinese has no inflection to mark subject-verb agreement, and the recovery of a dropped subject relies

exclusively on the wider context (or someone which is impersonal). Example (4.5) illustrates the full simple sentence and subject-drop in Chinese. Though grammatical relations are controversial in Chinese, the present study uses the terms “subject” and “object” (what otherwise might be interpreted as topic) for those that logically correspond the syntactic subject and object in the other languages.

(4.5) a. 我 没 吃 药。 (SVO)
wǒ méi chī yào
1.SG not eat medicine
‘I haven’t taken the medicine.’

b. ____ 没 吃 药。 (VO)
méi chī yào
not eat medicine
‘(I/someone) haven’t taken the medicine.’

Sentence (4.5a) is a complete sentence with both subject and object fully presented in the canonical order of subject before verb and object after the verb. (4.5b) is a subject-drop sentence in which the verb (“eat”) does not undergo any agreement but remains the same as in a full simple sentence (4.5a). The dropped subject can be the first person (“I”), someone which can be inferred form the discourse or someone which is impersonal. In fact, in Chinese, it is also possible to drop the object as in (4.6) or drop both subject and object like the answer in (4.7) as long as there is contextual support.

(4.6) 你 没 吃 药， 我 也 没 吃 ____。(SV)
nǐ méi chī yào wǒ yě méi chī
2.SG not eat medicine 1.SG too not eat
‘You haven’t taken the medicine, I haven’t taken (the medicine) either.’

(4.7) Q: 你 吃 药 了 吗? (SVO)
nǐ chī yào le ma
2.SG eat medicine ASP QP
‘Have you taken medicine?’

A: 吃 了。 (V)

chī le

eat ASP

'(I) have taken (the medicine). '

From (4.5)-(4.7), we can see that all types of pro-drop are possible in Chinese when taking advantage of pragmatic information such as context and world knowledge. Pro-drop is very common in this language, too. According to Huang and Chui (1997)'s corpus study based on one ordinary conversation and two oral narratives in Chinese, in a total of 748 transitive clauses, 366 clauses (49%) have pro-drops[25] (cf. Table 4 in Huang & Chui 1997). Furthermore, 249 out of 366 clauses (68%) are subject-drop (cf. Table 3 in Huang & Chui 1997). Concerning the most frequent subject-drop, there are also different, more or less pragmatic approaches Chinese linguists have argued for Huang (1984, 1989) claims that a dropped subject in Chinese can be syntactically recovered by an noun phrase in a superordinate clause, due to the absence of agreement; by contrast, Tsao (1979) and Li and Thompson (1981) observed that subject-drop in Chinese is actually Topic-NP reduction (cf. Example 4.3), as an optional process alternating with the use of overt pronouns in subject position. In a more pragmatic analysis, Li (1985) and Chen (1986) argued that a dropped subject in Chinese is more likely in cases of topic continuity, in which the information represented by the subject is the component of a series of related actions, events or states. Nevertheless, it is obviously true that the presence of a "subject" in Chinese is "freer" than those languages that require a subject in a clause.

4.3 Word Order Variation in Chinese

There are two basic rules that govern Chinese word order. One is the SVO (transitive) order and SV (intransitive) order of a simple sentence; another is

25 Huang and Chui (1997) encoded the subject of a transitive sentence as "A" (agent) and the subject of an intransitive sentence as "S", separately. Thus "SV" does not stand for object-dropped sentences, but stands for intransitive sentences in their study.

that the modifier precedes the head noun, which is being modified. These two rules lead Chinese to be a rather "different" language because they fail to fit either of the typological generations on word order: prenominal modifiers in OV languages and postnominal modifiers in VO languages (Greenberg 1963). Because of the contradicting pattern of word order, some linguists assume that Chinese word order had been undergoing a diachronic change from SVO to SOV (Li & Thompson 1974, 1975). To date, however, there is no significant evidence to support this assumption. Rather, it has been statistically demonstrated that the predominant word order in Chinese is SVO, just like English (Sun & Givón 1985). As the word order of modifier/RC is not of the primary concern for the present study, we will focus on word order in simple sentences in this section.

In Chinese, to encode a transitive event involving an S and an O, the most common order is SVO (94% for the written data and 92% for the spoken data in Sun & Givón 1985; 84% for the spoken data in Huang & Chui 1997[26]), followed by SOV/OSV, and then VOS. OVS and VSO do not exist in Chinese (cf. Sun & Givón 1985; Huang & Chui 1997). As VOS sentences are restricted to a particular situation in which the S is an afterthought (as in "kàn nàbù diànyǐng, tāmen", Eng. Lit: 'saw film, they') (for a detailed discussion, cf. Lu 1980), the present section will only focus the first three types of word orders. Below, we start from the canonical SVO order, and then turn to SOV/OSV orders which can be further separated into two cases: the one with *bǎ/bèi* markers and the one without any marker.

26 Sun and Givón (1985) distinguished pre-/post-verbal object and thus the 94% and 92% reported here result from dividing the sum of the frequency of preverbal object (SVO and VO) by a total of the frequency of the transitive sentences with overt objects. This appears to us that they excluded SV (object-drop) and V (subject- and object-drop) from their corpus. If we only count SVO and VO in Huang & Chui (1997) as Sun and Givón reported, the sum of 382 clauses with SVO order and 249 clauses with VO order should be divided by a total of 748 transitive clauses (see Table 3 and 4 in Huang and Chui's study), it results in 84%. However, in view of the present study, transitive sentences with any type of pro-drop should be taken as potential SVO order because the arguments are in their base positions but just not overtly present. By adding the frequency of SV and V, then the ratio amounts to 89%.

4.3.1 SVO

Since Li and Thompson (1978, p.687) argued "*word order in Chinese serves primarily to signal semantic and pragmatic factors rather than grammatical relations such as subject, direct object, indirect object*" (cf. also Li & Thompson 1981, p. 19 for similar arguments), a large number of studies have been working on this line. For example, topic (Li & Thompson 1975, 1978) or information structure (LaPolla 1993) can account for a wide range of word orders in Chinese. This group of studies thus categorises Chinese as a semantic/pragmatic word order language, as opposed to a syntactic word order language such as English. Interestingly, the statistic analysis of word order in Chinese speaks against the argument, showing that it is the syntactic factor (subject/object) rather than semantic/pragmatic factors that drive word orders in Chinese. Thus, this approach views Chinese word order much similar to English. Below, we address each approach in turn.

As the basic sentence type in Chinese is topic-comment, word order in Chinese has long been associated with the definiteness of nouns in that the topic must be definite by definition. The relationship has been formalised by Li and Thompson (1975, p. 170) as the following tendency: "*nouns preceding the verb tend to be definite, while those following the verb tend to be indefinite*." This tendency has been confirmed in a number of corpus studies including Sun and Givón (1985), Wang (1988) and Huang and Chui (1997). As the subject occurs preverbally and the object post-verbally in SVO order, the subject is more likely to be definite and the object is more likely to be indefinite. Furthermore, definiteness also influences the topicality/subjecthood of a noun, that is, a definite noun is often considered to have increased topic/subjecthood in a transitive sentence (cf. Comrie's definition of "natural transitive constructions" in Chapter 1). Consequently, the triangle relationships between preverbal position, subject and definite, and between post-verbal position, object and indefinite, are seldom taken apart when talking about Chinese word order. According to the generalization above, a sentence with a definite subject followed by an indefinite object as in (4.8a) is the most typical and frequent in Chinese; when definiteness does not adhere to these positions, as in (4.8b), the sentence is atypical and infrequent.

(4.8) a. 那 位 客人 吃了 一只 苹果[27]。 (SVO)
nà wèi kèrén chī le yī zhī píngguǒ
[that-CL guest]$_{DEF}$ eat-ASP [one-CL apple]$_{INDEF}$
'That guest ate an apple.'

b. 一 位 客人 吃了 那只 苹果。 (SVO)
yī wèi kèrén chī le nàzhī píngguǒ
[one-CL guest]$_{INDEF}$ eat-ASP [that-CL apple]$_{DEF}$
'one guest ate that apple.'

In Chinese, there is no particular article to mark definiteness as in English ("the" for definite and "a/an" for indefinite). However, Chinese can mark definiteness explicitly if necessary. As in (4.8), "that" indicates that "guest" is definite while "one" indicates "apple" is indefinite. In line with Li and Thompson's generalization, given a sentence with two bare nouns, i.e. no overt markers for both nouns like "guest ate apple", it is more likely to be interpreted as (4.8a) rather than (4.8b) because the word order will assign the former to be definite and the latter to be indefinite in default. Moreover, the definiteness of the preverbal noun also increases its topicality/subjecthood, i.e. a definite subject is better than an indefinite subject.

It should be kept in mind, however, that the association between preverbal position and a subject is not absolute in Chinese as it allows an object to occur preverbally via topicalisation, i.e OSV and SOV. Then, one may think the association between preverbal position and definiteness (given the grammatical category of definiteness exists in Chinese) is more reliable in Chinese. Indeed, the preverbal nouns in these non-canonical constructions are necessarily definite[28], either because they are the topic of the sentence, or because they are usually marked with *bǎ* which requires a definite object (see below). However, the association between word order and definiteness is problematic as well. Givón (1978, p. 319) first questioned whether the preverbal

27 Because *yī* marks indefiniteness very often in modern Chinese, Li and Thompson (1981) argue that the unstressed *yī* is beginning to function likes the English indefinite article.

28 The only exception is SOV. As will be discussed in more details in Sec. 4.4.3, the SOV allows the preverbal object to be indefinite if it is contrastively focused in a context. However, an indefinite object is very rarely compared with definite object.

position is indeed associated with definitization based on the observation that the preverbal noun could be either definite or generic (non-referential and thus not definite). He pointed out that "*the distributional restrictions in the word order devices in Mandarin, including the bǎ construction, strongly hint that they are topic-shifting rather than definitization devices*". Following Givón, LaPolla (1995) explicitly suggested to give up this association because Chinese lacks the grammatical category of "definiteness". LaPolla (1995) proposed that it is not definiteness but focus structure that is coded by word order. Considering the grammatical category of "definiteness" is language-specific, in his study, LaPolla adopted a more universal cognitive category of "identificability" from Givón (1978, p. 293) and Du Bois (1980, p. 208). In this way, the referential Chinese noun phrases in discourse can be generally divided into "identifiable" and "unidentifiable". A referent first introduced into the discourse is often "unidentifiable". According to how they are introduced, they can be "anchored" (a new referent first introduced via associating it with an identifiable noun, as with NPs marked by modifiers/RCs like "*a girl that I know*") and "unanchored" (a "brand-new" referent). Using these cognitive criteria, LaPolla demonstrated that in Chinese, an identifiable noun phrase can generally be distinguished from unidentifiable one by using the deictic (demonstrative) pronoun ("that" in Example 4.8). However, LaPolla disagrees with the view that deictic (demonstrative) pronouns simply mark definiteness since Chafe (1976, p. 39) and Givón (1978, p. 319) pointed out that they do not lose their original deictic force. Given this fact, and the observation from Chen's study that a bare noun in Chinese (like "*guest ate apple*" mentioned in last paragraph) can be either interpreted as definite or indefinite on the basis of "*syntactic or discourse context*" (Chen 1986, p. 19), LaPolla concluded that Chinese does not have grammatical categories of definiteness.

As we can see from above, the ban on the notion of definiteness is consistent with LaPolla (1990, 1993)'s proposal that Chinese does not have grammaticalised subjects or objects. According to LaPolla (1995), information structures rather than syntactic structures are used to convey information, and the only notions grammaticalised in Chinese are topic and focus. Therefore, the tendency observed by Li and Thompson (1975) is actually

subsumed to a more general tendency that "*topical and non-focal*[29] *NPs occur preverbally and focal or non-topical NPs occur post-verbally*". LaPolla pointed out that the apparent association between word order and definiteness results from the fact that referents newly introduced into the discourse will almost always occur in the post-verbal (focus) position, and most of them are "indefinite"; thus post-verbal position became associated with "indefiniteness". The underlying device of focus structure is easier to see if we examine intransitive sentences, namely "Entity-central presentative sentences" and "event-central presentative sentences", as shown in (4.9) and (4.10).

(4.9) Entity-central presentative sentences from Li & Thompson (1981, p. 509-510).

a.	在	院子里	有	一只	狗。	(VS)
	zài	yuànzilǐ	yǒu	yìzhī	gǒu	
	LOC	yard-inside	exist	[one-CL	dog]$_{FOC}$	
	'In the yard there is a dog.'					
b.	爬	出来	一只	老虎。		(VS)
	pá	chūlái	yīzhī	lǎohǔ		
	climb	exit	[one-CL	tiger]$_{FOC}$		

29 The non-focal NPs in LaPolla (1995) refer to second topics like *ba*-marked objects. Further, LaPolla (1995) follows Lambrecht (1994) to define focus structure as "*A grammatical system used to mark the focus of the assertion in a sentence by setting it off against the pragmatic presupposition*". According to Lambrecht (1989), there are three main types of focus structure: predicate focus (PF), narrow focus (NF, or contrastive focus) and sentence focus (SF). For example, in "Q: *How's your car? A: My car is broke DOWN?*", "down" in the answer is a PF, which makes a common to the topic ("my car") already within the presupposition. In "Q: *I heard your motorcycle broke down? A: My CAR broke down.*", only "CAR" is in focus and the rest of the assertion is within the presupposition. In "Q: *What happened? A: My car broke down.*", the whole sentence is focused because there is no preposition. The "car" is accented in English to avoid the subject to be interpreted as topic (which otherwise is in the presupposition). The first two types of focus are more relevant to the present study. The present study only distinguishes "completive focus" and "contrastive focus", following Dik et al. (1981) and Choi (1997). The former type is close to PF in the sentence it provides pure new information to the topic here and the latter type is equal to NF (cf. Sec. 4.4.3).

‘A tiger climbed out.’

(4.10) Event-central presentative sentences from LaPolla (1995, p. 318)

下	雨	了	(VS)
xià	yǔ	le	
fall	rain	ASP	

‘It is raining.’

The sentences in (4.9) are typically used in Chinese to introduce a new referent into discourse. In (4.9a), the new referent follows the existential verb (“yǒu”). In (4.9b), the new referent follows the verb of motion (“pá”). Both of them occur at the post-verbal position because they are new and in focus. The sentence in (4.10) addresses the existence of an event, not an entity as in (4.9). “Rain” is pragmatically not referential and not topical since it is not salient in the discourse Givón (1981). Here, again, it is after the verb. It is clear from (4.9) and (4.10) that the aforementioned association between preverbal position, subject and definite does not always hold, as the subject is post-verbal and either indefinite or non-referential. By contrast, focus structure can go a long way to account for word orders in Chinese.

So far, we have seen that in Chinese linguistics, there are attempts to de-emphasise the “syntactic” categories defined within the western grammatical tradition such as subject, object and definiteness, and to distinguish Chinese from English for its pragmatic word order. By contrast, there are also attempts that establish a somewhat “syntactic” category, namely “grammaticalised topic” (Comrie 1988). These attempts thus take Chinese word order into an opposite direction, that is, no longer pragmatic, but just as syntactic as English. The following corpus study in Huang and Chui (1997) is such a case.

In a corpus comprised of spoken data from one ordinary conversation and two oral narratives (*Ghost* and *Pear*), Huang and Chui (1997) coded core arguments in a clause (i.e. the basic unit in their analysis) mainly for their valency roles (A, S and O, which are used in the same sense as in Comrie (1978), activation status (given vs. new, which LaPolla refers to topic vs. focus), identifiability (identifiable vs. non-identifiable), generality (generic vs. particular) and humanness (human vs. non-human, which the present thesis refers to animate vs. inanimate). They also coded positions of arguments

(preverbal vs. post-verbal) for the clause with one or two overt arguments (in a total of 1674 clauses, only 4 transitive clauses dropped both A and O and none of the intransitive clauses has dropped S, thus 1670 clauses were taken into their analysis here).

The statistic analysis revealed that the positions of arguments are more strongly associated with valency roles rather than activation status (Tables 5-7 vs. Tables 9-11 in Huang's and Chui's paper). More precisely, there is a strong tendency for preverbal arguments to correlate with S/A (for transitive clause, all preverbal nouns in all of the three texts are A; for intransitive clauses, 93.4% preverbal arguments in conversation, 88.3% preverbal arguments in *Ghost* and 66.7% in *Pear* are S). Furthermore, there is a similar strong tendency for post-verbal arguments to correlate with O (92.4% in conversation, 92.7% in *Ghost* and 81.7% in *Pear*). The association between the positions and activation status is also strong; however, it is still weaker than that between positions and grammatical roles. The preverbal arguments are strongly given (88.5% in conversation; 93.7% in *Ghost* and 90.2% in *Pear* are given). By contrast, post-verbal arguments may equally be given and new (41.3% in conversation, 52.5% in *Ghost* and 59.4% in *Pear* are new).

Considering that activation status is only one of the pragmatic factors, in a next step, Huang and Chui added other factors into their analysis: two discourse categories, identifiability and generality; and one semantic category (in a traditional sense), humanness. The results (Tables 15 and 16 Huang's and Chui's paper) showed that activation status and identifiability have the same ability to predict arguments' positions, that is, they are equally strong predictors for the positions of S (pre. vs. post are both around 90%: 25%) and equally poor predictors for the positions of O (pre. vs. post. are both around 85%: 65%) while generality and humanness are both poor predictors of argument's positions (generic: pre- vs. post-verbal S is 9.5%: 21.4%, pre- vs. post-verbal O is 9.9%: 33.2%; human: pre- vs. post-verbal S is 78.7%: 70.6%, pre- vs. post-verbal O is 20.6%: 30.6%).

In summary, there are two important findings in Huang and Chui (1997). First, Chinese word order (i.e. the positions of arguments) is more sensitive to valency roles than discourse pragmatics. This is based on the fact that, while valency roles can predict more than 90% of arguments' positions, discourse

pragmatics also has the same ability to predict preverbal arguments but lose half of this predictive power for the post-verbal argument.

Secondly, Chinese exhibits the following "topicality hierarchy" which is defined in terms of the valency roles's ability to form anaphoric links. In this hierarchy, the preverbal S and A are aligned together and higher ranked than O as well as post-verbal S.

(4.11) Topicality Hierarchy in Chinese from Huang and Chui (1997, p.68)
{A, preverbal S} > {post-verbal S, preverbal O, post-verbal O}

Findings from Huang and Chui (1997) support the topicality hierarchy in the following respects. First of all, A and preverbal S are overwhelmingly given information in the discourse (97.4% for A, 92.5% for preverbal S), identifiable (94.8% for A, 93.3% for S) and human (94.6% for A, 78.7% for the preverbal S), while these factors are less converged on O and post-verbal S. Furthermore, the preverbal and post-verbal split of S can be exclusively argued by S in the intransitive sentence and S in existence sentence (cf. Example 4.9), while the preverbal and post-verbal split of O is not driven by a single motivation. Finally, a later step of investigation on topic continuity shows that A and preverbal S far outnumber post-verbal S and O in forming anaphoric links. Due to the fact that both preverbal O and post-verbal O are equally low in anaphoric links and are equally difficult to be predicted by pragmatic factors, both are equally ranked lower at the hierarchy. Therefore, S/A generally comprise of one nominative category, namely a category marks topical information, distinct from accusative category.

All in all, the discussion on Chinese word order can be summarised as follows: Li and Thompson (1975, 1978) and LaPolla (1995) argued for the semantic and pragmatic nature of Chinese word order and justified their argument by demonstrating their generalisation on different Chinese word orders. On the other hand, the statistic analysis in Huang and Chui (1997)'s corpus study showed that Chinese word order is more sensitive to valency roles than discourse pragmatics. Again, the distinct arguments are closely tied to the status of "subject" in Chinese. In the former view, Chinese has no grammatical subject, but only topic. However, the latter argues that topic in Chinese shares many similarities with the grammatical subject and there exist

a “grammaticalised topic”, distinct from topic and from subject, following Comrie (1988).

4.3.2 S *bǎ* OV and O *bèi* SV

In contrast to canonical SVO order, verb-final orders provided by 把(*bǎ*)/被(*bèi*) constructions (i.e. S *bǎ* OV and O *bèi* SV) are also common in Chinese. In fact, not only their deviated word order, but also the diachronic development of *bǎ* and *bèi* and the semantic/pragmatic status of these two constructions have been much studied among linguists working with different theoretical frameworks (cf. Zhu 1957; Wang 1970; Li & Thompson 1974，1981 for starters).

Bǎ and *bèi* are coverbs that are similar to English prepositions and generally occur in conjunction with other verbs (cf. Po-Ching & Rimmington 2004). As their lexical verbal meanings (*bǎ* is ‘to grasp, to hold’ and *bèi* is ‘to cover, to suffer’) have been bleached due to a process of grammaticalisation (Li & Thompson 1981), in modern Chinese, a sequence of S *bǎ* O and O *bèi* S are generally treated as ungrammatical sentences unless sentence-final verbs are added to form a “package” with *bǎ*/*bèi*.

As apparent form their configuration, both *bǎ* and *bèi* serve to explicitly mark the relationship between the two preverbal arguments. *Bǎ* usually requires the following argument to be an object of the verb and thus indicates that the initial argument is a subject of the sentence while *bèi* requires the second argument to be a subject of the verb and thus signals the initial argument is an object in the sentence[30]. Thereby, *bǎ* and *bèi* can be viewed structurally as an object-marker and a passive marker, respectively. Moreover, both share some semantic features, that is, both require that the object of the sentence be highly affected by the activity of the verb. Thus a typical *bǎ*/*bèi* construction normally contains a highly transitive verb (or complex verb

30 In some cases, the *bǎ*-marked argument may not be the undergoer of the action in the sentence. For example, “Bǎ wǒ lèi sǐ le.” (BA I tired-dead ASP, ‘It made me extremely tired’). The *bǎ*-marked argument is an experiencer of the activity. By contrast the argument marked by *bèi* is always an actor though it is often dropped. For example, “Háizi bèi jīngxǐng le.” (Baby BEI surprise-awake ASP, ‘the baby was woken up’).

phrase) with causative or resultative meaning (Li 1990; Sun 1991), such as Example 4.12.

(4.12) a. 我 把 手 洗 干净 了。 (S *bǎ* OV)
wǒ bǎ shǒu xǐ gānjìng le
1.SG BA hand wash clean ASP
'I washed (my) hands (until they became clean).'

b. 孩子 被 电话 惊醒 了。 (O *bèi* SV)
háizi bèi diànhuà jīng xǐng le
baby BEI telephone surprise-awake ASP
'The baby was woken up by the telephone.'

The complex verb phrase in (4.12a) consists of an action and its result, which can be reflected by LS of the verb phrase, [wish' (I, Ø)] CAUSE [BECOME clean' (hand)], so as the verb in (4.12b), [surprise' (telephone, Ø)] CAUSE [BECOME awake' (child)]. Both of them describe a changing state of the object caused by the subject. Furthermore, these events are often bounded, which is inherent in the meaning of a *bǎ*-verb combined with the aspect marker LE (Liu 1997; also cf. Sybesma 1997 for verb-LE as a resultative predicate). If one removes the boundary/resultative element (干净'clean' and 醒'awake') from the verb phrase but keeps the action element (洗'wash', 惊'surprise'), then both of sentences are odd and even unacceptable. This is further supported by the fact that single monosyllabic verbs are seldom to co-occur with *bǎ* and *bèi* for they usually express a simple action (e.g. Ding 1961; Li 1990).

The optimal environments for *bǎ* and *bèi* involve not only the semantic meaning of the verb, but also require some semantic/pragmatic constraints on the preverbal arguments. For example, in line with the transitivity of the verb and the lexical verbal meaning of *bǎ*, the *bǎ*-marked object must be disposal (Wang 1945; Wang 1957; Hashimoto 1971; Li 1974). Furthermore, this object is a definite rather than an indefinite noun. In light of its definiteness and preverbal position, some linguists focus on the information structure of *bǎ*-construction and analyse the *bǎ*-marked object as a second topic, which combines with the comment that follows to make a comment to the main

topic at the initial position of the sentence (Givón 1978; Tsao 1987; Hsueh 1987).

The *bèi*-construction in Chinese requires the initial object/undegoer to be negatively affected, unlike passives in Indo-European languages, which are neutral; pragmatically speaking, the *bèi*-construction triggers an "adversative" reading/interpretation. In (4.12b) the baby is obviously negatively affected as the telephone interrupted its sleep. One extreme situation is that, a benefited undegoer will be interpreted as a sufferer if this event is encoded with a passive construction in Chinese. For example, the Chinese counterpart of an English passive like "John was kissed by Mary" implies that to be kissed by Mary is not John's wish or a disaster for John (cf. Li & Thompson 1981; Huang 1999). To recover a more neutral tone as in English, a SVO sentence (i.e. "Mary kissed John") is used instead. This special pragmatic constraint can account for the relative infrequency of passive sentences in Chinese as opposed to English. Furthermore, as will become apparent in the next section, the OSV order also provides an alternative way to express a "passive meaning" for which English would use a passive construction.

To summarise, *bǎ*-/*bèi*-constructions render themselves verb-final in contrast to the canonical SVO order in Chinese. Structurally, both of them require the object to precede the verb. *Bǎ* serves as an object marker and *bèi* functions as a passive marker. Both impose semantic/pragmatic constraints on the verb as well as the preverbal arguments: the verbs co-occurring with *bǎ* and *bèi* are required to be highly transitive so that the objects of *bǎ* and *bèi* are strongly affected. The *bǎ*-marked object is often required to be "disposable", or to be a second "topic" and the object in the *bèi*-construction is usually conditioned by an adversative requirement.

4.3.3 SOV and OSV

SOV and OSV constructions are similar to *bǎ*-/*bèi*-constructions with respect to the verb-final order. As shown in (4.13), in some cases, SOV and OSV constructions can be taken as alternatives to *bǎ*-/*bèi*-constructions, respectively. However, because of the lack of overt markers, SOV and OSV constructions require more semantic/pragmatic support than *bǎ*-/*bèi*-constructions. This is evident from the fact that they are usually found in

spoken Chinese where the speaker and the hearer are already aware of who did what to whom in a discourse. In fact, according to the different semantic/pragmatic requirement, SOV and OSV constructions differ from *bǎ-/bèi*-constructions and further differ from one another. Below, we first start with Example 4.13 where SOV and OSV constructions can be used as alternatives to *bǎ-/bèi*-constructions.

(4.13) 'Lisi has done the homework'

a.	李四	(把)	作业	做完	了。	(SOV)
	Lǐsì	bǎ	zuòyè	zuòwán	le	
	Lisi	BA	homework	do-finish	ASP	
b.	作业	(被)	李四	做完	了 。	(OSV)
	zuòyè	bèi	Lǐsì	zuòwán	le	
	homework	BEI	Lisi	do-finish	ASP	

It is clear from (4.13) that whether or not *bǎ* and *bèi* are overt, sentences (a) and (b) share the same interpretation that Lisi is the subject and homework is the object. From a pragmatic perspective, however, they are actually four different sentences. Compared with a SVO sentence like "Lisi do-finished ASP homework", whose usage is relatively context-independent as it simply describes an event of "who did what to whom", the usages of (a) and (b) are more or less dependent on context. With overt *bǎ* and *bèi*, (a) is often used when there is a need to emphasise that Lisi dealt with his homework and (b) is used when the homework-assigner is negatively affected in the sense that s/he did not expect Lisi would finish the homework. Without *bǎ* and *bèi*, native speakers of Chinese report that (a) occurs when there is a context providing a set of things for Lisi to do, one of which is his homework. In other words, "homework" in (a) should be in contrast with something else. Similarly, "homework" in (b) could also be interpreted as in (a) if a contrastive context is provided. Without such a contrastive context, it is similar to an SVO sentence, but with its object topicalised. We will turn back to the pragmatic differences between SOV and OSV at a later point. Here, besides the different pragmatic requirements on both the preverbal arguments, SOV and OSV also differ from *bǎ-/bèi*-constructions with respect to constraints on the sentence-final verb.

Verbs in SOV and OSV are not necessarily causative or resultative as in the *bǎ-/bèi*-constructions, as shown in (4.14).

(4.14) 'Lisi can speak English but cannot/doesn't want to speak German.'

a.	李四	(*把)	英语	会	说，	德语	不	会	说	(SOV)
	Lǐsì	bǎ	yīngyǔ	huì	shuō	déyǔ	bù	huì	shuō	
	Lisi	BA	English	can	speak	German	not	can	speak	
b.	英语	(*被)	李四	会	说，	但	他	不	想	说。	(OSV)
	yīngyǔ	bèi	Lǐsì	huì	shuō	dàn	tā	bù	xiǎng	shuō	
	English	BEI	Lisi	can	speak	but	3.SG	not	want	speak	

Sentences (a) and (b) with *bǎ/bèi* are unacceptable sentences because the predicate of the first clause ("can speak") cannot co-occur with *bǎ/bèi*. The inherent meaning of the sentence-final verb ("speak") is neither causative nor resultative. Furthermore, the predicate describes an individual ability; it neither changes over time as with the *bǎ*-construction, nor does it express a negatively affected object as with *bèi*-construction. Nevertheless, they are perfectly fine without *bǎ/bèi*. In fact, examples of SOV and OSV discussed below will continue to show that these two constructions do not require a particular verb type, as long as their contextual requirement is fulfilled. Therefore, SOV/OSV are not simply reduced versions of *bǎ-/bèi*-constructions; they have their own semantic/pragmatic requirements and should be taken as an independent research topic.

As SOV and OSV share similarities that both of their objects are preverbal, they are frequently classified as OV constructions in contrast to VO constructions (e.g. the SVO order mentioned above). From the view of information flow, Tao (1996) compared OV and VO constructions in a corpus study on Mandarin conversation. The author found that the post-verbal Os were always new information, while the preverbal Os were not necessarily new. Out of his three tokens of preverbal Os, one is given information and two are new but contrastive information. As will be addressed below, his findings support the idea of making a further distinction between OV constructions according to the information status of the preverbal Os: the object in SOV is on contrastive focus and is usually stressed; the object in OSV is more topical than focal, thus there is usually a pause between O and S with O not stressed.

Since "focus" and "topic" seem to be critical for understanding these two constructions, relevant knowledge about the relationship between topic and focus[31] need to be given first.

Recall that in Section 1.2.3, Choi (1997) distinguishes two types of focus, following Dik et al. (1981). One is "completive focus" (CPF) and the other is "contrastive focus"(CTF). The former is purely "new" information while the latter is less new because it evokes a set of alternatives and this set contextulises the potential referent. Furthermore, Choi argues that the distinctive feature between these two types of focus is discourse "prominent". Compared with completive focus, the contrastive focus is more prominent because the current referent is in contasrt to the other alternatives. These two types of focus are illustrated in (4.15) and (4.16), respectively. (4.16) provides two representatives of contrastive focuses, "parallel" (a) and "replacing" (b).

(4.15) Q: What are you reading?
A: (I'm reading) a [novel]$_{CPF}$.

(4.16) a. Markus bought [tea]$_{CTF}$, but Thomas bought [coffee]$_{CTF}$.
b. Q: I heard Markus went to Marburg.
A: No, he went to [Magdeburg]$_{CTF}$ (not [Marburg]$_{CTF}$).

Depending on its relationship with the comment, the topic can also be divided into two types (cf. Gundel 1977; Culicover 1992): "discourse topic" (DT) and "focus topic" (FT). The former functions to set up the scene or establish what will be talked about, as shown in (4.17), and the latter introduces an entity to be focused on in contrast to another, with respect to the following comments, as shown in (4.18).

(4.17) [Markus]$_{TP}$ is ill today, but I think he will come tomorrow.

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31 "Topic-comment" and "ground-focus" are binary distinctions used conventionally in the field of information structure. The following example adopted from Choi (1997, p.3) shows that topic and focus *do* have relationship although they are namely separate.
Q: what about John? What does he drink?
A: [John]$_{TOP}$ [drinks beer]$_{COM}$ or [John drinks]$_{GRO}$ [beer]$_{FOC}$

(4.18) [Markus]$_{FT}$, I know him, but other people, I have no idea.

One may already notice that the focus topic and the contrastive focus are actually the same thing, just defined in different domains. The overlap between the two is understandable since making a comment is always about the current topic, not about another potential topic, which leads to a contrastive reading (Choi 1997). This is also supported by the fact that the topic and the contrastive focus share the same morphological case marking in some languages (e.g. *wa* in Japanese and *ka* in Korean) and the same clause-initial position. (4.18) is such a case, termed as "topicalization" or "focus fronting" in English (cf. Ward 1988). It shows that the object ("Markus"), which should come after the verb in a SVO order, is topicalised to the clause-initial position, and receives both topic and contrastive focus readings. Keeping these in mind, let's turn to SOV and OSV in Chinese, as shown in (4.19) and (4.20).

(4.19) Contrastive context: I drink beer but I do not drink alcohol.

a.	我	啤酒	喝	(,	白酒	不	喝)。	(SOV)
	wǒ	píjiǔ	hē		báijiǔ	bù	hē	
	1.SG	[beer]$_{CTF/FT}$	drink		alcohol	don't	drink	
b.	啤酒	我	喝	(,	白酒	不	喝)。	(OSV)
	píjiǔ	wǒ	hē		báijiǔ	bù	hē	
	[beer]$_{CTF/FT}$	1.SG	drink		alcohol	don't	drink	

(4.20) Discourse context: I drink beer, if I cannot drink up, I take it away.

