MAX PLANCK INSTITUTE FOR HUMAN COGNITIVE AND BRAIN SCIENCES LEIPZIG

Şükrü Bariş Demiral: Incremental argument interpretation in turkish sentence comprehension. Leipzig: Max Planck Institute for Human Cognitive and Brain Sciences, 2007 (MPI Series in Human Cognitive and Brain Sciences; 94)

Incremental Argument Interpretation in Turkish Sentence Comprehension

Von der Fakultät für Biowissenschaften, Pharmazie und Psychologie
der Universität Leipzig
genehmigte

DISSERTATION

zur Erlangung des akademischen Grades
doctor rerum naturalium
Dr. rer. nat.

vorgelegt
von MSc. Şükrü Barış Demiral
geboren am 29. Januar 1975 in Merzifon, Türkei

Dekanin: Prof. Dr. Annette Beck-Sickinger

Gutachter: Prof. Dr. Angela Friederici
Prof. Dr. Jörg Jescheniak
Prof. Dr. Charles Clifton

Tag der Verteidigung: Leipzig, den 29. November 2007

WILL is a promise,
DID is a proof.

Acknowledgements

Naturally, this dissertation would not have been possible without the support of Max Planck Institute, particularly Prof. Angela Friederici, and Dr. Ina Bornkessel-Schlesewsky. I would like to thank them, especially Ina, for the valuable discussions we had throughout my thesis work. On the other hand, I cannot pass without mentioning the support of Prof. Matthias Schlesewsky, who made very critical contributions to my academic life throughout the project.

During the Leipzig-Berlin days, I made a number of nice friends to whom I owe many thanks. These people made my life easier and feasible in Germany, and supported me socially, culturally, academically, and personally. My office mates Friederike Haupt and R. Muralikrishnan contributed with many things from statistical and computational software to German translations, and particularly with Baumkuchen support whenever our blood sugar dropped. My other colleagues, Kamal Kumar Choudhary has always been a very good friend with whom I shared valuable moments talking on philosophy, cult, and linguistics. Susann Wolff and Luming Wang were also very helpful and supportive in many aspects, with their lovely and charming smiles. Dietmar Röhm helped me to get accustomed to the electrophysiological methods, particularly in the initial phases of the project. I would also like to thank Safiye Genç, who as a Turkish colleague, supported and is still supporting, my cause directly or indirectly in many ways.

The Turkish community in Berlin was also very generous and helpful. Members of the Institute of Turkology of the Free University of Berlin, the Berlin Turkish Science and Technology Center at the Technical University of Berlin, and all other Turkish residents in different parts of the city were very interested, supportive and hopeful about my research. Without their positive support and curiosity, it would be very hard for me to conduct my research. Thank you. I hope you enjoy my work.

There are many others I would like to mention; Tricia Striano, Amelie Mahlstedt, Jutta Müller, Nicole Lorenz, Margund Greiner, Sonja Kotz, Henning

Holle, Felix Botner, Frank Burkhart, Daniela Sammler, Stephan Liebig, Heike Schmidt, Katja Brüning ... and the ones from whom I needed help in many different occasions. They deserve the greatest thanks. I feel very lucky to know these people.

Above all, I am grateful to my wife Melanie for her continuous support, patience and encouragement. Our lovely daughter Clara Defne was another gift from Allah, who made our lives very exciting, and complete.

Abbreviations

1s,2s,3s	first, second, third person singular
1p,2p,3p	first, second, third person plural
ABL	ablative (−dAn)
ACC	accusative (−yI)
ACTOR	actor generalized semantic role
ADV	adverbial clause marker
AGR	agreement
AOR	aorist
AMB	ambiguous
CAUS	causative
DAT	dative (−yA)
DER:N	noun derivation
EEG	electroencephalogram
ERP	event-related potential
GEN	genitive (−In)
GR	generalized roles
IMP	imperative
LS	logical structure
MASC	masculine
OBL	oblique
POSS	possesive
PAST	past (−dI)
SMR	semantic macro roles
SUBJ	subject
OBJ	object
UNDERGOER	undergoer generalized semantic role

Contents

Introduction

Psycholinguistic studies of human language are majorly concerned with the mechanisms, constraints, and preferences generated by the language processing system. There can be simultaneous effects of language particular specifications as well as domain general specifications on the linguistic system. One general aim of psycholinguistic research is to understand the language particular processes in relation to the general cognitive preferences (which are driven by many other aspects of human cognition, like memory, attention and problem solving). On the other hand, psycholinguists compare findings from particular structures from a particular language, develop theories about the underlying mechanisms, preferences and constraints, and then try to generalize these findings not only to the different structures in the same language, but also to other languages in question. Thus, psycholinguists evaluate similarities and differences in the structures of a language, evaluate findings, test their validity with other languages, and update the initial hypothesis according to cross-linguistic data. In this respect, the cross-linguistic dimension of psycholinguistic research plays a very important role.

World languages, however, differ from each other in many ways. For decades, typologists have investigated varieties of languages according to a number of typological dimensions like word-order and case-marking (Comrie, 1989). For example, it is a well known fact that English has Subject-Verb-Object (SVO) word order which is similar to Chinese and Italian, whereas Turkish has Subject-Object-Verb (SOV) word order which is similar to Hindi and the subordinate clauses of German. It has also been acknowledged that languages differ in the ways they use morphological case marking to assign semantic and/or syntactic functions to the arguments. For instance, German uses case marking to assign functional roles to nominals like nouns and pronouns (i.e. "der" assigns subject function). On the other hand, English has no overt case marking.

Studies about the linguistic diversity and language universals have shown that it is not an easy task to find simple and universal explanations/mechanisms which explain the underlying, core structures of all languages at once. How-

ever, one of the basic properties of all languages, which is interesting to psycholinguistic research, is that the linguistic structure is constructed as each lexical item is processed, namely **incremental processing.** This process, at the lowest level, can be thought of as the formation of words, phrases, morphological marking and other informative material, or more elaborately making partial compositions of structure and meaning as soon as possible. Incremental language processing requires the use of multiple sources to make on-line syntactic and interpretational decisions about the current lexical item in the sentence. Functional, structural, grammatical and interpretational evaluations of an argument are made as soon as the morphological, syntactic and lexical information provided by the word is available to the system.

Thus, the main goal of this thesis is to explore electrophysiological correlates of on-line sentence comprehension in Turkish by using the Event-Related Potential (ERP) method. The ERP method provides fine-grained temporal resolution for the examination of such on-line processes. A number of general psycholinguistic issues like subject-preference, subject-drop and argument-argument and argument-verb relations are examined. The thesis contributes to the language comprehension literature not only by measuring on-line measures of particular linguistic structures but also by assessing off-line measures where a detailed corpus study and information about the acceptability of linguistic structures are provided. The work also adds to the literature by exploring similar conditions with different experimental tasks. Findings emerging from these different sources contribute to an understanding of the interactions between general cognitive and language particular processes.

The thesis also brings complementary ideas to the psycholinguistic studies of verb-final languages in which the verb information is available only after the arguments of the sentence are processed. Turkish, with its morphological, syntactic and pragmatic properties provides an opportunity to explore the effects of word-order, case marking and animacy information during on-line sentence processing in unique ways that other languages may not be able to provide.

The research questions of the thesis can be summarized as follows:

(a) Does the language processor make any decisions on the locally ambiguous part of the sentence? (Experiment 1 and Experiment 2)

(b) How does animacy information influence this initial parsing decision? (Experiment 1 and Experiment 2)

(c) How do the semantic and syntactic cues like animacy and case marking influence the interpretation of the object of the sentence? (Experiment 2)

(d) How does the redundant use of the pronoun influence sentence processing? (Experiment 2)

(e) How are the interpretational and formal prominence hierarchies between the arguments formed? (Experiment 1)

(f) How and when do the argument structure of the verb as well as the syntactic and semantic constraints influence the linking of the arguments to the verb? (Experiment 3)

(g) How can frequency of usage and acceptability of the linguistic structure influence incremental processing? [Corpus study, Experiment 1(b), and Experiment 3(b)]

(h) Where and when do these processes emerge as ERP components?

(i) Can we generalize ERP findings from other languages to Turkish, which shows syntactic similarities to, and differences from, those languages?

I will now describe how these questions will be explored in the experiments of the thesis. One of the questions of incremental sentence processing is to examine how the language comprehension mechanism acts under local ambiguities. For instance, one example of local ambiguity resolution strategies is the subject-preference phenomenon, in which the parser interprets the sentence-initial ambiguous argument as the subject of the sentence, rather than the object of the sentence. In many languages (but not in all of them), the subject argument agrees with the verb. There are proposals why this preference emerges, but most of the proposals assume that subject-preference is the most minimal or economical solution (in terms of grammar and memory capacity) to produce an on-line decision about the ambiguous part of the sentence.

The general tendency of the languages investigated so far (English, German, Italian etc.) has been to choose the ambiguous argument as the subject of the sentence. But these languages differ from Turkish either because they have Subject-Verb-Object (SVO) word order, or they do not show a subject-drop (or pronoun-drop, Pro-Drop) preference. That is why the investigation of subject-preference in Turkish reveals how alternative representations may influence each other and whether such a preference still holds if both object and subject preference options equally lead to minimal structures which are both economical.

As a verb-final Subject-Object-Verb (SOV) language, Turkish provides alternative linguistic forms to test the validity of the subject-preference phenomenon. For instance, one of the well-known preferences in Turkish is to drop the subject of the sentence, which is known as subject-drop (or Pro-Drop). Thus, when somebody wants to construct a transitive sentence (having both subject

and object arguments), the subject can be dropped to yield an OV structure. This preference is particularly strong when the subject is a 1st or 2nd person pronoun (like "I" or "you"). The verb bears the person and number agreement with the subject, thus giving enough information about the subject of the sentence. In most cases, it is not necessary to use the pronoun overtly.

In the first experiment of the thesis (Chapter 4), I investigated the interpretation of the sentence-initial ambiguous argument in Turkish. Standard word order in Turkish is SOV and if the subject-preference, emerging via SOV, dominates parsing, then the initial ambiguous argument must be taken as the subject. On the other hand, if Pro-Drop has a strong influence on parsing, then the initial argument would be chosen as the object of the sentence. In Experiment 1, I observed a positive deflection in the ERPs for the experimental conditions on the verb following the locally ambiguous part of the sentence compared to the control conditions where the initial syntactic decision was already made towards the object. These types of positive deflections have been found to indicate syntactic reanalysis effects. For instance, in one of the studies in German, beim Graben et al. (2002) found positive deflections on the verb when it did not match with the sentence-initial wh-clause in number (which forced the parser to change the initial subject analysis to object reading).

The result of Experiment 1 indicated that the subject preference holds and the initial subject preference must be revised on the sentence-final verb to yield the object reading of the ambiguous argument. On the other hand, acceptability ratings showed that the reanalysis towards object reading was easier for the inanimate objects (which are more prototypical objects) than the animate object (which are more prototypical subjects). ERPs on the other hand did not show any animacy difference. Both animate and inanimate arguments were equally likely to be preferred as the subject. Thus, these findings showed the time course of the application of different information types where the effect of animacy only emerged at the later time point in comprehension. This did not appear on the ERPs.

In the second experiment (Chapter 5), I extended the experimental conditions to include case marking, animacy of the object and the existence of a pronoun as three factors in order to investigate morphosyntactic and pragmatic interactions in Turkish. The behavioural task in this experiment was a comprehension task rather than an acceptability task as in Experiment 1. In Turkish, morphosyntactic cues like case marking and word order interact with animacy information leading to different levels of semantic and pragmatic information. The existence of a pronoun may also bear pragmatic information, by emphasizing and changing the topic of the sentence or by scrambling and topicalizing the object of the sentence. The temporal information from the ERPs (i.e.,

in which time window an ERP effect is observed) may be used to interpret whether the interactions are semantically or pragmatically oriented. It is also important to observe when all information types combine to yield a general evaluative analysis of the sentence.

Turkish uses case marking to give information about the particular semantic and syntactic uses of the object. For instance certain case markings are used for indirect objects to give meaning like the prepositions "to" and "at" in English. While indirect object cases are used obligatorily, the direct object case, namely the accusative case (-I), is not. A direct object can exist without the accusative case. In many instances, the accusative case is used as a specificity marker in Turkish. In Experiment 2, by manipulating the accusative case marking, I investigated how specific and non-specific readings of the objects interact as they are interpreted by the language processor. For instance, using case marking for a common animate noun required that this argument must be definite while an inanimate common noun was not required to be definite. Experiment 2 revealed that specificity and animacy interact with each other. Such referential and pragmatic effects are observed as late positive ERP deflections in the anterior parts of the scalp. Investigation of the ERPs in different time-windows revealed that the level of the referential status of the animate and inanimate objects change depending on their case marking and position in the sentence.

In Experiment 2, I used a pronoun in some conditions in the sentence-initial position. I observed that the effect of pronoun continued on the following noun as well as on the sentence-final verb, indicating that the incremental sentence processing system evaluates the overt usage of the pronoun and updates the interpretation of the sentence as each lexical item is processed. ERP deflections revealed that the existence of the overt pronoun influences the argument following it in the middle and late time windows, and this effect continues in the early time window on the verb. These ERP deflections revealed that the redundant usage of the pronoun requires the evaluation of the necessity of the larger structural and categorical template vs. simpler structures. Thus, minimal structures are preferred in every instance and this influences electrophysiological waveforms.

One of the most impressive results of Experiment 2 was that it revealed the effect of the experimental task. The same conditions used in Experiment 1 and 2 did not show exactly the same ERP patterns in the two experiments. The data showed that the experimental task in Experiment 1 (acceptability judgment) affected the ERP components such that the point where the task relevant item was recognized was different for experimental and control con-

ditions in this experiment. Such task related effects influenced the cognitive requirements, which in turn reflected on the ERP components.

In the last experiment (Experiment 3, Chapter 7), my goal was to investigate how the argument structure of the verb, as well as the precedence and prominence relations of the arguments, influence linking of the arguments to the verb. The argument structure of the verb grossly corresponds to the lexical representation of the event structure of the verb. In this thesis I assume that argument structure has two modules: a logical structure module and a thematic structure module. Argument structure generally links to the syntax by using a linking mechanism derived from its logical structure module. On the other hand, the thematic structure module of the argument structure helps to define the thematic nature of the arguments. In Experiment 3, the main manipulations were word order of the arguments, animacy of the subject argument and the type of verb. The type of verb was either an active accusative verb or an accusative experiencer verb. Both verb types imposed a causative reading in which the subject caused something to happen to the object. The experiencer verbs, however, had a marked argument structure in which the object was the psychological experiencer of the event, not the theme of the event.

I developed a theory here (θ-distance theory) which indicated that the thematic distance of the arguments in the thematic structure module influences the linking process. Theta distance corresponds to the distance of the thematic roles of the arguments from each other in the theoretical thematic role hierarchy, extending from Agent to Theme. The verb with shorter theta distance in the thematic role hierarchy (i.e., experiencer verb with Agent-Experiencer thematic roles) will be more marked and more difficult to link than the verb with longer theta distance (i.e. active verb with Agent-Theme thematic roles which has the unmarked thematic structure). The main assumption here is that when the arguments are thematically closer, they cannot be differentiated easily, thus leading to a linking cost. Theta-distance theory can be thought of as a bottle-neck situation. For instance, only under constraining contexts (i.e., if the comprehension mechanism is presented with two animate arguments, and if the verbs with similar logical structures are compared) argument structure becomes more dependent on the theta-distance during linking.

The results of the experiment revealed that particular information structures lead the comprehension process in a hierarchical manner. For instance, the semantic distinctness of the arguments played a crucial role during the linking process. When the arguments were from different classes (animate vs. inanimate) they were more easily linked to the verb. This was observed in the behavioural results of the experiment as well. More errors for two animate

arguments were observed relative to a distinct argument situation (an animate and an inanimate argument). Interestingly, the effect of the θ-distance appeared under such constraining environments where the processing has to go through a bottle-neck situation. When both arguments are animate, theta distance influenced the linking and made it more difficult for the comprehension system to link the arguments to the verb.Thus, after animacy, the second most important information type in linking is the unmarked argument structure, which the processing system takes as a reference to initialize linking. Also, the results of Experiment 3 suggested that even though case marking is informative regarding the grammatical and semantic nature of the arguments in Turkish, word-order seems to be the main determinant for the linking proper.

In addition to the ERP experiments, I conducted a corpus count study (Chapter 6). I analysed approximately two thousand sentences in a Turkish language corpus (METU-Sabanci Turkish TreeBank) in order to investigate the distribution of definite arguments, animate arguments, the most frequent word-order options, Pro-Drop preference and subject-preference in Turkish. The corpus study revealed that most of the sentence-initial arguments (also the ambiguous arguments) turn out to be the subject of the sentence. Thus, frequency of usage provides an alternative explanation for the subject preference phenomenon. Strikingly, one of the interesting findings of the corpus counts was that when there are two overt arguments in the sentence, an animate and definite argument precedes the inanimate argument most of the time. Thus, corpus counts revealed the most frequent precedence and prominence relations in Turkish. The animate argument precedes the inanimate argument as well as the definite argument precedes the indefinite or definite arguments as in: $+animate > -animate$ and $+definite > \pm definite$.

The corpus counts also showed, however, that it is not always possible to find frequency-related explanations for all of the on-line linguistic preferences observed in the ERP experiments. Some structures, such as the existence of a pronoun and case-marked animate and inanimate objects in particular positions are equally likely to appear in the language, but only the on-line measures can reveal the high temporal resolution of the differences in the interpretation of these arguments. Corpus counts can reveal general tendencies in a language, but it cannot show all of the interpretational aspects of incremental language processing.

Overall, the thesis contributes greatly to the incremental sentence processing literature, particularly as it provides more information on the less known verb-final languages. It brings new evidence supporting the incremental nature of the linguistic processes where the minimal and economical solutions are favored. The thesis also puts forward the fine-grained differences derived from

the processing of the arguments at different levels of referential status, which may not be easily observed by the off-line and some on-line techniques (i.e. eye-tracking). It provides a topographic, temporal and electrophysiological map of the processes related to the syntactic, pragmatic and semantic nature of the arguments. Particularly, it provides evidence for the language particular and task relevant processes that are reflected in ERPs.

In the theoretical part of the thesis, I start by exploring incremental processing of language comprehension in Chapter 1. Following this section, I present a chapter on ERPs and their relevance in linguistic research. Then, in the following chapter, I continue with a brief introduction to Turkish grammar to give the reader background knowledge with this language, a language once described as "sober logic" by the well known American linguist, Sapir (1921) (Chapter 3).

In the morphosyntactic part of the thesis, I will go through the syntactic explorations of Turkish by using the ERP method. Experiment 1 is presented in Chapter 4. Syntactic and pragmatic investigations, which are the main themes of Experiment 2 are presented in Chapter 5. The corpus study will be presented in Chapter 6. In the last part of the thesis, semantic explorations are presented as the main research matter of Experiment 3 presented in Chapter 7.

Part I

Theoretical Issues

Chapter 1

Language Comprehension and Incremental Processing of Sentential Elements

Incrementality can be simply described as composing structures and meaning as the linguistic items appear left-to-right during sentence comprehension (Crocker, 1994). The general assumption is that there is no reason to delay the comprehension process which uses the lexical and morphosyntactic representations to a great extent. All the lexical, syntactic, morphological and semantic cues are used instantaneously leading to predictions about the nature of the sentence being uttered. That is because either the lexical material provides enough bottom-up predictions (projections),[1] or the cognitive mechanism is favoring some kind of top-down processes revealing the structural and semantic properties of the following material (see Pritchett, 1991, for opposite claims). The heuristic and predictive power of the language processor may ease the comprehension process and aid the comprehender to extract meaning quickly. On the other hand, incremental sentence processing leads to the partial contruction of the sentence. From the items already being processed, the comprehension system forms the syntactic, semantic and relational structure to yield a partial representation of the sentence. Interestingly, and related to

[1]One example of bottom-up prediction is the left-corner parser, where the category of the current lexical item is taken as the first symbol in the right hand side of the phrase structure rule that fits to the current sentential environment. For instance, when the parser sees "The" in the sentence, it initializes the projection of "Det" category derived from this lexical item as $Det - - >$ the. This then yields another bottom-up prediction for a noun, derived from $NP - - >$ Det N phrase rule, because the Det is the first symbol in the right hand side of the phrase structure. Thus, the first symbol of the right hand side of the rule projects the higher level phrase structure.

that, incrementality may also implicitly play a role in theoretical linguistic approaches, for instance in constituency diagnostics where the new constituent may be formed while the previous constituent is revised (Phillips, 2003). Incrementality, then, has a major contribution not only to our understanding of the sentence, but also to the theoretical aspects of linguistic representation. Syntactic preferences are constructed and semantic features are realized without any delay.

Within the scope of incremental processing, one of the interesting phenomena of psycholinguistic research is to understand how on-line, continuous composition of meaning is derived from the component parts of the sentence. This can be considered the core property of the models of the human sentence processing mechanism. Most sentence processing models derive meaning via thematic role assignment to the arguments. Thematic roles represent attributes of the arguments that code features about the event that is represented by the verb. The verb, as the main determiner of the event and meaning (and the one which reveals the semantic nature of the event), takes a major role in the semantic derivation. For instance, while the transitive forms of the verbs "eat" and "feed" in the sentences "Martha ate the sheep" vs. "Martha fed the sheep" have similar syntactic and logical structures (i.e., the aspectual and temporal structure of the verbs are similar), how the object of the sentence is influenced from these actions are very different. In the former case, the "sheep" is the Theme (be consumed and disappears by the event eventually), in the other case it is the Beneficiary. Thus, while the syntactic, aspectual and temporal properties of the verbs bear important properties of the sentence, the semantic features of the verb for the final comprehension of the arguments must also be taken into account for the final evaluation of the event. But, this does not necessitate that the comprehension mechanism should do nothing at all until the verb emerges, particularly in verb-final languages. Bottom-up projections may not only predict structural relations, but also project semantic and logical positions of the arguments with relation to each other. Features like animacy, case marking and word order may help the comprehension system to initialize such predictions.

In this thesis, I adopt the hypothesis that the comprehension mechanism establishes a number of interpretive and formal relations between the arguments of the verb before the verb is processed in Turkish, in line with the hypothesis developed in the incremental processing literature (Aoshima, Phillips, & Weinberg, 2004; Bader & Lasser, 1994; Bornkessel, 2002; Kamide & Mitchell, 1999; McRae, Hare, Elman, & Ferretti, 2005). But, I also hypothesise that establishment of interpretational and formal relations (by using features like case marking, position or animacy) is not only a hierarchically oriented cue driven process, but is also required to aid the language comprehension sys-

tem during linking of the arguments to the verb - especially, for a verb-final language like Turkish, these types of relations may play an important role in the linking process that we may not be able to observe in other languages (languages having verb-second or verb-initial word-order) easily.

How do we derive formal and interpretational relations between the arguments? Depending on the main emphasis of an approach, deriving such relations between the arguments may happen in three different ways. In the first type of models, structure is mapped to meaning; mapping is **uni-directional.** Characterization of the **form**, how it combines sub-forms with each other or which operations it chooses to combine these sub-forms that lead to meaning, depends on the particular approach we follow. The general trend in this approach is to use phrasal structures (constituents) or templates. The main goal is to find principles to combine these structures. Whether these structures are simple templates, or $\overline{X}$ structures; or whether these compositions happen to emerge simultaneously on the current lexical input, or only when the head/verb is processed, these approaches derive meaning after the successful integration of the form (Ferreira & Clifton, 1986; Fodor, 1998; Pritchett, 1988).

The second type of approach suggests global interactions of various elements with the on-line sentence comprehension. This approach takes into consideration all information types (the structure, the contextual and various other information types like lexical semantic information) to interpret the current sentential string as well as to make predictions about the upcoming items. The frequency of usage of these attributes also plays a major role. In most of cases, a more typical **schematic** representation of the world is produced (in some cases with the verb-to-noun or noun-to-verb priming effects) (Ferretti, Kutas, & McRae, 2006; McRae et al., 2005; Van Berkum, Brown, Zwitserlood, Kooijman, & Hagoort, 2005; Vosse & Kempen, 2000). Constraints are weighted and **associative** processes take place between the items. In some other approaches similar to this group of theories, different languages show different dependencies in the cues (case, word order, animacy etc.) in differing degrees for sentence interpretation (MacWhinney, Bates, & Kliegl, 1982).

The third group of models of language processing assumes that the procedural (and systematic) application of syntactic processes exist while semantic assignments are made. For instance, if the **modular architecture** between syntactic (algorithmic) and semantic (interpretational) processes happen to be more transparent and interactive, these models lead to approaches that are either parallel (syntactic and semantic components act at the same time and affect each other simultaneously) (Jackendoff, 2007; Kuperberg, 2007), or partially parallel (allowing the syntactic or semantic component to take the lead at particular times during processing) models of parsing (Bornkessel &

Schlesewsky, 2006).[2] In the former approach, the semantics (event representation) of the sentence shows similar structural properties in parallel with the syntactic structure. Syntactic and semantic composition may intract to aid each other. On the other hand, the latter approach mainly emphasizes the relational nature of the syntactic and interpretational aspects of the arguments. In the latest versions of these approaches, most of the syntactic representations are minimized. Also, in some cases syntactic operations like "movement" (generally proposed in the mainstream language processing literature) is prohibited. These approaches also differ from the interactionist (and association based) approaches such that the syntactic and semantic composition happen in a relational and structural manner, and semantic associations between the items do not take part in the core sentence processing mechanism. Particularly in these approaches, the goal is to capture a direct link between structure and meaning via on-line measures (ERPs), which provide strong temporal resolution for when and how these relations emerge.

Recent findings in psycholinguistic research suggest that **incremental interpretation** is handled in a very systematic way where category and constituent structure initializes the processing and the **semantic and relational** information is handled after this initial, core syntactic check (Friederici, 1999) similar to the proposals of the uni-directional models. Major contextual and pragmatic information interacts with the previous information in the later steps of processing (Gunter, Stowe, & Mulder, 1997; Gunter, Friederici, & Schriefers, 2000).

In this thesis, I assume the theory proposed by Bornkessel and Schlesewsky (2006), so called the extendended Argument Dependency Model (eADM). This model has novel representations and processing assumptions brought together with the language comprehension literature (like generalized roles, prominence hierarchies). It assumes different interpretational and functional attributes elicited by the linguistic elements (i.e. interpretational-relational attributes signaled by case information) where the cross-linguistic variation represents one of the important dimensions. The general frame of the model follows the previous theoretical approaches of sentence processing (Friederici, 1999; Gunter et al., 2000; Hahne & Friederici, 1999; Kamide & Mitchell, 1999). That is, the processes are handled in a serial (hierarchical) order. The assumptions about the electrophysiological correlates in the initial (category information) and final processing steps (well-formedness check) of the lexical item are similar. But, it should be noted that the handling of the interpretational relations, linking of the arguments to the verb between the initial and final steps, as

[2]For similar approaches in theoretical linguistics where semantics or syntax can constrain each other while certain operations are being handled by the language processor see Bresnan (2000); Pollard and Sag (1994).

well as how cross-linguistic variations emerging from language specific case, word order, animacy and agreement information are specified elaborately in this model. eADM extends its range to multiple languages in which linguistic diversity becomes the testbed for cross-linguistic generalization. Thus, this model is the starting point for my exploration of Turkish language processing.

Also note that, eADM is currently still being developed: not only does it contribute to the interpretation of new data coming from varieties of languages, it also benefits from these new data, continuously updating itself. I will describe the main principles of the model here. Particulars of this model will be described in different parts of the thesis whenever detailed information on syntactic or semantic processing is needed. Briefly, this model assumes that human sentence processing is incremental, operating on each lexical input in a principled manner, starting from **lexical-category** information, leading to a formulation of **relational prominence information** between items. It also brings hypotheses about how argument linking (or the linking of these relational constructs to the verb) happens. While this model extends its perspective to the neuroanatomical correlates of these processes, this thesis will focus only on the electrophysiological correlates.

There are four properties of eADM that are critical for this thesis. The first is the **minimality** that generally applies at the structural and relational levels. Second is the formation of **prominence relations** and the assignment of **generalized semantic roles** by using prominence hierarchies (which are constructed before the verb and affect linking). The third is the **linking mechanism** that happens at the verb, which is influenced by the logical structure of the verb and the prominence hierarchies constructed before the verb. The last one is the **well-formedness** checking mechanism that applies to each item after formal and interpretational information is established. These principles are organized in a hierarchical manner. Each one applies when a previous step is completed. They have corresponding ERP components with different topographical and temporal dimensions.

Now, I will explore these properties in more detail, and use them to explore the incremental processing in head-final languages such as Turkish. The study of Turkish can benefit from the research on incremental processing of other head-final languages.

1.1 Main Principles of Incremental Processing

1.1.1 Minimality and Sentence Processing

The first property I will discuss is "Minimality". It states that the language processing system will favor minimal structures (e.g., intransitive sentence or minimum possible template/syntactic tree) whenever possible, in line with the previous proposals made in the literature (Fodor, 1998; Inoue & Fodor, 1995). Case marking or position may or may not reveal information about the grammatical or semantic role of the argument, but the system always assumes a minimal structure to initialize the comprehension process.

The general assumption is that there are multiple levels where minimality can apply. In this thesis, two levels of minimality are important: (a) relational and (b) structural minimality. For the former, the model proposes that under a local ambiguity, the initial ambiguous argument is interpreted as the sole argument of an intransitive relation (an intransitive event in which only one generalized role (GR), a concept which will be explained below, is expected). An intransitive structure is one in which there is only a single participant (e.g. *Yusuf slept*) and consequently only one GR exists. As this single participant must be a subject (in languages like German and Turkish), the subject preference emerges. Thus, relational minimality is a kind of ambiguity resolution strategy, which provides ways to resolve this situation in a systematic manner.

The second type of minimality is structural minimality. In this case, the minimum number of overtly stated categories is expected without any further assumption about their positions in deep hierarchical tree structures. For instance, if it is possible to drop a subject in a transitive relation having two arguments, then NP-V structure is preferred over NP-NP-V structure, because the former has only one argument overtly stated, rather then two.

Thus, as each lexical item is perceived, lexical categorical information is retrieved. This information triggers the formation of a template that obeys the minimal structure. This template does not contain any syntactic or semantic function of the argument. It only forms the basis of the core structure of the sentence like NP-V.

An important point of the minimality principle for the thesis is that Turkish represents local ambiguities in which either object or subject reading is possible. I will particularly investigate this principle under the phenomenon called subject-preference in Experiments 1 and 2, in which I manipulate local ambiguities in order to assess what kind of local preferences emerge.

Subject preference is a phenomenon in which an initial locally ambiguous argument of the sentence is preferentially chosen as the subject. Ambiguity here refers to a situation in which the argument has no clear indication (i.e., via case marking) that it is the subject. Thus, under certain situations, the language processing mechanism prefers this argument to be the subject, rather than the object. As will be explored in detail in Chapter 3, Turkish shows both subject initial Subject-Object-Verb (SOV) or Subject-Verb (SV) word orders, as well as the object initial Object-Verb (OV) word order in which the subject is dropped (and marked on the verb as the number and person agreement marker). Thus, an initial ambiguous argument has the potential of being the subject [as in example (2) below] of a sentence or the object of the sentence via subject drop [as in example (1) below].

(1) Dün pilot gördüm.
yesterday pilot see-Past-1s
Yesterday (I) saw (a) pilot.

(2) Dün pilot uyudu.
yesterday pilot sleep-Past-3s
Yesterday (the) pilot slept.

In examples (1) and (2), subject preference emerges from relational minimality on the ambiguous argument "Pilot" in both cases. On the other hand, structural minimality proposes an NP-V but does not propose any grammatical function like relational minimality does. When this initial subject-preference is violated, as in example (1), then a revision happens on the verb from a subject reading of the initial argument to an object reading of it. On the other hand, this process does not conflict with the NP-V template, and does not require any change in this template which was previously proposed by the structural minimality. Subject-drop still satisfies minimal structure with an NP-V template.

I will present theories about selecting the initial ambiguous argument as the subject of the sentence in the following chapters. Evidence for this preference and the theoretical explanations of why such a preference emerges will be presented in Experiment 1 (Chapter 4) and Experiment 2 (Chapter 5). I will briefly give examples and explain what these theories propose. Also, I will discuss the Subject-Drop property in detail in Chapter 3 while Turkish grammar is being presented. On the other hand, the impact of structural minimality will be shown in Experiment 2 (Chapter 5), when the effect of an overt pronoun on sentence comprehension is investigated.

1.1.2 Incremental interpretation on the basis of prominence hierarchies

The second property is related to the formulation of prominence hierarchies. eADM assumes that the incremental interpretation of arguments takes place on the basis of verb-independent prominence hierarchies encoding a variety of cross-linguistically motivated, relational information types (e.g. $definite > indefinite$, $animate > inanimate$, $position\ 1 > position\ 2$) (Comrie, 1989; Croft, 2003). It assumes that the general tendency of languages is to have arguments which are distinct from each other on many dimensions defined by these information types. Even before the verb is processed, the language processing system makes some hypothesis about the relational status of an argument with respect to the other argument. An argument can simultaneously be definite, animate, nominative marked and have a higher prominence status than its co-argument, for instance. Any conflict between these relations leads to a processing cost [i.e., Position 1 (first argument position) in the sentence is taken by the inanimate argument while Position 2 (second argument position) is taken by the animate argument]. Thus, prominence is a relational term, applying when two arguments exist in the sentence. It is used to define the level of the argument in relation to its co-argument by using their relative animacy, definiteness and agreement information.

There are essentially two types of prominence hierarchies, namely those encoding interpretive information and those encoding formal information. Interpretive prominence hierarchies drive incremental interpretation within the eADM. These are: (a) animacy [$Animate > Inanimate$ (e.g. $Doctor > Book$)], (b) definiteness [$Specific/definite > Non-specific/indefinite$ (e.g. $My\ book > a\ book$)] and (c) cause [$+causer > -causer$]. Position [$POS1/POS2$] and case marking [NOM/ACC] are used for deriving the formal promience hierarchy [$+agrt > -agrt$]. But note that, in many languages (like German), case not only plays an important role to construct formal prominence hierarchy but also interpretational prominence hierarchy (i.e., in general, nominative is given the higher prominence status while accusative is given the lower prominence both in formal and interpretational terms).

For English, sentence position provides important prominence information. The initial argument is always given a higher prominence status. If the lexical features of that argument do not match with the positional prominence assignment (like if the sentence-initial argument being given a $+Agr$ higher formal prominence status is inanimate), a conflict arises. One study supporting this hypothesis comes from Wickerly and Kutas (1999) as is shown in example (3). The word *movie* leads to an N400 effect (an ERP effect indexed to the levels of

semantic and contextual processing, as will be more elaborately investigated in Chapter 2) relative to *novelist* before the relative clause is realized.[3]

(3) The novelist that
The movie that ...

While the interpretation of an argument is dependent on the linear precedence rules for English, it is generally case marking for German. One study showing prominence hierarchy mismatch comes from Frisch and Schlesewsky (2001).

(4) ... welchen Lehrer der Zweig streifte.
...$[which\ teacher]_{ACC}$ $[the\ twig]_{NOM}$ brushed
"... which teacher the twig brushed."

In example (4), the noun "the twig" leads to an N400 effect relative to the animate NP in the same position (following the same accusative NP "the teacher"). The assumption is that the ACC marking assigns a lower prominence status to the initial NP, thus a "prediction" for a more prominent argument occurs (since a lower argument cannot exist without the higher argument). The second nominative NP is given the higher prominence status via the $Nom > Acc$ hierarchy. This is an expectancy generated by the language comprehension system. But, on the other hand, the animacy hierarchy ($+Anim > -Anim$) imposes that the animate NP must be higher and the inanimate argument must be lower in the prominence scale. Prediction towards a more prominent item and the animacy information of the second NP revealing the less prominent item conflict, and this expectancy failure leads to an N400 effect.

As this example shows, prominence-based dependencies are established between the arguments even before the verb is encountered. Interpretive prominence dependencies essentially amount to a minimal interpretation in the sense of "who is acting on whom." For instance, the most prototypical interpretation of B being dependent upon A is that "A is acting upon B," i.e., A causes an event by which B is affected. By contrast, formal prominence is not primarily used for argument interpretation, but rather used to assign an agreement attribute to the argument (either $+Agr$ or $-Agr$).

[3]It is not clear whether the negativity observed in this study is the result of the mismatch between the prominence status and inanimacy, or purely lexical differences. The authors interpreted the result as the assignment of the Subject grammatical function to the inanimate argument, which is a non-prototypical subject. Note that in a similar experiment Ott (2004) did not observe an animacy difference for sentence-initial case unambiguous arguments for German. Even though this time the language was German (and typologically different than English), in both languages, conflict in the prominence assignments is simiar. Thus, it is not clear whether the interpretational difference about the sentence-initial NPs were for typological, lexical, or experimental reasons.