?a.	我	啤酒	喝,	喝	不	完，	带走。	(SOV)
	wǒ	píjiǔ	hē	hē	bù	wán	dàizǒu	
	1.SG	[beer]$_{DT}$	drink	drink	don't	complete	take away	
b.	啤酒	我	喝,	喝	不	完，	带走。	(OSV)
	píjiǔ	wǒ	hē	hē	bù	wán	dàizǒu	
	[beer]$_{DT}$	1.SG	drink	drink	don't	complete	take away	

Comparing (4.19) with (4.20), both objects in SVO and OSV are topicalised to a preverbal position, but according to the observation in English (cf. Example 4.18), the one topicalised to the clause-initial position (OSV) should receive

both contrastive focus/focus topic and discourse topic readings (see Example 4.19b and Example 4.20b, respectively). By contrast, the one topicalised to the preverbal but post-subject position (SOV) don't have such two readings (Example 4.19a vs. Example 4.20a). Native Chinese speakers report a similar intuition that the OSV sentence sounds fine if "beer" continues to be the topic of the following "drink up" and "take away" (Example 4.20b), but it is difficult for the SOV sentence (Example 4.20a). The OSV sentence is also fine if "beer" is continued by a contrastive comment and even perfect if "beer" is stressed as a focus (4.19b).

The low ability for the object in SOV to form topic chains (anaphoric links) thus suggests that the topicality of the object in SOV is not as high as the one in OSV. Rather, SOV is strongly driven by the contrastive context. This is not only supported by the fact that an indefinite noun can occupy the object position (Tsai 1994) as long as it is a contrastive focus, but also by the fact that SOV is generally reported to be better if there are "emphatic" markers (in terms of Ernst & Wang 1995) such as *dōu* ("all"), *yě* ("also"), *bù* ("not") and explicit contrasting conjuncts (like 4.19a), which can facilitate the contrasting reading. On the other hand, OSV shows a higher ability to form topic chains (Example 4.20b). It is also argued that OSV can be conveyed from SVO without much contextual support (cf. Li 1990). In the default case, i.e. when neither SOV nor OSV in (4.19) has contrasting conjuncts in parentheses, the sequence of "beer I drink" is interpreted as "I drink beer", like a SVO sentence. Thus, it is more acceptable than SOV when there is no context. Finally, the emphatic markers are completely optional for OSV (Ernst & Wang 1995).

In short, the observed differences between SVO and OSV can be summarised as follows: the SOV construction makes the object on focus in contrast with other alternatives, thus it provides information for the listener to choose or information counter to the expectation of the listener (Li & Thompson 1981). The OSV construction emphasises the topic-hood of the sentence object. The object information is always given to both speaker and listener (cf. Ernst & Wang 1995)[32].

32 In a *Government and Binding Theory* framework, some researchers assume that SOV derives from double-topicalisation constructions in which the object first adjoining to IP as in OSV (Xu & Langendon 1985; Tang 1990). However, as Ernst and Wang (1995) demonstrated, some SOV must be derived by adjoining the object

So far we have reviewed the pragmatic requirements of SOV and OSV, which are different from *bǎ-/bèi*-constructions. Below, we will look at semantic requirements of SOV and OSV, which are considered to be stronger than in *bǎ-/bèi*-constructions. As mentioned in the beginning of word order section, Chinese has no OVS order, thus a verb-medial NP1-V-NP2 order could only be interpreted as SVO. The thematic role identification (i.e. identify which is subject and which is object) is strongly guided by the arguments' positions rather than animacy (cf. "human/non-human" in Huang and Chui (1997)). In verb-final orders like NP1-NP2-V with *bǎ* and *bèi*, the role identification is guided by *bǎ* and *bèi* rather than animacy since *bǎ* and *bèi* are in-between and explicitly indicate the relationship of the two preverbal arguments. However, in NP1-NP2-V without *bǎ* and *bèi*, and of course without case marking and verb agreement in Chinese, animacy is considered to be more responsible for the role identification.

All the Chinese examples of SOV and OSV presented above have distinct animacy information, that is, either NP1 is animate and NP2 is inanimate or the other way round. Take (4.13) for example, although preverbal arguments could be SO or OS, the interpretation is always "Lisi has done the homework" but never "the homework has done Lisi". Here, the background of our world knowledge certainly contributes to this role identification, the local animacy information of the two arguments certainly point to the same direction: an animate noun is more likely to be a topic/subject than an inanimate noun (recall natural transitive constructions in Comrie 1989). The animacy information also matches the verb's requirement for an animate subject and inanimate object. Thus, the desirable animacy information for SOV and OSV can be depicted as follows (an = animate, in = inanimate):

(4.21) a. S(an)-O(in)-V
b. O(in)-S(an)-V

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directly to VP, not necessarily involve the double-topicalisation. The distinction between SOV and OSV can be easily handled if taken (respectively) as VP- vs. IP-adjunctions. According to their demonstration, all the SOV and OSV sentences in the present study support this distinction.

Interestingly, if preverbal arguments do not differ in animacy, i.e. if both are animate or both are inanimate, OSV is shown to be more acceptable than SOV (Shyu 1995; Lu 1994; Qu 1994). The animate case and inanimate case are given in (4.22) and (4.23), respectively.

(4.22) Animate example from Shyu (1995, p. 108)

马丽	张三	看见	了	(an-an-V)
Mǎlì	Zhāngsān	kànjiàn	le	
Mali	Zhangsan	see	ASP	

*a. 'Mali saw Zhangsan.' (SOV)

b. 'Mali, Zhangsan saw.' (OSV)

(4.23) Inanimate example from Qu (1994, p. 71)[33]

纽约时报，	他的	文章	已经	批评过	了。(in-in-V)
Niǔyuēshíbào	tāde	wénzhāng	yǐjīng	pīpíngguò	le
N. Y. Times	his	article	already	criticised	ASP

*a. 'The New York Times has criticised his article.' (SOV)

b. 'The New York Times, his article has criticised.' (OSV)

33 Shyu (1995) argued that the unacceptability of (4.23a) is not what Qu originally meant, i.e. that not only animate case, but also inanimate case shows OSV is preferred over SOV. From Shyu's perspective, the sentence in canonical SVO order ("His article has criticised the New York Times") itself sounds unnatural, thus (4.23b) is unacceptable in any case. However, Shyu did not address the possible reason why even SVO sounds unnatural in this case. It seems to us that the unnaturalness mainly comes from the inanimate subject. Clearly, in this case, "he" rather than "his article" would sound better. Since it is difficult to rule out that an inanimate subject might be treated as an animate one (also, the verb, "criticise", often takes two animate arguments), it is questionable whether the acceptability really reflects a judgement between two "inanimate" arguments. Furthermore, the comma after the first noun (a pause in intonation) leads to a strong topicalisation reading, so it is not surprising to see (4.23b) is preferred over (4.23a). In summary, Qu's example doesn't provide a "fair" ground for testing word order preference between SOV and OSV. The inanimate cases need to be investigated more stringently (i.e. only strictly inanimate arguments) in the future. Nevertheless, Shyu, Lu and Qu all agree on that in the case where both arguments are animate, OSV is definitely preferred over SOV. To give a complete data pattern of animacy and word order, we keep Qu's example here.

Examples (4.22) and (4.23) thus lead us to summarise the cases where both arguments have the same animacy as follows:

(4.24) *a. S(an)-O(an)-V and S(in)-O(in)-V
b. O(an)-S(an)-V and O(in)-S(in)-V

Parallel to the case in (4.21), the relationship between animacy and verb-final orders can be formalised with the generalisation proposed by Qu (1994, p.71): if S and O *cannot* switch their thematic roles, then both OSV and SOV are possible; if S and O *can* switch the thematic roles, then only OSV is possible, not SOV. The "switching thematic roles" here refers to the so-called "symmetric verbs" where the results of switching subject and object is still interpretable, such as "see" in (4.22) and "criticise" in (4.23). Thereby, within a null context, SOV resorts more to semantic information than OSV in that it is less acceptable than OSV when both of them lose animacy support.

To conclude, the different pragmatic and semantic requirements contrast SOV/OSV against *bǎ-/bèi*-constructions. Both of them are verb-final and face with the same task of assigning thematic roles to the preverbal arguments; however, the former requires more semantic/pragmatic information than the latter. Furthermore, unlike VO constructions, different semantic/pragmatic requirements also distinguish SOV and OSV themselves. Pragmatically, SOV must rely on a more prominent context, i.e. a contrastive context, while OSV need not. Moreover, OSV can be drived from SVO by topicalising the object to the clause-initial position. Beside the different pragmatic requirements, SOV also requires more support from animacy information as compared to OSV. The different "loads" on semantic/pragmatic information thus lead to the conclusion that SOV is more "marked" than OSV in Chinese.

4.4 Research Questions and Predictions

This chapter describes three important features that have been used to argue that Chinese is different from most of the languages in which the subject-preference was previously examined: topic-prominent vs. subject-prominent; discourse pro-drop vs. agreement pro-drop/no pro-drop, pragmatic-driven word order vs. syntactic-driven word order. The first two features, topic and

discourse pro-drop contribute to the word order variations in Chinese. This chapter mainly introduced two types of word order, the canonical SVO order and verb-final orders such as S *bǎ* OV/O *bèi* SV and SOV/OSV.

Concerning about Chinese word order, theoretical linguistic analyses are divided over whether Chinese word order is purely semantics/pragmatics deriven or more syntactically motivated, similar to English. It is not difficult to see that the debates roots in the status of "subject" in Chinese: compared with languages where the syntactic subject is more stable, subject in Chinese is "thinner" and "freer", more open to the invasion of semantic and pragmatic information. Therefore, it is of great interest to test whether the subject-preference can also be found in this language or not, and how semantic/pragmatic information influences word order processing.

Furthermore, the psycholinguistic theories vary considerably with respect to *whether* semantic/pragmatic information influences the argument interpretation. Chinese thus provides an ideal ground to examine the validity of different theories from both theoretical linguistic and psycholinguistic fields as well as an opportunity to identify language-specific processing characteristics and possible language universals. Incorporating descriptions of Chinese word order, the present study aims to examine word order preference in processing ambiguous NP-V and NP1-NP2-V constructions in Chinese on the following two questions:

(i) The initial ambiguous argument in NP-V constructions could either be a subject or an object in Chinese (SV order or OV order with subject-drop). Will this language show a subject-preference? If no, this would speak against the assumption of subject-preference being a universal processing strategy; if yes, this would support the assumption of the universal processing strategy but also raise a second question on language-specific processing characteristics: will this topic-prominent language differ from the previously examined subject-prominent languages with respect to allowing a topic context to override the subject-preference?

(ii) The two preverbal ambiguous arguments in NP1-NP2-V constructions could either be SOV or OSV orders. Since these two orders require more semantic support as compared with SVO and S *bǎ* OV and O *bèi* SV, how

animacy influences the processing of NP1-NP2-V constructions as opposed to NP-V constructions?

As mentioned in Chapter 3, most of existing accounts for word order processing are syntactically based, thus they all face problems when syntax is not sufficient to explain why the subject-preference can be observed in Turkish, a language where the subject/object is in its base position and thus does not involve moved argument and empty category. Furthermore, they fail to make predictions for the present study because the subject/object in Chinese is difficult to define syntactically. Thereby we are in favour of the cross-linguistically motivated eADM, which can make predictions for the questions above and also provides a direction of distinguishing the language-universal processing strategy and language-specific processing characteristics.

The eADM posits that argument interpretation is not determined by the syntactic structure. Thus the minimal-dependencies account in Stage 2 can explain the cases when those structural factors do not suffice for a cross-linguistic derivation of the subject preference. However, this does not mean that argument interpretation is not influenced by structural factors. The eADM also leaves the possibility that the subject-preference can be influenced by the syntactic templates that the processing system chooses in Stage 1. The syntactic template selection, like argument interpretation, is subject to simplicity-based considerations, such that the simplest structure is chosen in the case of an ambiguity. Thus, it can serve to constrain the types of interpretations that are considered by the system during Stage 2 of processing. For example, a simplicity-based choice of a particular structure in Stage 1 will lead the processing system to attempt to assign the meaning which is compatible with the minimal structure and also calls for the assumption of the smallest number of dependencies.

Now consider how this can be applied to Chinese, a language for which it is typically assumed that the basic and pragmatically neutral word order is SVO. An example of the syntactic template in the eADM is given in Figure 4.1, adopted from RRG (cf. Van Valin 2005 for a recent introduction). Figure 4.1A shows core templates in Chinese are either NP-V-NP (for SVO sentences), NP-V (for intransitive SV sentences) or V-NP (for VO sentences with subject drop and, perhaps, for VS sentences). As Figure 4.1B shows, the core templates are

actually under a hierarchical syntactic structure known as the "layered structure of the clause". In addition to the "core" region of a sentence, which includes the verb and its arguments, there is a pre-core slot and a left-detached position (note that depending on the language in question, post-core slots and right-detached positions are also possible). The positions external to the core, in contrast to the core itself, are typically subject to information structural or pragmatic restrictions.

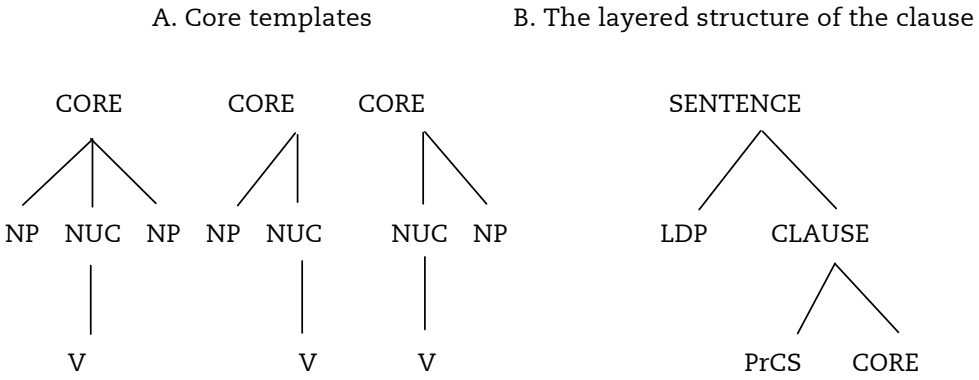


Figure 4.1: An illustration of syntactic templates in Chinese within the eADM.

When the processing system encounters the initial NP, it first prefers the simplest structure, i.e. NP-V in Stage 1, and an intransitive SV interpretation in Stage 2 via assigning a [-dep] feature to the initial NP since an intransitive subject is independent from the state of affairs by virtue of the fact that there is no second argument. When such an intransitive interpretation cannot be upheld, i.e. when the verb disambiguates the sentence into a transitive interpretation, the processing system switches the interpretation from SV into AV rather than OV since [-dep] feature is assigned to a transitive subject, whereas in the case of OV, [+dep] feature would be assigned to an object. Hence, the eADM predicts that we should still be able to see a subject-preference in Chinese even though the subject is difficult to define syntactically in this language. As the subject-preference is derived from the assumption of the initial argument being the sole argument, the eADM also predicts that the subject-preference should not be influenced by animacy and a topic context (which render the initial argument as given information) since

a sole argument can be animate or inanimate, topicalised/given or not topicalised/given.

However, the subject-preference can be influenced by the syntactic templates that the processing system chooses in Stage 1. Compared with NP-V constructions, NP1-NP2-V constructions without *bǎ* and *bèi* are more pragmatically restricted. As shown in this chapter, OSV is used to highlight the topichood of the NP1, while SOV is used to express a contrast (Ernst & Wang 1995) or a meaning that does not match the expectations of the listener (Li & Thompson 1981). Hence, we may assume that there are no NP1-NP2-V core templates (without coverbs *bǎ* and *bèi*), i.e. core templates like in Figure 4.1A.

Although both OSV and SOV orders contain non-core positions, they differ with respect to the number of NP positions before the core. OSV can be modelled via the assumption of one NP before the core, i.e. a LDP for the topical object, combined with a core template, whereas SOV requires two NP before the core, i.e. a LDP for the topical subject and a PrCS for the focal object (also see Footnote 32 for a comparable analysis which assumes that objects are adjoined to IP in OSV orders but to VP in SOV orders). Hence, in a circumstance where both NP-V and NP1-NP2-V templates are available, the processing system chooses the simplest one, i.e. NP-V, with the minimal S reading, which induces a subject-preference. However, when there are only NP1-NP2-V templates available, the processing system prefers the simpler one, i.e. OSV. Thus, an object preference (OSV rather than SOV) should result in this case. Animacy could play a bigger role in the processing of NP1-NP2-V constrcutions than in NP-V constructions since it can serve to distinguish the two preverbal arguments (cf. Example 4.21).

In summary, for our question (i), the eADM predicts a subject-preference when processing NP-V constructions in Chinese; furthermore, this preference should not be influenced by animacy and context. With regard to question (ii), the eADM predicts an object preference during processing NP1-NP2-V constructions. Animacy is more likely to influence NP1-NP2-V constrcutions than in NP-V constructions due to the relatively higher semantic/pragmatic requirements of the former.

Part II

Experiments

Chapter 5

Subject Preference in Processing NP-V Constructions

5.1 Experiment 1: A comparison of OV vs. SV orders

As mentioned in Chapter 1, the term "subject-preference" has a twofold meaning in the psycholinguistic literature, i.e. it is used to refer to the preferred analysis of ambiguous arguments in simple sentences, but also to the preference for SRCs vs. ORCs. Previous empirical studies of the subject-preference in Chinese have exclusively concerned themselves with the second of these two senses, i.e. with the processing preferences obtaining in Chinese RCs. However, the overall pattern of results is currently somewhat contradictory. Whereas Hsiao and Gibson (2003) originally reported a reading time advantage for ORCs over SRCs, other researchers observed a preference for SRCs in experiments using self-paced reading (Lin & Bever 2006) and ERPs (Packard, Ye & Zhou 2006). The status of the subject-preference in RCs in Chinese has thus not yet been fully resolved.

Yet the question of whether a language shows a subject-preference in RCs overlaps only in part with the cross-linguistic issues raised above. In addition to the question of how a subject-preference might be engendered by possible subject-object asymmetries, RCs introduce a range of additional influences that could potentially impact upon the way in which these constructions are processed (e.g. the relation between the grammatical relations of the head noun in the main clause and in the RC, cf. Footnote 4 in Chapter 1). Furthermore, the typologically exceptional status of RCs in Chinese (i.e. prenominal RCs in a VO language) could also impact upon the processing choices in RCs in this language in some way. In view of all of these potentially confounding influences, a more straightforward approach to the question of whether Chinese shows a subject-preference in spite of the controversial status of grammatical relations appears to lie in the examination of simple

sentences. Hence, the aim of Experiment 1[34] was to examine whether Chinese shows a subject-preference for *an initial ambiguous argument in simple declarative sentences*.

As described in Chapter 4, this question is rendered particularly interesting by several unique features of this language. Firstly, Chinese is often described as a "topic-prominent" language. This means those pragmatic or discourse-related criteria rather than structural or thematic role-related constraints serve to determine which argument occupies the clause-initial position (Li & Thompson 1976). For this reason, object-initial orders are also possible in addition to the basic SVO order. Secondly, Chinese permits subject-drop, which means the subject is not necessary to be overtly expressed in this language. Because of these specific features, a simple NP-V sequence as in (5.1) is readily interpreted as a sentence with a topicalised object ("novel") and a dropped subject, i.e. the first person ("I"), someone that can be inferred form the discourse or someone that is impersonal. Since Chinese has no case marking or subject-verb agreement, disambiguation is effected via an animacy restriction (i.e. the verb "read" requires an animate subject while the first NP is inanimate). Note that animacy is the only cue available in the disambiguation because an object is allowed to be topicalised to the clause-initial position only when it is supported by animacy, i.e. a topicalised object must be inanimate[35]. An animate NP, for example, the "actor" in "actor read …" can never be interpreted as a topicalised object since it is animate, a plausible subject of the verb.

(5.1)	小说	阅读了。	(OV)
	xiǎoshuō	yuèdú le	
	novel	read-ASP	

34 Experiments 1 and 2 have been published. See Wang, Schlesewsky, Bickel, & Bornkessel-Schlesewsky (2009) in Publication in this thesis.

35 A topicalised object can be animate only when it is marked by a pause or a pause articles, which serves to separated the topic from the comment (Li & Thompson 1981, p.86). However, since Experiments 1-2 were visual experiments and presented no pause article in the stimuli, it should be impossible to obtain an animate topicalised object reading. For the same reason, it is less likely to obtain a focal object reading (as in SOV) since this reading would require a stress on the object which is on focus.

'I/someone read the novel.'

If Chinese like all of the languages previously examined shows a subject-preference in simple sentences, we should be able to observe reanalysis effects at the position of the verb in sentences such as (5.1). To examine this question, we used critical sentences such as those in Table 5.1.

Table 5.1: Examples for each of the three conditions in Experiment 1. Conditions are abbreviated as follows: IO (inanimate object-initial condition), AS (animate subject-initial condition), IS (inanimate subject-initial condition).

Condition	*NP1*	*Verb*	*NP2*	*Translation*
a. IO	*小说	阅读了	演员	*novel read-ASP actor
	xiǎoshuō	yuèdú le	yǎnyuán	'The actor read the novel.'
b. AS	演员	阅读了	小说	actor read-ASP novel
	yǎnyuán	yuèdú le	xiǎoshuō	'The actor read the novel.'
c. IS	小说	教育了	演员	novel educate-ASP actor
	xiǎoshuō	jiàoyù le	yǎnyuán	'The novel educated the actor.'

The initial NP in all of the sentence conditions shown in Table 5.1 was ambiguous between a subject and an object reading. In accordance with the aims of the present study, the condition of primary interest is IO. Here, "novel" was disambiguated as the object of the sentence when the verb "read" is encountered.

As mentioned above, this disambiguation was effected via an animacy restriction. In the IO condition, verbs always required an animate subject, while the initial NP was inanimate. Recall from the discussion of Example 5.1 above that, at the position of the verb, a string such as "novel read" can be interpreted as a sentence with a topicalised object and a dropped subject. As the dropped subject is usually the first person ("I") or someone, the post-verbal animate NP, which can only be analysed as the subject of the verb, results in a highly non-preferred word order (OVS). Note that in spite of the inacceptability of OVS word orders in Chinese, previous behavioural findings suggest that NP-V-NP sentences with an inanimate first NP and an animate second NP (as in our IO condition) are preferentially interpreted as OVS (e.g. Li, Bates & MacWhinney 1993; Miao, Chen & Ying 1986).

Because of the impossibility of grammatically based word order disambiguation in Chinese, it was not possible to construct a subject-initial control condition which differs from the critical condition in only a single feature (e.g. agreement or case). Therefore, two subject-initial control conditions (AS/IS) were chosen, each of which controlled for different stimulus parameters. AS has the same meaning as IO, but a canonical SVO word order, and IS begins with the same inanimate NP as IO but disambiguates this NP to a subject reading. Furthermore, AS includes identical verbs to IO and therefore allows for a comparison of identical lexical items at the position of the verb. By contrast, IS provides a lexically identical control for IO at the position of NP2. Our hypotheses for these three positions are as follows:

a. NP1: At this position, we compare inanimate-initial conditions (IO/IS) with animate-initial condition (AS). If the initial ambiguous argument is assigned to a formal analysis such as "subject" and no more information such as animacy is considered, there should be no effect between IO/IS and AS. By contrast, if an initial argument is assigned to a "deeper" analysis such as Actor, such comparison should lead to an N400 since an inanimate argument is not a prototypical actor. An alternative cross-linguistic perspective is that the role of animacy in processing depends on the type of language/construction (cf. Philipp et al. 2008): if animacy in Chinese plays a similar role as in German (language with flexible word order), there should be no animacy effect for IO/IS as opposed to AS at the initial position because animacy only plays a role at the position of the second argument; if animacy in this language patterns with English (language with strict word order), IO/IS in comparison to AS should immediately elicit an N400 at the initial position. However, it should be kept in mind that the presence of N400 might not only reflect the animacy-difference but also the lexical difference between these two NP1s.

b. Verb: At this position, contrasting IO with AS allows for a comparison of lexically identical materials. The verb ("read") disambiguating either to an object- or a subject-initial order. By contrast, the comparison between IO and IS ensures that the ambiguous region ("novel") is kept constant across conditions. If the initial ambiguous NP is analysed as the subject of the sentence, a reanalysis effect should be observable for IO in comparison to both

control conditions (AS/IS). By contrast, if an inanimate argument leads processing system to assign it as an Undergoer, then no reanalysis effect for IO is observable here. Previous investigations of subject-object-ambiguities in other languages have revealed several ERP correlates of this type of reanalysis depending on the language and construction type under examination (e.g. early late positivities in Demiral et al. 2008 in Chapter 3; late positivity and N400 in Bornkessel et al. 2004b and N400-late positivity in Haupt et al. 2008 in Chapter 2; cf. Bornkessel & Schlesewsky 2006a for discussion). Hence, as this is the first ERP investigation of the subject-preference in simple sentences in Chinese, it is virtually impossible to predict a particular type of ERP effect for the verb position.

c. NP2: At this position, the comparison between IO and AS contrasts sentences with an identical meaning, whereas IO vs. IS involves a comparison across lexically identical materials. Here, we expect to observe an ERP response to a non-preferred word order (OVS), which should again be observable for IO in comparison to both control conditions (IS/AS). Previous findings suggest that the ill-formedness of the IO condition should be reflected in a late positive ERP effect (P600; e.g. Hagoort, Brown & Groothusen 1993; Osterhout & Holcomb 1992).

5.1.1 Methods

Participants. Twenty-eight monolingually raised native speakers of Chinese participated in the experiment after giving informed consent (15 females; mean age: 27.0 years; age range: 23-34 years). At the time of the experiment, all participants were residing in Berlin, Germany. Participants were right handed (as assessed by an adapted Chinese version of the Edinburgh handedness inventory; Oldfield 1971) and had normal or corrected-to-normal vision. Three participants were subsequently excluded from the final data analysis on the basis of excessive EEG artefacts and/or too many errors in the behavioural control task.

Materials. As shown in Table 5.1, three critical conditions were examined in this experiment. Each of the critical sentences contained two nouns and a verb in a string of NP1-verb-NP2 (Appendix 1). Within each of the three conditions, the total number of characters in each sentence was held constant: only two character nouns and verbs were used for all sentences. As Chinese lacks overt inflections to distinguish between a set of "words" and a "sentence", the aspect marker "了"(le) was included after the verb to ensure that the sequence NP1-verb-le-NP2 would be interpreted as a sentence expressing a completed event. 40 sets of the three conditions in Table 5.1 were constructed. In order to ensure that all individual verbs would be repeated equally often in the critical sentences, only 20 verbs were used in the inanimate subject-initial condition (IS) and repeated twice across the 40 sets, while 40 verbs were used to construct the IO and AS conditions. The 120 critical sentences (40 in each condition) were interspersed with 120 filler sentences, which included O/S-V-Adv structures such as (lit: 'Novel read for a while'; i.e. 'I/someone read the novel for a while') and (lit: 'Novel was popular for over half a year'; i.e. 'The novel was popular for over half a year'). Overall, the filler sentences ensured an equal probability of an initial inanimate noun being disambiguated as the subject or the object of the sentence. The 240 sentences in the experiment (120 critical sentences and 120 fillers) were presented to participants in two different randomised presentation orders.

Procedure. The experiment was conducted in a dimly lit, sound attenuated room. Participants were seated approximately 1.2 m in front of a 17-inch computer screen. The experiment began with a short training session followed by 6 experimental blocks, each of which contained 40 trials. Participants took short breaks between blocks. The whole experiment (including electrode preparation) lasted approximately 3 hours. The course of a trial is depicted in Figure 5.1.

As shown in Figure 5.1, sentences were presented visually in the centre of a computer screen in a word-by-word manner with a presentation time of 650 ms per word and an inter-stimulus interval (ISI) of 100 ms. Each trial began with the presentation of an asterisk (800 ms stimulus onset asynchrony; SOA) and ended with a 600 ms pause. Subsequently, participants were required to

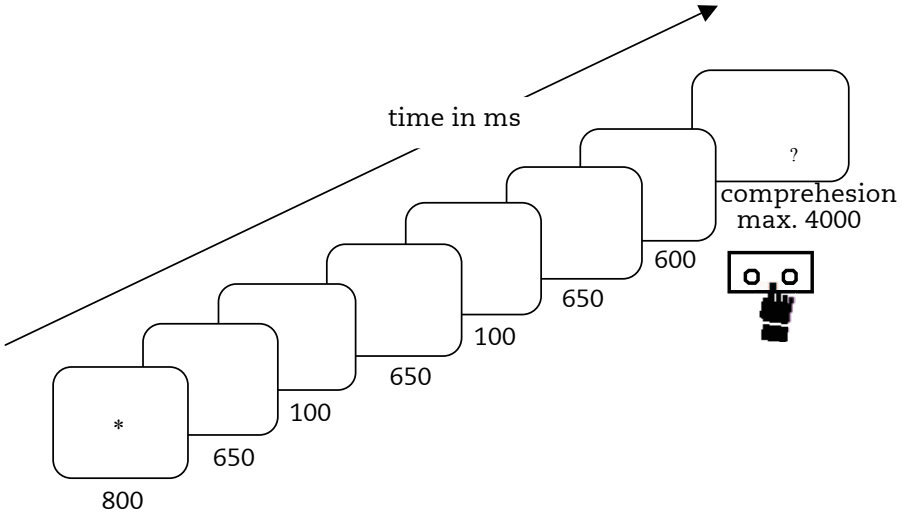


Figure 5.1: The course of a single trial in the comprehension questions session in Experiment 1. All time data is depicted in ms.

complete a comprehension task by answering a yes/no question based on the content of the preceding experimental sentence. Comprehension questions were constructed by rephrasing the preceding experimental sentence as a canonically ordered active sentence (SVO) or as a passive sentence (O *bèi* SV) with a question particle “ (ma)” at the end.

Comprehension questions were presented in both active and passive form in order to ensure that participants could not simply answer the question by means of a visual match between the experimental sentence and the question. Questions to be answered with “yes” (50% of all questions) were consistent with the proposition of the preceding sentence. Examples of correct active and passive questions are shown in (5.2b) and (5.2c), respectively. Questions to be answered with “no” were constructed in the same way but included a substituted subject, object, or verb (e.g. “magazine” instead of “book” or “read loudly” instead of “read”). Comprehension questions were presented on the screen as a whole and without spaces between the words.

(5.2) a. Sample experimental sentence for condition IO

xiǎoshuō yuèdú le yǎnyuán

novel read-ASP actor

* ‘The actor read the novel.’

b. Corresponding correct active question

演员	阅读了	小说	吗?
yǎnyuán	yuèdú le	xiǎoshuō	ma
actor	read-ASP	novel	QP

‘Did the actor read the novel?’

c. Corresponding correct passive question

小说	被	演员	阅读了	吗?
xiǎoshuō	bèi	yǎnyuán	yuèdú le	ma
novel	BEI	actor	read-ASP	QP

‘Was the novel read by the actor?’

The comprehension task required the answer “yes” equally as often as the answer “no” in each of the experimental conditions. The assignment of the left and right buttons to the answers yes and no for the comprehension task was counterbalanced across participants. Participants were asked to avoid movements and to only blink their eyes between their response to the comprehension task and the presentation of the next sentence.

EEG recording. The EEG was recorded via 25 AgAgCl-electrodes fixed at the scalp by means of an elastic cap (ElectroCap International, Eaton, OH). The ground electrode was positioned at AFZ. Recordings were referenced to the left mastoid, but re-referenced 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 5kΩ. All EEG and EOG channels were amplified using a Twente Medical Systems DC amplifier (Enschede, The Netherlands) and recorded with a digitisation rate of 250Hz. The EEG data were filtered with 0.3-20 Hz band pass off-line to exclude slow signal drifts.

Average ERPs were calculated per condition per participant from the onset of the critical stimulus items (i.e. the verb and NP2) 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, amplifiersaturation or other artefacts (the EOG rejection criterion was 40 mV). Less than 10% of all trials were excluded in this manner (8.6% for the position of NP1, 8.4% for the position of the verb and 9.7% for the position of NP2) and exclusion rates did not differ significantly across conditions.

Data analysis. For the behavioural data, the mean accuracy rates and reaction times were calculated for each condition. Incorrectly answered trials were excluded from the reaction time analysis. We computed a repeated measures analysis of variance (ANOVA) involving the within-participants factor CONDITION (IO vs. AS vs. IS) and the random factors participants (F_1) and items (F_2). In the case of a significant result, post-hoc pair-wise comparisons of the three levels of the factor CONDITION were computed. For these multiple comparisons, the critical alpha level was adjusted according to a modified Bonferroni procedure (Keppel 1991). In these cases, we report unadjusted p-values for all comparisons reaching significance at the corrected alpha level of .033 (with a corrected alpha level of .046 amounting to a marginally significant effect).

For the statistical analysis of the ERP data, repeated measures ANOVAs involving the factors CONDITION (IO vs. AS vs. IS at the positions of verb and NP2) and ANIMACY (IO/IS vs. AS at the position of NP1) were calculated for mean amplitude values per time window per condition. Analyses additionally involved the topographical factor 'region of interest' (ROI). Lateral regions of interest were defined as follows: left-anterior (F3, F7, FC1, FC5); left-posterior (CP1, CP5, P3, P7); right-anterior (F4, F8, FC2, FC6); and right-posterior (CP2, CP6, P4, P8). For midline sites, each electrode was defined as a ROI of its own: FZ, FCZ, CZ, CPZ, PZ, POZ. As for the behavioural data, significant effects of CONDITION were followed up by means of Bonferroni-adjusted pairwise comparisons between the critical conditions. Time windows were chosen on the basis of visual inspection of the data.

The statistical analysis was carried out in a hierarchical manner, i.e. only significant effects ($p < .05$) were resolved. To avoid excessive type 1 errors due to violations of sphericity, we applied the correction of Huynh and Feldt (1970) when the analysis involved factors with more than one degree of freedom in the numerator.

5.1.2 Results

Behavioural data. Table 5.2 shows the mean accuracy rates and reaction times for the three critical conditions. Standard deviations are given in parentheses. As is apparent from the table, participants were generally very accurate in interpreting the sentences, with all conditions showing an accuracy of over 90%.

Table 5.2: Mean accuracy rates and reaction times for the comprehension tasks in Experiment 1. Standard deviations are given in parentheses.

Condition	*Accuracy (%)*	*RT (ms)*
a. IO	92.0 (12.8)	1266.9 (292.5)
b. AS	97.9 (2.2)	1252.1 (267.5)
c. IS	96.6 (2.9)	1338.0 (296.0)

The results in Table 5.2 suggest that participants were less likely to interpret the OVS order in condition IO correctly in comparison to the subject-initial control conditions (AS/IS). This descriptive impression was confirmed by the statistical analysis of the accuracy rates. Here, a repeated measures ANOVA revealed a main effect of CONDITION, F_1 (2, 48) = 4.02, p <. 03; F_2 (2, 78) = 6.07, p <. 01. Subsequent pair-wise comparisons revealed a significant difference (marginal in the analysis by participants) between IO and AS, F_1 (1, 24) = 4.54, p <. 05; F_2 (1, 39) = 15.80, p <. 001, and a marginally significant difference between IO and IS only in the analysis by items, F_1 (1, 24) = 3.34, p <. 09; F_2 (1, 39) = 4.27, p <. 05. The two subject-initial conditions (AS/IS) also differed marginally from one another in the analysis by participants, F_1 (1, 24) = 4.81, p < .04; F_2 < 1.

For the reaction times, the analysis revealed a main effect of CONDITION, F_1 (2, 48) = 11.28, p < .001; F_2 (2, 78) = 6.31, p < .01. Pair-wise comparisons showed a significant difference between IO and IS, F_1 (1, 24) = 8.32, p < .01; F_2 (1, 39) = 6.02, p < .02, and AS and IS, F_1 (1, 24) = 40.23, p < .001; F_2 (1, 39) = 9.74, p < .01, but not between IO and AS, F_1 < 1; F_2 (1, 39) = 1.23, p <. 27. Thus, reaction times were higher for the condition with an inanimate initial subject (IS) in comparison to the other two conditions.

In summary, though performance accuracy was generally very high, participants were most likely to assign a correct interpretation to sentences in condition AS and least likely to interpret sentences in condition IO correctly. Accuracy rates for condition IS were intermediary between those for the other two conditions, with the additional difficulty in this condition likely stemming from the presence of an inanimate subject/Actor. This assumption is supported by the reaction times, which were longer for condition IS in comparison to both AS and IO.

ERP data. In the analysis of the ERP data, the two positions of interest in our critical sentences – namely the verb and the second NP – were considered in turn.

NP1. Grand average ERPs at the position of the verb are shown in Figure 5.2.

Visual inspection of Figure 5.2 suggested a sign of N400 effect for the inanimate-initial conditions (IO/IS) compared with animate-initial condition (AS) in approximately 250-400 ms. However, the statistical analysis of this time window revealed that the effect of ANIMACY did not reach significance for both lateral and midline electrode sites (both *F*s < 1).

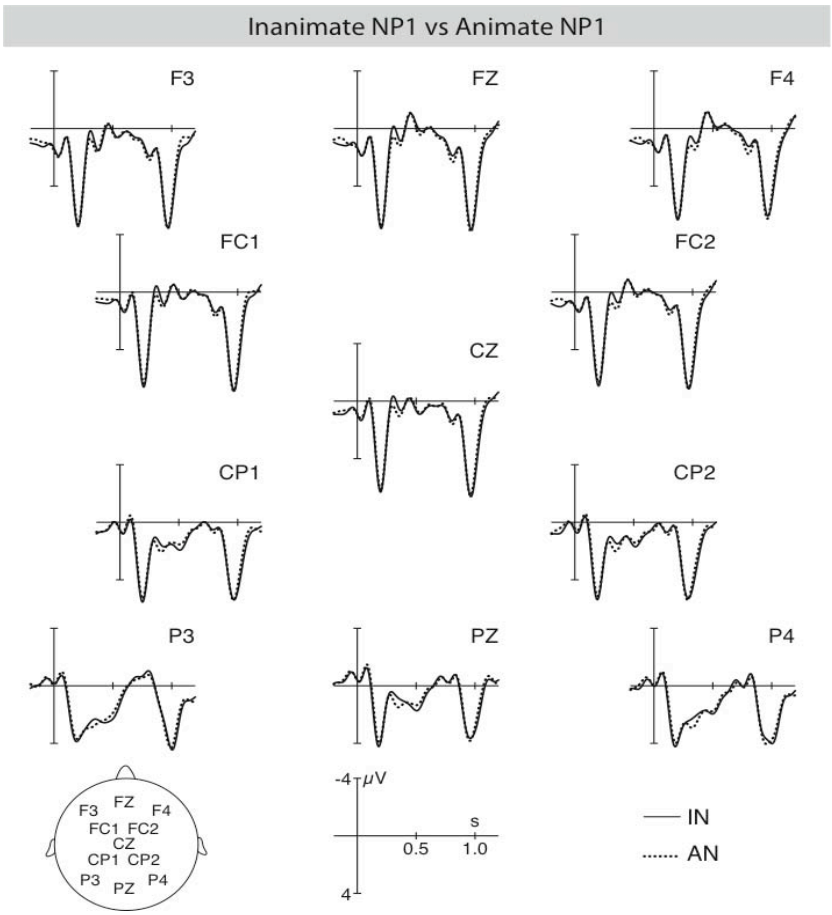


Figure 5.2: Grand average ERPs (n=25) time-locked to NP1 (onset at the vertical bar) in the three critical conditions in Experiment 1. A comparison of the inanimate-initial conditions (IO and IS) and the animate-initial (AS) control. Negativity is plotted upwards.

Verb. Grand average ERPs at the position of the verb are shown in Figure 5.3.

As is apparent from Figure 5.3, the ERPs at the position of the verb revealed no signs of reanalysis-related processing difficulty for the object-initial condition (IO). There was, however, a centro-parietal negativity between approximately 300 and 550 ms (N400) for both subject-initial control conditions (IS/AS) in comparison to IO (Figure 5.3A: AS vs. IO; Figure 5.3B: IS vs. IO). The time window 300-550 ms was therefore chosen for the statistical analysis of the verb.

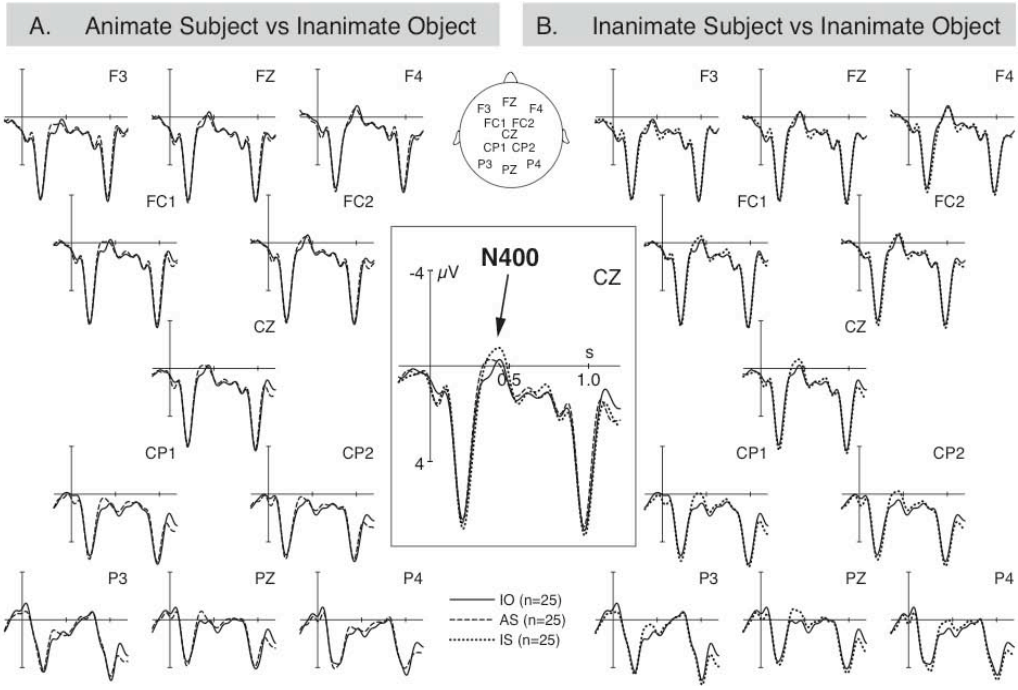


Figure 5.3: Grand average ERPs (n=25) time-locked to the verb (onset at the vertical bar) in the three critical conditions in Experiment 1. Pair-wise comparisons of the critical object-initial condition (IO) and the animate (AS) and inanimate subject-initial (IS) controls are shown in Panels A and B, respectively. The enlarged centre panel shows a direct comparison of all three conditions at one electrode. Negativity is plotted upwards.

In this time window (300-550 ms), a repeated measures ANOVA revealed interactions of CONDITION x ROI for both lateral, F (3, 72) = 9.03, p < .001, and midline, F (5, 120) = 6.16, p < .001, electrode sites. Resolving these interactions by ROI showed significant effects of CONDITION in both posterior regions for the lateral electrodes: left, F (1, 24) = 4.18, p < .03; right, F (1, 24) = 5.66, p <.01, and at the midline electrodes CPZ, F (1, 24) = 4.37, p <.03, PZ, F (1, 24) = 5.88, p <.01, and POZ, F (1, 24) = 7.50, p <.01.

Subsequent pair-wise comparisons within the ROIs showing an effect of CONDITION revealed a significant difference between IS and IO within all of these regions, all Fs (1, 24) = 7.40, all ps < .02, due to a larger N400 in the IS condition. By contrast, the comparison between AS and IO did not reach significance in any region. Finally, IS also showed a slightly larger N400 in

comparison to AS, as reflected in a marginally significant difference between the two conditions in the right-posterior region, F (1, 24) = 4.34, p < .05, and a significant difference at POZ, F (1, 24) = 6.07, p < .03. While the N400 effect for AS vs. IO did not reach significance within the time window from 300 to 550 ms, visual inspection of Figure 5.2 suggests that effect was confined to a smaller time window. This impression was confirmed by a subsequent analysis in a time window between 300 and 400 ms. In this time window, AS differed significantly from IO in all of the regions that showed a main effect of condition within the overall time window, all Fs (1, 24) =5.20, all ps < .03.

To summarise, at the position of the verb, both subject-initial control conditions (IS/AS) showed an N400 in comparison to the critical object-initial condition (IO). This effect was somewhat more pronounced in the IS as opposed to the AS condition.

NP2. Figure 5.4 shows grand average ERPs at the position of NP2.

Figure 5.4 shows that, in contrast to the pattern of results observed at the verb, ERPs timelocked to the onset of NP2 are indicative of increased processing costs in condition IO. At this position, IO engendered a biphasic N400-late positivity pattern in comparison to both control conditions (Figure 5.4A: IO vs. AS; Figure 5.4B: IO vs. IS). Two time-windows were chosen for the statistical analysis of the ERP data at NP2: 300-450 ms for the N400 and 550-750 ms for the late positivity.

In the earlier time window (300-450 ms), the statistical analysis revealed interactions CONDITION x ROI: lateral, F (3, 72) = 4.09, p < .01; midline, F (5, 120) = 3.90, p < .01. Separate analyses per ROI showed significant effects of CONDITION in the left-posterior region, F(1, 24) = 7.89, p< .01, and at PZ, F(1, 24) = 4.95, p < .02. In addition, the effect of CONDITION reached marginal significance in the right-posterior region, F (1, 24) = 3.29, p < .06) as well as at CPZ, F (1, 24) = 3.18, p < .07, and POZ, F (1, 24) = 3.41, p < .06.

Pair-wise comparisons in the ROIs showing an effect of CONDITION revealed a significant difference between IO and IS in all of these regions (all Fs > 5.60, all ps < .03), while the difference between IO and AS only reached significance in the left-posterior region (F (1, 24) = 6.80, p < .02). In all cases, the effects were due to a negativity in condition IO as compared to IS/AS. By

contrast, the two subject-initial conditions (IS/AS) did not differ from one another in any region.

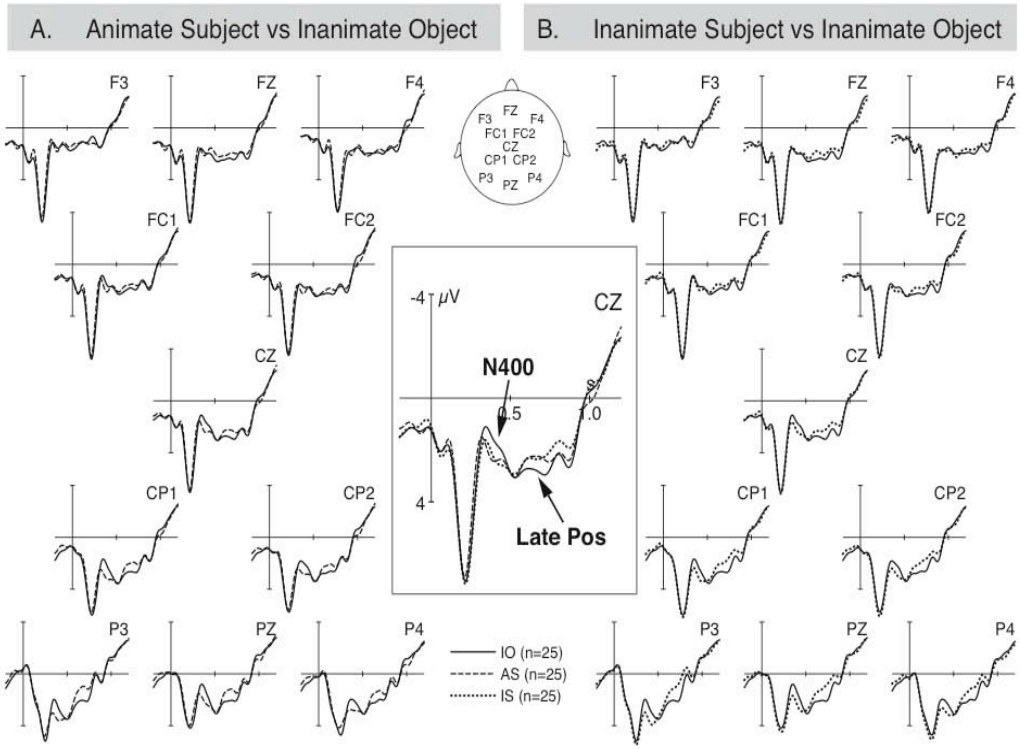


Figure 5.4: Grand average ERPs (n=25) time-locked to NP2 (onset at the vertical bar) in the three critical conditions in Experiment 1. Pair-wise comparisons of the critical object-initial condition (IO) and the animate (AS) and inanimate subject-initial (IS) controls are shown in Panels A and B, respectively. The enlarged centre panel shows a direct comparison of all three conditions at one electrode. Negativity is plotted upwards.

The analysis of the later time window (550-750 ms) showed the following results. For the lateral electrodes, we observed an interaction CONDITION x ROI, F (3, 72) = 4.42, p < .001, which resulted from significant effects of CONDITION in the two posterior regions: left, F (1, 24) = 9.40, p < .001; right, F (1, 24) = 4.46, p < .02. Pair-wise comparisons between individual conditions within these regions revealed a significant difference between IO and IS in both ROIs: left, F (1, 24) = 18.26, p < .001; right, F (1, 24) = 10.98, p < .01), while the difference between IO and AS only reached significance in the left-

posterior region, F (1, 24) = 12.80, $p < .01$. In all cases, effects were due to a positivity for IO in comparison to IS/AS. The two subject-initial conditions (IS/AS) did not differ from one another in any region.

The analysis of the midline electrodes showed a main effect of CONDITION, F (2, 48) = 3.54, $p < .04$. Subsequent pair-wise comparisons only revealed a difference between conditions IO and IS, F (1, 24) = 8.39, $p < .01$, which was due to more positive-going ERPs for condition IO.

In summary, the analysis of the ERPs at the position of NP2 showed a biphasic N400 late positivity pattern for IO in comparison to both subject-initial control conditions (IS/AS). These effects, both of which showed a clear posterior maximum, were somewhat more pronounced in the comparison with the lexically identical control condition IS.

5.1.3 Relatedness Questionnaire Study

The most surprising result of Experiment 1 was that both subject-initial control conditions (AS/IS) engendered N400 effects in comparison to the critical object-initial condition (IO) at the position of the verb. This finding might be attributable to differences in lexical-semantic relatedness between NP1 and the verb (for a review, cf. Kutas & Federmeier 2000). That is, the verb "read" in condition IO is closely related to the meaning of the first NP "novel", while the verbs "read" in AS and "educated" in IS are less expected from the meaning of the first NP. To examine whether our critical conditions indeed differed in terms of lexical-semantic relatedness, we conducted an additional questionnaire study.

Participants. Twenty-four native speakers of Chinese residing in mainland China at the time of the study took part in the questionnaire study (15 females; mean age: 28.2 years; age range: 18-52 years). None of them had ever lived outside of China.

Materials. The 120 critical NP1-verb pairs used in our ERP study were randomly interspersed with 240 filler pairs. Fillers were constructed so as to display varying degrees of relatedness.

Procedure. Participants judged the relatedness of the word pairs on a 4-point scale (1 = "closely related"; 4 = "not at all related").

Results. The mean relatedness ratings obtained in the questionnaire study are shown in Table 5.3.

Table 5.3: Mean relatedness ratings between NP1 and the verb for the critical conditions in Experiment 1. Standard deviations are given in parentheses.

Condition	*Accuracy (%)*
a. IO	1.26 (0.27)
b. AS	2.82 (0.50)
c. IS	2.72 (0.49)

The ratings in Table 5.3 suggest that the NP1-verb pairs in the object-initial condition (IO) were judged to be more closely related to each other than those in the subject-initial conditions (AS/IS). This impression was confirmed by the statistical analysis, which revealed a significant main effect of CONDITION, F_1 (2, 46) =168.23, $p < .001$; F_2 (2, 78) = 71.44, $p < .001$. Subsequent pair-wise comparisons showed significant differences between the object-initial condition and both subject-initial conditions: IO vs. AS, F_1 (1, 23) = 246.63, $p < .001$; F_2 (2, 78) = 197.21, $p < .001$; IO vs. IS, F_1 (1, 23) = 191.76, $p < .001$; F_2 (2, 78) = 112.02, $p < .001$. By contrast, the two subject-initial conditions did not differ significantly in relatedness: AS vs. IS, F_1 (1, 23) = 1.612, $p < .2$; $F_2 < 1$.

In summary, the findings of the questionnaire suggest that the lexical-semantic relatedness between NP1 and the verb was indeed higher in the IO condition than in conditions AS and IS.

5.1.4 Discussion

Experiment 1 investigated whether Chinese shows a subject-preference (i.e. a preference for an S/A reading of an initial argument) in simple sentences. To examine this question, we compared the processing of OVS and SVO orders in a visual ERP study. At the position of NP1, the comparison between inanimate initial conditions (IO/IS) and animate condition (AS) did not reveal a significant

effect of animacy. At the position of the verb, which disambiguated the initial argument to an object reading in the critical object-initial condition, we observed no signs of reanalysis-related processing difficulty for this condition. Rather, both subject-initial controls showed an N400 in comparison to the critical object-initial condition at this position. At the post-verbal NP, by contrast, the object-initial condition showed a biphasic N400-late positivity pattern in comparison to both controls. This finding, which is corroborated by higher error rates for the OVS condition on the behavioural task, suggests that the non-preferred OVS order engendered higher processing costs when the post-verbal subject was encountered. In the following, we will discuss the effects observed at the position of the verb and at the position of NP2 in turn, leaving the discussion of the non-significant effect at the position of NP1 until after Experiment 2.

At the position of the verb, we observed a graded N400 response, with the inanimate subject-initial control condition (IS) showing the largest N400 and the critical object-initial condition (IO) showing the smallest N400. The animate subject-initial condition (AS) elicited an intermediary N400 response. Most generally, the results of the relatedness questionnaire study suggest that the finding of an N400 effect for the subject-initial conditions in comparison to the object-initial condition can be accounted for in terms of differences in the lexical-semantic relatedness between NP1 and the verb. Whereas these two constituents were closely related/associated in the IO condition, they were judged to be significantly less closely related in the AS/IS conditions. However, as the two subject-initial conditions did not differ in the questionnaire study, the overall pattern of results at the position of the verb in which condition IS also engendered a more pronounced N400 than condition AS cannot be accounted for in terms of relatedness alone. Perhaps, the additional N400 difference between IS and AS is due to differences in the lexical frequency of the verbs used in the two conditions: a preliminary analysis of the individual verb frequencies in the Modern Chinese Frequency Dictionary (1986) suggests that the verbs in condition IS were indeed somewhat less frequent than the verbs in conditions AS/IO. However, this analysis is not fully conclusive as a number of the verbs that were used in our materials were not listed in the dictionary (IS: 5 verbs; AS/IO: 14 verbs). Nonetheless, the findings at the position of the verb appear to be parsimoniously accounted for in terms of

lexical differences. Hence, it is not clear whether a possible subject-preference might have been obscured by these potentially confounding factors.

In contrast to the somewhat inconclusive findings for the verb position, the effects observed at the position of NP2 attest to the fact that an object-verb-subject order is clearly non-preferred in Chinese. Thus, the critical IO condition engendered an N400-late positivity response in comparison to both control conditions. However, based on the findings of Experiment 1 alone, it is difficult to go beyond the rather global interpretation that condition IO engendered increased processing costs relative to AS/IS, as a more precise functional interpretation of the ERP pattern at NP2 crucially depends on the question of which processing choices were undertaken at the position of the verb. This requires a clarification of the relative role of lexical factors in engendering the graded N400 pattern observed in the present study.

In order to disentangle the relative contribution of lexical and non-lexical factors in eliciting the ERP pattern observed in Experiment 1, we conducted a second ERP experiment that controlled for the relatedness between NP1 and the verb across conditions.

5.2 Experiment 2: A comparison of OV vs. SV orders without differences in lexical-semantic relatedness between the preverbal NP and V across conditions

Experiment 2 aimed to examine whether the results of Experiment 1 could be replicated when the degree of relatedness between NP1 and the verb is controlled for. To this end, we constructed new experimental materials by replacing the verbs used in conditions IO/AS in Experiment 1 with verbs showing a "looser" semantic relationship with their objects (i.e. with NP1 in condition IO). The critical conditions thus resulting are exemplified in Table 5.4.

Table 5.4: Examples for each of the three conditions in Experiment 2. Conditions are abbreviated as for Experiment 1. Note that the materials only

differed from those of Experiment 1 in the use of different verbs for conditions IO and AS. Condition IS was identical to Experiment 1.

Condition	*NP1*	*Verb*	*NP2*	*Translation*
a. IO	*小说	理解了	演员	*novel understand-ASP actor
	xiǎoshuō	lǐjiěle	yǎnyuán	'The actor understood the novel.'
b. AS	演员	理解了	小说	actor understand-ASP novel
	yǎnyuán	lǐjiěle	xiǎoshuō	'The actor understood the novel.'
c. IS	小说	教育了	演员	novel educate-ASP actor
	xiǎoshuō	jiàoyùle	yǎnyuán	'The novel educated the actor.'

By examining sentences of the type in Table 5.4, Experiment 2 explored whether a reanalysis-related effect can be observed at the verb position for the critical object-initial condition (IO) when differences in lexical-semantic relatedness between the first NP and the verb are ruled out. Furthermore, we aimed to replicate the N400-late positivity pattern for IO vs. IS/AS at the position of the post-verbal NP.

5.2.1 Relatedness Pre-test

In order to ensure that the relatedness between NP1 and the verb was indeed equated across conditions in Experiment 2, we conducted a second relatedness questionnaire study for the new materials.

Participants. Twenty-four native speakers of Chinese residing in Germany took part in the questionnaire study (14 females; mean age: 23.7 years; age range: 20-31 years). Participants were students of the Universities of Leipzig and Marburg and the vast majority of them (19) had only been in Germany for approximately one month.

Materials. The 120 critical NP1-verb pairs used in Experiment 2 were randomly interspersed with 280 filler pairs. The fillers were constructed so as to display varying degrees of relatedness.

Procedure. As for the first questionnaire study, participants judged the relatedness of the word pairs on a 4-point scale (1 = "closely related"; 4 = "not at all related").

Results. The mean relatedness ratings obtained for the materials of Experiment 2 are shown in Table 5.5.

Table 5.5: Mean relatedness ratings between NP1 and the verb for the critical conditions in Experiment 2. Standard deviations are given in parentheses.

Condition	*Rating (SD)*
a. IO	2.53 (0.49)
b. AS	2.43 (0.55)
c. IS	2.70 (0.57)

From Table 5.5, it is apparent that the relatedness between NP1 and the verb was very similar across conditions in the new materials. This impression was confirmed by the statistical analysis, which revealed that the object-initial condition IO did not differ from the two subject-initial conditions (AS/IS). By contrast, the relatedness ratings for the two subject-initial conditions proved to differ marginally. Specifically, the statistical analysis revealed that the main effect of CONDITION only reached significance in the analysis by participants, F_1 (2, 46) = 3.60, p < .04; F_2 (2, 78) = 1.93, p < .15. Subsequent pair-wise comparisons showed that condition IO did not differ from the two subject-initial conditions: IO vs. AS, F_1 (1, 23) = 1.25, p < .27; F_2 (1, 39) < 1; IO vs. IS, F_1 (1, 23) = 3.19, p < .09; F_2 (1, 39) = 1.23, p < .27. However, the relatedness ratings for IS were lower than those for AS, though this difference was only marginal in the analysis by items, F_1 (1, 23) = 5.35, p < .03; F_2 (1, 39) = 3.24, p <.08.

In summary, the relatedness questionnaire study revealed that, with the materials used in Experiment 2, condition IO was comparable to the two subject-initial conditions (AS/IS) in terms of lexical-semantic relatedness.

5.2.2 Methods

Participants. Twenty-eight monolingually raised native speakers of Chinese (Beijing dialect) participated in the experiment after giving informed consent (14 females; mean age: 26.1 years; age range: 20-34 years). None had participated in Experiment 1. At the time of the experiment, all participants were residing in Leipzig, Germany. Participants were right handed (as assessed by an adapted Chinese version of the Edinburgh handedness inventory; Oldfield 1971) and had normal or corrected-to-normal vision. Six participants were subsequently excluded from the final data analysis on the basis of excessive EEG artefacts and/or too many errors in the behavioural control task.

Materials. The materials for Experiment 2 were identical to those used in Experiment 1, with the exception that the verbs in conditions IO and AS were replaced (Appendix 1). Thus, there were again 120 critical sentences, which were interspersed with 140 fillers. As for Experiment 1, the verbs in condition IS were again somewhat less frequent than the verbs in conditions AS/IO (IS: 0.00639, IO/AS: 0.02035) according to the Modern Chinese Frequency Dictionary (1986). However, the frequency analysis was again not fully conclusive as a number of the verbs that were used in our materials were not listed in the dictionary (IS: 5 verbs; AS/IO: 3 verbs).

Procedure. The experimental procedure, task, and EEG recording parameters were identical to Experiment 1 with the exception that the EEG was amplified by a Neuroscan synamps amplifier (DC-50 Hz) in this experiment.

Data analysis. The behavioural data and the ERP data were analysed as for Experiment 1. Similar with Experiment 1, less than 11% of all trials were excluded from the ERP analysis due to artefacts or errors in the behavioural task (9.8% for NP1, 9.0% for the position of the verb and 10.8% for the position of NP2) and exclusion rates did not differ significantly across conditions.

5.2.3 Results

Behavioural data. Table 5.6 shows the mean accuracy rates and reaction times for the three critical conditions. Standard deviations are given in parentheses.

Table 5.6: Mean accuracy rates and reaction times for the comprehension tasks in Experiment 2. Standard deviations are given in parentheses.

Condition	*Accuracy (%)*	*RT (ms)*
a. IO	95.0 (3.5)	1495.5 (277.7)
b. AS	97.2 (3.8)	1444.3 (257.9)
c. IS	94.5 (5.3)	1521.4 (294.6)

As in Experiment 1, participants' performance on the comprehension task was very accurate, thus indicating that they processed the sentences attentively and understood them. The statistical analysis of the accuracy rates revealed that the main effect of CONDITION only reached significance in the analysis by participants, F_1 (2, 42) = 3.22, $p < .05$; F_2 (2, 78) = 1.31, $p < .27$. Subsequent pair-wise comparisons showed a marginally significant difference between IO and AS in the analysis by participants only, F_1 (1, 21) = 4.63, $p < .05$; F_2 (1, 39) = 1.28, $p < .26$, while the difference between IS and AS was significant by participants and marginal by items, F_1 (1, 21) = 7.79, $p < .02$; F_2 (1, 39) = 4.14, $p < .05$. There was no difference between conditions IO and IS ($F_1 < 1$; $F_2 < 1$). Thus, participants were more accurate in answering the comprehension task for the animate subject-initial condition AS as opposed to the other two conditions (IO/IS).

For the reaction times, the analysis revealed a main effect of CONDITION, which again only reached significance in the analysis by participants, F_1 (2, 42) = 5.39, $p < .01$; F_2 (2, 78) = 2.56, $p < .09$. Pair-wise comparisons showed a significant difference between the two subject-initial control conditions IS and AS, F_1 (1, 21) = 10.71, $p < .01$; F_2 (1, 39) = 4.55, $p < .04$, whereas the difference between IO and AS only reached significance in the analysis by participants, F_1 (1, 21) = 5.63, $p < .03$; F_2 (1, 39) = 2.67, $p > .11$. There was no difference between IO and IS ($F_1 < 1$; $F_2 < 1$). The reaction times thus showed a very similar pattern

to the accuracy rates in that conditions IO and IS engendered slower responses in comparison to condition AS.

ERP data. In the analysis of the ERP data, the two positions of interest in our critical sentences – namely the verb and the second NP – were considered in turn. Statistical analyses were computed in identical time windows to those used in Experiment 1.

NP1. Grand average ERPs at the position of NP1 are shown in Figure 5.5.

Visual inspection of Figure 5.5 suggests a seeming animacy-related N400 for IO/IS as opposed to AS in approximately 250-400 ms as in Experiment 1. However, unlike Experiment 1, a repeated measures ANOVA revealed the effect of ANIMACY reached significance for both later lateral, F (1, 21) = 9.31, p < .007, and midline, F (1, 21) = 9.15, p < .007, electrode sites.

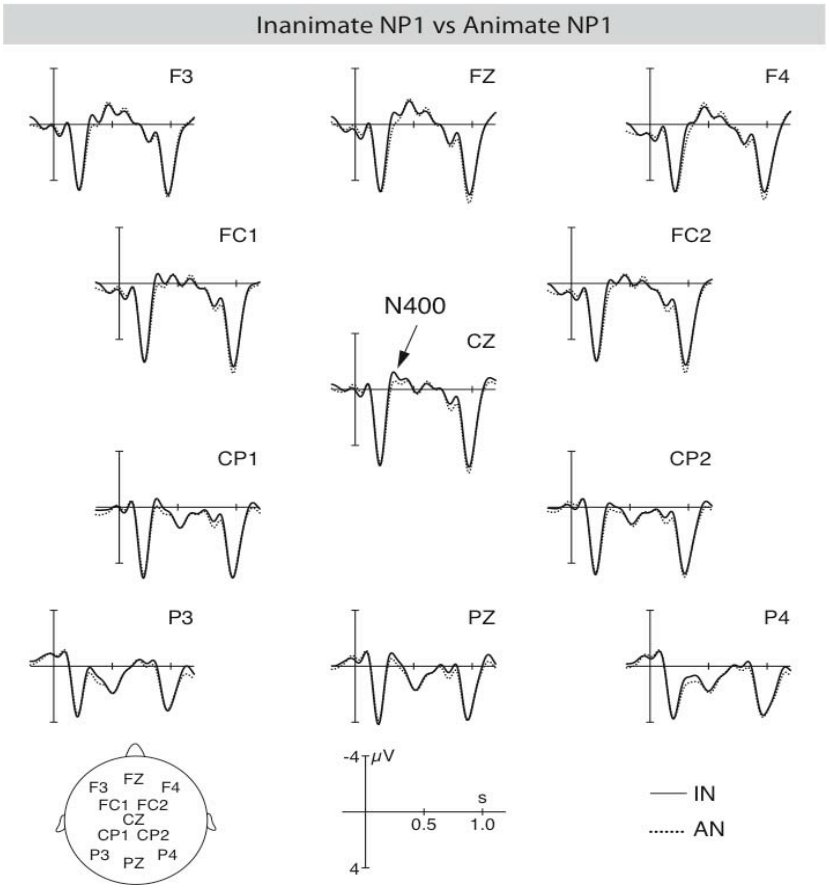


Figure 5.5: Grand average ERPs (n=25) time-locked to NP1 (onset at the vertical bar) in the three critical conditions in Experiment 2. A comparison of the inanimate-initial conditions (IO and IS) and the animate-initial (AS) control. Negativity is plotted upwards.