Thus, there are three important aspects of incremental sentence processing that the model follows: (a) Pre-verbal prominence assignments are semantically (e.g., animacy) or morphosyntactically (e.g., case) determined, (b) prominence is relational (e.g., high vs. low in the hierarchy) and (c) relational information is used for linking the arguments with the verb. These issues will be explored in Experiments 1 and 3.

One may ask why such prominence relations are favored in languages, or, why prominence relations do not generally tend to mismatch. For instance, when an inanimate object appears in the sentence why is an animate subject expected? One answer comes from the unmarked transitivity hypothesis from Comrie (1989). According to this hypothesis, the general tendency of world languages is to have an animate and definite subject, and an inanimate and indefinite object. This hypothesis puts forward the general tendency, but does not explain why this is the case. Another answer might be that the number of incidents we come across in life in which an inanimate entity affects the inanimate entity are very few. The general observation is that animate entities act on animate or inanimate entities. Thus, it is highly possible that prominence-related predictions may be influenced by experience-based world knowledge. These explanations take into consideration only the status of the arguments. On the other hand, prominence relations are also known to play a role in the definition of the grammatical roles. In a language such as Fore (Scott, 1978), the animacy hierarchy may strictly determine the who-is-doing-what-to-whom relation. For instance, if both a human noun and an animate noun exist in the sentence, the human argument is taken as the one doing the action to the animate noun, not vice versa. Thus, the main motivation of prominence hierarchies is to link the argument to the positions of the verb to lead to a syntactically and semantically well-formed sentence.

Thus, depending on the particular language being processed, the argument showing formal prominence (i.e., be the $+Agr$ argument) may also be required to be interpretively more prominent (i.e., be the Agent, animate and definite), or the two dimensions may be independent of one another (in which the $-Agr$ argument may be the Agent, animate and definite) (Bickel & Yadava, 2000). There are cross-linguistic differences in how linking of the arguments to the verb is handled. In the next section, the nature of the lexical representation of the arguments, the concept of generalized semantic roles, the relation between prominence relations and the generalized semantic roles, and how linking of the arguments to the verb is handled will be investigated.

1.1.3 Linking of Arguments to the Verb

This property of the eADM proposes that the verb has a Logical Structure (LS) which is derived from the *Aktionsart* based classification of the verbs (Vendler, 1967; Dowty, 1979) following the similar principles of Role and Reference Grammar (RRG) Van Valin (2005).*Aktionsart* classification reveals mainly the aspectual and temporal character of the verb.

In this classification, "state" represents the event implying a state (e.g., "be sick, be dead"), "achievement" represents verbs implying an instantaneous temporally bound event (e.g., "to pop, to explode"), "activity" represents verbs implying a dynamic, temporally unbound event (e.g., "to walk, to roll") (Vendler, 1967). In RRG, verbs are analysed in terms of a lexical decomposition system in which state [**know'**(x,y)] and activity [**do'**(x,[**eat'**(x,(y))]] predicates are taken as basic predicates (see Table 1.1). The other verb LSs are derived from them. On the other hand, RRG introduces operators like DO, BECOME and CAUSE in order to impove the representational power of the LS. These operators actually stand for cognitive states that represent intentions, relations and changes that are triggered by the event (verb).

For instance two possible logical structures of the verb "to melt" can be shown as follows. In the first example the verb is in the intransitive form; in the second example it is in the transitive form:

(5) Ice melted:
BECOME **melted'**(x)
BECOME **melted'**(ice)

(6) The girl melted the ice.
[**do'**(x)] CAUSE [BECOME **melted'**(y)]
[**do'**(girl)] CAUSE [BECOME **melted'**(ice)]

The operator "BECOME" shows that a "change" emerged and "x" "became" *melted* in the first example. In the second example, the verb is in the causative form where the external causer "The girl" causes the ice to melt (via heating or some other method). The CAUSE operator takes precedence and the BECOME operator now occurs after the CAUSE with a "y" argument.

Similarly, the sentence "The dog scared the boy" will lead to the LS as follows:

(7) The dog scared the boy.
[**do'**(x)] CAUSE[**feel'**(y,[**afraid'**])]
[**do'**(dog)] CAUSE[**feel'**(boy,[**afraid'**])]

The reason why "dog" takes the position in the scope of the do' predicate rather than the position in the scope of the feel' predicate is because "dog" acts and

ACTOR				UNDERGOER
——————————->				
		<——————————-		
Arg. of DO	1st arg. of **do'** (x,..	1st arg. of **pred'** (x,y)	2nd arg. of **pred'** (x,y)	Arg. of **pred'** (x)

Table 1.1: Van Valin' Actor-Undergoer hierarchy

causes a state change for the "boy". The argument positions are not arbitrary. The positions of the arguments in the LS are driven by event semantics, not by their syntactic position or agreement marking. Structural and syntactic properties are deriven from the semantically derived argument positions of the LS via a mechanism known as "Argument Linking". For instance in the examples above, "the girl" and "the dog" are the subjects of the sentence because they appear on the left in the LS and they are not as deeply embedded in the LS as the other arguments.

While the LS (via operators and basic predicates) inherently reveals the lexical-aspectual roles of the arguments, it does not impose any thematic role (like a list of thematic roles, e.g., Agent, Patient, Instrument). RRG proposes that the LS majorly defines the argument positions in syntax. There is a mechanism called "Linking" between the LS and syntax which is mediated by the "Semantic Macro Roles" (SMRs). SMRs are "generalizations" over the arguments' positions in the LS. They are defined in terms of the arguments' positions in the decompositional LS of the verb.

There are only two SMRs: Actor and Undergoer.[4] A core argument in a sentence is either an Actor or Undergoer, and the other argument, if there is any, is considered to be the non-macro role argument.

As Table 1.1 shows, in the unmarked linking situation, Actor is assigned to the left-most argument in the LS, and Undergoer is assigned to the right-most argument in the LS. eADM defines SMR as Generalized Roles (GRs) and I will follow the notation "GR" from now on to refer to Actor and Undergoer generalized roles.

For eADM, constructing a pre-verbal prominence relation actually means to construct an interpretive (Actor-Undergoer) GR hierarchy between the argu-

[4]They correspond to what is commonly called 'logical subject' and 'logical object' (Van Valin, 2005, p.60.). Also, the Actor can be regarded as the external argument which takes the Agent $\theta - role$ (Chomsky, 1981).

ments even in the absence of explicit verb-based information (as mentioned in the previous section). I will call the pre-verbal GR "pre-GR", representing the outcome of the prominence status of the arguments (constructed via case, animacy, agreement, position and/or definiteness prominence hierarchies). When the verb is processed, pre-GRs link to the LS. The GR hierarchy coded in the LS of the verb must map to this pre-GR smoothly. There are two things that are very important to note: (a) Both arguments (or pre-GRs) are mapped to the LS simultaneously during linking and (b) case marking and position of the pre-GRs play a major role during linking.

One hypothesis in eADM is that GR revisions that emerge from the mismach between the pre-verbal and the verbal GR hierarchy should lead to early positivities. These positivities are "revision" related. One example of GR revisions during argument linking comes from German (Bornkessel, Schlesewsky, & Friederici, 2002a, 2003):

(8) .....dass der Dirigent den Sängerinnen auffällt / dankt.
...that $[the\ conductor]_{NOM}$ $[the\ singers]_{DAT}$ is-striking-to / thanks.
"...that the conductor is striking to the singers."

Pre-GR assignment via prominence hierarchy $Nom > Dat$ is established to yield $Actor - Undergoer$ GR order. When the Agent-Patient verb *danken* is perceived, its LS requires the NOM argument to be the Actor. But, when the verb *auffällen* is perceived, the LS of the verb is activated in the form of be'(x,[striking-to' (y)]) where the Undergoer GR should be assigned to the Nominative argument (because the DAT argument will be the "experiencer" and will be located in a higher prominence hierarchy). This verb dictates the revision of the pre-GRs that had an opposite alignment, particularly updating the NOM argument from Actor to Undergoer, leading to the revision related positivity (an ERP component which will be investigated in Chapter 2).[5]

Another assumption in eADM is that, if case is ambiguous then it does not establish any pre-GR. The relative position of the arguments ($\mp agr$ assignment) determines the expected hierarchical alignment of arguments in the LS for an unmarked linking (Bornkessel & Schlesewsky, 2006, p.801). The hypothesis is that, in these cases, a word order difference (Object-Subject vs. Subject-Object) influences the linking process. If word-order deviates from the unmarked linking option, this leads to an N400 ERP component.

One important hypothesis here is that the LS majorly defines the argument linking process. Lexical decomposition of the verb only takes into account

[5]Note that in the current version of the model, dative arguments are considered not to have GRs, because they are considerd to be the non-macro role arguments as defined in RRG.

the LS in eADM. But on the other hand, in the linguistic literature, there exist a number of different hypotheses for the lexical verb semantics. For instance some of the theories are thematic role based (Dowty, 1991), others are decompositional, similar to Van Valin's (2005) approach (see also Levin & Rappaport Hovav, 1994), assuming operators (or primitive predicates) like CAUSE and BECOME. Some other approaches majorly emphasize events and sub-events in an event structure where complex event type "transition" between "process" to "state" is important (Pustejovsky, 1991). Some theories tend to include all these representations at once (Enfelberg, 2000). In general, event structure (or lexical decomposition) of the argument structure is considered to be responsible for the linking of the arguments to syntactic positions (Grimshaw, 1990; Tenny, 1987; Tenny & Pustejovsky, 2000). For instance, in Grimshaw's (1990) approach, argument structure of the verb mediates linking between the aspectual and thematic structure of the verb and the syntax. Only the aspectual structure (causative component) dominates thematic hierarchy during linking. Supporting evidence for such interactions between the causative structure and thematic role structure comes from cross-linguistic research (Li, 1995). Thus, argument linking and assignment of syntactic roles are basically directed by causative (aspectual) prominence information, while thematic roles play a secondary role in refining comprehension, even though the thematic hierarchy they provide may be violated by the former one.

The LS may be the main determinant of linking, but it cannot provide all the lexical verb semantics. In this thesis, I assume that the LS is only one of the modules in argument structure. I assume that both the LS and thematic structure constitute the argument structure of the verb. The LS determines linking, but thematic structure provides semantic features necessary for language comprehension, where thematic roles may ease the linking as well as the comprehension of the arguments. Only under certain situations in which the LS cannot determine the linking differences, thematic structure defines the quality of the linking in particular and comprehension in general.

Thus, the argument structure for the verb "scare" will then be taken as follows:

LS Module: [**do'**(x)] CAUSE[**feel'**(y,[**afraid'**])]

Thematic Role Module: scare' (Agent,Experiencer)

Experment 3 will focus on these issues and the infuence of the semantic and syntactic factors during the linking of the arguments to the verb.

1.1.4 Well-formedness Check

The properties mentioned above (word category information, GR assignment, agreement assignment and linking) are considered core relations in the model. Core relations are clause-internal dependencies between the arguments or between the arguments and the verb. On the other hand, similar to the assumptions proposed by Frazier and Clifton (1996) and core vs. non-core distinctions proposed by Van Valin (2005), eADM assumes that there are non-core information structures like prosody, plausibility, word knowledge, frequency of occurence and semantic updating. For instance, relative clauses are in the non-core relation category and they display different properties than the core relations. eADM proposes that core and non-core properties combine in the later steps of the parsing process. Any problem (e.g., a sentence bearing a pragmatic violation) will lead to a late positivity in the ERPs. (Note that this type of late-positivity is different than the early positivities which are associated with the GR revisions as mentioned above.) One important thing to note here is that core and non-core processes happen in parallel, but temporal position of where this information is combined and evaluted is observed in the late time windows (corresponding to the 600-1000ms time window) in ERPs. Well-formedness will be the topic of Experiments 2 and 3.

In the next chapter, I will introduce ERPs in psycholinguistic research. I will define widely known and agreed upon ERP components which are affiliated with a number of linguistic functions. My main goal will be to provide basic information of how the ERP method can be used to extract most of the meaningful comprehension related functions of the human brain during incremental processing of a sentence.

Chapter 2

Event-Related Potentials in Psycholinguistic Research

Event-related potentials (ERPs) are voltage fluctuations in the electrical activity of the brain that are associated in time with some physical or mental event (Picton et al., 2000; Rugg & Coles, 1997). This electrical activity occuring in the brain may be directly related to an external event (exogenous) and/or may be driven by the internal mental states emerging as a combination of the properties of the event and the cognitive state of the brain (endogenous). These activities can be detected by sensitive electrodes that are placed on the scalp. The most common belief about the origin of the ERPs in the brain is that they originate from the summed post-synaptic potentials of thousands of synchronously activated pyramidal cells in the neocortex (Kutas & Federmeier, 2000; Kutas, Van Petten, & Kluender, 2006).

Electrical voltage is the result of the electrical potential difference between two points in space. Like a simple battery, this potential is the result of the negative and positive charges which create an electrical tension between these points. Thus, during the measurement of the electrophysical activity from the scalp, the voltage we observe on a particular electrode is actually the potential difference between that electrode and the reference electrode we choose. In language research, the reference electrode is generally placed on a location where the electrical potential is not very high. One such position is the mastoids (area behind the ears). In the experiments in this thesis, the reference electrode was always the left mastoid during ERP recordings (but then also re-referenced with the right mastoid off-line). It is important to keep in mind that when the results of different ERP experiments are compared, special attention must be given to which reference electrode was used (or what

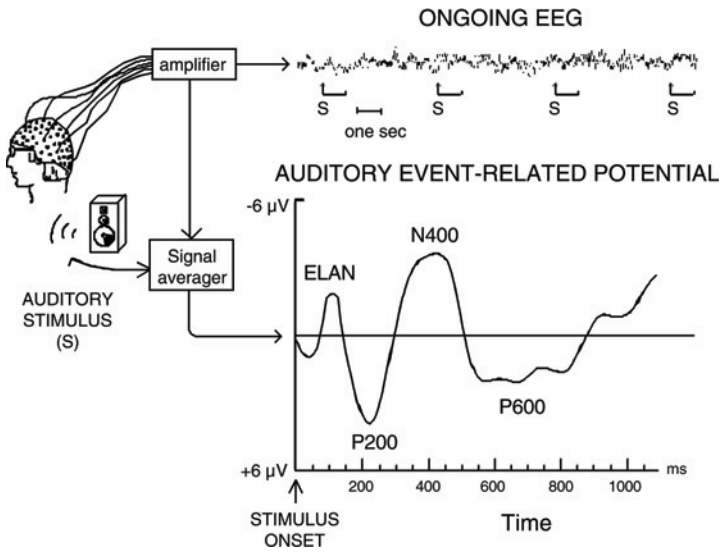

Figure 2.1: EEG activity obtained from each trial is averaged over all trials to yield a corresponding ERP waveform. ERP components are labeled as LAN, N400 etc. depending on their polarity, peaking time, or scalp location.

the final re-referencing status is). This information may dramatically influence the spatial distribution of the ERPs.

As can be seen in Figure 2.1, the electrical potential measured from the scalp is converted from analog to digital form (to be recorded in the computer) and also amplified to yield a stronger signal. This raw form is called electroencephalogram (EEG). Raw EEGs can be used to diagnose certain mental problems, for instance, by observing a very deviant and sharp EEG activity. These raw EEGs may not only be related to a particular task or stimulus, but related to the neurological activity produced by a neurological problem in the brain.

In order for the raw EEGs to gain a functional interpretation about the perceptual and cognitive tasks at hand, they are evaluted via many different techniques. For instance, EEGs can be measured for each trial, and then filtered and averaged over all the trials of the experiment. This gives a time-locked activity plot which is the result of the collection of the similar types of electrophysical activity observed for all the trials at particular time points after stimulus onset (Figure 2.1). The term "ERP" is generally associated with this type of analysis. The basic assumption in this technique is that the averaging will help to filter out the background activity which is regarded as noise. Averaging will help to extract the signal from this noise. The resulting ERP form

after the averaging will be the one which is associated with cognitive functions. This type of ERP component yields the plots showing the voltage change as a function of time. For instance, in Figure 2.2, the amplitude change in the ERP component termed N400, which is influenced by the experimental condition, can be seen in the voltage-time plot.

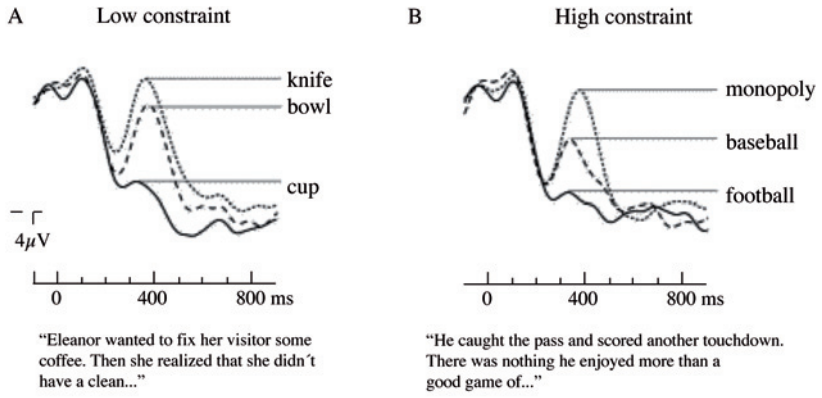

Figure 2.2: The interaction of memory organization and contextual constraint. The low-constraint condition is in column (A) and the high-constraint condition is in column (B). (Adapted from Kutas & Federmeier, 2000.)

Another technique is the one where potential fluctuations are assumed to be the result of the simultaneous superposition of many sinusodial brain waves. This approach assumes that particular frequency components of these EEG waves are more influenced by the task (either change their amplitudes or phases), and one can examine correlations between these frequency components and the cognitive task at hand (Başar, 1980). Note that in this approach, background brain activity is not noise, but rather regarded as the complementary part of the cognitive processes. In Figure 2.3, such a plot generated with amplitude-frequeny dimensions can be seen. Similarly, one of the common ways to analyse EEG in this category is to plot the amplitude of particular frequencies onto the time axis for each trial, and then average the ampitude-frequency-time characteristics for all the trials. This approach gives the frequency-time plots of the activity for that particular event, and may be used to extract the underlying electrophysical components of the cognitive task. In general, it is possible to define trial-to-trial differences with this method.