Verb. Grand average ERPs at the position of the verb are shown in Figure 5.6.

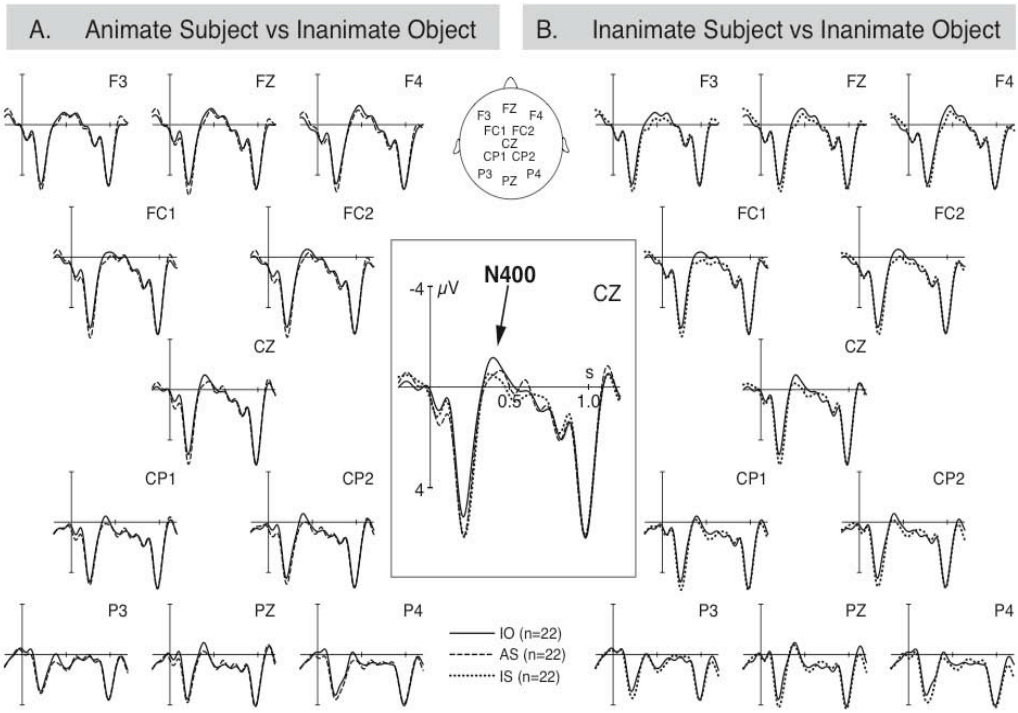


Figure 5.6: Grand average ERPs (n=22) time-locked to the verb (onset at the vertical bar) in the three critical conditions in Experiment 2. Pair-wise comparisons of the critical object-initial condition (IO) and the animate (AS) and inanimate subject-initial (IS) controls are shown in Panels A and B, respectively. The enlarged centre panel shows a direct comparison of all three conditions at one electrode. Negativity is plotted upwards.

As is apparent from Figure 5.6, condition IO engendered an N400 in comparison to both subject-initial control conditions. In addition, visual inspection suggests that the animate subject-initial condition AS also elicited a small negativity as opposed to the inanimate subject-initial condition IS.

In the 300-550 ms time window, a repeated measures ANOVA revealed interactions of CONDITION x ROI for the lateral, F (3, 63) = 3.22, $p < .02$, and midline electrodes, F (5, 105) = 3.29, $p < .02$. Resolving these interactions by region showed significant effects of CONDITION in both anterior ROIs: left-anterior, F (1, 21) = 5.65, $p < .01$; right-anterior, F (1, 21) = 4.19, $p < .03$, and a marginal effect of CONDITION in the right-posterior region, F (1, 21) = 2.91, $p < .07$. For midline sites, we observed significant effects of CONDITION at FZ, F (1, 21) = 3.72, $p < .04$, and FCZ, F (1, 21) = 4.37, $p < .03$. Subsequent pair-wise comparisons within the ROIs showing an effect of CONDITION revealed a significant difference between IO and IS within both anterior ROIs: left-anterior, F (1, 21) = 11.03, $p < .01$; right-anterior: F (1, 21) = 6.85, $p < .02$; and at the midline electrodes: FZ, F (1, 21) = 6.21, $p < .03$), FCZ, F (1, 21) = 10.55, $p < .01$, and CZ, F (1, 21) = 6.51, $p < .02$. By contrast, the difference between IO and AS only reached significance in the right-posterior region, F (1, 21) = 7.29, $p < .02$. Finally, we observed a marginally significant difference between IS and AS in the left-anterior ROI, F (1, 21) = 5.35, $p < .04$.

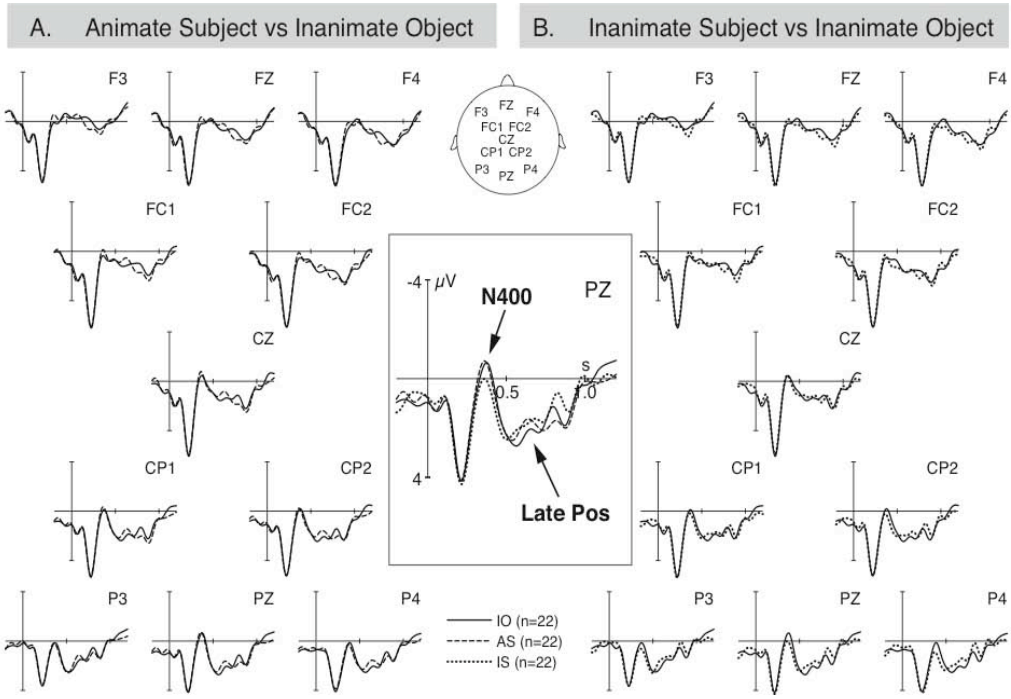
To summarise, at the position of the verb, the inanimate object-initial condition (IO) engendered significantly more negative ERP deflections than both subject-initial control conditions. Whereas the negativity for IO vs. AS showed a classic N400 distribution (right-posterior), the effect for IO vs. IS was more frontally distributed. In addition, condition AS also showed a marginally significant negativity in comparison to IS in the left-anterior region.

NP2. Figure 5.7 shows grand average ERPs at the position of NP2.

Visual inspection of Figure 5.7 suggests that the biphasic N400-late positivity pattern observed for IO in Experiment 1 was replicated in Experiment 2. However, while the late positivity was again observable in comparison to both subject-initial control conditions (AS/IS), condition IO did not differ from condition AS with respect to the N400 in this experiment. Rather, it appears as though both IO and AS engendered an increased N400 in comparison to IS. Furthermore, it appears that condition IS engendered a very late negativity in comparison to IO and AS.

In the N400 time window (300-450 ms), the statistical analysis revealed interactions CONDITION x ROI for lateral, F (3, 63) = 4.80, $p < .01$, and midline, F (5, 105) = 3.41, $p < .02$, sites. Resolving these interactions by ROI showed

significant effects of CONDITION in the right-posterior ROI, F (1, 21) = 6.26, p <



.01, as well as at the midline electrodes PZ, F (1, 21) = 5.27, p < .04, and POZ, F

Figure 5.7: Grand average ERPs (n=22) time-locked to NP2 (onset at the vertical bar) in the three critical conditions in Experiment 2. Pair-wise comparisons of the critical object-initial condition (IO) and the animate (AS) and inanimate subject-initial (IS) controls are shown in Panels A and B, respectively. The enlarged centre panel shows a direct comparison of all three conditions at one electrode. Negativity is plotted upwards.

(1, 21) = 4.38, p < .02. Pair-wise comparisons in the ROIs showing an effect of CONDITION revealed a significant difference between IO and IS in the right-posterior ROI and at POZ (Fs > 6.19, ps < .03) and a marginal difference between these conditions at PZ, F (1, 21) = 5.27, p < .04. In all cases, IO showed a negativity in comparison to IS. The two subjectinitial conditions (IS/AS) only differed from one another in right-posterior electrodes, F (1, 21) = 8.20, p < .01, with AS more negative than IS. Finally, there was no difference between IO and AS in any region.

The analysis of the late positivity time window (550-750 ms) showed the following results. We observed an interaction CONDITION x ROI for lateral, F (3, 63) = 3.18, $p < .02$, and midline electrodes. For the lateral electrodes, the interaction was due to a marginally significant effect of CONDITION in the right-posterior region, F (1, 21) = 3.23, $p < .08$. With respect to the midline electrodes, we observed a marginal effect of CONDITION at the electrode POZ, F (1, 21) = 2.78, $p < .08$. Pair-wise comparisons between individual conditions within these regions revealed a significant difference between IO and IS in all regions, all Fs (1, 21) > 5.74, ps < .03, while the difference between IO and AS only reached marginal significance in the right-posterior region, F (1, 21) = 4.34, $p < .05$. In all cases, effects were due to a positivity for IO in comparison to IS/AS. The two subject-initial conditions (IS/AS) did not differ from one another in any region.

Finally, for the analysis of the very late negativity, we chose a time window from 750-900 ms. In this time window, the statistical analysis revealed interactions of CONDITION x ROI for both lateral, F (3, 63) = 3.62, $p < .01$, and midline, F (5, 105) = 4.04, $p < .02$, electrode sites. Resolving these interactions by ROI showed significant effects of CONDITION in the right posterior region, F (1, 21) = 5.22, $p < .01$, and at the midline electrodes PZ, F (1, 21) = 5.19, $p < .01$, and POZ, F (1, 21) = 5.41, $p < .01$. In addition, we observed a marginally significant effect of CONDITION at CPZ, F (1, 21) = 2.85, $p < .07$. Pair-wise comparisons in the ROIs showing an effect of CONDITION revealed a significant difference between AS and IS in all of these regions (all Fs > 6.15, $p < .03$). The difference between IO and IS reached significance at POZ, F (1, 21) = 4.92, $p < .04$, and marginal significance in the right-posterior region, F (1, 21) = 3.92, $p < .07$, while AS and IO did not differ from one another in any region.

In summary, the comparison of IO and IS replicated the findings of Experiment 1, in that IO showed an N400-late positivity pattern in comparison to IS. In comparison to condition AS, by contrast, IO only elicited a late positivity in Experiment 2. In addition to the biphasic pattern that was expected from Experiment 1, Experiment 2 revealed a late posterior negativity for condition IS as opposed to IO and AS.

5.2.4 Discussion

At the position of NP1, we observed an N400 for the inanimate-initial conditions (IO/IS) as opposed to animate condition (AS) in Experiment 2 while this effect was not significant in Experiment 1. As the NP1s in Experiment 2 were identical with those in Experiment 1, these results seem conflicting and we are thus not allowed to draw any decisive conclusions on the influence of animacy in the processing of an initial ambiguous argument. However, we are at least justified to say that the animacy-related N400 at the position of NP1 was not reliable compared to ERP effects observed at the positions of the verb and NP2 across both experiments. The unreliability of this animacy-related N400 could be due to the fact that we were comparing a single argument of the sentence, while a number of studies reported a reliable animacy effect at the second argument (cf. Section 3.2.2 in Chapter 3). It could also be due to the fact that we were comparing different lexical items at this position (e.g. “novel” in IO/IS vs. “actor” in AS). For the reasons above, we will continue to explore the influence of animacy on processing word order in the following experiments. In accordance with the aim of the present two experiments (i.e. whether a preference for an S/A reading of an ambiguous argument can be observed in Chinese), below, we would rather focus on discussing the main effects observed at the positions of disambiguating verb and NP2.

At the position of the verb, which disambiguated our critical conditions to a subject- or an object-initial order, Experiment 2 revealed an N400 for the object-initial condition (IO) in comparison to both subject-initial control conditions (AS/IS). The difference between IO and AS is particularly revealing as these two conditions employed identical verbs, thereby ruling out lexical differences as a possible source of the effect. We therefore interpret the finding of an N400 for IO vs. AS as a correlate of a reanalysis to an object-initial reading. This effect, which was obscured by differences in the relatedness between NP1 and the verb in Experiment 1, suggests that Chinese shows a subject-preference (i.e. a preference for an S/A reading of the first argument) in simple sentences.

At the position of NP2, we replicated the basic N400-late positivity pattern for condition IO that had already been observed in Experiment 1. However, in contrast to Experiment 1, the biphasic pattern was only fully reliable for the

comparison between IO and IS, whereas IO and AS only differed with respect to the late positivity. Thus, both IO and AS engendered an N400 in comparison to IS in Experiment 2. Yet a closer consideration of the statistical analysis reveals that the N400 for AS vs. IS was somewhat less pronounced than that for IO vs. IS, as the latter comparison reached significance in more regions and showed higher *F*-values. Hence, the N400 response at the position of NP2 was graded in the following manner: IO > AS > IS. This pattern in fact mirrors that observed for the N400 response in Experiment 1: there, the N400 difference between IO and IS reached significance in both posterior regions and at several midlines sites, whereas the N400 difference between IO and AS was only observable in the left posterior region. Thus, in spite of the fact that condition AS generally clustered with condition IO in the N400 time window for NP2 in Experiment 2 and with condition IS in Experiment 1, the overall graded N400 pattern is quite comparable across the two experiments. Possible functional interpretations of these results will be discussed later.

Finally, at the position of NP2, Experiment 2 revealed a late negativity (750-900 ms) for condition IS in comparison to the other two critical conditions. To determine whether this effect was also present in Experiment 1, in which it had not been as strongly apparent from visual inspection, we reanalysed the ERPs from Experiment 1 within the 750-900 ms time window relative to the onset of NP2. However, while this analysis did reveal an increased negativity for IS, this effect only reached significance between 750 and 800 ms. Thus, the late negativity is only partially consistent across the two experiments. Furthermore, as late negativities of this type are not typically reported in ERP studies of language processing, it is not entirely clear how this effect should be interpreted. Speculatively, it might be related to the processing of a sentence with an inanimate subject acting upon an animate object. Indeed, condition IS engendered higher error rates and slower reaction times than condition AS, its subject-initial counterpart with an animate subject and an inanimate object. In addition, Demiral (2007) observed an increased N400 effect at NP2 for sentences with an inanimate subject and an animate object in Turkish. In view of all of these observations, it appears quite plausible that condition IS should have engendered increased processing costs at NP2 in comparison to the other two critical conditions. However, given that the effect observed here (a late posterior negativity) is not consistent with previous findings (Demiral

2007) and that it was not fully reliable across both experiments, it clearly calls for further investigation in the future. We will therefore refrain from further speculations with respect to possible functional interpretations of this result.

To summarise, in Experiment 1, we observed an N400 response for both subject-initial control conditions (AS/IS) as opposed to our critical object-initial condition (IO) at the position of the disambiguating verb. At the position of NP2, by contrast, the object-initial condition (IO) engendered a biphasic N400-late positivity pattern in comparison to the two subject-initial conditions. Experiment 2 showed that the pattern of results at the verb changes fundamentally when effects of lexical-semantic relatedness between NP1 and the verb are controlled for. Thus, at the verb position, this study revealed N400 effects for the condition in which NP1 was disambiguated to an object reading (IO) in comparison to both control conditions (AS/IS). At the position of NP2, Experiment 2 replicated the basic N400-late positivity pattern for condition IO. However, in contrast to Experiment 1, condition AS clustered with IO as opposed to IS in the N400 time window. In the following, we discuss these two main results (N400 at the verb, biphasic pattern at NP2) in turn.

Effects at the position of the verb: Evidence for a subject-preference in NP-V constructions

When lexical-semantic relatedness between NP1 and the verb was controlled for, the disambiguation to an object reading of the initial argument engendered an N400 at the position of the verb. The finding of an N400 for the critical object-initial condition IO as opposed to the animate subject-initial condition AS is particularly conclusive as these two conditions used identical verbs. This comparison therefore serves to exclude a lexically based interpretation of the N400. Hence, we interpret the N400 effect for IO as a correlate of the reanalysis to an object reading of the initial argument and, thereby, as evidence for the existence of a subject-preference in Chinese (i.e. as evidence for an S/A preference for an initial ambiguous argument). This result of course raises the intriguing question of why a language in which there is no strong evidence for a subject category might display such a preference. Before turning to this issue, we will discuss the ERP evidence for a subject-preference in a little more details.

Readers familiar with the ERP literature on sentence comprehension may wonder why a subject-object reanalysis should be reflected in an N400 rather than in a late positivity (P600). However, while syntactic reanalyses were traditionally associated with P600 effects (e.g. Osterhout & Holcomb 1992, 1993; for a recent review, cf. Kutas, van Petten & Kluender 2006), subject/object reanalyses have in fact been shown to correlate with N400 effects in a number of recent ERP studies (German: Bornkessel et al. 2004b; Haupt et al. 2008; Leuckefeld 2005; Schlesewsky & Bornkessel 2006; Japanese: Wolff, Schlesewsky & Bornkessel 2007). In contrast to the present experiments, all of these previous studies employed grammatical means of disambiguation (e.g. via subject-verb agreement or via case marking), thereby suggesting that the N400 observed here did not simply result from the animacy-based means of disambiguation employed. Furthermore, it appears unlikely that the N400 simply reflected a perceived implausibility: according to our questionnaire pre-test, the verb was equally expected given NP1 in conditions IO and AS in Experiment 2. Furthermore, given that object topicalisation is a frequent option in Chinese and that the inclusion of fillers ensured that, at the position of the verb, the IO sentences could still plausibly be analysed as a highly acceptable OV order, participants should not have adopted an implausible SV analysis at this point. Indeed, findings from comparable structures in English suggest that, had such an implausible inanimate subject analysis been adopted (e.g. in the sense of "The novel was understanding…"), this animacy violation should have been reflected in a P600 effect (e.g Kuperberg et al. 2007, cf. "semantic P600" in Chapter 2). In view of all of these observations, we believe that we are justified in interpreting the N400 as a correlate of the reanalysis to an object-initial reading.

But which properties of the first NP required a revision when the verb was reached? After all, the verb in condition IO not only disambiguated the initial argument to an object reading, but also to an Undergoer interpretation. However, it appears unlikely that the effect observed at the position of the verb should be interpreted in terms of a semantically/thematically based processing strategy, which assigns the Actor role to the first argument encountered (i.e. a strategy leading to an interpretation of the first NP as the argument primarily responsible for the state of affairs being described). Firstly, the initial arguments in our critical IO condition were inanimate and thereby

non-prototypical Actors. Secondly, the findings from Philipp et al. (2008) suggest that independently of animacy, an initial argument in Chinese is interpreted neither as an Actor nor as an Undergoer (cf. Section 3.2.2 in Chapter 3). Preferences with respect to Actor- and Undergoer-hood only became observable at the position of NP2, when the two arguments must be related to one another. These findings therefore support the claim that the N400 observed for condition IO at the position of the verb does not reflect a semantic/thematic revision.

Given that semantically/thematically based processing preferences don't seem to account for our findings, how do other accounts of the subject-preference fare? Assuming that the base position of an object is indeed behind the verb in Chinese, de Vincenzi's (1991) Minimal Chain Principle (MCP) can derive the finding of a subject-preference in our data. An analysis of the initial NP as a subject (with a base position in front of the verb) rather than as a topicalised object serves to create a more minimal chain. However, since many scholars have questioned the idea of structural asymmetries between subjects and objects in Chinese (cf. Section 4.1 in Chapter 4), an MCP-based analysis of our results would require an additional justification of this crucial representational assumption.

An alternative explanation is offered by the minimal dependencies-based account (Bornkessel & Schlesewsky 2006a; Demiral et al., 2008). From this perspective, a default reading for the initial ambiguous NP is the sole argument of an intransitive relation. When the verb in our critical IO condition is subsequently reached, a reanalysis to a transitive reading is required. Moreover, within this transitive relation, the initial NP must be associated with the argument that does not correspond to the sole argument in an intransitive relation (i.e. from A to O reading in the transitive event). However, similarly to the additional structural assumptions required by an MCP-based explanation, a minimal dependencies-based derivation of the Chinese findings would need to account for the fact that a revision/extension from an S reading to an A reading is less costly than the revision/extension to an O reading.

Thus, both the MCP and MP approach are, in principle, capable of deriving our findings, though additional assumptions are required in both cases. We shall return to a more detailed discussion of these two explanations on consequences for the characterization of the subject-preference below.

Effects at the position of NP2: Evidence for a structural preference against post-verbal subject in OVS

At the position of NP2, the critical condition IO engendered a biphasic N400-late positivity pattern in comparison to the (lexically identical) condition IS in both experiments. The late positivity was also observable in both studies when IO was compared with AS (i.e. to the control condition with an identical meaning). With regard to the N400, however, AS clustered with IS in Experiment 1 and with IO in Experiment 2, though both experiments revealed the following overall trend with regard to N400 amplitude: IO > AS > IS. In the following, we first discuss possible functional interpretations for the biphasic pattern for the critical object-initial condition IO, before turning to the question of why condition AS showed a different pattern of results across the two experiments[36].

Firstly, the observation of a late positivity in condition IO appears relatively straightforward. Recall from Chapter 2 that late positive ERP effects ("P600s") are typically observed in response to non-preferred disambiguations, syntactically complex or ill-formed structures (Friederici et al. 2001; Hagoort et al. 1993; Kaan et al. 2000; Osterhout & Holcomb 1992; Osterhout, Holcomb & Swinney 1994). The P600 has also been linked to a more general sense of "conflict monitoring" during language processing (Kolk et al. 2003; Vissers et al. 2006, cf. Example 2.7 in Section 2.3.3). From this perspective, the observation of a late positivity at NP2 is not at all surprising, as this is the position that renders the sentences in condition IO unacceptable.

Though P600 effects have recently also been observed for the processing of semantically implausible sentences (Hoeks et al. 2004; Kim & Osterhout 2005; Kolk et al. 2003; Kuperberg, Sitnikova, Caplan & Holcomb 2003), a "semantic P600" interpretation does not appear to lend itself to the present findings. Notably, our participants' performance on the comprehension task indicates

36 Note that since NP2 was also the sentence-final constituent in both experiments, it cannot be excluded that the ERP effects observed at this position were partly influenced by processes of sentence wrap-up. However, sentence wrap-up in and of itself clearly cannot explain the more fine-grained modulations of the overall component pattern between Experiment 1 and Experiment 2.

that they did not assign an implausible SVO interpretation to the sentences in condition IO: accuracy rates were over 90% for this condition in both experiments. As the comprehension task included questions in both active and passive form, this high accuracy rate could not have resulted from a simple linear matching strategy between the constituents of the experimental sentence and those of the comprehension question. Rather, participants must have understood the sentences in order to perform the comprehension task correctly (and only trials for which the task was performed correctly entered the data analysis). In this way, our results stand in contrast to those of the studies reporting "semantic P600" effects, in which the critical sentences were judged to be implausible.

In view of these observations, we interpret the late positivity observed at NP2 in condition IO as a correlate of ill-formedness detection (also cf. Bornkessel & Schlesewsky 2006a).

Turning now to the N400 for condition IO at NP2, this additional finding appears somewhat less expected from the perspective of standard processing accounts. As already outlined with respect to the late positivity, an implausibility-based explanation of this effect appears unlikely in view of the fact that our participants understood the sentences correctly. However, recall from Chapter 3 that the previous findings on processing unambiguously case marked sentences in Japanese and German (Wolff et al. 2008; Bornkessel et al. 2004a), at the position of the second argument, a N400 was observed for the canonical subject-before-object order in comparison to the object-before-subject order, because the processing system assumes the first nominative argument is the only argument in an intransitive relation and thus does not expect a second argument. A similar line of argumentation can be applied to the present findings. In condition IO, the processing system does not expect to encounter an additional argument after the verb, since this would render the structure ungrammatical. Thus, when a second argument is encountered post-verbally, the processing system must revise its assumption that only one of the two arguments in the transitive relation is overtly expressed. From this perspective, the N400 at the position of NP2 might either reflect the increased effort required to process an unpredicted argument or costs of the additional referential specification of a subject that was previously thought to be unexpressed.

These ideas also provide a possible avenue of explanation for the pattern of results in the animate subject-initial condition AS. Recall that, while this condition essentially showed an intermediary N400 effect between those in conditions IO and IS in both experiments, it clustered more strongly with IS in Experiment 1 and with IO in Experiment 2. Why should the preferred subject-initial condition with an animate subject and an inanimate object have shown an N400 in Experiment 2? Assuming, as argued above, that the N400 at this position reflects the degree of expectedness of the second argument, the data suggest that the object argument was less expected in Experiment 2 than in Experiment 1 for condition AS. This very likely resulted from the critical change in materials between the two experiments: recall that, in order to equate the lexical-semantic relatedness between NP1 and the verb in conditions AS and IO, we loosened the relationship between the object and the verb when constructing the sentence materials for Experiment 2. Thus, by this very fact, the post-verbal object in condition AS was less expected in Experiment 2. In the same way as for condition IO, this relatively general line of explanation could be specified further in at least two different ways: either, the processing system did not predict an object at all in condition AS in Experiment 2, or there was simply no expectation for a particular object or class of objects (in contrast to Experiment 1). However, these two possibilities cannot be teased apart on the basis of the present materials.

Most generally, the observation of a similar N400 effect in conditions IO and AS lends further support to the assumption that the N400 observed for IO does not reflect the processing of an ill-formed or implausible structure. If this were the case, it would be very difficult to explain why this type of effect was also observed for the highly preferred animate subject-initial condition AS. As indicated above, the different proposals for a more fine-grained functional interpretation of the N400 effects observed here will need to be contrasted in future studies. However, we presently favour the explanation based on the idea of reference specification, as this provides a coherent explanation for the N400 effects in both critical conditions. Neither IO nor AS allows for a clear specification of the post-verbal NP before this constituent is actually encountered in the input. In condition IO, this is the case because the processing system assumes a structure with a dropped subject. In condition AS, by contrast, it results from the fact that the verb is not closely associated

with a particular object. In this way, we can derive a coherent explanation for the N400 across both experiments: the second NP always calls for an additional referential specification in condition IO, but for condition AS this depends on how strongly the verb predicts a particular object.

To summarise, Experiments 1-2 aimed to examine whether a subject-preference can be observed in Chinese in spite of the controversial status of a subject category in this language. Our findings revealed that Chinese *does* show a subject-preference (i.e. an S/A preference) for an initial ambiguous argument, like other subject-prominent languages examined to date. However, as word order in Chinese is argued to be sensitive to information structure, this initial preference could be overridden by additional information such as context, in contrast to the other languages previously examined. This prediction was tested in Experiment 3.

5.3 Experiment 3: A comparison of OV vs. SV orders in which the initial NP is either topicalised or not topicalised by the context

The aim of Experiment 3 was to investigate whether the subject-preference can be influenced by a topic context. Previous studies in German provided an initial ERP investigation on how context influences the sentence-internal word order realisation (cf. Bornkessel et al. 2003 in Chapter 3). However, these studies were using *unambiguously case marked sentences*, i.e. scrambled sentences. Since Chinese lacks grammatical disambiguating devices such as case marking and verb agreement, it provides a good case for examining the influence of context on processing *ambiguous sentences*. Furthermore, word order in Chinese is often described as pragmatically driven, with the clause-initial position viewed as a topic rather than a subject (cf. Chapter 4). In this view, the Chinese processing system may analyse the initial ambiguous argument as a topic rather than a subject (i.e. a topic-preference). Based on the default association between topics and subjects, the reanalysis effect for the object-initial condition observed in Experiment 2 may therefore result from

the necessity of interpreting an object/Undergoer as a topic (which is not a good topic). Given that the topic is a discourse-based notion, the initial argument in Experiments 1-2, however, was not rendered a topic by a discourse context, but simply occupied the clause-initial position. Perhaps, it may be the case that the true implications of topic-prominence for language processing are only revealed when the critical sentences are presented in context. Thus, in Experiment 3, we used a context to topicalise or not topicalise the initial arguments in the critical sentences, as shown in Table 5.7.

Table 5.7: Examples for each of the two critical conditions in Experiment 3. Contexts are abbreviated as IN (inanimate topic context) and AN (animate topic context) and critical conditions (IO and AS) were abbreviated as for Experiment 2. The abbreviations of conditions describe both the context and the word order. For example, IN-IO refers to an inanimate topic context followed by an inanimate object-initial order. Note that the meaning of the critical condition was different depending on which context it followed.

	Example			***Translation***
IN	小说	怎么了?		novel how-ASP
	xiǎoshuō	zěnmele		'What is about the novel?'
a. IO	小说	理解了	一点点。	novel understand-ASP a little
	xiǎoshuō	lǐjiěle	yīdiǎndiǎn	'I/someone understood the novel a little.'
b. AS	演员	理解了	一点点。	actor understand-ASP a little
	yǎnyuán	lǐjiěle	yīdiǎndiǎn	'The actor understood the novel a little.'
	Example			***Translation***
AN	演员	怎么了?		actor how-ASP
	yǎnyuán	zěnmele		'What is about the actor?'
a. IO	小说	理解了	一点点。	novel understand-ASP a little
	xiǎoshuō	lǐjiěle	yīdiǎndiǎn	'The actor understood the novel a little.'
b. AS	演员	理解了	一点点。	actor understand-ASP a little
	yǎnyuán	lǐjiěle	yīdiǎndiǎn	'The actor understood something a little.'

As is apparent in Table 5.7, Experiment 3 was designed very similarly to Experiment 2 but with some exceptions.

First of all, an inanimate topic context (IN) and an animate topic context (AN) are added before the critical conditions (IO and AS) that were used in Experiment 2. This results in a 2 x 2 design that crosses the factors CONTEXT (CO: IN vs. AN) and WORD ORDER (WO: IO vs. AS). Thereby, we have four conditions: IN-IO, IN-AS, AN-IO, and AN-AS. As the initial arguments in the critical conditions are topicalised or not topicalised by the context, NP1 is of great interest for comparing ERP responses.

Secondly, IO and AS conditions were selected to ensure a comparison of lexically identical verbs. The lexical-semantic relatedness of NP1-Verb adopted from Experiment 2 is strictly balanced (see Table 5.8 below). Thus, in an intra-sentential environment, we should obtain a similar subject-preference as in Experiment 2. However, in an inter-sentential environment, the context either supports (IN-IO, AN-AS) or does not support (IN-AS, AN-IO) the subject preference. Hence, the verb is the critical position for examining whether the subject-preference can be influenced by a topic context or not.

Finally, IO and AS conditions are completed by adverbs, which renders both conditions grammatical. In Experiments 1-2, the post-verbal position is occupied by NP2 (NP1-Verb-NP2). Thus, the post-verbal NP2 disambiguates condition IO to an ungrammatical OVS order on the one hand, while disambiguates condition AS to a grammatical SVO order on the other hand. In order to rule out the possible effect of having included ungrammatical sentences earlier (even though the ungrammaticality was not apparent until NP2), here, we use grammatical conditions ending with adverbs (NP1-Verb-Adverb). When the adverb is encountered, condition IO is disambiguated to a sentence with a topicalised object and a dropped subject (O-V-Adv) and condition AS is disambiguated to a sentence with a topicalised subject and a dropped object (S-V-Adv). As the transitive verbs in the critical conditions always calls for two arguments, the dropped subject or object is either interpreted as someone or something when there is only one argument present in the sentence (i.e. IN-IO, AN-AS) or recovered by the preceding context (i.e. IN-AS, AN-IO). However, adverb is not the critical position for examining the relation between context and subject-preference, thus it is not taken into account when comparing ERP responses.

In summary, the critical positions for comparing ERP responses in Experiment 3 are the NP1 and the verb in the critical conditions. Below, we will address our hypotheses for these two positions in turn.

a. NP1: At this position, the NP1 is either topicalised or not topicalised by the preceding context. Two linearization principles are assumed when the NP1 is not topicalised by the context, namely, topic/given-before-non-topic/new (cf. Section 1.2.3 in Chapter 1) and animate-before-inanimate (cf. Grewe et al. 2006 for neuroimaging evidence). Thus, we should be able to see an increased processing cost for new vs. given NP1s (IN-AS vs. IN-IO; AN-IO vs. AN-AS), which may interact with animacy as follows:

• Animate topic context (AN-IO/AN-AS)
Here, animacy and topicality (givenness) agree with each other. Both of them favour given-/animate-initial order. We thus expect a processing disadvantage for the sentences disambiguated to the non-preferred new-/inanimate-initial order (AN-IO vs. AN-AS).