Thus, there are multiple ways to extract meaningful changes in the EEG activity. Researchers have been exploring how these EEG changes can reflect the most meaningful correlations with the cognitive functions attributed to the task. In the thesis, I use voltage-time analysis which is a very common

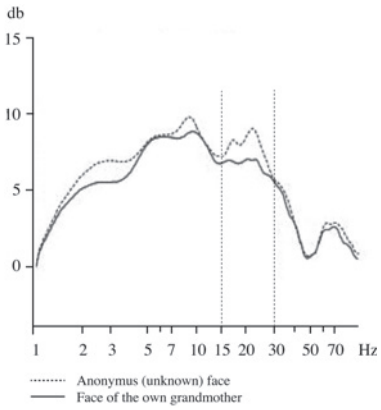

Figure 2.3: Amplitude-frequency change for a face recognition paradigm. When people see an unfamiliar face, the amplitude of the waves with frequencies between 15-30 Hz increases. (Adapted from Özgören et al., 2005.)

and well-know approach in psycholinguistic research. The ERP measurement locked to the onset of the critical stimulus will be averaged over the trials and over the participants to yield a grand average of the ERPs. Then, this ERP form will be compared with the ERPs derived for the control conditon to see the influence of the stimulus on the experimental condition (how the peaks, polarity, location and time of the activity change by the experimental conditions).

ERPs are informative via four main dimensions. The first is the temporal dimension where the exact time of the electrical fluctuation can be measured with high precision. The second is the spatial distribution of the activity. Even though the exact brain location of the activity cannot be detected (via the inverse problem, stating that there might be multiple sources of the activity observed on the scalp and that ERPs are not powerful enough to verify information with respect to locating the electrophysical sources in the brain), ERPs provide a spatial dimension at least on the scalp that can be correlated with the cognitive functions attributed to the brain systems. The third dimension is the polarity. Since ERPs are relative electrical potential measures, any measurement on any of the electrodes can either be positive or negative. Lastly, ERPs provide amplitude information, such that the amount of any deviation from a control condition may be informative about the difficulty of the cognitive process (as can be seen in Figure 2.2.)

In most cases, these dimensions are used to name or define a component. For instance, as it will be shown in the following figures, a negative polarity peak having an amplitude increase around 400ms in the centro-parietal scalp

region is generally named N400 (N stands for negative, and 400 stands for the time in milliseconds from when the component peak emerges after the stimulus onset). Under some cases, a component can be named by the position of its peak relative to the other peaks. For instance, P2 means the second positive peak coming after P1, and N2 is negative peak coming after N1. In psycholinguistic research, the general convention is to name the location or the polarity first, then the time window the ERP deflection emerges. For instance, P600 means the positive deflection emerging around and after 600ms stimulus onset. Generally P600 emerges at the centro-parietal region of the scalp and has a broader distribution, but location information is not coded in this name overtly. On the other hand, another component, Left Anterior Negativity (LAN) is totally derived from the topography of the component.

The most important question is to ask what is the definition of a component. A component does not have to be a peak. Any deviation from the reference condition may be regarded as a component as soon as it can be correlated with any of the cognitive factors under investigation.

2.1 Modeling Language Comprehension with ERPs

The finding of the close correlation between ERPs and cognitive processes dates back to the beginning of the 1980s (Başar, 1980; Kutas & Hillyard, 1980, 1984). As can be seen in Figure 2.2, one of the first ERP correlates of cognitive processes revealed a direct correlation between the amplitude of the N400 component and the semantic fit of the word expected during sentence comprehension. In this study, sentences were sorted into constraint categories based on the cloze probability of the expected exemplar. An item's cloze probability is defined as the percentage of individuals who continue a sentence fragment with that item in an off-line sentence completition task (Taylor, 1953). Low constraint sentences (A) had best completions with cloze probabilities under 75%, whereas high constraint sentences (B) had best completions with cloze probability 75% or higher. Thus, high constraint sentences tended to lead individuals to strongly expect a single completion (or a set of features that strongly associate with that item), whereas expectations in low constraint sentences were weaker and more variable (possibly there were not many expected features). N400 amplitudes to expected exemplars (solid lines) and between-category violations (dotted lines) did not differ as a function of constraint. The response to within-category violations (dashed lines), on the other hand, was significantly smaller (more like the response to expected exemplars) in high-

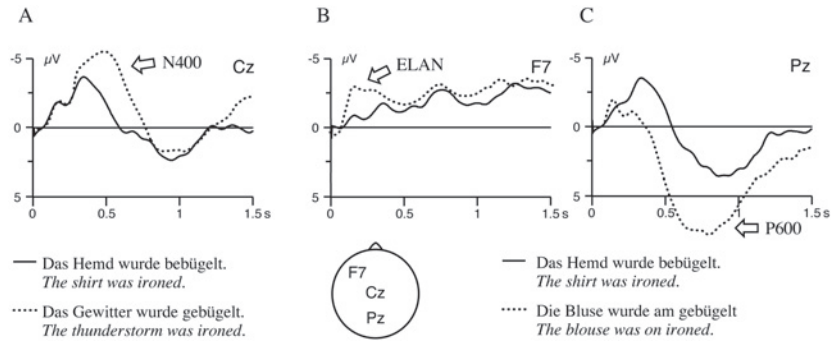

Figure 2.4: The three language related components in the ERP: (A) N400, (B) very early left-anterior negativity (ELAN), and (C) P600. Shown are average ERPs for the semantic- and syntactic-violation condition at selected electrode sites. Solid lines represent the correct condition, and dotted lines the incorrect condition. (Adapted from Friederici, 2002.)

constraint contexts than low. This finding suggests that linguistic expectancy does not solely look for a particular item, but an item that can easily integrate with the previous context by providing necessary semantic features (Kutas & Federmeier, 2000).

Since the time the N400 component was found as an ERP correlate of semantic memory during sentence comprehension, multiple components related to language processing have been discovered. Three widely used components are the Early Left Anterior Negativity (ELAN) (Hahne & Friederici, 1999), the Left Anteror Negativity (LAN) (Coulson, King, & Kutas, 1998), and the Late Posterior Positivity (P600) (or Syntactic Positive Shift-SPS) (Osterhout & Holcomb, 1992; Osterhout, 1997). They have been used as ERP evidence for the language processing models proposed. ELAN occurs during an early time window (between 100-300ms) in left-frontal electrodes, LAN occurs between 300-600ms in frontal electrodes, and a late centro-parietal positivity, termed P600, occurs between 600-1000ms in centro-posterior electrodes.

In Figure 2.4 these components can be seen together with N400. Generally, earlier interpretations of these components suggested that they are related purely to the syntactic processes of language. For instance, experiments showed that ELAN is correlated with rapidly detectable word-category errors (Hahne & Friederici, 1999; Hahne & Jescheniak, 2001) as well as function words (articles and prepositions) relative to content words (nouns and verbs) (Neville, Mills, & Lawson, 1992). On the other hand, LAN is generally correlated with morphosyntactic errors (Coulson, King, & Kutas, 1998; Gunter, Stowe, & Mulder, 1997; Gunter, Friederici, & Schriefers, 2000; Osterhout & Mobley, 1995).

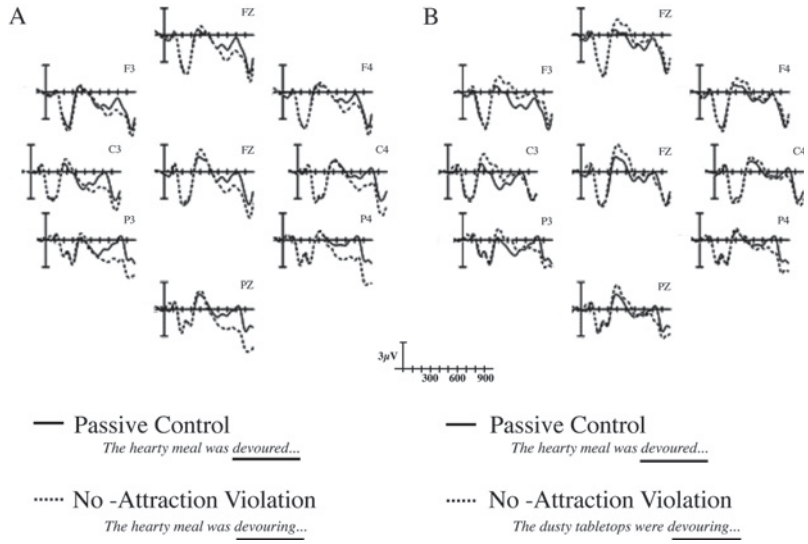

Figure 2.5: Thematically repairable sentences on the left (A) and non-repairable sentences on the right (B). ERPs for repairable sentences elicited P600 and the non-repairable ones did not. (Adapted from Kim & Osterhout, 2005.)

Early investigations of the P600 component showed that this component correlates with outright syntactic violations, with sentences that require syntactic revision, and with processing of syntactically complex sentences (Hagoort & Brown, 2000; Kaan, 2000; Osterhout & Holcomb, 1992; Osterhout & Mobley, 1995) and varies as a function of both the semantic and syntactic factors. These findings suggested that P600 reflects an interaction of multiple factors in the late time-window (Gunter et al., 2000). Recent neurocognitive evidence also suggests that late positivities are related to the thematic and semantic relations in which such relations are evaluated and reanalysed (Kim & Osterhout, 2005; Kolk, Chwilla, van Herten, & Oor, 2003). In these studies, the sentence contained reversible or thematically repairable sentences even though the inital form of the sentence includes a semantically ill-formed structure (as can be seen in Figure 2.5).

Since the late positive components are related to multiple information types, the interaction of semantic, thematic and syntactic constraints in the late windows led the researchers to treat P600 (or late positivities in general) as a well-formedness component (which checks and repairs the mistakes in the form or the meaning) (Bornkessel & Schlesewsky, 2006; Friederici, 2002), or a cognitive monitoring component (Van Herten, Chwilla, & Kolk, 2006) where conflicts are monitored and resolved.

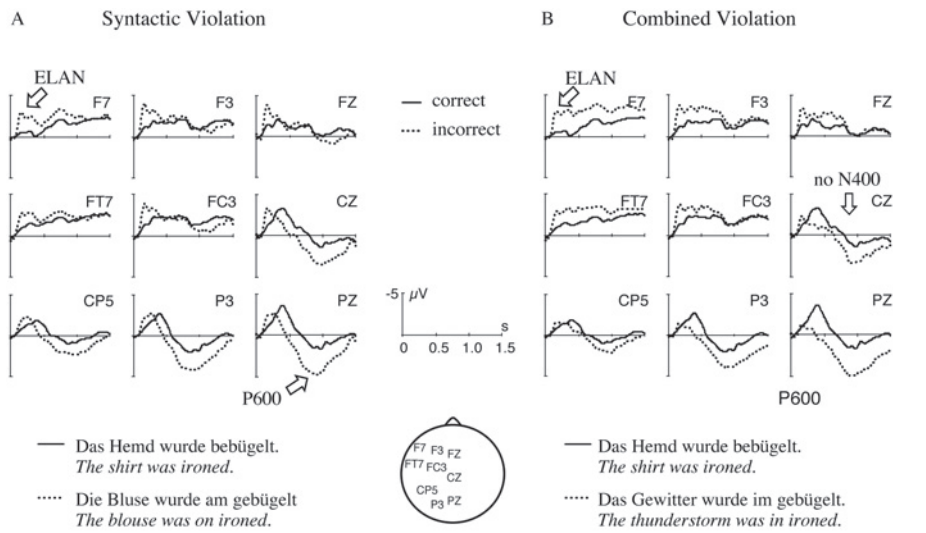

Figure 2.6: Average ERPs for the syntactic violation (A) and the combined violation (B). Solid lines represent the correct condition, and dotted lines the incorrect condition. (Adapted from Friederici, 2002.)

To give a better idea about how different components may interact and lead to different functional interpretations in the language processing models, I selected an example from Friederici, 2002. As mentioned above, ERPs (and possible components) can be correlated with the functional interpretations. For instance, the electrophysiological relation between ELAN, N400 and P600 is taken as evidence supporting the three-phase neurocognitive model developed by Friederici (2002). In Figure 2.6, the ELAN, N400 and P600 components are presented together.

When a word-category violation, usually reflected by ELAN, and a semantic violation, usually reflected by N400, are combined in one target word, only ELAN is observed (Friederici, 1999; Hahne & Friederici, 1998). The absence of N400 in double-violation conditions is interpreted by Friederici (2002) as the outcome of the linguistic process where the target word is not semantically integrated if it had not already been categorically integrated into the sentence. This finding indicates that syntactic structure building precedes semantic processes. On the other hand, when combining a morphosyntactic violation (e.g. syntactic gender), usually reflected by LAN, and a semantic anomaly usually reflected by N400, both ERP components are present and independent of one another. In this condition, the amplitude of the P600 varies as a function of both the semantic and syntactic factors, thus suggesting an interaction between these factors in the late-time window.

Statistical distribution, like the frequency of the items used in the experiment (and items in the corpus of the language at hand), or domain general principles like the constraints of (working) memory, or the context in which the linguistic process is achieved may influence the ERP components in differing degrees. Sometimes, the experimental task may lead to a different waveform than when another task is used (Hahne & Friederici, 2002). Thus, the important point here is to consider all these effects when a component analysis is made.

2.2 Examination of Verb-Final Structures via ERPs

Apart from a number of investigations [see Aoshima et al. (2004); Bader and Lasser (1994); Bornkessel and Schlesewsky (2006); Kamide and Mitchell (1999)], theoretical and experimental studies on the incremental processing of the verb-final sentences (clauses), particularly studies using ERPs, are very limited. These studies generally showed that before the verb is processed, on the locally ambiguous part of the sentence, the language processor makes particular syntactic decisions which are disambiguated (corrected or disconfirmed) later on. Such findings are presented as supporting evidence for incremental sentence processing.

On the other hand, as mentioned above, most psycholinguistic studies using ERPs investigated paradigms in which either syntactic or semantic violations were used. Also, in many cases local ambiguities are used to diagnose linguistic preferences.One such study in which ERP related components in the verb-final clauses are investigated in a non-violational paradigm comes from Bornkessel et al. (2003). The authors found an early positive ERP component, which they interpreted as a unique component of thematic revision. As mentioned in Chapter 1, the hypothesis is that pre-verbal generalized role (pre-GR) asssignments need to be changed on the verb, because the verb requires these roles to be in the opposite manner in the LS. The example given in Chapter 1 (8) is repeated as (9)below:

(9) .....dass der Dirigent den Sängerinnen auffällt / dankt.
...that $[the\ conductor]_{NOM}$ $[the\ singers]_{DAT}$ is-striking-to / thanks.
"...that the conductor is striking to the singers."

The hypothesis is that the incremental pre-verbal GR assignment via prominence hierarchy $Nom > Dat$ is established to yield $Actor - Undergoer$ GR order. When the Agent-Patient verb *danken* is perceived, its LS requires the NOM argument to be the Actor, but when the verb *auffällt* is perceived, the

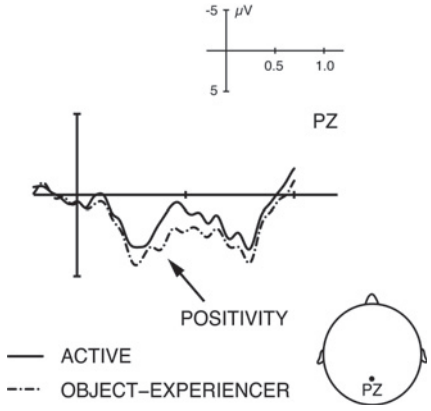

Figure 2.7: Positive ERP deviation observed for the dative-object experiencer verb vs. active-object experiencer verbs. (Adapted from Bornkessel et al., 2003.)

LS requires the NOM argument to be the Undergoer. GR revision of the Macro role of the Nom argument (from Actor to the Undergoer role) leads to the revision related processing cost. The positivity that emerged on the object-experiencer verb vs. the active verb is shown in Figure 2.7.

In this thesis, I will examine such ERP components in sentences without any syntactic and semantic violations. Any difference between the minimally differing conditions will reveal both the processing related differences as well as the parsing preferences. Incremental processing will require certain predictions and constructions to be made, and different constructions in the sentences will trigger different compositions and interpretations. For instance, as it will be explored in Experiment 2, the presence or absence of a pronoun may not greatly differ when it comes to the final interpretation of the sentence in Turkish, but comprehension processes as well as the processing costs related to the non-minimal usage of this item may interactively contribute to the deviation of the ERPs. These deviations may reveal clues about incremental language processing which take into account all varieties of information types. This provides observations which are not possible with off-line measures.

Particularly, I will examine components emerging in three time windows. The early time-window (around 150-300ms) is generally associated with early positivities related to thematic role switching, category violations, template formation and structural violations. The second window is the one around 300-600ms and bears the components related to thematic hierarchy problems, semantic expectancy violations, infrequency, thematic role assignment problems and prominence conflicts, morphosyntactic and agreement violations. The third window is the late time-window (around and after 600ms) which is generally

considered to be the temporal region associated with syntactic reanalysis, task related factors, well-formedness check, conflict monitoring, and the general problems in combining all sorts of information derived from semantic, syntactic, language general and particular domains. I assume the existence of quite different processing components for each time window acting in an ordered manner. During the presentation of the experimental findings, I will present a number of different interpretations of the ERP components related to the hypothesized language processes derived from previous studies.

In the next chapter, I will introduce the basics of the Turkish language that are relevant for the thesis. As a verb-final language, Turkish provides fine grounds for inspecting incremental processing via ERPs. It is possible to detect multiple syntactic, semantic and pragmatic factors that influence sentence processing on-line, even before the verb is processed. The syntactic and semantic preferences in Turkish will then be linked to the ERP findings in the consecutive chapters. Finally, interpretations will be connected to the corpus counts and other cross-linguistic ERP studies.

Chapter 3

A Brief Investigation of Turkish

My goal in this chapter is to give a brief introduction to the Turkish language; especially the properties that are relevant for the thesis. I will start by explaining Turkish morphosyntax. Effects of pragmatic and semantic constraints, as well as effects of case marking on word order will follow. Then I will extend these arguments and investigate how subjects and objects in Turkish behave in different environments.[6]

How and why certain positions in a sentence must be occupied with particular (grammatical) constituents is an important issue for the understanding of incremental sentence processing and the processing of arguments in an online fashion. The working hypothesis of this thesis is that the pycholinguistic preferences are not only influenced by language general preferences – assuming there are such preferences – but also language specific preferences. Thus, understanding the basic disribution of the syntactic forms in a language will be an essential part of identifying the underlying cognitive/psycholinguistic processes of language processing.

Below, I outline the particulars of the Turkish language which will be useful to examine conflicting and overlapping properties with other languages. These properties (like subject-drop, case marking) will then be investigated as the main factors that represent language particular constraints which may influence/reveal universal parsing mechanisms.

[6]For more details about Turkish grammar, I would like to recommend Erguvanlı (1984), Knecht (1986) and Kornfilt (1997).

3.1 Preliminaries of Turkish Morphosyntax

Turkish is a Subject-Object-Verb (SOV), verb-final language which has exclusive suffixing with postpositions (agglutinative) as in example (10):

(10) Ali eve gitti.
Ali house-DAT go-Past-3s
Ali went to the house.

Turkish has a Nominative-Accusative case system in which subjects are marked with the Nominative (Null) case and direct objects are marked with the accusative (*-acc*) case. Note that oblique (indirect) objects (generally used by prepositions in some languages like English, e.g., "in the house" or "at the beach") are used with other cases. For instance in the example above, "house" is an oblique object marked with the DAT case yielding the meaning "to the house."

The treatment of case is somewhat ambiguous in Turkish. As will be elaborated below, -acc case is a by-product of (and related to) specificity and word order. It is not obligatory to mark an object with the -acc case unless it is specific. On the other hand, oblique objects cannot be caseless, the meaning of the sentence cannot be driven otherwise.

There are six cases in Turkish, which occur as postpositional suffixes: Accusative (-yI), dative (-yA), ablative (-dAn), locative (-dA), genitive (-In) and nominative (Null element/Bare NP). The letter "y" is used to combine words ending with a vowel to a suffix that is starting with a vowel. "A" and "I" stand for the vowels (a,e) and (ı, i) respectively to make the word obey the vowel harmony.

Finite verbs are inflected for tense and agree with their subjects in person and number. Tense preceeds the person and number agreement like in (11) and (12).

(11) Ben gittim.
I go-PAST-1s
I went.

(12) Sen gittin.
You go-PAST-2s
You went.

Subject pronouns and their corresponding agreement markers that attach to the predicate are shown in Table 3.1.

	Subject Pronoun		-Agr marking
1s	Ben	(I)	-(I)m
2s	Sen	(You)	-(I)n
3s	O	(He/She)	$-\phi$
1p	Biz	(We)	-(I)k
2p	Siz	(You)	-(I)nIz
3p	Onlar	(They)	-(I)lar/$-\phi$

Table 3.1: Subject pronouns and their corresponding agreement markers.

3.1.1 Pro-Drop

In Turkish, pronouns can be dropped if the pragmatic context is available and when the subject is non-emphatic (not emphasised). Especially first and second person non-emphatic subject pronouns delete freely in the 'out-of-the-blue' context, e.g.,, in the first utterance of the discourse. This is the phenomenon known as Subject-Drop or Pro-Drop as in (13) vs. (14).

(13) Ben İstanbul'a gittim.
I İstanbul-DAT go-PAST-1s
I went to İstanbul.

(14) İstanbul'a gittim.
İstanbul-DAT go-PAST-1s
(I) went to İstanbul.

In (13), there is a subject-object-verb (SOV) order. In (14) the word order is object-verb (OV). Since person and number become apparent at the end of the predicate, comprehenders can directly understand the 'Actor' of the event (like in "yazdım" "write-Past-1s") or the 'Undergoer' (like in "düştüm" "fall-Past-1s") without any need for an overtly occuring grammatical 'Subject'.[7] Morphological marking, in that regard, signifies syntactic and semantic elements of the sentence directly.[8] Genitives can also be dropped if they are non-emphatic.[9]

Thus, Pro-Drop is a very common option in Turkish. How Pro-Drop (OV) order and canonical (SOV) order interact represents a unique situation, because

[7]The concepts Actor and Undergoer refer to Semantic Macro Roles (Van Valin, 2005) as shown in Chapter 1.

[8]As we will see in the next section, the pragmatic "Topic" is generally the subject and occupies the sentence inital position. It is important to note that sentences bearing two overt arguments are the ones which generally obey this criterion; the first argument being the topic and the second one being the focus.

[9]In the examples below, the noun "araba" (car) takes -(I)m suffix to agree with the possesor first person singular (1s):

SOV order imposes subject initiality, while pro-drop (OV) imposes object initiality. This issue will be investigated in the next sections of the thesis and it will form the main question of Experiment 1.

3.1.2 Word Order and Argument-Argument Relations

Argument interpretation and pragmatic resolution of the sentence are very relational in Turkish; for instance, the processing system can only understand that the sentence initial subject is dropped after the next elements are processed. That is, during incremental processing, the status of the first NP is ambiguous in many times in many dimensions (sentence structure; OV vs. SOV, pragmatics; definite vs. indefinite). One has to see the next items in the sentence to understand the grammatical and/or referential status of the argument.

At this point, it is essential to define two main positions in a sentence: the left-adjacent pre-verbal position will be called the *verb-neighbouring position* and the position where the NP is located further away from the verb will be called the *verb-distant position*. From now on, I will use these names to distinguish the particular positions of the sentence.[10]

In example (15), the noun "kitap" (book) is in the verb-distant position. In example (16), it is in the verb-neighbouring position. In both cases it is the object:

(15) Kitabı doktor okudu.
Book-ACC doctor read-Past-3s
The doctor read the book.

- Siyah araba.
Black car
Black car.
- Benim siyah arabam.
1s-GEN-1s black car-POSS-1s
My black car.
- Siyah arabam
Black car-POSS-1s
(My) black car.

[10]In many of the sources on Turkish languages the term "sentence initial NP" somehow overlaps with the "sentence initial NP in a sentence with two arguments." Most of the time, the pro-drop phenomena is left unnoticed in studies on Turkish (Erguvanlı, 1984; Slobin & Bever, 1982). I believe that this phenomena should be given more weight not only in language acquisition but also language comprehension.

(16) Doktor kitabı okudu.
The doctor book-ACC read-Past-3s
My mother read the book.

As these examples show, Turkish has flexible word-order under certain circumstances. These situations will be investigated elaborately below.

3.1.2.1 Default Word-order

In Turkish, when morphological case marking clearly signifies the grammatical object, there is high degree of word-order freedom. If the arguments clearly reveal their syntactic function via case marking, almost all word order combinations become possible. But, while Turkish seems to have highly flexible word order due to the morphological features, word order is actually constrained in many instances in which case marking disappears. Under such constraints, the only possible word order becomes SOV (Erguvanli, 1984). When the NPs are not marked, word order falls into a default SOV order and it is grammaticalized in that way. Note that the star in the following examples indicate that the sentence is ungrammatical:

(17) Mutuluk huzur getirir.
happiness peace-of-mind bring-AOR[11]
Happiness brings peace of mind.
∗Peace of mind brings happiness

(18) Huzur mutuluk getirir.
peace-of-mind happiness bring-AOR
Peace of mind brings happiness.
∗Happiness brings peace of mind
(Erguvanlı (1984), p. 5)

On the other hand, a question may arise whether the semantic nature of the NPs influence SOV preference under such conditions, for instance, if NPs have distinct conceptual/semantic representations (e.g., one NP being more agentive and animate and the other more likely to be the theme and inanimate). The basic assumption here is that, semantic prominence and word order may interact and comprehension may become more complex particularly when the animate NP emerges in the second position of the sentence. But actually, SOV word order seems to be preserved even under such cases:

[11]Aorist refers to wide-tense and it is very close to Simple Present Tense in English. It is used to express habitual action, or to express an idea that is generally accepted as true. It can cover action in the past, the present, and the future.

(19) Toplumsal baskı diktatörler yaratır.
Social pressure dictators create-AOR
Social pressure creates dictators.
? Dictators create social pressure.

3.1.2.2 Word-Order Flexibility

The linear ordering of the elements and their variations serve pragmatic purposes such as signaling the topic or distinguishing between old and new information. For this reason, Turkish can be classified as a Pragmatic Word Order type (Thompson, 1978).

Generally, semantic features, like animacy or definiteness of the arguments, play a crucial role in word order flexibility. Before I describe these factors in the next section, there are two structures that I want to mention: topicalization and extraposition. Topicalization corresponds to S/O inversion[12] and extraposition corresponds to the cases in which subject and object are inverted with respect to the verb (Hankamer, 1971):

Topicalization:[13]

(20) Masayı kadın kırdı.
Table-ACC woman break-PAST-3s
The woman broke the table.

Extraposition:

(21) Kadın kırdı masayı.
Woman break-PAST-3s table-ACC
The woman broke the table.

While these structures are different on the surface, they may have a similar pragmatic interpretation. For instance "the woman" in both of the examples is emphasized, but in extraposition it feels like both the subject and the verb are emphasized. Note that topicalization or extraposition are defined with relation to the other elements in the sentence. That is, it is not clear whether

[12]Sometimes this phenomenon is called contrastive focus in which the definite subject is in the focus position:

- İstanbul'a ben gittim.
İstanbul-DAT 1s go-PAST-1s
I went to İstanbul.

[13]Underlining shows the focused element.

the sentence involves topicalization, pro-drop or extraposition until the verb or the other arguments are processed. Thus, they bear local ambiguity with respect to pragmatic, syntactic and semantic dimensions. Pragmatic resolution of the arguments may happen not on the argument itself, but later in the sentence, when the relational status of that argument to the other arguments becomes clear.

Assuming there are two arguments in the sentence, the natural flow of information is generally: Known > Unknown, Specific > Non-specific, with a Subject > Object order. These pragmatic and syntactic prominence hierarchies (with a precedence relation) play a major role in the interpretation of a sentence. Throughout the thesis the existence of the similar hierarchies will be investigated.

The first prominence hierarchy I showed here is the formal prominence hierarchy $+agr > -agr$ which emerges in SOV order. In the next section I will investigate other prominence relations in Turkish. How these hierarchies interact with each other and how incremental processing happens within these processing constraints constitutes one of the major frames of the thesis.

3.1.3 Specificity, Definiteness and Referentiality in Turkish

In this section, I will describe the effects of definiteness, specificity and referentiality on word order (and vice versa) in detail. I will analyse the syntactic functions Subject and Object in the verb-neighboring and verb-distant positions via their degrees of referentiality, animacy and specificy. For instance we will see that the same entity we refer to may take different case marking and sentence position depending on its grammatical function. For each of the two sentential positions presented above, I will investigate the subject and object functional roles seperately.

3.1.3.1 Basics

Since semantics and pragmatics are two major contributors to Turkish morphosyntax, concepts like referentiality and specificity must be clearly defined.[14] In

[14]In this section, the phenomenon known as 'Specificity' will be taken as an independent semantic phenomenon. Specificity will be taken as an element independent of the scope approach proposed by some linguists (Fodor & Sag, 1982) and will be analysed as a functional component in the syntax.

English, specificity is asumed to be marked only with adjectives such as *"certain"* like "a certain car". Indefinites without such adjectives (like *a chair*, *one car*) can be interpreted either as specific or non-specific. They are ambiguous with respect to specificity (Enç, 1991, p. 4-5). On the other hand, in Turkish, "NPs in certain positions" are always (or should be) unambiguous with respect to specificity if they are the core arguments of the sentence.

For instance in the examples below, the same noun "kitap" (book) can have different levels of meaning in the same sentential context with different levels of referentiality.

Definite reading of the object "book":

(22) Ben kitab-ı gördüm.
I book-ACC see-PAST-3s
I saw the book.

Indefinite non-specific reading of the object "book":

(23) Ben bir kitap gördüm.
I a book see-PAST-3s
I saw a book.

Indefinite specific reading of the object "book":

(24) Ben bir kitab-ı gördüm.
I a book-ACC see-PAST-3s
I saw a certain book.

In each of these examples, the speaker intends to give a different "view" about the item "book". Speaker and hearer share a certain amount of information about the world (in these examples it is the information about the book) and the speaker generally conveys a certain degree of information for the hearer to perceive the entity talked about. For instance in example (22), "the book" implies that the entity is specific and definite; speaker and hearer know which book it is. -(y)I (accusative) marking is used in Turkish to mark this specific entity. On the other hand "a book" in example (23) is just any book among a number of books. While the speaker may know what particular book he/she means, the hearer does not need to know the details about the book. It takes the *bir* (indefinite) marker, corresponding to "a" in English. As these examples show, the speaker can change the level of reference (and the level of information to be shared by the hearer) by using case and/or an article.

On the other hand, sometimes the entity is inherently specific, and the speaker does not have any freedom to make it less specific (or less important) for the

hearer. He cannot change the level of referentiality. For instance in the example below, "my father" is inherently specific and it refers to a particular person. Speaker and hearer would acknowledge that this entity is specific and should be treated properly. Note that, now the speaker cannot use "my father" without -(y)I marking:

Definite reading of the object "my father":

(25) Ben baba-m-ı gördüm.
I father-GEN-1s-ACC see-PAST-3s
I saw my father.

Indefinite non-specific reading of the object "my father" is not possible and it is ungrammatical:

(26) ∗ Ben baba-m gördüm.
I my father-GEN-1s see-PAST-3s
∗ I saw my father.

These examples reveal that specificity, referentiality and case marking are closely related in Turkish. Inherent definiteness of an item may trigger case marking automatically, while in many other instances, the speaker's intention as well as sentential position and grammatical function of the argument determine specificity and case. Thus we can list five factors that are closely interacting in Turkish:

1. Morphological marking
2. Grammatical function
3. Sentential position
4. Intention of the speaker
5. Inherent semantic features of the entity referred

I will briefly describe these interactions below. My main emphasis will be given to caseless and accusative case marked objects as well as subjects, in verb-neighbouring and verb-distant positions.

3.1.3.2 Definition of the Referentiality Scale

Erguvanlı (1984) defines referentiality and specificity as follows:

> "The relationship between a linguistic expression and the object it stands for in the world is that of *reference*. There may, then be a referent, an object of the linguistic expression stands for – in

Gram. Function		Referential			Non-referential
		Definite	Indefinite		
			Specific	Non-Specific	
Subject	**sg.**	$-\phi$	bir NP	bir NP	$-\phi$
	pl.	–lAr			–lAr
Direct Object	**sg.**	–(y)I	bir NP –(y)I	bir NP (–(y)I)	$-\phi$
	pl.	–lAr –(y)I			–lAr –(y)I
Oblique Object	**sg.**	–CASE	bir NP –CASE	bir NP –CASE	NP –CASE
	pl.	–lAr –CASE			–lAr –CASE

Table 3.2: The specificity hierarchy in Erguvanli (1984). "sg." means singular, "pl." means plural, $-\phi$ means null element, –CASE represents oblique cases like dative, ablative, locative etc., "bir" is the indefinite marker and precedes the Noun Phrase (NP). Case marking on the other hand follows and attaches to the NP. -Acc marks accusative case, and -lar is plural marker.

> which case the expression is labeled *referential* – or there may not be such an object in the world – in which case the expression is *non-referential*. Among referential expressions we can "distinguish those that refer to some specific individual (or class of individuals) from those which (granted that they do have reference) do not refer to a specific individual or class; and these we will call definite or indefinite expressions, respectively." (Lyons (1977), p:178). A further distinction can be drawn between *specific* and *non-specific indefinite* expressions: the former are expressions whose referent is not identifiable by either the speaker or the hearer but is nonetheless a particular individual or entity in the universe of discourse; the referent of a non-specific indefinite expression is any individual or entity in the universe of discourse. *Non-referential expressions* can neither be definite nor indefinite, since by definition they do not have a referent."

Table 3.2 summarizes the description of Erguvanli (1984) given above. The top rows in the table show the referentiality of the NP. It goes from "definite" to "non-referential" forming the referentiality hierarchy. Indefinite NPs are grouped into two categories: specific indefinites and non-specific indefinites. For instance the specificity hierarchy for objects [similar to examples (22),(23) and (24)] are shown below:

definite <	indefinite specific <	indefinite non-specific
adam-**ı**	**bir** adam-**ı**	**bir** adam
man-ACC	a man-ACC	a man

Non-referential meaning of a noun can be like the noun "man" in the sentence "Man should know what he wants". Such expressions are generally used in idioms and general truths about life.

The left column shows the grammatical role of the NP (subject, direct object and indirect object). Other cells show which morphological case the NP has if it is used as a particular referent having a particular syntactic function.

In general, there are two markers used for referentiality: the *bir* marker (corresponds to "a" in English) used for subject and object, and -(y)I (accusative marker) only used for direct objects. In Turkish, there is no definiteness marker for subject (like "the" in English) in the main clause[15] to make the subjects definite.

The *bir* marker is used for both subjects and objects to make them indefinite. It is prepositional, and occurs before the NP. It makes the NP indefinite but cannot represent anything about the specificity of that NP. The accusative marker is only used for objects. It is the morpheme (ı, i) attached to the NP and is used for specific objects.

It is a "necessary but not a sufficient condition" in Turkish to make the object "specific" via the -acc marking. Thus, when we use the -acc marking, it shifts the entity towards a more definite interpretation but this is not an absolute level of referentiality. Similarly when we use the *bir* indefinite marker, it shifts the entity we express towards a less definite interpretation. We should think of *bir* and -acc markers as relative markers, not absolute markers of referentiality.

Interestingly, Turkish shows specificity not only via case marking, but also via animacy. If the object NP is case marked, it "tends" to be specific by default. But animacy also has an influence on the determination of specificity, such that, in some cases, animates are considered inherently specific (but inanimates are not) and require case marking in the object position via inherent specificity (Çağrı, 2005; Erguvanlı, 1984). Since the effect of -acc case marking is relative, its effect on the animate and inanimate NPs may differ (von Heusinger & Kornfilt, 2005).

In sum, accusative case marking forces the NP to be more specific, but since the degree of inherent specificy changes according to animacy, inanimates may still be considered non-specific (even though they are -acc case marked). Also, animate NPs with -acc marking, need to be modified or "specified" more, even though they occur in the "Focus" position (verb-neighboring position) when

[15]In the subordinate clauses, the genitive marker (-In) is used to mark specific subjects under certain environments (von Heusinger & Kornfilt, 2005).

they are intended to give specific meaning.[16] This creates an asymetric effect of case marking between animates and inanimates.

3.1.3.3 Reformulating the Referentiality Scale

In this section, following Erguvanlı (1984), and preserving the main schema in Table 3.2, I will investigate how other information types like "animacy information" and "caseless non-definite NPs" can be inserted into the referentiality scale mentioned above.