• Inanimate topic context (IN-IO/IN-AS)
Here, animacy and topicality disagree with each other. The condition here is either supported by topicality or supported by animacy. We thus expect conditions in this context to engender less pronounced effects than in the animate topic context above. However, as this is the first ERP investigation examining how context influence the sentence-internal realisation at the initial ambiguous argument in Chinese, we are unable to predict a particular type of ERP effect for the NP1.

b. Verb: At this position, the verb disambiguates the NP1 to either an object- or a subject-initial reading via animacy information. If topicality can induces a subject reading of the NP1 (by the default association of "topic = subject/Actor"), we should observe a reanalysis effect for condition IN-IO because the topic context supports a subject reading of the NP1 while the verb disambiguates it to an object reading. By contrast, we should not be able to see any reanalysis effects for condition AN-IO, because no such conflict occurs when the topic context does not support a subject reading of the NP1.

However, if the subject-preference is independent of the topic context (i.e. no matter whether NP1 is topicalised or not), we should be able to see reanalysis effects for the object-initial condition in both contexts (i.e. IN-IO vs. IN-AS, AN-IO vs. AN-AS).

5.3.1 Methods

Participants. Twenty-seven monolingually raised native speakers of Mandarin Chinese (Beijing dialect) participated in the experiment after giving informed consent (18 females; mean age: 26.2 years; age range: 19-36 years). At the time of the experiment, all participants were residing in Leipzig, Germany. Participants were right handed (as assessed by an adapted Chinese version of the Edinburgh handedness inventory; Oldfield 1971) and had normal or corrected-to-normal vision. Five participants were subsequently excluded from the final data analysis on the basis of excessive EEG artefacts and/or too many errors in the behavioural control task.

Materials. 30 out of 40 NP1-Verb pairs used in Experiment 2 were selected for Experiment 3 (Appendix 1). The selected NP1-Verb pairs were best equated for their lexical-semantic relatedness between IO and AS conditions, as shown in Table 5.8.

Table 5.8: Mean relatedness ratings between NP1 and the verb for the critical conditions in Experiment 3. Standard deviations are given in parentheses.

Condition	*Relatedness (SD)*
a. IO	2.56 (0.56)
b. AS	2.56 (0.45)

The 120 critical sentences (30 in each condition) were interspersed with 432 filler sentences, which included various types of structures such as transitive sentences with canonical SVO order (e.g. 'the actor read the novel' or 'the novel educated the actor'), intransitive sentences with SV order (e.g. 'the novel disappeared'), ambiguous verb-final sentences with OSV or SOV order (e.g. "bullet detective hit", i.e. 'the detective hit the bullet'; e.g. "detective bullet

kept", i.e. 'the detective kept the bullet'). Overall, the filler sentences ensured an equal probability of an initial inanimate noun being disambiguated as the subject or the object in each type of the sentence. The 552 sentences in the experiment (120 critical sentences and 432 fillers) were presented to participants in two different randomised orders and also in two sections.

In order to underscore the dialogue-like nature of the critical question-answer pairs, we used auditory presentation rather than visual presentation like Experiments 1-2. Sentences were digitally recorded by two native speakers of Chinese (Beijing dialect), a male speaker for the questions and a female speaker for the answers, using a sampling rate of 44.1 kHz and a 16-bit resolution. They were subsequently checked for naturalness by a native speaker of Chinese and re-recorded if necessary.

Acoustic analyses. As the auditory stimuli were recorded as natural speech and not altered in any way, we conducted an acoustic analysis in order to examine possible prosodic differences between our critical conditions. To this end, the following parameters were extracted for each constituent (NP1, Verb, Adv): duration (ms), intensity (dB), and fundamental frequency (F0, Hz) for the onset, the offset and the minimal and maximal F0. Mean values for duration and intensity are given in Table 5.9 and pitch contours are visualised in Figure 5.8.

Table 5.9: Mean intensities and durations per constituent in each of the critical sentence conditions in Experiment 3. Standard deviations are given in parentheses.

Condition	*Mean intensity (dB)*			*Mean duration (ms)*		
	NP1	*Verb*	*Adv*	*NP1*	*Verb*	*Adv*
a. IO	66.5(1.6)	65.8(1.5)	61.3(1.8)	652.6(69.3)	715.5(60.3)	910.9(178.4)
b. AS	66.2(2.2)	66.1(1.4)	61.1(2.0)	676.2(58.0)	698.2(77.1)	922.8(166.2)

Descriptively, the values in Table 5.9 and Figure 5.8 indicate that there was a very low degree of variability in the acoustic parameters across conditions. The descriptive impression was confirmed by the statistical analysis. Since IO and AS were used identically in both contexts, all critical acoustic parameters were subjected to an item-based analysis of variance (ANOVA) involving only

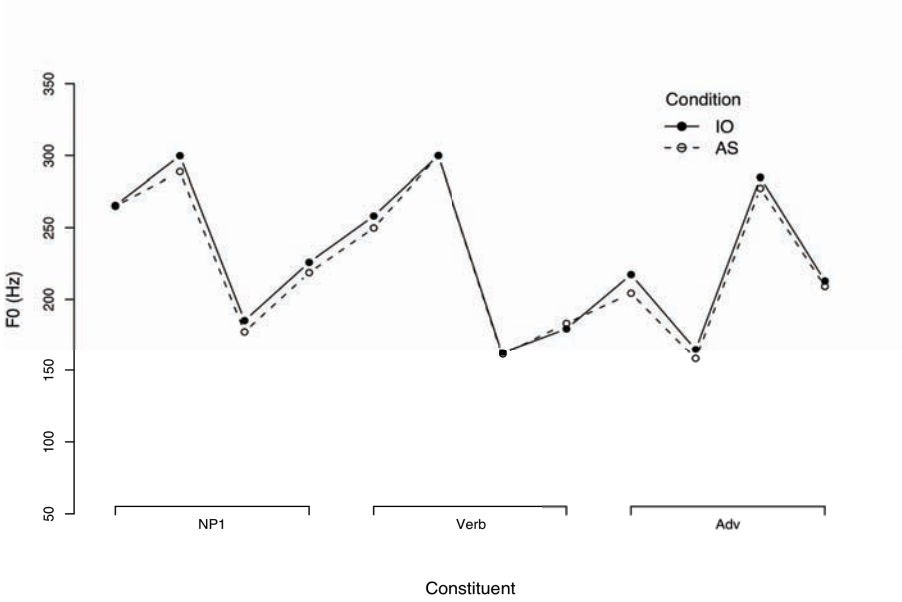


Figure 5.8: F0 contour of the critical sentence conditions in Experiment 3. Four values are given for each constituent: pitch onset, offset, maximum and minimum. Note that these are always displayed in a fixed order (onset, minimum, maximum, offset) and therefore do not reflect the true tonal contour of the individual sentence constituents.

one factor WORD ORDER (WO: IO vs. AS). Note that significant pitch differences will only be reported when they exceed the threshold for perception (cf. Rietveld & Gussenhoven 1985; t'Hart, Collier, & Cohen 1990). The statistical analysis revealed that neither the duration nor the intensity showed a main effect of WO at any position (the duration of NP1: F (1, 29) = 2, p >.1 and all the other Fs < 1).

Procedure. Participants were seated in a dimly lit, sound attenuated room in front of a computer screen. The sentences were presented auditorily via two loudspeakers positioned on both sides of the computer. The entire experiment had 12 blocks and each block contained 46 trials. Due to the length of the experiment, the whole experiment was separated into two sessions, each of which comprised 6 blocks. The two sessions were separated by a time interval of more than two weeks. Participants first listened attentively to the sentences and were then required to judge the acceptability of the current sentence. Then, they were asked to answer a yes/no comprehension question based on

the context of the current sentence. The course of a trial is depicted in Figure 5.9.

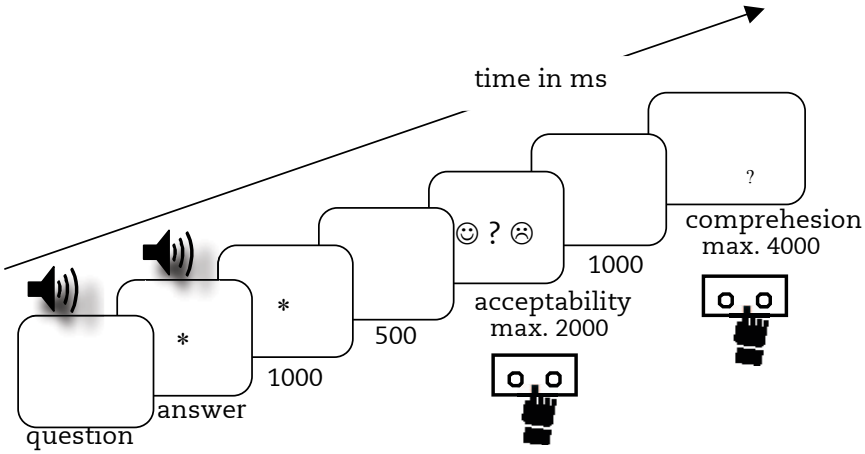


Figure 5.9: The course of a single trial in the acceptability judgment and the comprehension questions session in Experiment 3. All time data is depicted in ms.

As can be seen in Figure 5.9, context and target sentences were presented via loudspeakers in a question-answer manner. After hearing the question, each answer began with the presentation of a fixation cross (500 ms stimulus onset asynchrony; SOA). The fixation cross remained on the screen during the auditory presentation and for a further 1000 ms after the sentence offset. Following 500 ms of observing a blank screen, participants were asked to complete the acceptability judgement task by pressing a button (maximal reaction time: 2000 ms). As a cue for the acceptability judgement, a question mark was presented on the screen. Following the judgement task and a further 1000 ms of observing a blank screen, participants performed a comprehension task by judging whether this statement correctly described the content of the preceding sentence or not (maximal reaction time: 4000 ms). Comprehension questions were constructed as in the same way as in Experiments 1-2.

EEG recording. The EEG recording was done in the same as for Experiments 1-2 and only exhibited exceptions to this in the experimental environment.

The EEG was recorded via 72 AgAgCl-electrodes fixed to the scalp by means of an elastic cap (Easycap, Herrsching-Breitbrunn). The ground electrode was positioned at the sternum. All EEG and EOG channels were amplified using a Refa 8 amplifier (TMS International, the Netherlands). The average ERPs were calculated for each condition and participant from the onset of the critical stimulus items (i.e. NP1 and the verb) to 1000 ms post onset. Less than 11% of all trials were excluded in this manner (10.5% for the position of NP1, 9.9% for the position of the verb) and exclusion rates differ significantly between the two contexts (NP1: F (1, 21) = 17.25, p <. 001; Verb: F (1, 21) = 15.11, p <. 001).

Data analysis. For the behavioural data, the mean accuracy rates and reaction times were calculated for each condition. Incorrectly answered trials were excluded from the reaction time analysis. We computed a repeated measures analysis of variance (ANOVA) involving the within-participants factors CONTEXT (CO: inanimate topic context vs. animate topic context) and ANIMACY (AN: inanimate NP1 vs. animate NP1)/WORD ORDER (WO: object-initial order vs. subject-initial order) and the random factors participants (F_1) and items (F_2).

For the statistical analysis of the ERP data, repeated measures ANOVAs involving the factor CO and WO were calculated for mean amplitude values for each time window and condition. Analyses additionally involved the topographical factor "region of interest" (ROI). Lateral regions of interest were defined as follows: left-anterior (AF7, AF3, F7, F5, F3, FT7, FC5, FC3), left-posterior (TP7, CP5, CP3, P7, P5, P3, PO7, PO3), right-anterior (AF8, AF4, F8, F6, F4, FT8, FC6, FC4), and right-posterior (TP8, CP6, CP4, P8, P6, P4, PO8, PO4). For midline sites, each electrode was defined as a ROI of its own: FZ, FCZ, CZ, CPZ, PZ, POZ. The statistical analysis was carried out in the same way as in Experiments 1-2.

5.3.2 Results

Behavioural data. Results for the behavioural tasks in Experiment 3 are shown in Table 5.10.

Table 5.10: Mean acceptability rates and reaction times for the judgement task and mean percentages of correct responses and reaction times for the comprehension question in Experiment 3. Standard deviations (by participants and items) are given in parentheses.

	Acceptability judgement		*Comprehension question*	
	Acceptability (%)	*Reaction times (ms)*	*Correct responses (%)*	*Reaction times (ms)*
IN				
a. IO	47.4 (0.05)(0.05)	616.3 (107.94)(66.88)	94.6 (0.11)(0.15)	1580.0 (107.04)(128.54)
b. AS	79.8 (0.15)(0.14)	598.6 (94.62)(76.11)	96.6 (0.11)(0.14)	1502.3 (134.55)(126.44)
AN				
a. IO	44.9 (0.07)(0.06)	615.3 (113.32)(79.05)	92.5 (0.10)(0.17)	1578.0 (106.43)(120.27)
b. AS	75.7 (0.13)(0.12)	580.5 (119.90)(80.82)	90.7 (0.13)(0.17)	1543.5 (113.49)(134.10)

With regard to acceptability, a repeated measures ANOVA revealed a significant main effect of WO (F_1 (1, 21) = 86.09, p < .001; F_2 (1, 29) = 72.20, p < .001) but no significant effect of CO. Thus, the judgement task showed an acceptability advantage for the subject-initial condition (AS) over the object-initial condition (IO). Furthermore, such an advantage was not influenced by the context. For the reaction time of the judgement task, the statistical analysis of the reaction times for the acceptability task showed that neither the main effects of CO (F_1/F_2 < 1) nor WO (F_1/F_2 > 1.73, P > 1) reached significance.

As for the accuracy rates of the comprehension task, only the main effect of CO showed significance in the analysis by both participants and items: CO (F_1 (1, 21) = 20.07, p <. 001; F_2 (1, 29) = 6.54, p < .02). Thus, there was a tendency for higher accuracy rates in critical sentences following inanimate-initial contexts. However, accuracy was high for all four critical sentence types (all accuracy rates > 90%). In the analysis of the reaction times for the comprehension task, the main effect of WO reached significance only in the analysis by participants (F_1 (1, 21) = 13.3, p < .002; F_2 (1, 29) = 1.66, p > .2). In summary, there were longer reaction times for object-initial conditions.

ERP data. In the analysis of the ERP data, the two positions of interest in our critical sentences, namely the NP1 and the verb, were considered in turn.

NP1. Grand average ERPs at the position of the NP1 in the inanimate context and the animate context are shown in Figure 5.10A and 5.10B, respectively. An initial observation of Figure 5.10 suggested that there was a pronounced effect in posterior regions. We thus chose PZ to represent a cross-context comparison in Figure 5.10.

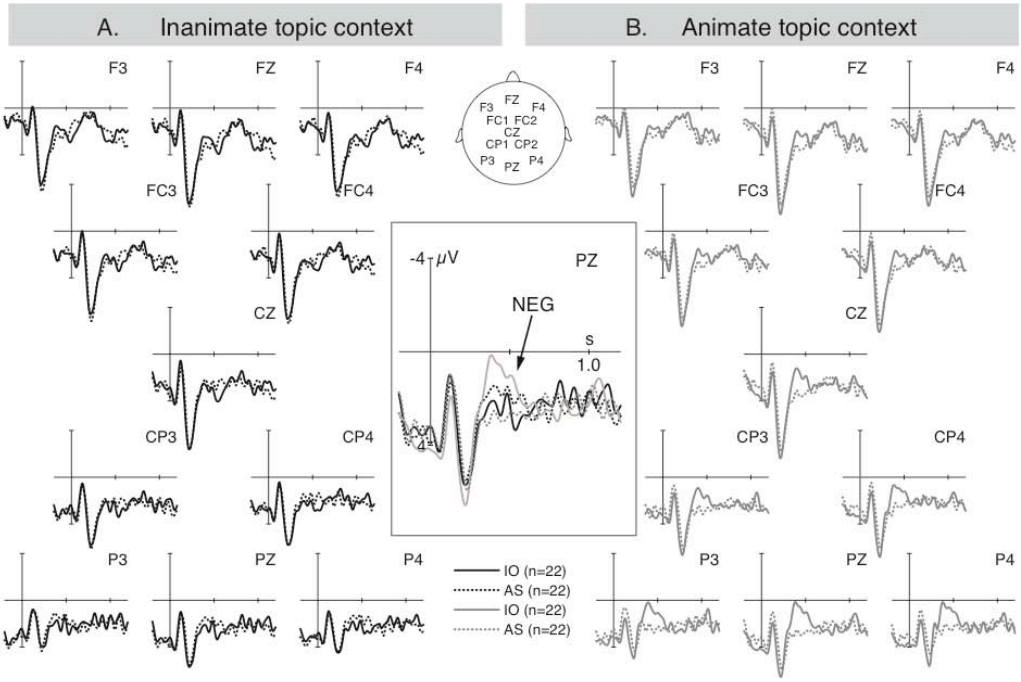


Figure 5.10: Grand average ERPs (n=22) time-locked to NP1 (onset at the vertical bar) in the two critical conditions in Experiment 3. Comparisons of the critical object-initial condition (IO) and the animate subject-initial condition (AS) in inanimate topic and animate topic contexts are shown in Panels A and B, respectively. The enlarged centre panel shows a direct comparison of two conditions in two different contexts at one electrode. Negativity is plotted upwards.

Visual inspection of the PZ suggested an interaction of the context and the word order from approximately 350 to 600 ms: a posterior negativity for non-topicalised/new vs. topicalised/given NP1s in both contexts, but it was more

pronounced in the animate topic context. These observations were supported by a statistical analysis of the effects at the position of the NP1. A repeated measures ANOVA revealed a main effect of AN for both lateral electrode sites, F (1, 21) = 10.60, p < .005, and midline electrode sites, F (1, 21) = 12.79, p < .01. Furthermore, there were interactions of CO x AN x ROI for both lateral electrodes, F (3, 63) = 23.34, p <. 0001, and midline electrodes, F (5, 105) = 21.30, p <. 0001). Resolving these interactions by ROI showed interactions of CO x AN in both posterior regions for the lateral electrodes: left, F (1, 21) = 32.98, p < .0001; right, F (1, 21) = 39.82, p < .0001, and the midline electrodes, FCZ, CZ, CPZ, PZ, POZ, all Fs > 12.25, all ps < .003. Resolving the interactions of CO x AN by CO further revealed a significant main effect of AN in the inanimate topic context (lateral: both Fs > 8.63, p < .01; midline: all Fs > 8.28, p < .01 except FCZ where F > 1, p < .4), and a more significant main effect of AN in the animate topic context, since this effect reached significance in all these regions and showed higher F-values (lateral: both Fs > 28.29, p < .0001; midline: all Fs > 12.46, p < .01).

To summarise, ERP time-locked at the position of NP1 revealed an interaction of context and animacy in a time window of 350-600 ms: a posterior negativity for new vs. given NP1. This effect was more pronounced in the animate topic context than in the inanimate topic context (AN-IO vs. AN-AS > IN-AS vs. IN-IO).

Verb. Grand average ERPs at the position of the verb in two different contexts are shown in Figures 5.11A and 5.11B, respectively.

Visual observation of Figure 5.11 reveals that the IO condition engenders increased processing costs as opposed to the AS condition in both contexts. This observation is easier to obtain from Figure 5.12, in which we combined conditions by word order across contexts (AN-/IN- IO vs. AN-/IN- AS). In Figure 5.12, the increased processing cost for IO condition was reflected by a biphasic N400-late positivity pattern. Visual inspection of Figure 5.11 further suggests that condition IO seemed to engender a second ERP effect, namely a left anterior negativity (LAN) in contrast to condition AS in the animate topic context but not in the inanimate topic context. Based on the observations above, the following time windows were selected for the statistical analysis of

the verb: 350-500 ms for the N400, 700-900 ms for the late positivity, and 200-300 ms for the LAN.

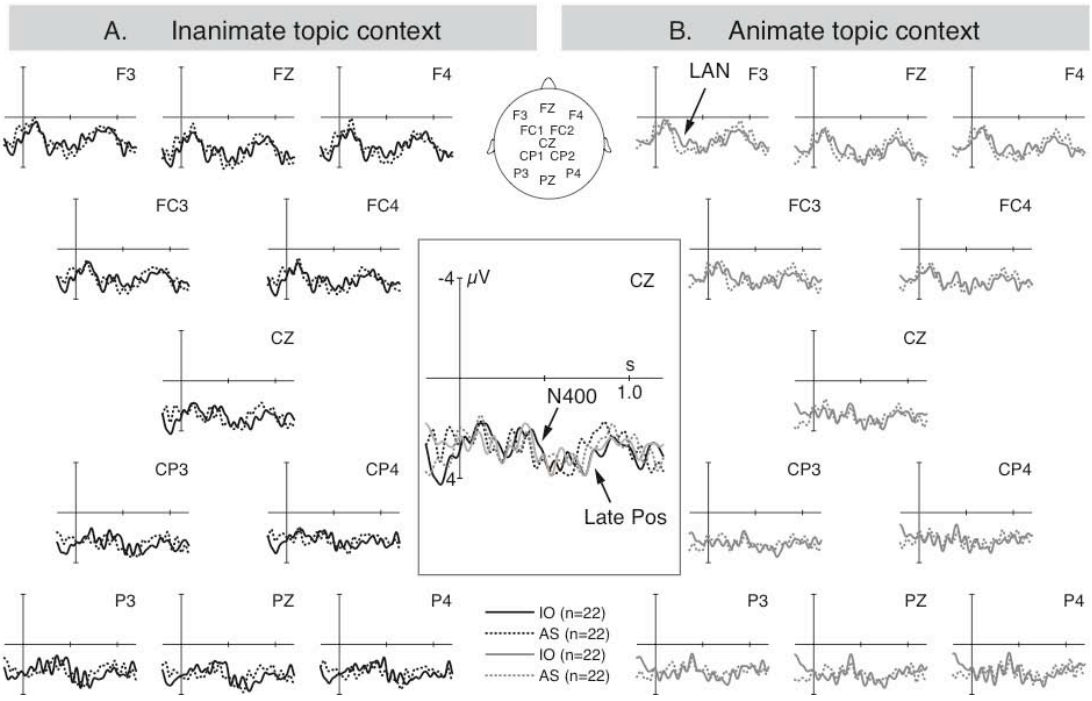


Figure 5.11: Grand average ERPs (n=22) time-locked to the verb (onset at the vertical bar) in the two critical conditions in Experiment 3. Comparisons of the critical object-initial condition (IO) and the animate subject-initial control (AS) in inanimate topic and animate topic contexts are shown in Panels A and B, respectively. The enlarged centre panel shows a direct comparison of two conditions in two different contexts at one electrode. Negativity is plotted upwards.

For the biphasic N400-late positivity, a repeated measures ANOVA revealed a significant main effect of WO between the IO and AS conditions in both time windows of 350-500 ms and 700-900 ms: significance in the earlier time window for both lateral electrode sites, F (1, 21) =14.30, p < .01, and midline electrode sites, F (1, 21) = 9.94, p <. 01; significance in the late time window for both lateral electrode sites, F (1, 21) =17.47, p < .001, and midline electrode sites, F (1, 21) = 28.59, p < .001.

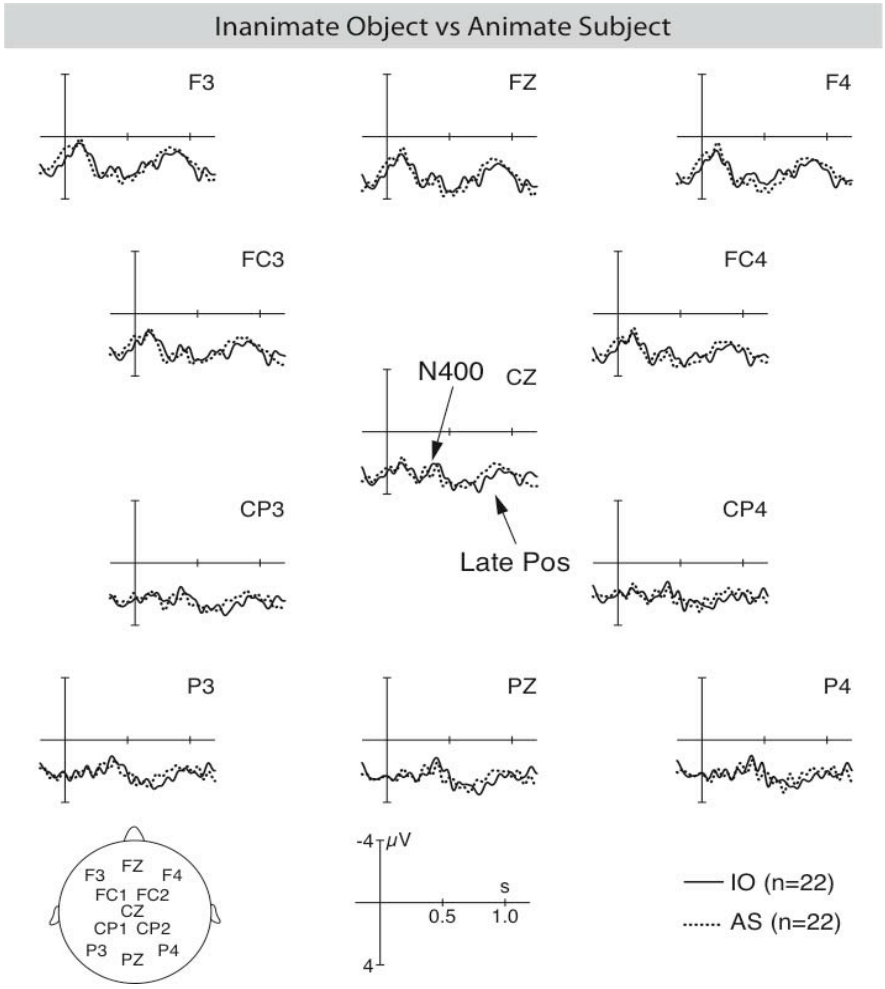


Figure 5.12: Grand average ERPs (n=22) time-locked to the verb (onset at the vertical bar) after combining inanimate-object condition and animate-subject condition across two contexts. Negativity is plotted upwards.

For the LAN, the statistics revealed significant interactions of CO x WO x ROI for both lateral electrode sites, F (3, 63) = 13.15, $p < .001$, and midline electrodes sites, F (5, 105) = 18.64, $p < .0001$. Resolving this interaction by ROI revealed these interactions of CO x WO were significant in the left anterior region, F (1, 21) = 9.43, $p < .01$ and FCZ, F (1, 21) = 8.14, $p < .01$. Resolving the interactions of CO x WO by CO further revealed significant effects of WO in the

animate topic context for both regions, left anterior region, F (1, 21) = 8.14, p < .01, FCZ, F (1, 21) = 9.91, p < .01.

In summary, the analysis of the ERPs at the position of the verb showed a biphasic N400-late positivity pattern for IO vs. AS in both contexts. This comparison also elicited an additional LAN in animate topic context.

5.3.3 Discussion

Experiment 3 was motivated by our first two visual experiments, which demonstrated that Chinese shows a subject-preference like all other languages examined so far. However, the clause-initial position in Chinese is often described as a topic rather than a subject, and the observed subject-preference could have resulted from the default "topic = subject/Actor" interpretation in this language. In order to examine whether the subject-preference can really be reuced to a topic preference, we thus employed a context that explicitly topicalised or did not topicalise the clause-initial ambiguous argument. The main findings are summarised as follows:

At the position of the NP1, we observed an interaction of the topic context (henceforth topicality) and animacy: a posterior negativity (350-600 ms) for new vs. given NP1s in both contexts but more pronounced in the animate topic context than in the inanimate topic context, as we hypothesised (AN-IO vs. AN-AS > IN-AS vs. IN-IO). At the position of the disambigulating verb, we observed a biphasic N400-late positivity pattern for the object-initial condition in both contexts (IO vs. AS). Finally, we found an additional LAN (approx. 200-300 ms) for inanimate-initial order in the animate topic context.

Correlating the present findings to the previous studies, we will discuss possible interpretations of the data patterns at position of the NP1 and the verb in turn below.

<u>Effects at the position of the NP1: Evidence for an interaction of topicality and animacy in S/OV</u>

A new finding in Experiment 3 is the interaction of topicality and animacy during online interpretation of the initial ambiguous argument, which was reflected by a posterior negativity in a time window of 350-600 ms. The

posterior negativity for new vs. given initial argument was more prominent in the animate topic context than in the inanimate topic context. This asymmetry can be attributed to the violation of both given-before-new and animate-before-inanimate principles in the former context: while an animate argument is given by the context, the target sentence begins with an inanimate argument. The posterior negativity cannot simply be due to the violation of topicality/givenness alone or reflects a repetition priming (Rugg 1985), because in either of the cases we should have seen a symmetry across contexts, i.e. AN-IO vs. AN-AS = IN-AS vs. IN-IO. Clearly, this is not true. Thus, the posterior negativity can be two overlapping effects as a result of violation of both principles. This result suggests that both topicality and animacy jointly determine online processing preference, which is consequently reflected by the LAN at the position of the verb.

Comparing the interaction of topicality and animacy, the main effect of animacy, which suggests a general processing difference between the inanimate-initial order and the animate-initial order, seems less conclusive. Similar to Experiments 1-2, it is unlikely to argue for a general preference for the initial argument to be animate rather than inanimate, since previous studies have showed that animacy does not play a role in processing a single argument (cf. Section 3.2.2 in Chapter 3). Rather, it could be due to the fact that we were comparing different lexical items at this position (e.g. “novel” in IO vs. “actor” in AS). It could also reflect the processing system’s attempt to interpret an atypical subject, i.e. an inanimate subject. One may argue that if this effect reflects that an inanimate subject is not preferred, then why wasn’t there a similar effect for inanimate-initial conditions in Experiment 2? This could be due to the relatively pragmatically marked experimental environment in Experiment 3. As animate topic and inanimate topic contexts were used and ambiguous verb-final constructions were included as filler sentences in Experiment 3 (cf. Experiment 4 in Chapter 6 for this kind of constructions), the animacy information could have been globally enhanced compared to Experiment 2. This interpretation is also compatible with the late posterior negativity observed at the position of NP2 in Experiment 2, which was tentatively interpreted as a processing disadvantage for an inanimate subject following an animate object (i.e. condition IS). However, because of the pragmatically marked experimental environment, the inanimate initial

argument in Experiment 3 directly lead to a processing disadvantage for an inanimate subject order even though there was no animate object, in contrast to Experiment 2. This explanation is also compatible with the observation at the following verb position. At this position, we found a context-independent subject-preference, which replicated the previous findings in Experiment 2 by showing that the subject reading was already established when the processing system encountered the initial argument. Due to the difficulty in interpreting the role of animacy in processing a single argument at the moment, we need to clarify this problem in another experiment.

Effects at the position of the verb: Evidence for a context-independent subject-preference and for the interaction of topicality and animacy again in S/OV

The most important finding in Experiment 3 is that a topic context can only induce an additional processing cost but *cannot* override the subject-preference in Chinese. The object-initial order elicited a biphasic N400-late positivity pattern as opposed to the subject-initial order independent of context (i.e. IN-IO vs. IN-AS; AN-IO vs. AN-AS). The N400, replicated the finding in Experiment 2, is the correlate of grammatical function reanalysis – from subject reading to object reading – for the initial ambiguous argument. The late positivity, on the other hand, is a reflection of the processing of *well-formedness*, which usually accompanies the N400 when the sentence is disambiguated into a marked word order (Bornkessel & Schlesewsky 2006a). In addition, the topic context induced a LAN for the inanimate object-initial order in an animate topic context (i.e. AN-IO vs. AN-AS).

The reanalysis effect observed at the position of the verb indicates that neither topicality nor animacy can determine the interpretation of the clause-initial argument in this language. If topicality can determine a subject reading of the initial argument (i.e. topic = subject/Actor), a reanalysis is not needed for disambiguation to an object reading in the animate topic context (AN-IO), since the initial argument is not topicalised by the context and is thus an unlikely subject (i.e. non-topic ≠ subject/Actor). Our data pattern thereby suggests that the subject-preference cannot be reduced to a topic-preference in Chinese. Furthermore, this data pattern cannot be explained by semantically based accounts either. If an inanimate argument can induce an

Undergoer reading, reanalysis is not needed for the object-initial condition in both contexts, especially in the animate topic context (AN-IO) because the initial inanimate argument is not topicalised, which is even less likely to be an Actor. Hence, we do not think the reanalysis effect observed at the position of the verb reflects a semantic/thematic revision. Rather, such a revision was reflected by the LAN, which is an additional effect of the grammatical function reanalysis.

Finally, pragmatically based accounts seem unable to derive this reanalysis effect at the verb. Regardless of whether it is more difficult to recover a dropped argument with someone or something (e.g. to construe "I/someone" as the subject in "the novel understood …" after "what is about the novel?") or it is more difficult to integrate the argument in the context to the dropped argument position (e.g. to integrate "novel" as the object in "the actor understood .." after "what is about the novel?"), we should have seen a modulating influence of integration across contexts (i.e. either AN-AS > AN-IO vs. IN-IO > IN-AS or AN-IO > AN-AS vs. IN-AS > IN-IO). The assumption that the sentences with a subject-drop are generally more costly than those with an object-drop is difficult to derive from our data pattern as well (i.e. IO > AS in both contexts), as it clearly challenges the linguistic consent and previous corpus findings that a subject is more easily and often dropped than an object. In Experiment 3, this assumption is even less applicable. Recall that the verb in the sentence with an object-drop was unable to specify a particular object after we had loosened the lexical-semantic relatedness between the NP1 and the verb as in Experiment 2. Hence, it is not easy to obtain an object-drop reading at the verb position. Moreover, the filler sentences with overt objects also make us believe that the processing system would not fully establish an object-drop reading until the post-verbal constituent was encountered. A subject-drop in the object-initial condition, by contrast, could still be assumed since there were no OVS filler sentences, unlike in Experiment 2. Hence, the assumption that a subject-drop is more costly to process than an object-drop does not hold. Taken together, the N400-late positivity observed at the position of the verb reflects grammatical function reanalysis rather than semantic/thematic revision or pragmatic difficulties.

Although the topic context cannot override the subject-preference, it does mean that it does not influence the processing of an object-initial order at all.

Its influence is reflected by the LAN for the object-initial condition in the animate topic context (i.e. AN-IO). Recall that previous ERP studies conducted by Bornkessel et al. (2004b) also reported a similar LAN during word order processing in grammatical sentences. The LAN was interpreted as a reflection of a mismatch of the thematic hierarchy and case hierarchy (cf. Example 2.2 in Chapter 2). Applying a similar argumentation to the present LAN, it could also relate to two hierarchies: the topicality hierarchy (Given > New) and the animacy-based thematic hierarchy (Animate (Actor) > Inanimate (Undergoer)). However, unlike in German, it doesn't seem to result from one hierarchy mismatch with another, but results from the mismatch with both hierarchies, because the LAN disappeared in the inanimate topic context, where the condition was either supported by topicality hierarchy (IN-IO) or supported by the animacy-based thematic hierarchy (IN-AS). In the animate topic context, as the topicality hierarchy requires given-before-new order, and the animacy-based thematic hierarchy required animate-before-inanimate order, when the sentence was disambiguated into an opposite order of both hierarchies, a LAN resulted.

In summary, at the position of the verb, an N400-late positivity resulted from the violation of subject-preference on the one hand, and a LAN resulted from the violation of topicality and animacy on the other hand.

Altogether, we can argue that the overall data patterns at the position of the NP1 and the verb are most compatible with the minimal-dependencies account. As outlined in Chapter 3 and discussed in Experiment 2, the minimal-dependencies account assumes that the processing system preferentially analyses the first argument as the sole argument in an intransitive relation, i.e. an S reading. It is costly when this default intransitive relation has to be extended into a transitive relation and even more costly when the S reading has to be switched into a P reading rather than into an A reading. As the subject-preference is derived from the fact that it is the sole argument, it is independent of animacy and topicality. This is evident from the context-independent word order effects: an N400-late positivity for processing an object-inticial order at the position of the verb, in both contexts. Furthermore, this is also evident from our behavioural data as well. In the offline judgement, intransitive subject-initial filler was judged to be more acceptable than a

subject-initial condition (AS), and the latter was judged to be more acceptable than an object-initial condition (IO) in both contexts. Thus, the acceptability can be graded as follows: S-initial (99%) > AS (around 80%) > IO (around 50%). It is easy to see that the subject-initial condition was judged more acceptable than an object-initial condition in each of the two contexts; importantly, the subject-initial sentence and the object-initial sentence was judged the same in two different contexts, thereby indicating an overall subject-preference independent of the context.

Experiment 3 added a further piece of evidence to Experiment 2 in showing that the subject-preference in Chinese is so stable that it can be attested even when the initial argument is not topicalised by the context. Thus the subject-preference does not appear to be reducible to a topic-preference (i.e. topic = subject/Actor). Rather, the influence of a topic context is evident from the interaction of topicality and animacy: a posterior negativity (350-600 ms) for processing a new argument, but more pronounced in an animate topic context, and a LAN for the inanimate object-initial order in an animate topic context. In contrast to Experiment 2 where we did not use the context, the present findings revealed that the topic context cannot determine the interpretation of the initial ambiguous argument but only induce additional processing costs.

5.4 Summary of Experiments 1-3

Experiments 1-2 aimed to examine whether Chinese exhibits a subject-preference in spite of the controversial status of grammatical relations (e.g. “subject” and “object”) in this language. Experiment 3 aimed to examine whether Chinese was different from the previously examined languages in that it allows context to override such preference. As we wished to avoid the additional influences on processing that might be introduced by the use of complex constructions (e.g. RCs), we examined the subject-preference in simple NP-V sentences. Experiments 1-2 revealed that Chinese showed a subject-preference for an initial ambiguous argument as all other languages examined so far. Experiment 3 further revealed that this preference is independent of a topic context. These results thus support the view that the

relation of the S and A arguments *does* play an important role during online word order processing in Chinese as in previously examined languages.

The results above confirm the eADM's predictions on word order processing in Chinese NP-V constructions: the subject-preference should not be influenced by animacy and context since it derives from the fact that the initial argument is the sole argument independent of whether the sole argument is animate or inanimate, and whether it is topicalised or not topicalised by a context. However, the role of animacy in Experiments 1-3 was still not clear. This could be due to the fact that only one argument was involved in the ambiguous region in the NP-V constructions, which could have restricted the influence of animacy since it was reported to play a role between arguments (Philipp et al. 2008). Furthermore, due to the manipulation of Experiment 3, it was impossible to disentangle topicality and animacy. In order to clarify the influence of animacy in word order processing, we conducted Experiment 4 using simple sentences with two ambiguous arguments before the verb (NP1-NP2-V).

Chapter 6

Animacy in Processing NP1-NP2-V Constructions

6.1 Experiment 4: A comparison of SOV vs. OSV orders

The animacy effect at the initial ambiguous argument was not stable in Experiments 1-2. On the other hand, we did find an animacy-related effect for the inanimate subject-initial condition at the position of the verb (a larger N400 in Experiment 1) and at the position of the post-verbal argument (a late posterior NEG in Experiment 2), which suggested the processing system does not favour an inanimate subject in a transitive relation. Furthermore, in Experiment 3, a more pronounced processing cost was observed for non-topic/new vs. topic/given initial NPs in the animate topic context than in the inanimate topic context (a larger posterior NEG in Exp. 3). However, animacy cannot be easily disentangled from topicality in this experiment. Most importantly, the influence of animacy in Experiments 1-3 could have been restricted by the NP-V constructions in which the ambiguous region only spanned one single argument. Hence, the role of animacy is still unclear.

The auditory Experiment 4[37] thus aimed to shed light on the role of animacy in word order processing in Chinese by employing a sentence in which the ambiguous regions span over two arguments, i.e. ambiguous verb-final constructions (NP1-NP2-V). Such ambiguous verb-final constructions induce an object-initial preference rather than a subject-preference (OSV vs. SOV) (cf. Section 4.4 in Chapter 4). Furthermore, we should expect a stronger influence of animacy when the ambiguous region spans over more than one argument. The examples are shown in Table 6.1.

Table 6.1: Examples for each of the four critical conditions in Experiment 4. The abbreviations of contexts are the same as in Experiment 3: IN = inanimate topic context, AN = animate topic context. The abbreviations of conditions

37 Experiment 4 has been submitted. See Wang, Schlesewsky, Philipp, & Bornkessel-Schlesewsky (in press) in Publication in this thesis.

describe both the word order and the animacy of the two preverbal arguments. For example, O (in)-S (an) refers to a clause with an inanimate object preceding an animate subject. Note that the assignment of subject and object was disambiguated at the position of the sentence-final verb.

	Example	*Translation*
IN	子弹 怎么了?	bullet how-ASP
	zǐdàn zěnmele	'What is about the bullet?'
a. O(in)-S(an)	子弹 侦探 保存了。	bullet detective keep-ASP
	zǐdàn zhēntàn bǎocúnle	'The detective kept the bullet.'
b. S(in)-O(an)	子弹 侦探 击中了。	bullet detective hit-ASP
	zǐdàn zhēntàn jīzhòngle	'The bullet hit the detective.'
	Example	*Translation*
AN	侦探 怎么了?	detective how-ASP
	zhēntàn zěnmele	'What is about the detective?'
c. O(an)-S(in)	侦探 子弹 击中了。	detective bullet hit-ASP
	zhēntàn zǐdàn jīzhòngle	'The bullet hit the detective.'
d. S(an)-O(in)	侦探 子弹 保存了。	detective bullet keep-ASP
	zhēntàn zǐdàn bǎocúnle	'The detective kept the bullet.'

As is apparent from Table 6.1, the critical sentences are embedded in the same animate topic or inanimate topic contexts as in Experiment 3. However, in contrast to Experiment 3, there are two ambiguous arguments before the verb, only the first of which is rendered as the topic by the context. Furthermore, all of the sentences contained one animate and one inanimate argument followed by a verb requiring the animate argument to be the subject and the inanimate argument to be a plausible object. Such manipulation leads to the sentence-internal word order preference and animacy differing from those in Experiment 3.

Firstly, in contratst to the subject-preference in NP-V constructions attested in Experiment 4, an object preference (i.e. OSV) is derived from the NP1-NP2-V constructions via structural simplicity. As predicted by the eADM, in a highly pragmatically marked experimental environment in which only NP1-NP2-V templates are available (i.e. the simplest NP-V templates are not possible), OSV is preferred over SOV due to its simpler structure. The object-preference is also evident in offline judgement; under the condition that there

is no clear context bias, the ambiguous verb-final constructions are more likely to be interpreted as OSV order rather than SOV order, even though there is not any animacy support (cf. Example 4.22 and 4.23 in Chapter 4).

Furthermore, animacy functions as a relational information type rather than an animate-before-inanimate linear order. Recall that in Experiment 3 animacy applied only when two arguments appeared in the sentences. As only one argument had to be chosen to come before the verb in the target answer, the animate one was preferred. In Experiment 4, there were always two arguments before the verb and these two always differed in animacy. According to the theoretical assumptions put forward by Primus (1999), proto-Agent/Actor properties such as +control/+sentience entail animacy, whereas the corresponding proto-Patient/Undergoer properties (-control/-sentience etc.) do not entail inanimacy. Hence, deviations from animate Agent/Actor – inanimate Patient/Undergoer relations are costly because they lead to an increased overlap of potential Agent/Actor features. Given a two-argument relation with an animate and inanimate argument, NP1-NP2-V constructions can be either disambiguated to an OSV order or SOV order. There is not a clear animacy-based-linearization but a preference for animate subject and inanimate object (cf. Example 4.11 in Chapter 4) in contrast to Experiment 3.

Experiment 4 employed a 2 x 2 design that crossed the factors WORD ORDER (WO: SO vs. OS) and ANIMACY (AN: animate (an) vs. inanimate (in)). This manipulation allowed us to compare the effects of word order with animacy on online argument processing in Chinese. Concerning the point at which the disambiguation is affected, it could be at the NP2 or at the verb but not at the NP1 since it is always identical with the one in the context. If the OSV preference is already established at the NP1, an animacy-related N400 should be observable for the animate-initial sentence at the NP2, because the sentence is disambiguated to an object followed by an inanimate subject (cf. Philipp et al. 2008). However, as there is a completely equal chance of an initial argument being disambiguated as the subject or the object (see below), there is not a preference for the initial argument to be animate or inanimate (cf. Philipp et al. 2008). Hence, it is less likely for the processing system to already have a clear preference at the NP1[38] in NP1-NP2-V sentences. Rather, the

38 This is supported by a later statistical analysis for NP2, which showed that there was not any significant effect at this position.

preference should be established at the NP2, as a result of the preference of both OSV and animacy. Consequently, the sentence-final verb will disambiguate the sentence to an order going with or going against the preference established at the NP2. Thus, the disambiguating verb is chosen as the critical position for comparing ERP responses.

Below, we formulate hypotheses for the critical (disambiguating) verb position. If structure-induced object-initial order determines the interpretation of the preverbal two arguments, we should be able to see an increased processing cost for SOV as opposed to OSV in both contexts. However, if animacy (animate subject and inanimate object) determines the interpretation of the preverbal two arguments, we should be able to see a processing disadvantage for the conditions whenever the object is animate and the subject is inanimate (O (an)-S (in)/S (in)-O (an) vs. O (in)-S (an)/S (an)-O (in)). If word order and animacy jointly determine the interpretation of the preverbal two arguments, we predict the data pattern according to the contexts:

• Inanimate-initial conditions (O (in)-S (an)/S (in)-O (an))
Here, both word order and animacy favour the inanimate object-initial order. We thus expect to observe increased costs of disambiguation to the non-preferred inanimate subject-initial order (S (in)-O (an) vs. O (in)-S (an)). Previous results on word order disambiguation in verb-final constructions in German suggest that these may be reflected in an N400-like component (Haupt et al. 2008).

• Animate-initial conditions (O (an)-S (in)/S (an)-O (in))
Here, word order and animacy are in conflict. If word order overrides animacy, increased costs of disambiguation should be observable for the subject-initial condition (S (an)-O (in) vs. O (an)-S (in)). By contrast, the effect should be reversed if animacy overrides word order (O (an)-S (in) vs. S (an)-O (in)). If the two factors jointly determine the processing preference, the effects for this comparison should be less pronounced than for the comparison between the inanimate initial conditions (S (in)-O (an) vs. O (in)-S (an) > S (an)-O (in) vs. O (an)-S (in)).

• Residual influence of the subject preference?

If there is a residual influence of the subject preference in spite of the presence of two ambiguous preverbal arguments and a favouring OSV order, there may be some cost associated with the disambiguation to OSV order. However, even if such a preference is initially applied to the first argument, it likely would not persist until the position of the disambiguating sentence-final verb.

6.1.1 Materials and Methods

Participants. Twenty-eight monolingually raised native speakers of Mandarin Chinese (Beijing dialect) participated in the experiment after giving informed consent (13 females; mean age: 27.6 years; age range: 22-34 years). At the time of the experiment, all participants were residing in Berlin, Germany. Participants were right handed (as assessed by an adapted Chinese version of the Edinburgh handedness inventory; Oldfield 1971) and had normal or corrected-to-normal vision. Three participants were subsequently excluded from the final data analysis on the basis of excessive EEG artefacts and/or too many errors in the behavioural control task.

Materials. As shown in Table 6.1, four critical conditions were examined in this experiment. Each of the critical sentences contained two nouns and a verb in a string of NP1-NP2-V (Appendix 2). Within each of the four conditions, the total number of characters in each sentence was kept constant; only two character nouns and verbs were used for all sentences. 36 sets of the four conditions in Table 6.1 were constructed. The 144 critical sentences (36 in each condition) were interspersed with 288 filler sentences, which were composed by unambiguous verb-final constructions. They included active verb-final constructions with *bǎ* such as 侦探把子弹保存了(lit: “Detective BA bullet keep-ASP”; i.e. 'The detective kept the bullet.') and passive verb-final constructions with *bèi* such as 侦探被子弹击中了(lit: “Detective BEI bullet hit-ASP”; i.e. 'The detective was hit by the bullet.'). Hence, all the sentences were transitive sentences involving two arguments before the sentence-final verb. There was an equal probability of an initial argument being disambiguated as the subject or the object. Sentences were digitally recorded in the same way as for

Experiment 3. The 432 sentences in the experiment (144 critical sentences and 288 fillers) were presented to participants in two different randomised presentation orders.

Acoustic analyses. The auditory stimuli were recorded in the same way as for Experiment 3. Mean values for duration and intensity are given in Table 6.2 and pitch contours are visualised in Figure 6.1.

Table 6.2: Mean intensities and durations per constituent in each of the critical sentence conditions in Experiment 4. Standard deviations are given in parentheses.

Condition	*Mean intensity (dB)*			*Mean duration (ms)*		
	NP1	*NP2*	*Verb*	*NP1*	*NP2*	*Verb*
a. O(in)-S(an)	64.7(2.4)	62.1(2.7)	59.9(1.6)	741.2(67.8)	712.7(70.5)	1036.1(63.5)
b. S(in)-O(an)	64.8(2.5)	62.3(2.3)	59.7(1.4)	739.1(72.6)	701.5(55.6)	1017.3(48.5)
c. O(an)-S(in)	64.3(2.4)	62.7(2.5)	59.6(1.3)	762.0(78.0)	713.4(64.4)	1008.9(44.0)
d. S(an)-O(in)	64.4(2.2)	61.9(2.6)	59.6(1.4)	754.1(78.8)	708.7(61.6)	1034.1(60.7)

Descriptively, the values in Table 6.2 and Figure 6.1 indicate that there was a very low degree of variability in the acoustic parameters across conditions. The descriptive impression was confirmed by the statistical analysis. All critical acoustic parameters were subjected to an item-based 2 & 2 analysis of variance (ANOVA) involving the condition factors ANIMACY (AN: animate vs. inanimate) and WORD ORDER (WO: SO vs. OS). Note that significant pitch differences are only reported when they exceed the threshold for perception (cf. Rietveld & Gussenhoven 1985; t'Hart, Collier, & Cohen 1990). With regard to the duration of the constituents, the statistical analysis revealed marginally significant interactions of AN x WO at the verb position (F (1, 35) = 3.39, p <.08). Resolving this interaction by AN revealed a marginally significant simple main effect of WO in the animate-initial conditions (F (1, 35) = 4.11, p <. 06). The statistical analysis for intensity showed a main effect of WO for NP2 (F (1, 35) =

14.61, $p < .001$) and the verb (F (1, 35) = 16.40, $p < .001$). The analysis of the fundamental frequency did not demonstrate significance at any position.

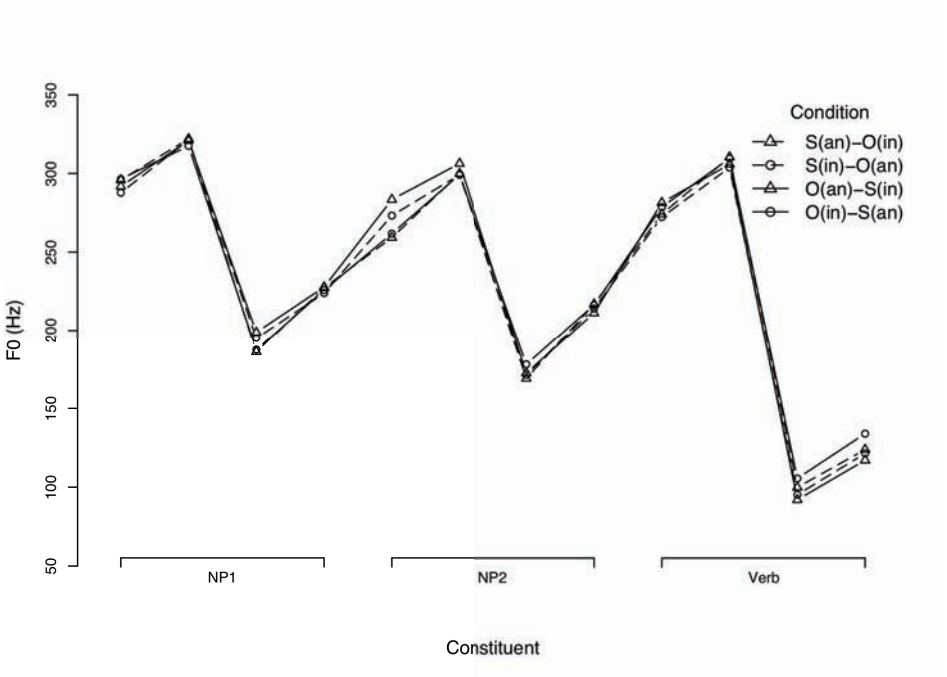


Figure 6.1: F0 contour of the critical sentence conditions in Experiment 4. Four values are given for each constituent: pitch onset, offset, maximum and minimum. Note that these are always displayed in a fixed order (onset, minimum, maximum, offset) and therefore do not reflect the true tonal contour of the individual sentence constituents.

Procedure. The experimental procedure was carried out in the same way as for Experiment 3, except that it was conducted as one session containing 12 experimental blocks, each of which comprise 36 sentences.

EEG Recording. The EEG recording was done in the same as in Experiments 1-2. Less than 11% of all trials were excluded from the analysis (10.6% for the position of NP1, 10.0% for the position of NP2 and 10.7 for the position of the verb) and exclusion rates differ significantly between the two word orders (NP1: F (1, 24) = 4.33, p<.05; NP2: F (1, 24) = 4.3, p<.05; Verb: F(1, 24) = 4.59, p<.05). □

Data analysis. The data analysis was carried out in the same way as in Experiments 1-2, except that we computed a repeated-measures analysis of variance (ANOVA) involving the within participants factors WORD ORDER (WO: OS vs. SO) and ANIMACY (AN: inanimate NP1 vs. animate NP1) and the random factors participants (F_1) and items (F_2).

6.1.2 Results

Behavioural data. The results from the behavioural tasks in Experiment 4 are shown in Table 6.3.

Table 6.3: Mean acceptability rates and reaction times for the judgement task and mean percentages of correct responses and reaction times for the comprehension task in Experiment 4. Standard deviations (by subjects and items) are given in parentheses.

Condition	*Acceptability judgement*		*Comprehension question*	
	Acceptability (%)	*Reaction times (ms)*	*Correct responses (%)*	*Reaction times (ms)*
a. O(in)-S(an)	90.0 (0.07)(0.14)	535.1 (134.5)(84.99)	96.5 (0.03)(0.07)	1319.0 (223.2)(180.89)
b. S(in)-O(an)	31.2 (0.26)(0.11)	653.2 (184.7)(73.95)	91.8 (0.06)(0.10)	1469.3 (266.5)(249.81)
c. O(an)-S(in)	44.6 (0.34)(0.11)	627.9 (188.4)(72.79)	93.0 (0.06)(0.10)	1441.1 (271.0)(219.77)
d. S(an)-O(in)	65.7 (0.24)(0.18)	638.0 (180.6)(87.94)	92.0 (0.06)(0.14)	1386.4 (217.8)(238.74)

With regard to the acceptability ratings of the judgement task, a repeated measures ANOVA revealed significant main effects of AN (F_1 (1, 24) =3.10, p < .1; F_2 (1, 35) = 8.05, p < .008) and WO (F_1 (1, 24) = 45.5, p < .001; F_2 (1, 35) = 139.03, p < .001) as well as an interaction AN x WO (F_1 (1, 24) =106.65, p < .001; F_2 (1, 35) =

213.54, $p < .001$). Resolving this interaction by AN showed that it resulted from a significant acceptability drop for subject- vs. object-initial sentences in the inanimate-initial conditions (F_1 (1, 24) =144.5, $p < .001$; F_2 (1, 35) = 445.7, $p < .001$) and a reversed word order effect (i.e. an acceptability drop for object-initial sentences) in the animate-initial conditions (F_1 (1, 24) = 20.57, $p < .001$; F_2 (1, 35) = 37.11, $p < .001$).

In summary, the judgement task showed an acceptability advantage for condition O (in)-S(an), in which both the object-initial order and the preference for an animate subject/inanimate object are fulfilled. All other conditions led to an acceptability drop. Interestingly, while the inanimate-initial conditions showed an acceptability advantage for the object-initial order, the preference reversed for the animate-initial conditions (which showed a higher acceptability for the subject-initial order). The statistical analysis of the reaction times for the acceptability task showed the main effects of AN (F_1 (1, 24) = 5.66, $p < .03$; F_2 (1, 35) = 12.10, $p < .001$) and WO (F_1 (1, 24) = 24.96, $p < .001$; F_2(1, 35) = 19.34, $p < .001$) as well as an interaction AN x WO (F_1 (1, 24) = 7.15, $p < .02$; F_2 (1, 35) = 14.09, $p < .001$). In accordance with the acceptability ratings, resolving this interaction by AN showed that the main effect of WO only reached significance in the inanimate-initial conditions (F_1 (1, 24) = 18.85, $p < .001$; F_2 (1, 35) = 37.05, $p < .001$) but not in the animate-initial conditions ($F_1/F_2 < 1$).

As for accuracy rates of the comprehension task, the main effects of AN and WO only reached significance in the analysis by participants: AN (F_1 (1, 24) = 3.57, $p < .08$; F_2 (1, 35) = 1.19, $p > .2$) and WO (F_1 (1, 24) = 11.84, $p < .003$; F_2 (1, 35) = 2.76, $p > .1$). There was not any interaction AN x WO neither by participants nor by items (F_1 (1, 24) = 2.91, $p > .1$; F_2 (1, 35) = 1.04, $p > .3$). Thus, there was a tendency for higher accuracy rates in inanimate-initial sentences and object-initial sentences. However, accuracy was high for all four critical sentence types (all accuracy rates > 90%). In the analysis of the reaction times for the comprehension task, the main effect of ORDER only reached significance in the analysis by participants (F_1 (1, 24) = 5.3, $p < .03$; F_2 (1, 35) =1.92, $p > .1$). In addition, there was an interaction AN x WO (F_1 (1, 24) = 31.0, $p < .001$; F_2 (1, 35) = 4.59, $p < .04$). Resolving the interaction by AN revealed that the simple main effect of WO was significant for inanimate-initial conditions (F_1 (1, 24) = 28.2, $p < .001$; F_2 (1, 35) = 6.60, $p < .02$) and marginally significant

only in the analysis by participants for animate-initial conditions (F_1 (1, 24) = 4.14, $p < .06$; F_2 (1, 35) < 1). Therefore, the interaction resulted mainly from the large difference in reaction times for the inanimate-initial sentences (with longer reaction times for subject-initial sentences).

ERP data. Grand average ERPs at the position of the disambiguating verb are shown in Figures 6.2 A and B for inanimate-initial and animate-initial sentences, respectively.

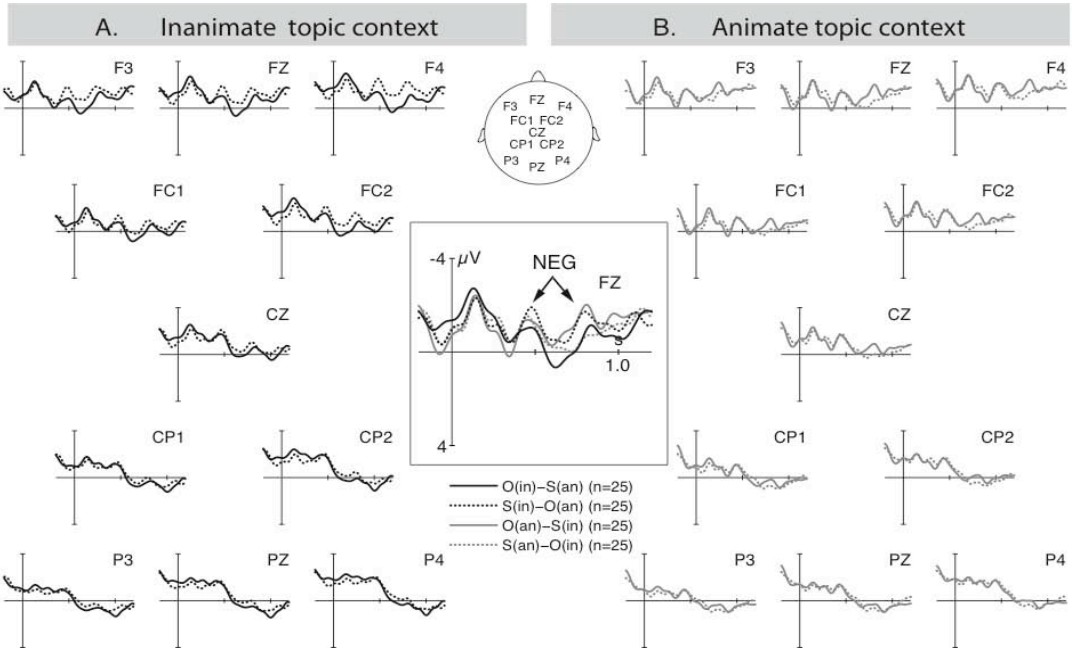


Figure 6.2: Grand average ERPs (n=25) time-locked to the disambiguating verb (onset at the vertical bar) in the four critical conditions in Experiment 4. Comparisons of OSV and SOV orders in inanimate-initial and animate-initial contexts are shown in Panels A and B, respectively. The enlarged centre panel shows a direct comparison of four conditions at one electrode. Negativity is plotted upwards.

As is apparent from Figure 6.2, inanimate–initial conditions disambiguated to a subject-initial order engendered an anterior negativity from approximately 400 to 800 ms post verb onset in comparison to their object-initial counterparts. Animate-initial conditions, in contrast, revealed that the object-initial word order elicited an anterior negativity in comparison to the

subject-initial order. However, this effect is delayed in comparison to that for inanimate-initial conditions, in which it appears between approximately 600 and 800 ms. In order to be able to provide an objective quantification of these effects and their respective latencies, we conducted an analysis in successive 50 ms time windows from 400 to 900 ms post verb onset. This analysis is summarised in Table 6.4.

Table 6.4: Summary of the statistical analysis of the ERP data in successive 50 ms time windows for Experiment 4. Significance codes used: ** (<0.01), * (<0.05), m (<0.08). Effects were considered reliable if they reached significance in at least two successive time windows (cf. Gunter, Friederici, & Schriefers 2000). These effects are indicated by shading. Abbreviations: AN (factor animacy: animate NP1 vs. inanimate NP1); WO (factor word order: SO vs. OS); LAT (lateral electrodes); MID (midline electrodes, FZ, FCZ, CZ); ROI (region of interest); N/A (not applicable, i.e. no simple comparison computed because of the absence of a higher-order interaction); df (degrees of freedom).

6.1.3 Discussion

In Experiment 4, we examined the role of animacy on incremental argument processing in Chinese by using NP1-NP2-V sentences in which the ambiguous region spanned two arguments.

For inanimate-initial conditions in which both the word order and animacy of the arguments favoured OSV order, we observed an anterior negativity between 450 and 850 ms for S (in)-O (an) sentences in comparison to O (in)-S (an). By contrast, animate-initial conditions, in which the two information types provided conflicting information, did not differ from one another in the earlier time window of 450-700 ms. Notably, however, they showed an ERP response that was intermediary between that of the two inanimate-initial conditions. In the later time window of 700-850 ms, animate-initial conditions showed an anterior negativity for subject-initial sentences in comparison to their object-initial counterparts. In the following, we first discuss possible interpretations of this data pattern and then discuss how it relates to the first three experiments and other cross-linguistic findings on incremental argument interpretation.

		400-450	450-500	500-550	550-600	600-650	650-700	700-750	750-800	800-850	850-900
AN df = (1, 24)	LAT	-	-	-	-	*	*	-	-	-	-
	MID	-	-	-	-			-	-	-	-
AN x ROI	LAT df = (3, 72)	-	-	-	-	* L-ANT: ** R-ANT: *	** L-ANT: ** R-ANT: **	-	-	-	-
	MID df = (2, 48)	-	m PZ: **	-	-	-	** FZ: m	-	-	-	-
WO df=(1, 24)	LAT	-	*	*	**	**	**	-	-	-	-
	MID	-	-	-	m	m	-	-	-	-	-
WO x ROI	LAT df = (3, 72)	-	-	-	-	-	-	-	-	-	-
	MID df = (2, 48)	-	-	-	-	-	-	-	-	-	-
AN x WO df= (1, 24)	LAT	-	*	-	*	**	**	**	**	**	-
	MID	-	-	-	-	-	*	*	**	*	-
AN x WO x ROI	LAT df = (3, 72)	-	-	*	-	*	*	m	**	-	-
	MID df = (2, 48)	-	-	-	-	*	*	-	**	-	-
Inanimate-initial conditions (effect of WO) df = (1, 24)	LAT	N/A	**	R-ANT: **	**	L-ANT: ** R-ANT: ** R-POST: **	L-ANT: ** R-ANT: m R-POST: **	L-ANT: * R-ANT: ** R-POST: **	L-ANT: ** R-ANT: ** R-POST: **	*	-
	MID	N/A	-	-	-	FZ: *	FZ: *	FZ: *	FZ: ** CZ: m	-	-
Animate-initial conditions (effect of WO) df = (1, 24)	LAT	N/A	-	-	-	-	-	L-ANT: ** R-ANT: m R-POST: m	L-ANT: ** R-ANT: **	*	-
	MID	N/A	-	-	-	-	FZ: *	FZ: * CZ: *	FZ: * CZ: *	*	-

Effects at the position of the verb: the interaction of word order and animacy in online argument interpretation in SOV/OSV

The present findings indicate that word order and animacy interact in online interpretation of arguments after extending the ambiguous regions spanning more than one argument in Chinese. Thus, we observed a negativity with an onset latency of approximately 450 ms for subject- vs. object-initial orders in the inanimate-initial conditions. In the same time window, animate-initial conditions did not differ from one another but engendered a negativity that was intermediary between the ERP responses for the two inanimate-initial conditions. This overall data pattern suggests that the language processing system of Chinese native speakers has a strong preference for an OSV analysis of NP1-NP2-V sentences; however, this is only the case when this analysis is also supported by animacy. When animacy conflicts with the OSV preference, there does not appear to be a clear preference for either object- or subject-initial orders. Rather, the intermediary ERP response to the animate-initial conditions suggests that the preferred analysis is not stable over trials, i.e. in some cases, the system follows the animacy cue, thereby adopting an Actor-initial analysis, whereas in other cases, it follows the word order cue, thereby adopting an object-initial analysis (for evidence that the analysis adopted by the processing system may have changed from trial to trial, see e.g. Traxler, Pickering, & Clifton, 1998; van Gompel, Pickering & Traxler 2001; van Gompel, Pickering, Pearson & Liversedge 2005). Assuming that both cues are approximately equally strong in determining the initial processing choice, both animate-initial conditions will require a reanalysis in approximately 50% of trials. In this way, both conditions engender a negativity in comparison to the optimal O (in)-S (an)-V condition, but this effect is smaller than in the S (in)-O (an)-V condition, which requires a reanalysis in all (or most) trials. These results therefore suggest that online interpretation of the arguments in NP1-NP2-V constructions in Chinese is jointly determined by word order and animacy.