Following Knecht (1986), I will use the term "caseless non-definite" to express NPs that have neither *bir* nor -acc marking. It is a bare NP and does not have a clear status with respect to definiteness [like "kitap"(book), "doktor" (doctor)]. The NP is neither definite nor indefinite. Under these situations, an NP may be taken as referential or non-specific depending on the discourse and sentential context as well as the animacy of the NP. Also the type of the predication that the NP goes through may influence the referential status.[17]

Following Aissen (2003), I will assume that inanimates are one level below animates in the animacy-definiteness hierarchy. Aissen uses a hierarchy structure called "Harmonic Alignment Hierarchy" within an Optimality theoretic approach (Smolensky & Legendre, 2006). In this hierarchy, specific common animates ("the doctor") are more prominent than specific common inanimates ("the table"). Their specificity level actually corresponds to the specificity level of the definite inanimates (like "my table", in which the table belongs to me and is definite, see Table 3.3) (Aissen, 2003, p.463).[18] Since specificity must

[16]We will see the details of this tendency in Chapter 6 in the Corpus survey, as a reflection of how frequently speakers/writers use these forms. While inanimates happen to occur more than animates in an -acc marked object position, case-marked animates tend to be definite (and modified and specified) most of the time. Thus for case marked objects, animacy entails definiteness. It seems like this effect might be related to the fact that the animate entities we are talking about in life are generally definite and specific most of the time.

[17]In Erguvanlı (1984), bare NPs in the object position without *bir* and -acc marking are not considered in detail. For bare subject NPs the situation is clearer: Erguvanli proposes that they may be definite or indefinite or non-referential, depending on their position (verb-neighboring or verb-distant position) in the sentence. For the non-definite object NPs, the situation is a little bit complex. Erguvanli takes them as non-referential. For some idiomatic expressions, or general truth about human nature or life, these NPs can be taken as non-referential, but in some other instances, the object is not the direct/indirect argument anymore. It becomes part of the new predication complex, a process which is known as object-incorporation. If the non-definite object is neither incorporated nor a part of idiomatic expression, then its specificity must be resolved in some way. It then can be taken as an indefinite non-specific or indefinite specific object.

[18]The reason why we have overt case marking on object or subject NPs has been one of the hot topics of linguistics. The main line of argumentation follows from Bossong (1985)

		Animates	Inanimates
Specific ∧	*-acc* effect	Definite	
		Indefinite Specific	Definite
		Caseless Non-definite	Indefinite Specific
Non-Specific ∨	*bir* effect	Indefinite Non-specific	Caseless Non-definite
			Indefinite Non-specific
		Non-referential	

Table 3.3: New referentiality scale I propose for animate and inanimate object NPs

be resolved in some way in Turkish, the status of non-definites represent an interesting situation. Depending on their animacy status, their level in the referentiality scale may change.

I will assume that the effects of *bir* and -acc are relative to each other. They are devices to "pull" the argument towards one side of the hierarchy (scale) shown in Table 3.3. The specificity marker "-(y)I" and indefiniteness marker *bir* are not making the argument absolutely definite, specific or indefinite. They create a relative effect, and even though we assume that the impact of this effect is the same on all NPs, the final positioning of the referentiality of the NP in this hierarchy depends on the NP's animacy and pragmatics within which it happens to emerge. For instance *adamı* (man-acc, object: "the man"), is more specific than *kitabı* (book-acc, object: "the book") because "man" is animate. Also, *bir kitabı* (object: "a certain book") is more definite than *bir kitap* ("a book") -because it has -acc marking, but less definite than *kitabi* (object: "the book") – because it has an indefiniteness marker *bir*. In the following section, I will present more examples and define the status of objects in Turkish in detail.

and Comrie (1989) in which to mark the object NP emerges from the fact that some objects diverge from the prototypical object-hood (being inanimate and indefinite) and show more proto-typical subject properties (i.e., being animate and definite). This idea represents the basics of the phenomenon called *Differential Object Marking (DOM)* (Aissen, 2003; Bossong, 1985).

3.1.4 Treatment of Objects

In this thesis, all NPs used are either caseless non-definite NPs or -acc marked object NPs. I did not use indefinite marked NPs (like *bir kitap* – a book) in the experiments. That is why the treatment of non-definite objects is important to mention.

3.1.4.1 Definiteness and Caseless Non-Definite Objects

Accusative case marking is used not only when the speaker tries to convey meaning, making the object NP specific, but also as the by-product of inherent specificity of this NP. The accusative marker in this regard must be used because the object NP is very specific (like a proper noun "Mary", definite noun "my father", see above). All definite direct objects in Turkish must be *-acc* marked in Turkish. Some NPs are inherently definite, i.e., have (or must have) a strong antecedant (discourse referent). Object pronouns, proper nouns, and definite descriptions must be -acc marked.

(27) ∗Hakan / O / Bu sandalye gördüm.
Hakan / He / This chair see-PAST-1s
I saw Hakan /He / This chair.

(28) Hakani/onu/this chair gördüm.
Hakan-acc/he-acc/this chair-acc see-PAST-1s.
I saw Hakan / him / this chair.

The first example is marked with a star indicating that this sentence is not possible in Turkish.

Animate common NPs tend to be more definite than inanimate common NPs when *-acc* marking does not follow.[19] While both examples below do not have *-acc* case marking, they refer to either non-referential objects or referential but indefinite objects. For inanimates, the status is assumed to be non-referential (Erguvanlı, 1984) depending on the verb used:

(29) Adam öğretmen gördü.
Man teacher see-PAST-3s
The man saw (a/the) teacher.

(29) Adam kitap gördü.
Man book see-PAST-3s
The man saw (a) book.

[19]In Turkish, what defines the status of case is mainly the definiteness and the referentiality of the object, not a universal principle like "Government" (e.g., Chomsky, 1981).

As will be seen below in the section on object-incorporation, I claim that the object does not totally lose its referentiality in some situations when it is a caseless non-definite. For instance, in the example above, *öğretmen* and *kitap* must be unambiguous with respect to specificity and the best possible way to interpret them is to take them as *bir öğretmen* (a teacher) and *bir kitap* (a book). But, since animates are inherently specific (such that, when they are referenced as objects they tend to be specific), the initial sentence requires a more specific reading of the animate object (teacher).[20]

On the other hand, in the second example, *kitap* (book) and *gördü* (see) form a constituent by taking *kitap* as *bir kitap* (a book) giving an indefinite non-specific interpretation leading to "The man saw a book". It is not difficult to obtain this reading because inanimates are inherently non-specific.

For some people, animate objects must be regarded as definite (or highly specific) so that they must be, as a default, *-acc* case marked, and if they are not, as it is the case in the example above, it is taken as an ill-formed sentence (Enç, 1991).

An object cannot be non-referential if it is marked by *bir*, which makes it indefinite but referential. But as mentioned above, while it is generally known as an "indefinite marker," it functions as a "contrastive element" such that it lowers the degree of specificity of the arguments towards indefinite in the definiteness-specificity scale. Also it makes the argument automatically referential. An argument cannot be non-referential if it is marked by *bir*.

[20]How animacy influences wh-clause is a very interesting phenomenon in Turkish. Animate objects are inherently specific, and in the Wh-clauses they require case marking:

- *Kim gördün?
  Who see-PAST-2s
  Who did you see?

- Kimi gördün?
  Who-acc see-PAST-2s
  Whom did you see?

But, inanimate questions are possible without case marking:

- Ne gördün?
  What see-PAST-2s
  What did you see?

A wh-clause must be marked by -acc when an animate entity is being questioned. Inherent specificity of the animates is a strong determinant of the case marking. In the example above, wh-question may require -acc not because it directly seeks for the strong antecedent in the context, but because the object is animate.

3.1.4.2 Indefinite Objects

The status of indefinite objects is important to note in order to determine the definiteness hierarchy in the sentence. As mentioned above, in Turkish, case alone does not determine/support the sentence initiality of the object (e.g., the NP is in the verb-distant position). A verb-distant object must be definite (or as definite as possible).

(30) ∗Bir kadını adam öptü.
A woman-ACC man kiss-PAST-3s
(The) man kissed a woman / A woman the man kissed.

In this example, the verb-distant object has both an indefinite marker *bir* and an -acc marker -(y)I. Thus, it is an indefinite specific object. It cannot be in the verb-distant position even though it is marked with -acc. ACC marking does not guarantee that it can stay in this position. It only shifts the referentiality of the noun towards definite, but the indefinite marker makes it more indefinite. But, now consider a situation where the *bir* indefinite marker does not exist:

(31) Kadını adam öptü.
Woman-ACC man kiss-PAST-3s
(The) man kissed the woman / The woman the man kissed.

Here, the initial verb-distant object is taken not only as specific but also as definite. Thus, the referentiality of *bir kadını* (a woman-ACC) is less than the referentiality of *kadını* (the woman-ACC), and this constrains the possible sentential positions where certain arguments can be represented.

3.1.5 Treatment of Subjects With and Without *bir*

The assumptions above seem to also be valid for indefinite subjects:

(32) ∗Bir yıldız gökten kaydı.
A star sky-abl slid
Gökten bir yıldız kaydı.
A star slid from the sky.

Indefinite subjects tend to be closer to the verb and they cannot stay in the verb-distant position.

It is interesting to observe how Subject NPs behave when they do not take the *bir* marker. Depending on the position in the sentence, they may either be specific or non-specific. Differences in specificity are signalled by linear order:

(33) Kedi içeri girdi.
cat inside came
The cat came inside

(34) İçeri kedi girdi.
inside cat came
A cat came inside.
(from Göksel, 1998)

As defined in Göksel (1998), characterising linearity in terms of grammatical hierarchy (dominance and c-commanding relations) may not be necessary. Göksel treats scope relations as a characterization of the surface string with no recourse to configurational hierarchy. Serial ordering plays a major role in defining the exact interpretation of the word *kedi* (cat) in the above example. In the first example (33) *kedi* is considered specific and definite because it holds the verb-distant position in the sentence. In the second sentence (34), *kedi* does not need to be specific and definite; depending on the semantics, it is preferentially interpreted as indefinite, but it can be definite too. In Turkish, the verb-distant position prefers the NP to be specific and definite. In the verb-neighbouring position, the NP is not required to be definite. Thus, if the status of the subject is not clear, position defines the specificity.

This does not mean that indefinite subjects can never be in the sentence-initial position:

(35) Bir çocuk öğretmene çiçek verdi.
A kid teacher-DAT flower gave.
A kid gave a flower to the teacher.

Here, the initial subject *bir çocuk* (A kid) is indefinite. Also, at least one of the arguments, *öğretmen* ("teacher") is considered (or can be interpreted) as a definite NP.

Now consider Erguvanli's (1984) example:

(36) *Bir elma ağaçtan düştü.
An apple tree-ABL fell.
An apple fell from the tree

Even though in the previous example, *Bir çocuk* can occur in the sentence-initial position, *Bir elma* cannot. Why?

It seems that there might be three factors affecting this:

- Animacy and definiteness of the subject

- Status of the event structure [Volitional (i.e., "give") vs. non-volitional (i.e., "fall") event]
- Status of the Subject (Active, volitional vs. non-volitional subject)

Now let us test which one holds true under some sentential contexts. It is a well known fact that animacy attributes not only definiteness but also volitionality (Primus, 1999). Animate effectors are interpreted as Agents by default (Holisky, 1987). Animate arguments bear control and agentive properties, so that animacy is considered a greater set covering volitionality as a subset. Let's see what happens when we use indefinite animates in volitional and non-volitional events:

(37) Bir hırsız evime girip bilgisayarımı çaldı.
A thief my house went in my computer stole
A thief went into my house and stole my computer.

(38) Bir kadın merdivenden aşağı büyük bir gürültüyle düştü.
A woman stairs-ABL down noisy-INST fell
A woman fell down from the stairs with a great noise.

These sentences are totally acceptable. In both examples, the indefinite subject is animate and the event in which it participates is either volitional or non-volitional. Thus, in both cases the indefinite animate subject NP can take the verb-distant position independent of the type of event (whether the event requires a volitional or non-volitional reading for the subject).

Now consider the examples below:

(39) *Bir kolye her kadına hoş bir his verir.
A necklace every woman a very pleasant feeling give-AOR-3s
A necklace gives every woman a very pleasant feeling.

(40) Bir şair her kadına hoş bir his verir.
A poet every woman a very pleasant feeling give-AOR-3s
A poet gives every woman a very pleasant feeling.

In these examples, the inanimate indefinite NP cannot occupy the sentence-initial position even though the verb is an object experiencer verb, which does not require a volitional subject. An indefinite reading of the inanimate subject is not possible in the verb-distant (sentence-initial) position, while it is possible for animate subjects. Thus, even though an active verb is not required, an indefinite inanimate subject cannot occupy the verb-distant position.

Thus, in Turkish, not only word order, but interaction between word order and animacy plays a crucial role in the interpretation of the status of the arguments. Animacy is generally the main factor in determining the accept-

ability/grammaticality of these structures. Since animate NPs are inherently specific and tend to be closer to the definite interpretation (upper side of the scale in Table 3.3) (Çağrı, 2005; Erguvanlı, 1984), animate subject NPs are more eligible to take the sentence-initial position even though they may bear the indefinite marker *bir* in some instances.

Now we can add new prominence hierarchies to the previous ones for Turkish: $+definite > \mp definite$ and $+animate > \mp animate$ where definite entities generally precede indefinite ones and human entities precede non-human ones. Also, these prominence relations go hand in hand in which animate entities generally prefer to be definite. These prominence hierarchies will form the main theoretical constructs of Experiment 3.

3.2 Non-Referentiality and Object Incorporation

In the last section of this chapter, I will describe one important behaviour of Turkish, namely object-incorporation. Caseless non-definite NPs, when they are in the verb-neighbouring region, may lose their referentiality and go into a process called object incorporation. In certain parts of my experiments I used caseless non-definite object NPs and it is important to know how they behave under such circumstances. In object incorporation, the caseless non-definite object NP is taken as a non-referential NP, and it forms a new predicate with the verb. The object NP and verb form one syntactic unit, different than a constituent (VP) having one unique object NP and a verb. At this point it is important to note that an object NP should be non-referential in order to be able to go into an object incorporation.

For instance in the sentence (41):

(41) Yusuf kitap okuyor.
Yusuf book read-Pres-3s
Yusuf is doing book-reading.

Kitap okuyor (book reading) forms a complex, creating a new form of predication "book-reading". "Book" loses its referentiality and incorporates into the verb.

In the following example (42) , *bir kitap* is referential, indefinite and non-specific. It cannot incorporate into the verb to form a syntactic unit. This sentence means: "Yusuf is reading a book. (We may not know what the book is but it is something that is referred).

(42) Yusuf bir kitap okuyor.
Yusuf a book read-Pres-3s
Yusuf is reading a book.

Not all predicates can have object-incorporation. Telicity of the predication should also be taken into consideration:

(43) Adam kitap aldi.
Man book bought
The man did book-buying.
The man bought (a/some) book(s).

In the example above, the constraint to incorporate an NP is mainly lexical. Telicity of the predicate-argument pair defines the possibility of object-incorporation. If the object NP is non-referential, it can have an atelic reading with the predicate only if the verb can go into an atelic predication (book-reading). If the caseless non-definite object is used with a verb that is biasing telic reading, it cannot go through object-incorporation (i.e., *book-buying). If this is the case, the default interpretation will be "bought book(s)/a book". Note that having an atelic predication also avails telic predication but not vice versa.

This is important, because, when caseless non-specific objects (objects without *bir* and the -acc case) are used, with particular verbs, the argument-predicate complex behaves as a unit (a new type of action, kind of intransitive event), while for other predicates it is an object-verb (VP) complex (a transitive event). In this regard, object-incorporated sentences can be taken as "intransitive" such that the object loses its referentiality and existence (see Hopper & Thompson, 1980 for a different version of the prototypical-transitivity hypothesis). That is, depending on the right context, right predication, and with a non-definite non-case marked status, transitivity is cancelled out to yield a minimal, intransitive event structure. Similar structures can be observed in English noun-verb compounds like "house cleaning," "woman chasing," but these structures can only be used as nouns, not verbs ("to woman-chase" or "to house-clean" are impossible). On the other hand, we can express similar object-incorporated sentences only as in the case "I did house cleaning," where the compound noun stays as the object with a light verb.

Finally, when an entity is interpreted as specific via its animacy, this constrains the possibility of object-incorporation. The animate object generally cannot be non-referential (since it is inherently specific). This also explains why most of the non-referential incorporated objects in Turkish are inanimates rather than animates. Here is a list of incorporated structures:

(44) (a) ders çalışmak
lesson study
to study

(b) yemek yapmak
food cook
to cook

(c) yemek yemek
food eat
to eat

(d) sigara içmek
cigar smoke
to smoke

(e) muzik dinlemek
music listen
to listen to music

(f) örgü örmek
knit knit
to knit

In Experiment 1 and 2, I used lexical items designed to prohibit object incorporation to a maximal degree. Since linguistic comprehension is very generative and it allows new ways of semantic expression, some items might have tended to show incorporation behaviour in which the object might have been close to non-referential reading. In most of the cases in the experiments of this thesis, the verbs used were telic in most of the material, and the caseless object was referential, and noun-verb constituent prevented possible semantic composition related to object-incorporated reading.

3.3 Summary

In general, I can conclude that, from a psycholinguistic perspective, the hierarchy of different information types in Turkish is a main contributor to the interpretation of the sentence. These prominence hierarchies, either in

the form of semantic/pragmatic hierarchies like $+animate > \mp animate$ or $+specific/definite > \mp specific/definite$ or $+topic > -topic$, or in the form of syntactic hierarchies like $+agr > -agr$ play a crucial role in the definition and relation between the arguments giving rise to overlapping or contrasting prominence patterns. Also, prominence hierarchies generally emerge within precedence relations (if there are two arguments, the more prominent item precedes the other item, the subject precedes the object etc.). Most probably, in incremental sentence processing, these hierarchies also determine the ways linking of the arguments to the verb should are computed.

Caseless non-definite NPs can shift to either side of the specificity scale, depending on the context, verb type, animacy and their position in the sentence. Caseless non-definite animate objects, for instance, are more specific than their inanimate versions. This may be one of the reasons why such NPs cannot go into object incorporation, in which the NP is taken to be non-referential, leading to an intransitive interpretation of the event.

The main idea behind -acc case marking and *bir* marking is that they are not absolute markers but are relative specificity markers. Their effect changes depending on the animacy and context in which the NP occurs.

In Turkish, animacy hierarchy and definiteness hierarchy have the general tendency to parallel one another. They go hand in hand in most instances. Definite arguments are generally animate, and indefinite arguments are generally inanimate.