Between 700 and 850 ms, the ERP responses to the disambiguating verb show an anterior negativity for inanimate subject-initial sentences and for animate object-initial sentences. On the one hand, this finding could be taken as an indication that in a post-initial processing stage at the position of the

disambiguating verb, the animacy cue dominates interpretation in the animate-initial conditions, thereby leading to a disadvantage for the object-initial structure. However, since the negativity between 700 and 850 ms essentially amounts to a main effect of verb type (i.e. a negativity for all sentences with an inanimate subject and animate object), there are also other possible explanations. One possibility which cannot be ruled out on the basis of the present data is that this effect simply reflects lexical differences between the two types of disambiguating verbs employed in the present experiment. According to this interpretation, the nature of the effect observed is somewhat surprising, because lexically-based differences are usually reflected in N400 effects (i.e. in centro-parietal negativities appearing within a time range of approximately 200-700 ms depending on the modality of presentation, cf. Kutas et al. 2006). Here, by contrast, we observed a late anterior negativity with a focus to the right for verbs leading to an inanimate subject/animate object interpretation. Nevertheless, since this comparison involves different verb types, a lexically-based explanation cannot be excluded.

Finally, an alternative possibility is suggested by Experiment 2 where we observed a late anterior negativity at the position of NP2 in NP1-V-NP2 sentences whenever the sentence involved a relation of an inanimate subject and an animate object. In other words, Experiment 2 showed a very similar effect to the late effect observed here, while not being subject to a lexical confound. This tentatively suggests that, rather than being due to inherent lexical differences between the two classes of verbs used for disambiguation in the present study, the late anterior negativity may reflect a more general disadvantage for transitive relations in which an inanimate entity acts upon an animate entity. It is possible that this additional disadvantage serves to tip the scales in favour of the subject-initial reading in the animate-initial conditions, thereby leading to a higher sentence-final acceptability for S (an) - O (in) vs. O (an)-S (in) sentences in spite of the preference for object-initial order. This interpretation fits well with the behavioural data, which suggests that in terms of offline judgements, animate subject-initial sentences are more acceptable than their animate object-initial counterparts. The overall behavioural data is supported by the *Competition Model* proposed by Li et al. (1993). This study showed that readers could more easily and rapidly interpret

NP1-NP2-V as OSV than SOV; however, there was a competition between SOV and OSV when both of the orders were in support of animacy, i.e. S (an)-O (in) vs. O (in)-S (an), which showed a similar interaction of animacy and word order as in the present study.

Summary of Experiment 4 in relation to Experiments 1-3 and other cross-linguistic findings

The clear influence of animacy in online argument interpretation in Experiment 4 contrasts the results of Experiments 1-2, where there was no stable animacy effect at the initial ambiguous argument. It also differs from the results of previous ERP experiments involving only one ambiguous argument before the verb in other languages (German: Schlesewsky et al., 2000; Turkish: Demiral et al., 2008) where there was not any effect of animacy under such circumstances. The results of Experiment 4 thus support that animacy serves to build up a thematic hierarchy between arguments rather than determine the interpretation of one single argument during online sentence processing. Furthermore, the relational nature of animacy is more visible in Experiment 4 than in Experiment 3, where it was difficult to separate the influence of animacy from topicality due to the ambiguous region spanning only one argument. In Experiment 4 where there were always two arguments before the verb and both subject-initial and object-initial orders were possible, animacy served as relational information to disambiguate the two preverbal arguments (i.e. animate subject and inanimate object) rather than a linear preference (i.e. animate-before-inanimate) as in Experiment 3.

Comparing the findings from sentences with two unambiguous arguments before the verb, the results of Experiment 4 are quite consistent with previous ERP findings on the processing of unambiguous verb-final sentences (*bǎ* and *bèi* constructions) in Chinese as well as in other languages in the sense that it showed that animacy influences online argument interpretation at the point where the processing system must construe a relation between the two arguments (cf. German, Tamil, Chinese results in Chapter 3, Section 3.2.2). Interestingly, the fact that Chinese allows animacy to be on par with word order preference (i.e. the intermediary response for the animate-initial conditions in the earlier 450-700 ms time window) and even allows animacy

override the word order preference (i.e. the negativity for the animate object condition vs. the animate subject condition in the later 700-850 ms time window), renders this language different from German, in which animacy is much weaker in processing the ambiguous verb-final constructions. Schlesewsky and Bornkessel-Schlesewsky (2009) used German NP1-NP2-V clauses, as shown in (6.1).

(6.1) Example stimuli from Schlesewsky & Bornkessel-Schlesewsky (2009)
a. S (an)-O (in): … dass Techniker Schalter bedienen.
that technicians switches operate
b. O (in)-S (an): … dass Schalter Techniker bedienen.
that switches technicians operate
'… that technicians operate switches.'

Similar to the present study, the clause-final verb served to disambiguate the animate argument to be the subject and the inanimate argument to be a plausible object. The only difference from the present study is that under the absence of unambiguous case marking, word order preference in German is subject-initial, although object-initial orders are possible and even preferred over their subject-initial counterparts in some circumstances in German (cf. Haupt et al. 2008). Hence, in (6.1a), both subject preference and animacy support a subject-initial reading, while in (6.1b), subject preference conflicts with animacy because the former calls for the NP1 to be the subject while the latter calls for the NP2 to be the subject. An ERP response time-locked to the disambiguating verb showed a broadly distributed negativity between 350 and 650 ms for O (in)-S (an) as opposed to S (an)-O (in), which suggested that animacy (animate subject and inanimate object) in German cannot override the preferred word order.

All things considered, Experiment 4 showed a clear interaction of word order and animacy in online argument interpretation in Chinese after extending the ambiguous regions to span more than one argument. In contrast to Experiments 1-2, the clear influence of animacy is highly compatible with the findings in unambiguous verb-final sentences (*bǎ* and *bèi* constructions) in showing that animacy only appears to play a crucial role in online argument interpretation in verb-final sentences when the processing

system must establish a relation between several arguments[39]. Furthermore, the role of animacy in processing ambiguous verb-final constructions distinguishes Chinese from German, in which the animacy is considerably weaker.

39 The effects of animacy on the processing of transitive relations in unambiguous sentences is further supported by a number of findings on the processing of relative clauses in English (Traxler et al. 2002, 2005; Chen, West, Waters & Caplan 2006) and Dutch (Mak et al. 2002, 2006).

Part III

Summary and Discussion

Chapter 7

General Discussion

The present thesis is the first ERP study to investigate whether or not the subject-preference[40] – a preference for an S/A reading of an initial ambiguous argument – can be observed in Chinese. In contrast to previously examined languages (most of which are Indo-European languages), Chinese is a language in which the grammatical relations such as the "subject" are not easy to define syntactically. Assuming that semantic/pragmatic information (traditionally defined) such as animacy and context could be responsible for the possible processing differences between Chinese and previously examined languages, the present thesis is also the first ERP study to examine whether and how these two information types influence word order processing in Chinese.

Previous behavioural and neurophysiological studies showed that the subject-preference can be widely observed in a number of languages (Dutch, English, French, German, Italian, and Spanish). All these languages showed that processing costs increase when the initial argument is disambiguated towards an {O} reading, because all of them involve the reanalysis of the previously {S, A}-relation assigned to that argument. In this context, the findings from Chinese become highly relevant. As outlined in Chapter 4, the relation between S and A arguments is not nearly as strong in Chinese as in these previously examined languages, as a {S, O}-relation is also allowed under many circumstances (e.g. in coordinations like Example 4.4 in Chapter 4). Thus, Chinese poses a challenge to the seemingly cross-linguistic universal processing strategy; hence, the findings from Chinese is of high importance to model language comprehension.

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40 The subject-preference also refers to the way the processing system prefers subject-extractions over object-extractions in relative clauses (see Sec. 1.3.1). However, since the Chinese experiment results are somewhat contradictory in this regard and further there are additional influences that could impact the processing of relative clauses (see Footnote 4 in Chapter 1), subject-preference in relative clauses was not of crucial concern in the present study.

If Chinese does not show subject-preference, this would imply that the subject-preference should only be confined to the previously examined languages (e.g. Indo-European languages in which the status of the subject are well-established) and thus speaks against the assumption of a universal processing strategy. If, by contrast, Chinese shows a subject-preference, given the controversial status of the subject category, such a finding would support the assumption of a universal language processing strategy that engenders the subject-preference. If Chinese shows a subject-preference but it differs from previously examined languages with respect to the fact that it allows animacy and context to override this preference in certain circumstances, this would require a distinction between a universal language processing strategy from specific language processing characteristics.

In order to shed light on this question, the present study employed the methodology of event-related potentials (ERPs) to investigate online word order processing in Chinese. Below, we first summarise the experimental results and then turn to discuss the implications for language comprehension architecture, especially how these data patterns are derived from the eADM. Finally, we provide an outlook for future research before concluding the present work.

7.1 Summary

Results of the four experiments are summarised in Table 7.1.

Table 7.1: Conditions and ERP components at the critical positions in four experiments. Conditions in Experiments 1-2 were abbreviated by both animacy and word order of the initial argument, for example, IO referred to an inanimate object-initial order. Conditions in Experiment 3 were abbreviated by adding the codes for the contexts (animate/inanimate topic contexts) to the target sentences used in Experiment 2. For example, IN-IO referred to an additional inanimate topic context before the sentence with inanimate object-initial order. Conditions in Experiment 4 were abbreviated by both the word order and the animacy of the two ambiguous arguments. For example, O (in)-S (an) referred to a sentence with an inanimate object preceding an animate subject. Different time windows were provided to distinguish the same effect in Experiment 4.

		NP1	*Verb*	*NP2*
Exp 1 (Visual)	**IO**	-	-	N400-late POS
	AS	-	N400	-
	IS	-	larger N400	-
Exp 2 (Visual)	**IO**	N400	N400	N400-late POS
	AS	-	-	-
	IS	N400	-	Late posterior NEG
		NP1	*Verb*	*Adv*
Exp 3 (Auditory)	**IN-IO**		N400-late POS	-
	IN-AS	Posterior NEG	-	-
	AN-IO	larger Posterior NEG	LAN, N400-late POS	-
	AN-AS	-	-	-
		NP1	*NP2*	*Verb*
Exp 4 (Auditory)	**O(in)-S(an)**	-	-	-
	S(in)-O(an)	-	-	Anterior NEG (450-850 ms)
	O(an)-S(in)	-	-	Anterior NEG (700-850 ms)
	S(an)-O(in)	-	-	-

In Experiments 1-3, we compared the processing of subject-initial and object-initial orders in NP-V constructions in which the ambiguous region only spanned over one argument. In the first visual experiment, we did not observe any signs of reanalysis-related processing difficulty for the condition that disambiguated to an object-initial condition (IO, e.g. "novel read …") at the position of the verb. Rather, both subject-initial conditions (AS, e.g. "actor read …"; IS, e.g. "novel educate …") showed an N400 in comparison to the object-initial condition at this position. The N400, as revealed in a relatedness questionnaire study, resulted from the fact the lexical-semantic relatedness between NP1 and the verb in subject-initial conditions was not as close as in object-initial conditions (e.g. "the actor" and "read" was not as close as "the novel" and "read") (for a lexical-semantic relatedness, cf. Kutas & Federmeier 2000). At the post-verbal NP, by contrast, the object-initial condition showed a biphasic N400-late positivity pattern in comparison to both controls, thereby suggesting that an OVS order is clearly non-preferred in Chinese. However, as

a more precise functional interpretation of the ERP pattern at post-verbal NP crucially depends on the question of which processing choices were undertaken at the position of the verb, we need to disentangle the relative contribution of lexical and non-lexical factors in eliciting the ERP pattern observed in Experiment 1. Thus, a second visual experiment was conducted to control for the relatedness between the NP1 and the verb across conditions.

After equating lexical-semantic relatedness across conditions in a second relatedness questionnaire study, the object-initial condition in Experiment 2 showed a reanalysis N400 at the position of the verb as opposed to both subject-initial conditions. The findings in Experiment 2 thus revealed that Chinese, like other languages that have been examined, also shows a subject-preference in spite of the controversial status of the subject category. Furthermore, Experiment 2 replicated the N400-late positivity at the position of the post-verbal NP for the object-initial condition as in Experiment 1. The late positivity, not surprisingly, reflected the ill-formedness detection (cf. Bornkessel & Schlesewsky 2006a) when the sentence was disambiguated to an ungrammatical OVS order (note that OV was grammatical until the post-verbal S was encountered). The N400 might either reflect the increased effort required to process an unpredicted argument or costs of the additional referential specification of a subject that was previously thought to be unexpressed.

Considering that the word order in Chinese is usually described as pragmatically driven, with the clause-initial position viewed as a topic rather than the subject. Given that there is a default association of "topic = subject/Actor", the subject-preference observed in Experiment 2 may therefore reflect a topic-preference (i.e. analysing an object/Undergoer as a topic is costly) in this language. In order to test this hypothesis, in Experiment 3, we added an inanimate topic context (IN) such as "what is about the novel?" and an animate topic context (AN) such as "what is about the actor?" before the object-initial condition (IO) such as "novel understood a little.", using audio to underscore the dialogue-like nature of the critical question-answer pairs. If the subject-preference can be reduce to the topic-preference, we should observe a reanalysis effect for the object-initial condition in the context IN because the topic context supports a subject reading of the NP1 while the verb disambiguates it to an object reading. By contrast, no reanalysis is needed for

the object-initial condition in context AN, because no such conflict occurs when the NP1 is not topicalised by the context (and is thus not a subject/Actor). However, the results showed that the object-initial condition elicited a biphasic N400-late positivity in comparison to the subject-initial condition in both contexts (IN-IO vs. IN-AS, AN-IO vs. AN-AS). These results thereby suggest that the subject-preference is independent of a topic context. In other words, a topic context *cannot* override the subject-preference in this language. Rather, it can only induce additional effects (a posterior NEG at NP1 and a LAN at the verb) for the object-initial condition. Thus, Experiment 3 provided strong evidence for supporting the subject-preference during the processing of NP-V constructions in Chinese, which is independent of a topic context. In accordance with Experiments 1-2, these results revealed that the {S, A}-relation does play an important role during online processing in Chinese, in contrast to the structure of this language that shows little evidence for the {S, A}-relation.

An overall observation across Experiments 1-3 suggested that the influence of animacy on processing initial ambiguous arguments still remains unclear. On the one hand, the inanimate initial argument did not consistently engender an N400 (absent in Exp. 1 but present in Exp. 2). On the other hand, we found animacy-related effects in all of these three experiments. There were increased processing costs for the inanimate subject-initial condition at the disambiguating verb (a larger N400 in Exp. 1) and at the post-verbal argument (late posterior NEG in Exp. 2), which suggested that the processing of a transitive relation with an inanimate subject and animate object was not preferred. Furthermore, when the initial NP follows an inanimate or animate topic context, a more pronounced processing cost was observed for non-topic/new vs. topic/given initial NPs in the animate topic context than in the inanimate topic context (a larger posterior NEG in Exp. 3). However, animacy cannot be easily disentangled from topicality in this case. Most importantly, the influence of animacy could have been restricted by the NP-V constructions used in Experiments 1-3, because these constructions were associated with the ambiguous region that only spanned one single argument.

In order to shed light on the role of animacy, in the auditory Experiment 4, we employed ambiguous verb-final constructions, i.e. NP1-NP2-V, where ambiguous regions extended over two arguments. The two preverbal

arguments always differed in animacy and ambiguity between subject/object readings until the verb was encountered. In an environment where the NP-V templates were not available, the processing system chooses an OSV rather than SVO order for NP1-NP2-V constructions via structural simplicity. Animacy serves as relational information between arguments: it either supports (i.e. animate subject and inanimate object) or is against (i.e. inanimate subject and animate object) this object-initial preference. At the position of the disambiguating verb, all of the sentences that deviated from inanimate object-animate subject-verb order elicited an anterior negativity. This negativity was most pronounced in inanimate-initial conditions in a time window of 450-850 ms, where both word order and animacy did not favour the non-preferred SOV. In animate-initial conditions where the context and animacy were in conflict, an intermediary response was observed in the earlier time window of 450-700 ms, which suggested that word order and animacy jointly determine online interpretation of arguments. This negativity was reversed in a later time window of 700-850 ms, thereby showing that animacy finally overrode the context-induced OSV preference. However, we cannot rule out the potential influence from the lexical difference between verb types.

In contrast to Experiments 1-3, Experiment 4 showed that animacy has a clear influence on the processing of more than one argument. The influence of animacy on two preverbal ambiguous arguments was consistent with previous ERP findings on the processing of unambiguous verb-final sentences in Chinese (i.e. *bǎ* and *bèi* constructions in Philipp et al. 2008) as well as in other languages such as German and Tamil. Interestingly, the finding that Chinese allows animacy to be on par with word order preference, and even allows animacy to override the word order preference, renders this language to be different from German, in which animacy is much weaker in processing ambiguous verb-final constructions (Schlesewsky & Bornkessel-Schlesewsky 2009).

7.2 Implications

7.2.1 The Subject-Preference (Exp. 1-3)

The online processing of Chinese is more conservative than its descriptive grammar, favouring the {S, A}-relation. This finding provides another important piece of evidence to the cross-linguistic preference for the S or A reading of an initial ambiguous argument. Assuming that the observations of a subject-preference in different languages all reflect a similar underlying processing strategy, this would appear to be the most parsimonious interpretation.

As outlined in Section 1.2.1, most studies derive the subject-preference examined previously in Indo-European languages (typologically "subject-prominent" languages) from the perspective of phrase structure. For example, a pure phrase structure-based account explains the subject-preference under the assumption that subject- and object-initial orders are associated with differing phrase structures (Gorrell 1996, 2000). Filler-gap approaches assume that object-initial orders are the result of movement operations. Consequently, subject- and object-initial sentences differ either with respect to the distance between a filler and its gap (Crocker 1994; Frazier 1987; Frazier & Flores d'Arcais 1989) or with respect to the existence of a filler-gap dependency (de Vincenzi 1991, 2000). However, as outlined in Section 3.2.1, these structure-based accounts encounter several problems in regard to the full range of cross-linguistic findings on subject preference. For example, the findings from Turkish cannot be derived straightforwardly via phrase structure, since this language allows – or even favours – subject drop. Hence, the initial argument can be analysed as residing in its base position whether it is assigned as a subject or an object reading.[41] Similarly, due to the possibility of a subject drop, the processing of an initial object does not entail the syntactic prediction of a subject at some later point in the sentence.[42] Furthermore, although

41 For arguments against a frequency-based account of the subject preference, see Fanselow, Schlesewsky, Cavar, & Kliegl (1999) and Demiral (2007) for German and Turkish, respectively.

42 Note that this argument holds whether the dropped subject is represented syntactically as a phonologically null element (pro; Chomsky 1981) or not (e.g. Van

working memory accounts could derive the processing advantage of subject-initiality in general (Gibson 1998, 2000), they also assume an additional object-gap to derive the increased memory-costs for object-initial orders. Thus, the common characteristic between working memory accounts and the first two structure-based accounts is that they are all syntactically based, i.e. they are crucially based on the assumption that subjects and objects can be distinguished structurally in a language. From a cross-linguistic perspective, however, the assumption of a universal "subject" category is rather controversial. Chinese is a case in which the subject category is difficult to define syntactically. Hence, the syntactically based accounts face difficulties in deriving a subject-preference in languages such as Turkish and in making predictions for word order processing in Chinese.

Furthermore, it is also difficult to derive the subject-preference from semantically/thematically based accounts that assign the Actor role to the first argument when it is animate (cf. *Agent-Action-Object strategy* in Bever 1974). Firstly, the initial arguments in the object-initial condition in the present study were inanimate and thereby not proto-actors. Secondly, the findings from unambiguous verb-final constructions in Philipp et al. (2008) revealed that an initial argument in Chinese is interpreted neither as an Actor nor as an Undergoer, independent of whether it is animate or inanimate. Preferences with respect to Actor or Undergoer only become observable when two arguments are related to one another (cf. discussion on the influence of animacy below for more details). Hence, the subject-preference should not be a semantic/thematic choice by the processing system either. The finding that the subject-preference can be observed for both initial ambiguous animate and inanimate arguments in Turkish further showed that this preference is not easily reconciled with a frequency-based account, because corpus analyses conducted by Demiral (2007) showed that an initial ambiguous inanimate argument is more likely to be an object than its animate counterpart.

Valin 2005). If a syntactic representation is assumed, the pro representing the null subject could simply be postulated and integrated as soon as the ambiguous argument is analysed as an object, thereby circumventing an additional prediction that must be maintained in working memory.

The present findings from Chinese are most compatible with the accounts of minimal dependencies and structural simplicity proposed within the eADM. In contrast to the syntactically based accounts above, the eADM accounts for the subject-preference in a cross-linguistic, phrase structure-independent way: it is a by-product of a more general processing preference for minimising dependencies. Notably, the minimal-dependencies account does not rule out the idea that subject-preference could be influenced by structural factors. In Experiments 1-3, where we used sentences with the ambiguous region spanning one argument, the processing system first preferred the simplest structure, i.e. NP-V in Stage 1 of the processing and an intransitive SV interpretation in Stage 2 of the processing via assigning a [-dep] feature to the initial NP, since an intransitive subject is independent from the state of affairs by virtue of the fact that there was no second argument. When such an intransitive interpretation cannot be upheld by the transitive verb calling for a second argument, the processing system switched the interpretation from SV to AV rather than OV since Undergoers are semantically dependent on Actors (Primus 1999). The [-dep] feature was assigned to a transitive subject whereas [+dep] was assigned to an object in order to avoid the need to establish unnecessary dependencies. In this way, a preference for the relation of {S, A} was observed in Chinese, even though it is difficulty to syntactically define the subject in this language.

The minimal-dependencies account also nicely explains why the subject-preference cannot be influenced by animacy (thus differs from semantically/thematically based accounts above) and context (which refers to the topic context in the present study). As this subject-preference is derived from the fact that it is the sole argument itself, it does not matter whether the sole argument is animate or inanimate, and whether it is topicalised or not topicalised by a context. However, it should be noted that such a minimal-dependencies-based account does not rule out the influence of structural factors. As shown in Experiment 4, the minimal-dependencies-based argument interpretation is constrained by the syntactic template selection in Stage 1 of the processing. When NP1-NP2-V excluded the simplest NP-V templates and thus the intransitive interpretation, the processing system chooses the object-initial order (OSV) over the subject-initial order (SOV) since the former has a simpler structure (the former has one NP before the core and

a core template while the latter requires two NPs before the core is in line with its extreme pragmatic markedness, cf. Fig. 4.1 in Chapter 4, cf. discussion on the influence of context below for more details).

To conclude, the proposal that the subject preference is a by-product of the processing system's endeavour to minimise dependencies (as formalised via the assignment of the [-dep] feature) can account for why this preference is so pervasive across typologically different languages and why it occurs even when there is not an obvious structural motivation for it (e.g. in Turkish) or when the subject category only plays an extremely limited role in the syntax of the language in question (e.g. in Chinese). Importantly, the minimal-dependencies account is also compatible with the findings that the subject-preference is not influenced by animacy and the topic context during the processing of NP-V constructions in Chinese. However, the simplicity-based structure selection can constrain the minimal-dependencies-based argument interpretation and thereby influences the subject-preference. Altogether, the findings of the subject preference in NP-V constructions (Exp. 1-3) and the object-initial preference in NP1-NP2-V constructions (Exp. 4) in Chinese support an underlying universal lingual mechanism – minimal-dependencies and structural simplicity – which is independent of the subject and object categories, as proposed by the eADM.

7.2.2 The Influence of Animacy (Exp. 4)

The results from Experiment 4 revealed a number of interesting similarities and differences between Chinese and other languages with respect to the effects of animacy on incremental argument interpretation. On the one hand, Chinese behaves similarly to languages such as German, Tamil and Turkish in that animacy does not impact the processing of a single argument but instead impacts the processing of more than one argument. Sentences involving ambiguous regions spanning two arguments, namely *ambiguous verb-final constructions* (NP1-NP2-V), showed a processing cost for the order of an animate object followed by an inanimate subject, like *unambiguous verb-final constructions* (NP1-*bǎ/bèi*-NP2-V, Philipp et al. 2008). On the other hand, Chinese differs quantitatively from languages such as German in the extent to which it allows animacy to modulate the processing preference in two pre-verbal

ambiguous arguments. While the findings in Experiment 4 are in favour of animacy playing a particularly strong role in Chinese, recent findings from German suggest a relatively weaker role of animacy, as they have showed that the subject-preference cannot be overridden by animacy in ambiguous verb-final constructions (Schlesewsky and Bornkessel-Schlesewsky (2009) [43] . Integrating the results of Experiment 4 into an overall cross-linguistic data pattern, the influence of animacy in an incremental argument interpretation can be summarised as follows:

(7.1) Animacy as a relational prominence information type. Animacy does not influence the interpretation of single arguments. Rather, it comes into play as soon as an intransitive reading has been ruled out and several arguments must be related to one another.

(7.2) Animacy as an information type that is cross-linguistically applicable but varies in strength of applicability. Whereas animacy generally modulates the processing of several arguments in relation to one another, the degree to which such a modulation takes place depends on the language being processed and on the other information types available to the processing system.

Then what are the consequences of this overall data pattern for models of language comprehension? First of all, it appears unlikely that we are simply dealing with frequency-based effects here (in the sense that the cross-linguistic differences observed could be due to differences in the likelihood of the subject and object in transitive relations being animate and inanimate, respectively). As shown in a corpus count by Jäger (Jäger, 2007), for example, sentences with an animate subject and inanimate object have a frequency advantage over deviating animacy patterns even in a language like English, in

43 Incidentally, similar considerations have been shown to apply for another prominence dimension in German, namely definiteness/specificity: results from ERPs (Haupt et al. 2008) and eye-tracking (Kretzschmar, Bornkessel-Schlesewsky, Staub, Roehm & Schlesewsky submitted) suggest that definiteness/specificity distinctions between two ambiguous arguments do not override the subject preference, but may help to ease reanalysis.

which animacy can never determine interpretation (cf. Section 3.2.2 in Chapter 3). Jäger reported a similar pattern for Swedish, as did Demiral (2007) for Turkish, thereby attesting to the cross-linguistic stability of this effect (also cf. the definition of "natural transitive constructions" in Comrie 1989).

Nevertheless, the use of animacy as a disambiguating feature in sentences with ambiguous regions spanning two arguments differs across languages. Of course, in the absence of detailed cross-linguistic corpus studies on this issue, it cannot be ruled out that the different patterns might be due to more subtle frequency differences or interactions between animacy and other information types. Nevertheless, it appears worth noting that the general, apparently cross-linguistically applicable frequency advantage for sentences with animate subjects and inanimate objects impacts the processing of individual languages and constructions in distinct ways. Whereas animacy appears to have a similar impact in *unambiguous verb-final constructions* cross-linguistically, its effects in *ambiguous verb-final constructions* are much more varied.

Secondly, the overall pattern of results is not easily reconciled with the syntactically based accounts. Whereas one might argue that the OSV preference in Chinese *ambiguous verb-final constructions* can be derived via some phrase structure principle, the modulation of this preference via animacy is not easily explained by such approaches. Similarly, the fact that animacy does not impact the processing of single arguments but only modulates the analysis of sentences with at least two arguments clearly cannot be explained in structural terms.

Finally, the findings in Experiment 4 could not be derived from semantically based accounts, i.e. where an animate argument directly leads to a subject interpretation and an inanimate argument directly lead to an object interpretation. For example, in interpreting the results from the processing of object relative clauses in Dutch, Mak et al. (2002, 2006) argue that animacy - and particularly the relative animacy of two arguments in relation to one another - may serve to guide readers' initial analysis of a relative clause (i.e. determine which argument is analysed as the subject and which as the object, cf. Section 1.2.2 in Chapter 1). This is clearly not the case when observing data from Chinese, as we should otherwise have found a reversal of the word order effect from 450 ms onwards depending on the animacy of NP1 and NP2.

Rather, our findings suggest that in Chinese, animacy and OSV order interact with each other in determining online interpretation of two ambiguous arguments. Furthermore, the reanalysis effect observed at the disambiguating verb in Experiments 1-3 strongly speak against the semantically/thematically based accounts. If the inanimate argument directly leads to an object reading, a reanalysis should not be required.

In a cross-linguistic view, the present data is most compatible with the eADM's proposal. As mentioned above, the eADM assumes that subject preference is a by-product of the processing system's endeavour to minimise dependencies. This also explains why the subject-preference is not influenced by animacy in the case of ambiguous regions spanning a single argument, since a [-dep] reading is also possible for an inanimate argument.[44] By contrast, animacy effects are expected to be potentially stronger when the ambiguous region spans two arguments since, in this case, two arguments can compete for the [-dep] feature. The avoidance of interference/competition for the [-dep] feature is expressed by the principle of Distinctness during Stage 2 of the processing within the eADM (for interference-based accounts in sentence processing, see e.g. Gordon, Hendrick, & Johnson 2001; Lewis, Vasishth & van Dyke 2006; van Dyke & McElree 2006; for details on the notion of competition for the [-dep] feature, cf. Bornkessel-Schlesewsky & Schlesewsky 2009). In fact, the preference for intransitive relations can also be derived from this principle since the simplest way to be distinct is to be the only argument ("vacuous distinctness") (Bornkessel-Schlesewsky & Schlesewsky 2009a).

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44 Note that this statement is not contradicted by the findings of animacy-based effects at the position of an initial argument (e.g. Weckerly & Kutas 1999, Kuperberg et al. 2003), since these could be due to lexical differences between animate and inanimate nouns. It is also compatible with the notion that the interpretation of an NP-V fragment is influenced by the animacy of the argument (e.g. Kuperberg et al. 2003; Kim & Osterhout 2005; also cf. Lamers & de Hoop 2005; Lamers 2007), as discussed, for example, in Bornkessel-Schlesewsky and Schlesewsky (2008). Rather, the crucial claim here is that there is no evidence to date to support that the inanimacy of an initial argument would lead the processing system to adopt an object reading before the next constituent is encountered.

Within this model, animacy is universally functionally equivalent to prominence information types such as case marking and linear order in determining the argument interpretation independently of the verb (also cf. Bates 1982). Processing requires the least amount of effort when the subject and the object are maximally distinct from one another in terms of all possible prominence information types, while the relative importance of prominence information types is language-specific or depends on the other information types available.

The effects of animacy are very similar cross-linguistically with respect to the processing of *unambiguous verb-final constructions*. This is likely the case because these effects are not due to violations of Distinctness: (a) since the structures in question are unambiguous, Distinctness is already guaranteed by some other means, and (b) if these effects were Distinctness violations, they should be symmetrical, i.e. manifest themselves in S-*bǎ*-O-V just as in O-*bèi*-S-V, which they do not as was evident in Philipp et al. (2008). Thus, rather than expressing Distinctness problems, the N400 for the inanimate subject following the object reflects the mismatch between an expected, proto-actor and the argument actually encountered.

In the processing of *ambiguous verb-final constructions*, the interaction of structure-induced OSV order and animacy observed in Chinese supports animacy as important prominence information that distinguishes the two ambiguous arguments and influences their interpretations. In the initial processing stage of this model, there are two potential template configurations available for NP1-NP2-V, i.e. OSV and SOV. The processing system chooses OSV since its structure is simpler than SOV. This preference is stronger when it is supported by animacy (i.e. O (inanimate)-S (animate)-V). When animacy supports an opposite SOV order, there is not a clear preference for either OSV or SOV in an early time window, thereby suggesting that both OSV and animacy jointly determine the interpretation of arguments. However, a preference for SOV results in a later time window, showing that the animacy cue finally overrides OSV order in a later processing stage.

Chinese differs from German with respect to the processing of *ambiguous verb-final constructions*, which revealed that the effect of animacy differs from language to language, or even differs from construction to construction within one language such as in Chinese. This presumably relates to the status of

other relevant information types, which might influence the argument of Distinctness. In a language like English, for example, the relative linear positioning of the arguments unambiguously serves to guarantee Distinctness. Hence, animacy does not impact subject and object interpretation, whereas in languages like German, Distinctness is typically guaranteed via case marking or in the absence of unambiguous case marking, via linear order. There are, however, certain limited conditions under which animacy steps in to determine subject/object interpretation (e.g. in sentences with dative object-experiencer verbs such as *gefallen*, "to be pleasing/appealing to"). In Chinese, interestingly, the strength of animacy influence seems to be different even across constructions. In NP-V constructions, like those used in Experiments 1-3, the verb serves to distinguish two arguments, which results in a closer correspondence between subject and the preverbal position, and between object and post-verbal position results like in English (also cf. similar observations from Huang and Chui (1997)'s corpus study in Chapter 4, Section 4.3.1). In fact, there's potential supporting evidence for this idea in Philipp et al (2008). In this study, inanimate-inanimate constructions engendered a late positivity at the position of NP2 in Experiment 1 (*bǎ* and *bèi* constructions), while no such effect was observed in Experiment 2, which employed relative clauses and therefore introduced an intervening verb between the two arguments. Though we could not rule out the possibility that the distinction could be realised by means of the clause boundary rather than the position of the verb, it nevertheless supports the basic idea that two arguments are guaranteed to be unambiguously distinct from each other. By contrast, in verb-final constructions as in Experiment 4, where topic-prominence ensures a relatively higher degree of freedom with respect to the positioning of subject and object. The linear position of the arguments is therefore not a sufficiently strong determinant of Distinctness, thus leading to animacy having relatively stronger influence.