Overall, there are three main psycholinguistically relevant contributions of this section to the understanding of incremental processing in Turkish. First, even though Turkish uses case marking extensively, it prefers syntactic (formal, e.g., subect-before-object) and interpretational (e.g., definite-before-indefinite) prominence orders (particularly in sentences with two overt arguments). Thus, the linking process in which the arguments are linked to the verb most probably favors this default prominence order. During sentence comprehension, when the verb emerges, the most straightforward linking may happen if the verb prefers the first argument in the sentence to be more prominent and the preverbal GRs to obey Actor-Undergoer word order. On the other hand, these preferences may only hold for cases where there are two arguments in the sentence. The verb-distant position should constrain the possible structure of the object while the verb-neighboring region provides more flexibility via being structurally close to the verb.

Second, while default word order imposes SOV structure, Pro-Drop imposes OV structure. Thus an initial ambiguous argument may either be a subject or an object. This represents an interesting challenge to sentence processing

theories, because if Pro-Drop is influencial on ambiguity resolution, then the initial ambiguous argument in the sentence is more likely to be chosen as an object rather than the subject of the sentence. Thus, this unique contrast in Turkish may reveal fine grained differences between language particular vs. language universal parsing preferences, or the degree of interaction between the two factors.

Third, animacy, sentential position and case marking have multi-directional influences on each other. For instance, sentence position requires a particular reading of the argument (like it being definite, subject etc.), which leads to the interpretation of the argument to be biased in certain ways. As an example, take a sentence-initial non-definite NP [like in example (33)]. If there is another argument following this argument, interpretation of the first argument is biased towards being definite because it is pushed to the verb-distant position. On the other hand, objects have different pragmatic interpretations depending on their case and animacy features. Specific (case-marked) animate objects require a relatively more definite referent, while inanimates and caseless objects are biased to have a relatively indefinite referent, even in the verb-neighboring position (the focus position which does not exclusively require specific objects).

Part II

Empirical Issues I: Morphosyntax

Chapter 4

Experiment 1: Investigation of the Subject Preference in Turkish

4.1 Introduction

In this experiment, I investigated whether there is a tendency in Turkish to analyse the ambiguous first argument as the subject of the clause. This phenomenon, introduced in the previous sections, is known as subject preference. The answer to this question will form a link to connect Turkish data to the cross-linguistic data coming from a variety of languages like German, Japanese, Dutch, English and Italian. This question presents a stage to test the universality of this phenomenon.

First, I will present why exploration of subject preference is an interesting phenomenon in Turkish, and why its existence can provide very strong evidence for the existence of universal parsing strategies. Then, I will present evidence from a number of psycholinguistic studies that support such a preference. These findings are relevant for the examination of the Turkish data, because either the language examined had structural similarities with Turkish, or the conditions used in the experiments had structural similarities with the conditions of the experiment I conducted. In the remainder of the section, I will describe the main theoretical approaches and explore whether this preference holds for Turkish.

4.2 Examining Subject Preference in Turkish

The simplest description of subject preference is that the initial argument (which contains subject/object ambiguity) is preferably chosen to be the subject of the sentence if there is no evidence to the contrary. For instance, in the example below, when someone reads the inital portion of the sentence, his/her dominant interpretation or syntactic preference would be to choose the initial wh-phrase, "which pilot", as the subject of the clause:

(45) I wonder which pilot ...

While subject preference favors the initial wh-phrase to be the subject, this preference may not be correct all through the sentence, such that "which pilot" can turn out to be the object of the relative clause:

(46) I wonder which pilot the air traffic controller warned before landing.

The general observation is that in sentences having local ambiguities, the regions where the initial subject preference is revised (or falsified) take longer to read. (For similar results found on English relative clauses by using the eye-tracking method see Traxler, Morris, & Seely, 2002.) Thus, the general assumption is that the initial ambiguous argument is chosen as the subject, and revising this preference temporarily causes a processing cost.

Thus, in order to understand the existence of subject preference, or any other linguistic preference, one way is to create two regions of interest: (a) a point where a local ambiguity exists (and where the parser makes a decision) and (b) a point where this decision is tested (either confirmed or rejected). In the example above, "which pilot" is locally ambiguous between subject and object reading. This preference will be tested later on, possibly when the next noun emerges. This test point is generally termed "disambiguation point," where the ambiguity is resolved.

Subject preference is a particularly interesting phenomenon in Turkish for two reasons. First, two unmarked (widely used) structures may bias two different readings. While subject-drop (Pro-Drop) biases object initial reading of the initial ambiguous argument [as being Object-Verb (OV) order], subject-object-verb (SOV) order biases subject initial reading. This conflict must be resolved in some way. Thus, when an initial caseless argument is ambiguous in Turkish, object/subject ambiguity emerges which forms a region of interest to test a possible preference.

Many of the theories related to subject preference were proposed as local ambiguity resolution strategies, in which the processor has to make a certain type of decision on the ambiguous part of the sentence in order to continue parsing.

How Turkish behaves under multiple alternatives and under such unmarked environments represents a challenge for linguistic assumptions.

Some theories propose universal mechanisms that dominate parsing to yield minimal syntactic structures where subject preference satisfies a "simplicity" constraint during incremental processing (Gorell, 2000). These types of theories assume a top-down mechanism to predict very basic structures of the sentence which are in line with the principles of the grammar (like $\overline{X}$-structures) (Crocker, 1994). For verb-final languages, they may not totally dependent on the verb to construct the sentence structure as some other theories suggest (Pritchett, 1991). Thus, they do not wait until the verb to handle parsing.

Some other theories propose that, at least under some cases, the parser can realize the existence of an ambiguous argument (in many cases the wh-phrase) and assumes that it must actually be moved from the hypothetical underlying base position. It is taken as the "filler," which is assigned to this base position (which is an empty position now because of the movement) during incremental processing (Frazier & Flores d'Arcais, 1989; Frazier & Clifton, 1996). These types of theories assume that the subject position is the closest available position,[21] thus subject preference occurs as a processing constraint which indicates assignment of this filler to the closest possible empty position.

On the other hand, other psycholinguists propose that (in line with the "super-strategy" principle of Fodor, 1979), during parsing, the parser tries to form the word sequence which is closely matching with the hypothetical underlying base position. More chains (or more operations to reach the underlying structure), by using the surface form, is prohibited (de Vincenzi, 1991).

All these theories depend on some kinds of principles and structural formulations that are required for assigning functional and semantic features to the arguments (like thematic features and case features). Without the underlying structure, or any attempt to link the surface form with the underlying structure using such relations of some sort, it is not possible to derive syntax and meaning.

On the other hand, other theories assume cognitive constraints, like working memory limitations, determine the linguistic processes. Memory storage capacity constrains the number of representations to be stored, and, related to that, the speed of processing. Extra representations create extra memory load and comprehenders are influenced to differing degrees depending on their indi-

[21]This is because the filler is automatically assigned to the [SPEC,CP] position in the grammar, which takes IP as the head. The head of the IP is generally the Subject position, thus it is closer to the [Spec,CP] than the [Comp,VP] which is the Object position. For similar assumptions about taking the wh-clauses as the Specifier of the CP see Travis (1991); Gorell (1996).

vidual memory capacity (Gibson, 1998; Just & Carpenter, 1992; MacWhinney, 1982). Particularly in Gibson (2000), subject preference satisfies the minimum amount of memory representations because it allows the parser to make no more predictions about the upcoming items. On the initial ambiguous argument, the subject is preferred. This minimizes working memory costs. The comprehension system only predicts the head of the clause without concominant object prediction.

Thus, overall, subject preference is a result of some constraints proposed by the theory, and it eventually satisfies the criteria. In most of these theories (but not all of them), the general assumption is that all of the arguments of a sentence should be overtly presented in the sentence (probably because of the unique characteristics of the language under study). Interestingly, in Turkish, the overt usage of a subject (particularly a pronoun) can be dropped. In some cases it is redundant to use a pronoun unless the speaker intends to change the topic or the subject of the conversation (Enç, 1986). Subject-drop satisfies a minimal or non-redundant structure by this way. This leads to structures in which there are a less number of overt categories (only the object and/or the verb) available to the comprehender when subject-drop happens. This represents a challenge to the existing models of parsing which are mainly developed for languages having an overt subject specification most of the time.

Since subject-drop is also a very common preference in Turkish, another extension of this investigation will be to observe how corpus-related frequency of usage may influence parsing preferences. A statistical distribution may favor object initiality (and subject preference may not hold that strongly), making object preference a more available option. But if there is a subject preference, then this will be counter evidence for the effects of statistics/frequency on incremental sentence processing. Thus, such issues will also be part of the investigation of the thesis and will be presented in Chapter 6.

4.3 Investigating Subject Preference Phenomenon from Multiple Dimensions

Each theory, which has something to say about subject preference, claims different reasons about why this preference holds. But in general, there are syntactic reasons on the one hand, and memory constraints on the other. It is also important to note that the experimental structures used in these studies (e.g., wh-clauses, relative clauses, specific sentence structures unique to a particular language, like German complement clauses) are very different from each other syntactically; their syntactic treatments and representations differ

on many dimensions. More than that, formulation of a particular structure (say, a subject relative clause) in one language may differ extensively from the categorically same structure in another language: Compare English subject relative (S *who* [V O]) vs. Turkish subject relative clauses ([O V]*rel* S). Categorically, these are all called subject-relative clauses, but each one has a very different word order and morphosyntactic marking than the other. Thus, any theoretical or experimental claim that was made about a particular structure for a particular language must be treated very carefully.

The subject preference phenomenon, directly or indirecly, has been investigated on a varieties of languages. Note that, for each of these languages, the sentence material used in the experiment differed in a number of ways. For instance some experiments on German used relative clauses (Mecklinger, Schriefers, Steinhuer, & Friederici, 1995; Schriefers, Friederici, & Kühn, 1995), or both relative clauses and complement clauses (Friederici, Mecklinger, Spencer, Steinhauer, & Donchin, 2001), and some studies only used complement clauses (Bornkessel, McElree, Friederici, & Schlesewsky, 2004). Experiments in English mainly used relative clauses or wh-clauses to create long distance dependencies (Gibson, Desmet, Grodner, Watson, & Ko, 2005; Ford, 1983; King & Just, 1991). Dutch (Frazier, 1987; Mak, Vonk, & Schriefers, 2002), Italian (de Vincenzi, 1991), Japanese (Miyamoto & Nakamura, 2003), Chinese (Hsiao & Gibson, 2003; Lin & Bever, 2006) and Korean (Kwon, Polinsky, & Kluender, 2006) are the other languages where the experimental sentences included locally ambiguous material (either as an ambiguous wh-clause or a ambiguous sentence-initial noun in a relative clause). With the exception of Hsiao and Gibson (2003),[22] all these studies claimed that there is a general parsing preference to choose the initial ambiguous argument as the subject, a process which was realized as a processing cost on the following material which disambiguates the preference.

In the studies mentioned above, many different methods were used. Some of these are: Reading-time measurement (King & Just, 1991), Blood Oxygen Dependent Level (BOLD) response measurement by functional magnetic resonance imaging (fMRI) (Caplan et al., 2001; Cooke et al., 2002; Just, Carpenter, & Keller, 1996), positron emission tomography (PET) (Caplan, Alpert, & Waters, 1998, 1999; Caplan, Alpert, Waters, & Olivieri, 2000; Stromswold, Caplan, & Rauch, 1996), eye-tracking (Traxler, Morris, & Seely, 2002) and event-related potentials (ERP) (King & Kutas, 1995; Schriefers, Friederici, & Kühn, 1995). The dimension of methodology also introduces many other constraints into the picture.

[22]For the opposite claims and the possible experimental and methodological problems of that study, see Lin and Bever (2006).

In the following section, I will present a couple of examples from these studies. Since there are many dimensions (different structures, methodologies, languages) affecting the psycholinguistic exploration, I will only focus on a number of particular languages, methods and structures that are relevant for the thesis.

4.4 Psycholinguistic Findings on Subject Preference

One example that is relevant for the current goal of the thesis comes from a study conducted on the German wh-clauses. In this study, beim Graben, Saddy, Schlesewsky, and Kurths (2000) investigated the ERP deflections on the main verb of the German wh-clasues. They compared two conditions: an experimental condition (47) having a local ambiguity on the sentence-initial wh-argument which turns out to be the object of the sentence, and a control condition (48) in which the ambiguous argument turns out to be the subject of the sentence:

(47) Welche Frau *sahen* die Männer?
Which woman see-PAST:3p the men?
Which men saw the woman?
∗ Which woman saw the men?

(48) Welche Frau *sah* die Männer?
Which woman see-PAST:3s the men?
Which woman saw the men?
∗Which men saw the woman?

This example is particularly chosen because it is an electrophysiological measurement (an ERP measurement) and has similar word order to the sentences I used in the experiments. As in example (47), the verb is marked with a plural marker which disambiguates the local ambiguity by the number agreement (which contradicts the number information on the initial NP which is singular marked). Later in the sentence, the plural NP *die Manner* appears, which confirms that *die Manner* is the subject of the sentence, and not *welche Frau*, leading to OVS order. In German such word orders are rare but possible. On the other hand, in the second example (48), the verb agrees with the initial NP in number which leads to an SVO order. If the initial preference is to select the initial NP as the subject of the sentence, then we should expect a processing difficulty on the verb where the number agreement is violated, but where there is still a possible syntactic alternative (like OVS) which allows processing to

continue. beim Graben et al. (2000) observed a P600 component on the verb when the verb did not agree with the inital NP (47) vs. when it did agree (48). They interpreted this result as the subject preference for the inital NP that was revised and changed into an object-initial reading on the verb.

Similar to this example, most of the behavioural or psychophysiological findings mentioned above sought for some kinds of processing difficulty on the disambiguating part of the sentence. The most general ERP form observed on subject-to-object revisions appears in the form of a positivity.[23] Note that, in the beim Graben et al. (2000) study, ambiguity can be resolved in some way. There is always a possible interpretation even though it is against the initial preference. On the other hand, superficially similar constructions in other languages have been shown to yield other types of ERP components observed as a reflection of a violation where there is "no possibility of a revision". Left anterior negativity (LAN) followed by a late positivity (P600) is such a wave form seen as a reflection for these types of violations. Such deflections were observed during the exploration of the subject preference phenomena in English (Coulson, King, & Kutas, 1998), in Dutch (Hagoort & Brown, 2000), and in Italian (de Vincenzi et al., 2003). Note that, anterior negativities are generally associated with morphosyntactic violations (Hahne & Friederici, 1999).

The next example I present has violations rather than only local ambiguities. It comes from Italian. In one of their studies, de Vincenzi et al. (2003) showed that when the verb emerges, initial subject preference must lead to a number agreement match with the singular verb "serve" ($serve_{SING}$) as in example (49) below:

(49) Il cameriere anziano serve/servono con espressione distratta.
the waiter old serves/serve with a vacant look
The old waiter serves/serve with a vacant look.

At the violation condition, the plural verb "serveno" ($serve_{PLU}$) does not obey the number agreement. Italian is a language in which the word order is more flexible than English. Object-verb-subject order (OVS) is possible in principle, but, here in this example, the initial noun is preferably taken as the subject, leading to a grammatical agreement mismatch. ERP showed LAN followed by late positivity. These findings are similar to the German experiments containing violations (Hahne & Friederici, 1999; Friederici et al., 2001) suggesting LAN-P600 components for morphosyntactic violations with revision of possible grammatical structures.

[23]For a set of different interpretations of early vs. late positivities and their similarities and differences in different types of constructions see Coulson, King, and Kutas (1998); Friederici, Mecklinger, Spencer, Steinhauer, and Donchin (2001); Frisch, Kotz, von Cramon, and Friederici (n.d.); Osterhout and Hagoort (1999).

The violation-based experiments mentioned above suggested that even under ambiguity, the language system sticks strongly to the syntactic preferences and can differentiate what is available and what is not available for the system as soon as possible (Friederici & Meyer, 2004).

4.5 Explanations for Subject Preference

In this section, I will briefly mention examplars of theories explaining subject preference. These theories emerged either as a local ambiguity resolution strategy, or as a proposal for a general sentence processing mechanism. They may or may not be particularly designed to explain subject preference, but their hypotheses also make claims about subject preference.

As mentioned in the previous sections, structural or memory based motivations share the common belief that the general tendency of parsing is to have the simplest possible operations: formulating the minimum number of syntactic structures or memory representations, and consequently expecting easier parsing steps. That leads to the minimum amount of load on the cognitive system. An important point here is that the cognitive representation of linguistic forms (either hierarchical or linear) have strong ties with the parsing steps or memory resources required to comprehend a sentence. Subject-preference is the most optimal solution that the parser can come up with under these constraints.

A number of theories have emerged from these motivations. These theories, eventhough they have similar motivations, generally differ from each other in the way how they handle the theoretical framework necessary for their explanation. Some of them assume the existence of phrase structures, hierarchical dependency relations, and abstract and null representations. Others only assume the existence of processes depending on the syntactic and semantic predictions, linear dependencies, locality and distance of the arguments, and memory costs related to the number and the distance of the dependency relations.

Recently, some proposals are made in favor of using a minimum number of syntactic representations, and not using theoretical constructs like gaps and fillers if the linguistic material provides good enough representations to achieve meaning (Jackendoff & Culicover, 2005; Van Valin, 2005). Similar approaches have previously been made in the psycholinguistic domain in which the comprehension mechanism does not use most of the conventional forms of representation, but includes the very basic representations like category and agreement information as well as includes predictions about the position of the arguments in the logical structure of the verb (Bornkessel & Schlesewsky, 2006). There is no underlying structure in which gaps and fillers must be assigned for a well-

formedness satisfaction and for an interpretation of the sentence, but a direct linking between the arguments and the verb (to satisfy a number of syntactic and semantic constraints, i.e., grammatical agreement, semantic interpretation etc.) is proposed. In this regard these approaches resemble some other theoretical approaches in which linking of the arguments is a direct mechanism (Pickering, 1991). Also, the main emphasis is given to the continuous linking of syntax and semantics via attributing relative positions to the arguments having prominence, case and word order as different dimensions. Predictions are not only syntactic, but also interpretational.

In the following section, I will briefly mention examplar theories related to these motivations which are closely related to the subject preference phenomenon. Also, the theories selected may have assumptions on Turkish, which is verb-final and shows Pro-Drop:

1. Structural Approaches:

   These approaches are mainly designed as ambiguity resolution strategies. Also, they are based on the assumptions of the existence of some kinds of theoretical representations like filler, gap and hierarchical syntactic tree structures. Filler corresponds to the argument which is moved from its original/hypothetical position, and the gap is the position where it is moved from. These approaches assume that, under local ambiguity, filler and gap should be linked as quickly as possible. This requires the minimum distance between the filler and the gap position possible.