7.2.3 The Influence of Context (Exp. 3)

Regarding the influence of context in incremental argument processing, first of all, it is important to note that it is not possible to provide specific conclusions in this regard since the present study is the first to investigate

how context influences online sentence-internal word order processing in Chinese. Moreover, because of the lack of parallel studies in other languages for the moment, there is not an existing model (including the current version of the eADM) available to evaluate the data patterns cross-linguistically. Nevertheless, we can at least make speculations on the basis of the present findings from Chinese.

The speculations on the context influence here are based on the influence of a topic context tested in Experiment 3. In this experiment, we used a minimal context, i.e. "what is about NP?", to explicitly topicalise or not topicalise the initial NP of the target sentence. The findings from Experiment 3 suggest that topicality shares similarities with animacy in the following respect:

(7.3) Topicality as a prominence information type. Topicality does not influence the interpretation of single arguments.

Much like animacy, Experiment 3 showed that a topic context cannot determine the interpretation of the initial argument by itself even in Chinese, a language in which the clause-initial position is often described as a topic rather than a subject. This means that the observed subject-preference should not be reduced to a topic-preference (i.e. a topicalised initial argument is a subject). However, a topic context can induce additional difficulties in processing the initial argument, i.e. a preference for the initial argument in NP-V constructions to be given rather than new. The fact that this preference was more pronounced in the animate topic contexts than in the inanimate topic contexts further suggests that this preference can be modulated by animacy. If similar observations can be obtained from other languages, a new prominence scale of topicality, i.e. given > new, could be introduced to processing Stage 2 in the eADM (cf. Example 3.1 in Chapter 3 for the current prominence scales in this model; for a similar proposal from a theoretical perspective, cf. Bisang 2006a) By treating topicality as a prominence information type like animacy, the preference for the initial argument to be given can be explained by the preference for intransitive relations, derived from the principle of "Distinctness". More precisely, when a topic context such as "what is about the novel?" followed by the answer beginning with "novel

…", the initial argument is given and can be interpreted as the sole argument (and thus is an intransitive subject) in order to distinguish itself from transitive relations (see "vacuous distinctness" above). However, when this topic context followed by the answer begins with "actor …", such intransitive interpretation cannot hold since the initial argument is new and is thus a second argument in a transitive relation.

One may argue that the topicality overlaps linear position and definiteness (which were already established within this model) in that the preverbal initial definite argument usually bears the highest topicality and the post-verbal indefinite argument bears the lowest topicality (cf. Chapter 4 for deriving a topicality hierarchy in a corpus study by Huang & Chui 1997). However, topicality was directly designed as one factor in Experiment 3; furthermore, it will be also used for modelling the context influences in future studies, which may not necessarily show influence in Stage 2 of processing. We are thus in favour of adding topicality as an individual prominence information type rather than decomposing it to linear position and definiteness.

Moreover, as a result of taking topicality as an information type that is cross-linguistically applicable, one may also assume that topicality varies in strength of applicability like animacy. This assumption can be tested by comparing the influence of a topic context in the same constructions but in different languages, or in different constructions in one language. However, such comparison is not possible in the present study, although we used the same topic context for NP-V constructions in Experiment 3 and for NP1-NP2-V constructions in Experiment 4. Unlike Experiment 3, the topic context in Experiment 4 always topicalised the initial argument. Hence, the distinction of given vs. new was not between initial arguments, but between the initial argument (given) and the second argument (new) before the sentence-final verb. As introduced in Chapter 4, the object at the clause-initial position (OSV) is highly topical while the object at the preverbal position (SOV) is focal rather than topical. From this perspective, the topic contexts used in Experiment 4 could have also induced an OSV order rather than an SOV order when NP1-NP2-V excluded NP-V templates. However, even when this was the case, it is very difficult to disentangle the contextual influence and the simplicity-based structural preference because both of them agree that the OSV order should be preferred over the SOV order. In order to examine whether and how the

context influences the processing NP1-NP2-V constriction, one could use a focus context biased towards the SOV order while the simplicity-based structural selection prefers the OSV order. But even then, there are still two possibilities to model the context influence, as shown in the eADM below.

The eADM posits that the context influence comes after the influence of prominent information, both of which are integrated in the *Generalised Mapping* step in processing Stage 3. In the latest version of this model, the relation between the processing Stages 1 and 2 is cascaded rather than strictly serial in that this model allows a certain degree of parallelism (cf. Bornkessel-Schlesewsky & Schlesewsky 2008, 2009c; also cf. McElree & Griffith 1995 for a discussion of cascaded vs. serial models). When only NP1-NP2-V is available, given a suitable context (which renders the preverbal object as a focus) can induce an SOV order, the context-induced word order could initialize the processing system's choice from OSV to SOV in processing Stage 1, or it could override OSV in processing Stage 3, i.e. a later processing stage after the prominent information. The second possibility, in fact, appears to make for a relatively efficient overall processing strategy: structural simplicity- and minimality-based processing decisions can be made locally (i.e. when no information is available beyond the ambiguous argument itself, OSV is chosen for NP1-NP2-V constructions and SV is chosen for NP-V constructions), whereas pragmatically-based processing choices will typically require further intra-sentential information (e.g. a focus context).

In summary, the present findings from Experiment 3 indicated that topicality could be viewed as one of the prominence information types much like animacy, subject to the processing principle of Distinctness. However, context information may differ from prominence information types in that context influence may show up in an earlier processing stage by defaulting to a word order preference or in a later processing stage after the prominent information. Thus, the present findings from Chinese suggested that these make up two directions of modelling the context influence, which need to be examined in the future.

7.3 Outlook

Compared with the relatively conclusive role of animacy, the way in which context processing can be modelled clearly requires more cross-linguistic work in the future. We are particularly interested in knowing the answers to the following questions that have risen from the present work:

(a) Is topicality is an information type that is cross-linguistically applicable?

This question could be examined in subject-prominent languages such as German and English. If topicality can influence but cannot determine the argument interpretation in these languages, topicality should be treated as a cross-linguistically applicable information type; yet, it varies in strength across languages. The typological distinction of subject-prominent languages vs. topic-prominent languages might be psychologically real in the sense that topicality cannot determine argument interpretation in any of the constructions in the subject-prominent languages while it can in some constructions in the topic-prominent languages (e.g. Chinese).

(b) What kind of context can override the sentence-internal word order preference?

Examining how context influences the sentence-internal word order processing is based on the idea that the context assigns a different information status to each augment and consequently constrains the positions of the arguments in a sentence. Hence, besides topicality which was examined in the present study, other types of context information such as focus could also influence the sentence-internal word order preference in principle. Indeed, previous findings from German suggested that a strong context manipulation such as corrective (contrastive) focus can reduce the processing disadvantage of a scrambled object (cf. Section 3.2.3 in Chapter 3). Given that any sentence-internal word order preference could be overridden by a certain context, the above question could help us find out to which the degree the sentence-internal word order preference holds true and when it is initiated into a context-induced word order preference.

(c) What kind of ERP component reflects the context processing?

It should be clarified that we are not saying that there exists a one-to-one mapping between ERP components and context processing, since the mapping failure of semantic N400 and syntactic P600 (cf. Chapter 2 for reanalysis N400 and semantic P600 as counterexample to the mapping idea) suggested that ERP components result from a multiplicity of environments rather than the processing of a particular linguistic domain (Schlesewsky & Bornkessel, 2006). However, this does not imply that the syntactic, semantic as well as context processes, do not differ; it only implies that the ERP components cannot be interpreted in absolute terms. According to the experimental design (which word, which construction and which language that we compare) and task (what kind of task we use), one could still specify the component which is responsible for the target context, for example, "focus positivity" found in German scrambling, or "topic negativity" for initial non-topic arguments in the present study. Observing what kind of ERP components result from a given context will contribute to the classification of different types of context processing.

7.4 Conclusion

The present thesis is the first ERP study to investigate the subject-preference as well as the influence of animacy and context on word order processing in Chinese. Like all other languages previously examined, Chinese shows a subject-preference for an initial ambiguous argument in simple sentences (NP-V constructions) in spite of the controversial status of a "subject" in this language. Furthermore, this preference is even observable when the initial argument is not topicalised by a context, thereby suggesting that the subject-preference does not result from a default association of "topic = subject/Actor" in this language. With regard to the role of animacy, Chinese shares similarities with previously examined languages in that animacy as a relational information type, serves to build up thematic hierarchy between arguments rather than influences the initial ambiguous argument. On the other hand, Chinese differs quantitatively from languages like German in the extent to which it allows animacy to modulate the processing preference in ambiguous verb-final sentences (NP1-NP2-V constructions). Generally, the

present study reveals that Chinese does not qualitatively differ from the previously examined languages in that it supports the assumption of subject-preference being a universal processing strategy; however, it quantitatively differs from the other languages in that it allows a stronger influence of animacy in certain circumstances. Thus, the overall data from Chinese is most compatible with the eADM, which not only captured the subject-preference as an epiphenomenon of the universal language mechanism to minimise dependencies, but also characterised language-specific processing features by computing the prominence of information types such as animacy.

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List of Figures

List of Tables

Appendix 1

	NP1 (Exp.1-3)	**Verb in IO/AS (Exp.1)**	**Verb in IO/AS (Exp.2-3)**	**Verb in IS (Exp.1-3）**	**NP2 (Exp.1-2）**	**Adv (Exp.3)**
1	小说 (xiǎoshuō) novel	阅读了 (yuèdú-LE) read	理解了 (lǐjiě-LE) understood	教育了 (jiàoyù-LE) educated	演员 (yǎnyuán) actor	一点点 (yìdiǎndiǎn) a little
2	电影 (diànyǐng) film	观看了 (guānkàn-LE) watched	思考了 (sīkǎo-LE) thought about	教育了 (jiàoyù-LE) educated	同学 (tóngxué) classmate	一整天 (yìzhěngtiān) the whole day
3	西装 (xīzhuāng) suit	试穿了 (shìchuān-LE) tried on	偷窃了 (tōuqiè-LE) stolen	逗乐了 (dòulè-LE) amused	学生 (xuéshēng) student	好几次 (hǎojǐcì) many times
4	考分 (kǎofēn) score	计算了 (jìsuàn-LE) graded	质疑了 (zhìyí-LE) doubted	打击了 (dǎjī-LE) made … upset	男孩 (nánhái) boy	很长时间 (hěncháng shíjiān) a long time
5	故障 (gùzhàng) problem	检查了 (jiǎnchá-LE) examined	总结了 (zǒngjié-LE) summarised	打击了 (dǎjī -LE) made … upset	局长 (júzhǎng) head of agency	两次 (liǎngcì) twice
6	报纸 (bàozhǐ) paper	订阅了 (dìngyuè-LE) subscribed	期待了 (qīdài-LE) looked forward to	鼓励了 (gǔlì-LE) encouraged	教授 (jiàoshòu) professor	很长时间 (hěnchángshíjiān) a long time
7	股票 (gǔpiào) stock	抛售了 (pāoshòu-LE) sold	提供了 (tígōng-LE) provided	愚弄了 (yúnòng-LE) fooled	大款 (dàkuǎn) millionaire	很多 (hěnduō) many
8	婚礼 (hūnlǐ) wedding	筹备了 (chóubèi-LE) prepared	反对了 (fǎnduì-LE) objected to	伤害了 (shānghài-LE) hurt	朋友 (péngyou) friend	好几次 (hǎojǐcì) many times
9	档案 (dàng'àn) document	查看了 (chákàn-LE) looked up	得到了 (dédào-LE) gained	伤害了 (shānghài-LE) hurt	律师 (lǜshī) lawyer	很多 (hěnduō) many
10	房屋 (fángwū) house	装修了 (zhuāngxiū-LE) decorated	比较了 (bǐjiào-LE) compared	启发了 (qǐfā-LE) inspired	师傅 (shīfu) instructor	一会儿 (yìhuìr) a while
11	剧本 (jùběn) script	修改了 (xiūgǎi-LE) modified	携带了 (xiédài-LE) brought	启发了 (qǐfā-LE) inspired	诗人 (shīrén) poet	一个月 (yìgèyuè) one month
12	美金 (měijīn) dollar	积攒了 (jīzǎn-LE) saved	准备了 (zhǔnbèi-LE) prepared)	困扰了 (kùnrǎo-LE) troubled	老板 (lǎobǎn) boss	很多 (hěnduō) many
13	垃圾 (lājī) rubbish	搬运了 (bānyùn-LE) moved	隐藏了 (yǐncáng-LE) hid	困扰了 (kùnrǎo-LE) troubled	司机 (sījī) driver	好几次 (hǎojǐcì) many times

14	诗词 (shīcí) poem	背诵了 (bèisòng-LE) recited	了解了 (liǎojiě-LE) acknowledged	安慰了 (ānwèi-LE) comforted	老人 (lǎorén) old man	一点点 (yìdiǎndiǎn) a little
15	首饰 (shǒushì) jewelry	设计了 (shèjì-LE) designed	打听了 (dǎtīng-LE) sounded	安慰了 (ānwèi-LE) comforted	太太 (tàitài) madam	很长时间 (hěnchángshíjiān) a long time
16	石头 (shítóu) stone	收藏了 (shōucáng-LE) collected	出售了 (chūshòu-LE) sold	惊吓了 (jīngxià-LE) surprised	学者 (xuézhe) scholar	很多 (hěnduō) many
17	头发 (tóufà) hair	挑染了 (tiǎorǎn-LE) coloured	炫耀了 (xuànyào-LE) flaunted	惊吓了 (jīngxià-LE) surprised	模特 (mótè) model	一星期 (yìxīngqī) one week
18	会议 (huìyì) meeting	参加了 (cānjiā-LE) attended	知道了 (zhīdào-LE) knew	警告了 (jǐnggào-LE) alarmed	经理 (jīnglǐ) manager	一点点 (yìdiǎndiǎn) a little
19	邮件 (yóujiàn) mail	编写了 (biānxiě-LE) edited	朗读了 (lǎngdú-LE) read loudly	警告了 (jǐnggào-LE) alarmed	疯子 (fēngzi) loony	一晚上 (yìwǎnshàng) one night
20	照片 (zhàopiān) photo	冲洗了 (chōngxǐ-LE) developed (a film)	相信了 (xiāngxìn-LE) believed	恐吓了 (kǒnghè-LE) threatened	记者 (jìzhě) journalist	一点点 (yìdiǎndiǎn) a little
21	毒酒 (dújiǔ) poison wine	调制了 (tiáozhì-LE) mixed	包装了 (bāozhuāng-LE) packaged	折磨了 (zhémó-LE) tortured	作家 (zuòjiā) writer	一半 (yībàn) half
22	摩托 (mótuō) motor	修理了 (xiūlǐ-LE) repaired	辨认了 (biànrèn-LE) distinguished	撞伤了 (zhuàngshāng-LE) injured	保姆 (bǎomǔ) nanny	一次 (yīcì) once
23	军舰 (jūnjiàn) warship	调遣了 (diàoqiǎn-LE) assigned	购买了 (gòumǎi-LE) bought	支持了 (zhīchí-LE) supported	将军 (jiāngjūn) general	两次 (liǎngcì) twice
24	政策 (zhèngcè) policy	制定了 (zhìdìng-LE) made (policy,law)	忽视了 (hūshì-LE) ignored	支持了 (zhīchí-LE) supported	校长 (xiàozhǎng) headmaster	很长时间 (hěnchángshíjiān) a long time
25	蛋糕 (dàngāo) cake	品尝了 (pǐncháng-LE) tasted	接受了 (jiēshòu-LE) accepted	引诱了 (yǐnyòu-LE) charmed	孤儿 (gūér) orphan	一两次 (yìliǎngcì) once or twice
26	财产 (cáichǎn) property	霸占了 (bàzhàn) occupied	听说了 (tīngshuō-LE) heard about	引诱了 (yǐnyòu-LE) charmed	凶手 (xiōngshǒu) murderer	一点点 (yīdiǎndiǎn) a little
27	中药 (zhōngyào) chinese medicine	服用了 (fúyòng-LE) drank	放弃了 (fàngqì-LE) gave up	帮助了 (bāngzhù-LE) helped	爷爷 (yéye) grandfather	好几次 (hǎojǐcì) many times
28	飞机 (fēijī) plane	驾驶了 (jiàshǐ-LE) drove	尝试了 (chángshì-LE) tried	帮助了 (bāngzhù-LE) helped	队员 (duìyuán) member	一次 (yīcì) once

29	日历 (rìlì) calender	撕破了 (sīpò-LE) tore … up	注意了 (zhùyì-LE) noticed	提醒了 (tíxǐng-LE) reminded	警察 (jǐngchá) police	好几次 (hǎojǐcì) many times
30	闹钟 (nàozhōng) alarm clock	设置了 (shèzhì-LE) set up	摆弄了 (bǎinòng-LE) played	提醒了 (tíxǐng-LE) reminded	园丁 (yuándīng) gardener	一会儿 (yīhuìr) a while
31	雕像 (diāoxiàng) statue	摆放了 (bǎifàng-LE) placed	观察了 (guānchá-LE) observed	逗乐了 (dòulè-LE) amused	秘书 (mìshū) secretary	-
32	电脑 (diànnǎo) computer	安装了 (ānzhuāng-LE) installed	介绍了 (jièshào-LE) introduced	鼓励了 (gǔlì-LE) encouraged	专家 (zhuānjiā) expert	-
33	手机 (shǒujī) mobile	购买了 (gòumǎi-LE) bought	寻找了 (xúnzhǎo-LE) searched	愚弄了 (yúnòng-LE) fooled	保镖 (bǎobiāo) bodyguard	-
34	化石 (huàshí) fossil	发现了 (fāxiàn-LE) discovered	测量了 (cèliáng-LE) measured	吸引了 (xīyǐn-LE) attracted	农民 (nóngmín) farmer	-
35	设备 (shèbèi) equipment	采购了 (cǎigòu-LE) purchased	询问了 (xúnwèn-LE) questioned	吸引了 (xīyǐn-LE) attracted	厂长 (chǎngzhǎng) factory owner	-
36	宫殿 (gōngdiàn) palace	建造了 (jiànzào-LE) built	眺望了 (tiàowàng-LE) overlooked	激怒了 (jīnù-LE) exasperated	皇帝 (huángdì) emperor	-
37	灰尘 (huīchén) dust	清扫了 (qīngsǎo-LE) cleared	发现了 (fāxiàn-LE) discovered	激怒了 (jīnù -LE) exasperated	公主 (gōngzhǔ) princess	-
38	炸药 (zhàyào) bomb	携带了 (xiédài-LE) brought	分类了 (fēnlèi-LE) grouped	恐吓了 (kǒnghè-LE) threatened	会计 (kuàijì) accountant	-
39	肿瘤 (zhǒngliú) tumor	切除了 (qiēchú-LE) cut away	否认了 (fǒurèn-LE) denied	折磨了 (zhémó-LE) tortured	店主 (diànzhǔ) shop owner	-
40	汽车 (qìchē) car	擦洗了 (cāxǐ-LE) cleaned	谈论了 (tánlùn-LE) talk about	撞伤了 (zhuàngshāng-LE) injured	球迷 (qiúmí) football fan	-

Note. NP1-Verb pairs from 1 to 30 in Experiment 2 were selected for Experiment 3.

Appendix 2

	animate NP	**inanimate NP**	**Verb with animate subject**	**Verb with inanimate subject**
1	居民 (jūmín) resident	垃圾 (lājī) rubbish	跨越了 (kuàyuè-LE) came over	阻碍了 (zǔ'ài-LE) blocked
2	行人 (xíngrén） passenger	栏杆 (lángān) railings	碰倒了 (pèngdǎo-LE) pushed down	阻碍了 (zǔ'ài-LE) blocked
3	连长 (liánzhǎng) company commander	纪律 (jìlǜ) discipline	宣布了 (xuānbù-LE) announced	牵制了 (qiānzhì-LE) constrained
4	敌人 (dírén) enemy	能源 (néngyuán) energy	霸占了 (bàzhàn-LE) occupied	牵制了 (qiānzhì-LE) constrained
5	少年 (shàonián) youngster	网络 (wǎngluò) internet	拆除了 (chāichú-LE) dismantled	毒害了 (dúhài-LE) poisoned
6	园丁 (yuándīng) gardener	农药 (nóngyào) pesticide	稀释了 (xīshì-LE) diluted	毒害了 (dúhài-LE) poisoned
7	战士 (zhànshì) fighter	炮火 (pàohuǒ) artillery	扑灭了 (pūmiè-LE) extinguished	考验了 (kǎoyàn-LE) tested
8	小偷 (xiǎotōu) thief	密码 (mìmǎ) password	破解了 (pòjiě-LE) cracked	考验了 (kǎoyàn-LE) tested
9	考生 (kǎoshēng) examinee	分数 (fēnshù) score	核对了 (héduì-LE) checked	激励了 (jīlì-LE) encouraged
10	律师 (lǜshī) lawyer	薪水 (xīnshuǐ) salary	领到了 (lǐngdào-LE) received	激励了 (jīlì-LE) encouraged
11	司机 (sījī) driver	歌词 (gēcí) song lyric	下载了 (xiàzài-LE) downloaded	启发了 (qǐfā-LE) inspired
12	专家 (zhuānjiā) expert	车祸 (chēhuò) accident	分析了 (fēnxī-LE) analysed	启发了 (qǐfā-LE) inspired
13	评委 (píngwěi) jury	论文 (lùnwén) thesis	审查了 (shěnchá-LE) reviewed	惹恼了 (rěnǎo-LE) annoyed
14	领导 (lǐngdǎo) leader	竞赛 (jìngsài) contest	取消了 (qǔxiāo-LE) cancelled	惹恼了 (rěnǎo-LE) annoyed

15	猎人 (lièrén) hunter	帐篷 (zhàngpéng) tent	搭好了 (dāhǎo-LE) build up	遮盖了 (zhēgài-LE) covered
16	模特 (mótè) model	窗帘 (chuānglián) curtain	拉上了 (lāshàng-LE) drew	遮盖了 (zhēgài-LE) covered
17	士兵 (shìbīng) soldiers	毛毯 (máotǎn) blankets	披上了 (pīshàng-LE) put	掩护了 (yǎnhù-LE) protected
18	刺客 (cìkè) assassin	面具 (miànjù) mask	摘掉了 (zhāidiào-LE) threw off	掩护了 (yǎnhù-LE) protected
19	侦探 (zhēntàn) detective	子弹 (zǐdàn) bullet	保存了 (bǎocún-LE) kept	击中了 (jīzhòng-LE) hit
20	将军 (jiāngjūn) general	弓箭 (gōngjiàn) arrow	拔掉了 (bádiào-LE) pulled out	击中了 (jīzhòng-LE) hit
21	医生 (yīshēng) doctor	病毒 (bìngdú) virus	消灭了 (xiāomiè-LE) disinfected	侵蚀了 (qīnshí-LE) eroded
22	读者 (dúzhě) reader	漫画 (mànhuà) comics	看完了 (kànwán-LE) finished reading	侵蚀了 (qīnshí-LE) eroded
23	木匠 (mùjiàng) carpenter	拐杖 (guǎizhàng) crutch	展示了 (zhǎnshì-LE) shown	支撑了 (zhīchēng-LE) supported
24	富翁 (fùwēng) millionaire	美元 (měiyuán) dollar	抛售了 (pāoshòu-LE) sold	支撑了 (zhīchēng-LE) supported
25	师傅 (shīfu) master	噪音 (zàoyīn) noise	排除了 (páichú-LE) cleared	刺激了 (cìjī-LE) irritated
26	保姆 (bǎomǔ) nanny	香水 (xiāngshuǐ) perfume	打翻了 (dǎfān-LE) pulled down	刺激了 (cìjī-LE) irritated
27	会计 (kuàijì) accountant	数据 (shùjù) data	记录了 (jìlù-LE) recorded	困扰了 (kùnrǎo-LE) troubled
28	厂长 (chǎngzhǎng) director	资金 (zījīn) finance	周转了 (zhōuzhuǎn-LE) ran	困扰了 (kùnrǎo-LE) troubled
29	妻子 (qīzi) wife	电视 (diànshì) TV	关掉了 (guāndiào-LE) turned off	触动了 (chùdòng-LE) touched (psychologically)

30	记者 (jìzhě) journalist	照片 (zhàopiān) photo	冲洗了 (chōngxǐ-LE) developed	触动了 (chùdòng-LE) touched (psychologically)
31	女孩 (nǚhái) girl	鲜花 (xiānhuā) flower	修剪了 (xiūjiǎn-LE) pruned	打动了 (dǎdòng-LE) touched (heart)
32	学者 (xuézhě) scholars	古诗 (gǔshī) poem	讲解了 (jiǎngjiě-LE) explained	打动了 (dǎdòng-LE) touched (heart)
33	孤儿 (gūér) orphan	糖果 (tángguǒ) sweet	吃光了 (chīguāng-LE) ate up	感化了 (gǎnhuà-LE) (psychologically) moved
34	教徒 (jiàotú) follower	圣经 (shèngjīng) Bible	抄写了 (chāoxiě-LE) copied	感化了 (gǎnhuà-LE) (psychologically) moved
35	游客 (yóukè) tourist	城堡 (chéngbǎo) castle	走遍了 (zǒubiàn-LE) travelled	吸引了 (xīyǐn-LE) attracted
36	作家 (zuòjiā) writer	小说 (xiǎoshuō) novel	写好了 (xiěhǎo-LE) finished writing	吸引了 (xīyǐn-LE) attracted

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Summary

The present thesis is the first ERP study to investigate whether or not the subject-preference – a preference for a subject reading of an initial ambiguous argument – can be observed in simple sentences in Mandarin Chinese. In contrast to the previously examined Indo-European languages such as German and English, Mandarin Chinese is a language in which the grammatical relations such as "subject" are not easy to define syntactically. Assuming that semantic/pragmatic information such as animacy and context could be responsible for the possible processing differences between Chinese and Indo-European languages, the present thesis also aims to shed light on whether and how these two information types influence word order processing in Chinese.

Our findings revealed that Chinese, like all the previously examined languages, shows a subject-preference in processing NP-V constructions (cf. Exp. 1-3). Context (i.e. topicality) cannot influence the interpretation of the initial argument, like animacy (cf. Exp. 3). An object-initial preference and a clear influence of aniamcy can be observed only when the ambiguous region spans over more than one argument, i.e. NP1-NP2-V construstions. (cf. Exp. 4). Overall, the subject-preferece in NP-V constructions and the object-initial preference in NP1-NP2-V constructions in Chinese support the underlying language universal mechanism – minimal-dependencies and structural simplicity – which is independent of the subject and object categories, as proposed by the eADM.

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Enlightening the Brain – Optical Imaging in Cognitive Neuroscience

73 Julia Reinholz
Interhemispheric interaction in object- and word-related visual areas

74 Evelyn C. Ferstl
The Functional Neuroanatomy of Text Comprehension

75 Miriam Gade
Aufgabeninhibition als Mechanismus der Konfliktreduktion zwischen Aufgabenrepräsentationen

76 Juliane Hofmann
Phonological, Morphological, and Semantic Aspects of Grammatical Gender Processing in German

77 Petra Augurzky
Attaching Relative Clauses in German – The Role of Implicit and Explicit Prosody in Sentence Processing

78 Uta Wolfensteller
Habituelle und arbiträre sensomotorische Verknüpfungen im lateralen prämotorischen Kortex des Menschen

79 Päivi Sivonen
Event-related brain activation in speech perception: From sensory to cognitive processes

80 Yun Nan
Music phrase structure perception: the neural basis, the effects of acculturation and musical training

81 Katrin Schulze
Neural Correlates of Working Memory for Verbal and Tonal Stimuli in Nonmusicians and Musicians With and Without Absolute Pitch

82 Korinna Eckstein
Interaktion von Syntax und Prosodie beim Sprachverstehen: Untersuchungen anhand ereigniskorrelierter Hirnpotentiale

83 Florian Th. Siebörger
Funktionelle Neuroanatomie des Textverstehens: Kohärenzbildung bei Witzen und anderen ungewöhnlichen Texten

84 Diana Böttger
Aktivität im Gamma-Frequenzbereich des EEG: Einfluss demographischer Faktoren und kognitiver Korrelate

85 Jörg Bahlmann
Neural correlates of the processing of linear and hierarchical artificial grammar rules: Electrophysiological and neuroimaging studies

86 Jan Zwickel
Specific Interference Effects Between Temporally Overlapping Action and Perception

87 Markus Ullsperger
Functional Neuroanatomy of Performance Monitoring: fMRI, ERP, and Patient Studies

88 Susanne Dietrich
Vom Brüllen zum Wort – MRT-Studien zur kognitiven Verarbeitung emotionaler Vokalisationen

89 Maren Schmidt-Kassow
What's Beat got to do with ist? The Influence of Meter on Syntactic Processing: ERP Evidence from Healthy and Patient populations

90 Monika Lück
Die Verarbeitung morphologisch komplexer Wörter bei Kindern im Schulalter: Neurophysiologische Korrelate der Entwicklung

91 Diana P. Szameitat
Perzeption und akustische Eigenschaften von Emotionen in menschlichem Lachen

92 Beate Sabisch
Mechanisms of auditory sentence comprehension in children with specific language impairment and children with developmental dyslexia: A neurophysiological investigation

93 Regine Oberecker
Grammatikverarbeitung im Kindesalter: EKP-Studien zum auditorischen Satzverstehen

94 Şükrü Barış Demiral
Incremental Argument Interpretation in Turkish Sentence Comprehension

95 Henning Holle
The Comprehension of Co-Speech Iconic Gestures: Behavioral, Electrophysiological and Neuroimaging Studies

96 Marcel Braß
Das inferior frontale Kreuzungsareal und seine Rolle bei der kognitiven Kontrolle unseres Verhaltens

97 Anna S. Hasting
Syntax in a blink: Early and automatic processing of syntactic rules as revealed by event-related brain potentials

98 Sebastian Jentschke
Neural Correlates of Processing Syntax in Music and Language – Influences of Development, Musical Training and Language Impairment

99 Amelie Mahlstedt
The Acquisition of Case marking Information as a Cue to Argument Interpretation in German An Electrophysiological Investigation with Pre-school Children

100 Nikolaus Steinbeis
Investigating the meaning of music using EEG and fMRI

101 Tilmann A. Klein
Learning from errors: Genetic evidence for a central role of dopamine in human performance monitoring

102 Franziska Maria Korb
Die funktionelle Spezialisierung des lateralen präfrontalen Cortex: Untersuchungen mittels funktioneller Magnetresonanztomographie

103 Sonja Fleischhauer
Neuronale Verarbeitung emotionaler Prosodie und Syntax: die Rolle des verbalen Arbeitsgedächtnisses

104 Friederike Sophie Haupt
The component mapping problem: An investigation of grammatical function reanalysis in differing experimental contexts using event-related brain potentials

105 Jens Brauer
Functional development and structural maturation in the brain's neural network underlying language comprehension

106 Philipp Kanske
Exploring executive attention in emotion: ERP and fMRI evidence

107 Julia Grieser Painter
Music, meaning, and a semantic space for musical sounds

108 Daniela Sammler
The Neuroanatomical Overlap of Syntax Processing in Music and Language - Evidence from Lesion and Intracranial ERP Studies

109 Norbert Zmyj
Selective Imitation in One-Year-Olds: How a Model's Characteristics Influence Imitation

110 Thomas Fritz
Emotion investigated with music of variable valence – neurophysiology and cultural influence

111 Stefanie Regel
The comprehension of figurative language: Electrophysiological evidence on the processing of irony

112 Miriam Beisert
Transformation Rules in Tool Use

113 Veronika Krieghoff
Neural correlates of Intentional Actions

114 Andreja Bubić
Violation of expectations in sequence processing

115 Claudia Männel
Prosodic processing during language acquisition: Electrophysiological studies on intonational phrase processing

116 Konstanze Albrecht
Brain correlates of cognitive processes underlying intertemporal choice for self and other

117 Katrin Sakreida
Nicht-motorische Funktionen des prämotorischen Kortex: Patientenstudien und funktionelle Bildgebung

118 Susann Wolff
The interplay of free word order and pro-drop in incremental sentence processing: Neurophysiological evidence from Japanese

119 Tim Raettig
The Cortical Infrastructure of Language Processing: Evidence from Functional and Anatomical Neuroimaging

120 Maria Golde
Premotor cortex contributions to abstract and action-related relational processing

121 Daniel S. Margulies
Resting-State Functional Connectivity fMRI: A new approach for assessing functional neuroanatomy in humans with applications to neuroanatomical, developmental and clinical questions

122 Franziska Süß
The interplay between attention and syntactic processes in the adult and developing brain: ERP evidences

123 Stefan Bode
From stimuli to motor responses: Decoding rules and decision mechanismsin the human brain

124 Christiane Diefenbach
Interactions between sentence comprehension and concurrent action: The role of movement effects and timing

125 Moritz M. Daum
Mechanismen der frühkindlichen Entwicklung des Handlungsverständnisses

126 Jürgen Dukart
Contribution of FDG-PET and MRI to improve Understanding, Detection and Differentiation of Dementia

127 Kamal Kumar Choudhary
Incremental Argument Interpretation in a Split Ergative Language: Neurophysiological Evidence from Hindi

128 Peggy Sparenberg
Filling the Gap: Temporal and Motor Aspects of the Mental Simulation of Occluded Actions