   The general assumption in these approaches is that the ambiguity between a subject- and an object-initial reading is structural in nature and that subject occupies a higher position in the phrase structure tree than the object (Crocker, 1994; Frazier & Flores d'Arcais, 1989). Therefore, subject preference allows for an earlier integration and interpretation of the initial ambiguous argument. That way, parsing takes part in a less effortful manner. In general, the language comprehension strategy should be minimal (Fodor, 1979, 1998; Frazier, 1987; Inoue & Fodor, 1995).

   (a) Filler-Gap Approach - Active Filler Hypothesis (AFH)

   One of the examplar approaches in this category is the Active Filler Hypothesis, in which the initial ambiguous argument, for instance, is chosen to be the filler of the sentence (automatically when a phrase occurs in the non-argument position) and whenever there is a potential gap site, [generally emerging just after the relative clause marker (who) or the verb]. This gap position is filled with the filler. It is assumed that this gap position is where the filler has originally moved from (Frazier & Flores d'Arcais, 1989). The pars-

ing mechanism would not wait until the next word available (i.e., the word after the verb) to make sure that the filler-gap assignment is fine.

The psycholinguistic manifestation of this type of hypothesis is that the assignment of argument-verb relation is required to be quick and the decision for choosing the filler as the subject is the outcome of the structural position of the subject in the tree structure.

For instance, in the sentence:

(50) I wonder who ...

When "who" is read, the parser recognizes that it is a potential filler, and may not be in its canonical argument position. "Who" is marked as the filler of the complement clause, and a gap is assigned just after "who" to yield a possible subject reading:

(51) I wonder who_i gap_i ...

But a possible continuation can turn out to be :

(52) I wonder who_i my dad saw gap_i yesterday.

Now "who" is not the filler of the gap position mapping to the subject position. It is the filler of the second minimal gap option after "saw." This option is more costly and is not preferred, because the filler has to be active for a longer time and the gap position is further away. Thus, AFH assumes fast integration of the arguments to their slots, where subject preference allows quick diagnosis and linking of the filler to the empty slot in the structurally most available and shortest location in the syntactic tree.

(b) Minimal Chain Principle (MCP)

de Vincenzi (1991) proposed a principle (MCP) , in cases of local ambiguities at the null subject position. Italian is a Subject-Verb-Object language (SVO) and it is similar to Turkish in that it also has the subject-drop property. In this approach, the parser will prefer to postulate a *pro* for the sentence-initial position (*pro* indicating a lexically null pronominal subject) that is in a singleton chain as in example (53) to a *pro* that is in a longer chain as in example (54). Analyzing an element as being in a one-member chain amounts to saying that the parser prefers to analyse an element as being in its base position, that is, in the position where it directly receives its theta role (de Vincenzi, 1991, p.199). In this respect, MCP is reminiscent of Fodor's (1979) 'Superstrategy' proposal that "the

parser processes a word sequence as if it were the terminal string of a well formed deep structure" (p.249).

(53) *pro* telefonera'
pro telephone-Fut-3s
He/She will telephone.

(54) *pro* telefonera' Gianni.
pro telephone-Fut-3s Gianni
Gianni will telephone.

This particular pre-verbal position – where a subject generally occurs – overlaps with the the position offered by the theoretical deep-structure representation. It is assumed that the minimal "chain" between a covert argument and its actual position is the one that represents the most simple, non-transformed structure and that is why a subject would be preferred.

Thus, in example (53), pro is assigned to the initial position leading to a 1-chain relation (chain from surface to deep-structure) while it is a 2-chain structure in (54) where a chain from Gianni to pro as well as a chain from pro to the deep-structure position must be formed. That is why, 1-chain is preferred over 2-chains, and reading must be slowed down at "Gianni" indicating the reversal of this initial preference.

2. Working Memory Approaches:

As briefly mentioned above, one approach in this category is Gibson (1998, 2000).[24] The main idea behind this approach is to form the minimum number of predictions during sentence comprehension. Predictions made so far in the sentence create a load on working memory. Predictions requiring more items to be held in memory creates processing difficulty.

In a sentence, a subject may be independent of the object (as in the case of intransitive sentences which require only a subject and a verb). But an object always requires the existence of a subject. Thus, the dependency-free subject analysis of an initial argument is preferred, leading only to

[24]Another approach using working memory comes from Lewis, Vasishth, and Van Dyke (2006). In this approach, locality is preserved as a factor on sentence processing via activation decay. The main emphasis is given to the interference emerging from the syntactic and semantic features of the NPs within the incomplete dependency relations. The NPs may have excitatory effects on each other by reactivating the features they share. But, in this aproach, preference to choose the initial argument as the subject has no structural or memory related reason. It is just the outcome of a syntactic preference. The subject is the default preference.

the prediction of a predicate. Since it is the minimal prediction possible, it is the least costly.

Note that the assumptions outlined above are generally valid for languages in which the arguments must be realized overtly, meaning that at the surface both the subject and object must be present. These assumptions are not very clear for languages like Turkish and Italian where there is no obligation to realize the subject of the sentence overtly. Thus, Gibson's (2000) account must be revised to include possible solutions for the Pro-Drop languages where OV is also a common syntactic option, the sentence inital unambiguous object does not entail an expectation of an overt subject.

3. Alternative Approaches:

   The last group of approaches assumes that there is no need to have memory-related explanations or assumptions like empty categories or fillers. It is possible to explain processing preferences by using only the relational and semantic features available on the surface of the sentence.

   One of the approaches in this category requires that there is no need to have unnecessary representations in grammar (for a theoretical proposal along these lines, see Jackendoff & Culicover, 2005). Argument processing happens incrementally and assignments of functional and thematic relations happen directly. The most pronounced examplar of this approach is the one mentioned in Chapter 1: eADM (Bornkessel & Schlesewsky, 2006).

   In this model, subject preference for the initially ambiguous argument is favored because it leads to the minimum number of GR assignments (one GR), and consecutively does not cause a prediction for another GR (by proposing an intransitive event structure). Thus, by selecting the ambiguous argument as the subject, only one GR assignment is provided and this satisfies relational minimality. Thus, here, rather than overtly specifying arguments, the relational semantic structure between the arguments is taken into account. This also automatically leads to a minimum number of overt arguments (satisfying structural minimality).

   One interesting prediction for eADM for Turkish sentences is that, if an object occurs sentence initially, no processing cost is expected as it may be the case for other theories (Gibson, 2000). This is because OV structure is possible in Turkish and having an initial accusative object still conserves structural minimality by NP-V structure.[25] The unambigu-

[25]While it is not clear what MCP predicts for Turkish data, I think that this approach would assume a processing cost for an accusative argument in the sentence inital position

ously case-marked initial argument is taken as the object of a transitive sentence where subject-drop is assumed.

4.6 Local Ambiguities and Subject Preference in Turkish

As mentioned in Chapter 3, Turkish is a language in which an ambiguous first argument can also function as either the subject or the object of the sentence. It is a verb-final (SOV) language and in many instances it does not require an overt realisation of the subject (i.e., allow pro-drop) allowing OV structures. Both arguments can precede the verb in an unmarked sentence, as in example (55). Also the subject can be dropped yielding the reduction of the overt arguments, as in example (56). Thus, an initial ambiguous argument can turn out to be the object, as in example (56), or the subject of the sentence, as in example (57).

(55) Dün ben pilot gördüm.
yesterday I pilot see-Past-1s
Yesterday I saw (a) pilot.

(56) Dün pilot gördüm.
yesterday pilot see-Past-1s
Yesterday (I) saw (a) pilot.

(57) Dün pilot uyudu.
yesterday pilot sleep-Past-3s
Yesterday (the) pilot slept.

Turkish therefore differs from all languages that have been shown to exhibit a subject preference, because these either do not allow pro-drop (Dutch, German, English) or are not verb-final (Italian, English). It allows us to examine whether the subject preference still holds when a subject reading is not the only unmarked analysis option for an ambiguous argument. As illustrated above, the second unmarked possibility is to analyse the argument as an object in a structure with a dropped subject [as in example (56)]. A choice between the simultaneous possibility of subject preference (via SOV word order) and

(by leading to a 1-member chain assuming that pro must be before the object in line with SOV order). But since object-verb (OV) structure is also a highly possible option in Turkish, MCP may not propose a processing cost (assuming OV). But Italian also allows such unmarked, frequent, subject-drop (VO) structures, in which MCP at least assumes a 1-chain member, because the surface structure must be mapped to the underlying base position (where pronoun is base generated). Thus, I assume MCP would assume a processing cost.

object preference (via subject-drop that leads to OV structure) occurs when the sentence-initial argument is ambiguous. Thus the investigation of subject preference in Turkish represents an interesting challenge for psycholinguistic research.

4.7 Garden-Path Strength and Cues Used in Disambiguation

The "strategical path" from the region of the sentence where a parser makes its inital syntactic decision (on the locally ambiguous part of the sentence) to the point where it realizes the existence of a problem in its initial syntactic decision (i.e., via strong disambiguating information) is generally referred as the "garden path." The parser must go back to its previous state where it made the initial decision, and it must choose another syntactic path to continue parsing to derive the most well-formed and possible sentence structure. Processing costs arising from this garden path effect are not the same for all the garden paths. The level of difficulty in reanalysing the initial interpretation (and resolving the garden path) is related to the "strength of the garden path". For instance, subject-to-object revision in German is easier (and garden path strength is lower) for dative-initial constructions for the experiencer verbs, while it is more difficult for the active verbs in ambiguous OSV structures (Bornkessel et al., 2004). There are multiple reasons for such garden-path strength differences (e.g., verb type, frequency of structures, the arguments' prominence relations, animacy information, definiteness information etc.).

Factors influencing subject preference have been investigated in a number of studies. One of these studies (Schlesewsky, Fanselow, Kliegl, & Krems, 2000), manipulated the semantic information of the initial wh-clause [in sentences similar to the examples in (47) and (48)] in reading-time experiments. In these experiments, both animate and inanimate locally ambiguous wh-phrases were chosen to be the subject of the sentence. Animacy was found *not* to be a factor in choosing the initial ambiguous argument as subject. That is, the animate argument, being the more prototypical subject (Comrie, 1989), was not treated differently than the inanimate argument for subject preference. But, animacy information may influence the garden path strength during subject-object reanalysis by providing an inanimate argument as the prototypical object. This point is important in the current study, because I introduce animacy information on the sentence-initial ambiguous argument. This may either influence the initial preference for the subject preference as soon as the argument is

read, or influence the garden path strength that reflects the ease of reanalysis in turn.

Thus, in the Turkish study here, the animacy of the initial argument of the sentence is introduced as the second level of investigation. Whether animacy influences the inital subject preference on the ambiguous argument, or it only influences reanalysis (toward object reading) and garden-path strength is also being questioned.

4.8 Experiment 1(a): ERP Study

As partially introduced above, the present ERP study investigates (a) whether the subject preference or pro-drop determines interpretation of an initial ambiguous argument and (b) whether the availability of two alternative unmarked structures (OV vs. SOV) lead to a higher susceptibility for the use of semantic information (animacy) in ambiguity resolution. Also, this study explores two further questions as the experimental conditions avail the possibility to explore these questions as by-products of the experimental design: (c) whether unambiguous initial objects engender increased processing cost (where previously mentioned processing theories may predict represntational or prediction costs), and (d) whether relational prominence hierarchy conflict observed on the NP2 leads to an N400 effect, testing prominence mismatch. I will mainly focus on the first two questions, but the other two questions will also be in the scope of the evaluation.[26]

Regarding questions (a) and (b) above, while the subject preference has been shown to be independent of animacy in German (Schlesewsky et al., 2000), this might not be the case in a language that does not require the overt realisation of a subject. Thus, an inanimate initial argument, i.e., a non-prototypical subject (Comrie, 1989; Hopper & Thompson, 1980), may lead to the pro-drop reading being favoured over the subject reading.

Question (c) will mainly deal with the nature of the template selection that is formed at the initial phase of the comprehension of the sentence. If the initial argument triggers an NP-V structure (because the minimum number of categories are assumed via structural minimality), then depending on the ambiguity of the initial argument, this will allow for either a subject-drop transitive OV structure or an intransitive SV structure. If subject preference is preferred via relational minimality indicating an intransitive event, then SV is chosen. But if the initial NP is accusative marked and unambiguous,

[26]The material to be presented appears as Demiral et al., Cognition (2007), doi:10.1016/j.cognition.2007.01.008, available at the Elsevier web page on-line.

then OV will be the best option because it is more minimal than OSV. The question for the current study is that, even though an overt subject is not required in Turkish, can we find a processing cost for the initial object similar to the scrambling effect in German (Schlesewsky, Bornkessel, & Frisch, 2003) or in parallel to the prediction based memory accounts? Realization of the existence of a subject, independent of being overtly or covertly represented in the sentence, may create a processing cost via extending the number of the participants in the event without additional overt category on the surface of the sentence.

In question (d), on the other hand, I investigated whether prominence conflicts show themselves as ERP deflections (generally N400) on the second noun of the sentence. For instance, assume that we compare two sentences both having SOV structure. If the agreement alignment happens to be $+Agr > -Agr$, but the animacy alignment happens to be $-animate > +animate$, then on the second NP, the conflict between these alignments will result in an N400 (particularly for the sentences in which an animate object follows the inanimate subject). The N400 effects found in the previous studies (Frisch & Schlesewsky, 2001; Roehm, Schlesewsky, Bornkessel, Frisch, & Haider, 2004) on the nominative inanimate argument following a sentence-initial accusative animate was interpreted as a cost resulting from the failure to satisfy the prediction of a more prominent item (Bornkessel & Schlesewsky, 2006). The initial animate accusative argument yielded an expectation to have a more prominent argument (Actor) for the subject ($+Agr$) position, and the inanimate argument cannot fulfill this expectation. Thus, in this study, if I observe a negativity on the accusative animate argument (object) following the nominative inanimate argument (subject), this will bring a new explanation for these findings, such that not the prediction cost per se, but "creating an event structure where inanimates act on animates" is very difficult (or hard to find), in parallel with the unmarked transitivity hypothesis of Comrie (1989). Thus, a prediction based account will be abandoned. I will explore such a prominence conflict on the NP2 of the filler sentences.

4.8.1 Materials and Methods

4.8.1.1 Participants

After giving informed consent, twenty-six participants (8 females and 18 males) from the Turkish community of Berlin participated in the experiment. Their mean age was 27.1 years with a range of 21-40. Nineteen of them were native speakers of Turkish (6 females, 13 males) and seven of them were bilinguals of either Turkish-Bulgarian or Turkish-German (3 females, 4 males). The

first language of the bilingual participants (language spoken at home) was Turkish, but in contrast to the non-bilinguals they started learning their second language during early childhood. Participants who were not bilingual scored their knowledge of German with a mean rating of 2.37 (std: 0.96; scale: 1-5, with 1 equalling "very well"). All the participants were right-handed and had normal or corrected-to-normal vision. Three further participants were excluded from the final data analysis due to excessive EEG artefacts.

4.8.1.2 Experimental Design

In accordance with the main questions of the experiment (Is there a subject preference? Can this preference be modulated via animacy?), the experimental conditions were centred around a $2x2$ design manipulating the factors AMBiguity (initial argument ambiguous vs. unambiguous) and ANIMancy (initial argument animate vs. inanimate):

Condition	Sentence and Meaning
a. Ambiguous Animate:	Dün palyaço gördüm. Yesterday clown-Acc saw-1s Yesterday (I) saw (a) clown.
b. Unambiguous Animate:	Dün palyaçoyu ben gördüm. Yesterday the clown-Acc 1s saw-1s Yesterday I saw the clown.
c. Ambiguous Inanimate:	Dün kale gördüm. Yesterday castle saw-1s Yesterday (I) saw (a) castle.
d. Unambiguous Inanimate:	Dün kaleyi ben gördüm. Yesterday the castle-Acc 1s saw-1s Yesterday I saw the castle.

Table 4.1: Critical conditions in Experiment 1.

The design shown in Table 4.1 capitalises upon the fact that accusative case can, but need not be, marked overtly in Turkish (see Chapter 3). Furthermore, only first person (singular or plural) pronouns (and verb agreement endings) were used, as these (i) unambiguously rule out a subject reading for the critical NP in the locally ambiguous conditions [Table 4.1 (a/c)], and (ii) do not require any specific context for pro-drop.

The critical position in all the conditions in Table 4.1 was the verb, which disambiguates the first NP towards an object reading (via person information) in the ambiguous conditions [Table 4.1(a/c)]. If there is a subject-preference, this disambiguation should engender increased processing difficulty [Table 4.1(a/c)

vs. (b/d)]. Furthermore, if the preference is influenced by animacy, the effect at the position of the verb should be modulated for inanimates (c vs. d) as opposed to animates (a vs. b).

In order to avoid artificial processing strategies due to a predictable reading of the first NP, I introduced four filler conditions (see Table 4.2) designed to render the materials more variable and thereby minimise strategic influences. Conditions e and f (Table 4.2) led to a (transitive) subject reading of the ambiguous initial argument, while conditions g and h (Table 4.2) led to a (transitive) object reading of the ambiguous initial argument.

Condition	Sentence and Meaning
e. Transitive SO Animate:	Dün palyaço adamı gördü. Yesterday clown man-Acc saw-3s Yesterday clown saw the man.
f. Transitive SO Inanimate:	Dün kale adamı korkuttu. Yesterday castle man-Acc scare-3s Yesterday the castle scared the man.
g. Transitive OS Animate:	Dün palyaço ben gördüm. Yesterday the clown 1s saw-1s Yesterday I saw the clown.
h. Transitive OS Inanimate:	Dün kale ben gördüm. Yesterday the castle 1s saw-1s Yesterday I saw the castle.

Table 4.2: Filler conditions in Experiment 1.

Note that, in the absence of a suitable context, conditions g and h (Table 4.2) are very highly marked and therefore associated with a considerable acceptability drop. However, they were included as to further extend the possible range of readings for the first NP.

4.8.1.3 Materials

Sentence materials were constructed on the basis of 80 adverb - noun (animate) - noun (inanimate) - (noun / pronoun / null) - verb combinations, which were used to generate sentences as in Table 4.1 and Table 4.2. All adverbs were temporal (e.g., yesterday, last night). The animate nouns were human common nouns (e.g., doctor, man, singer), while inanimate nouns were nouns (e.g., medicine, car, rock etc.) (See Appendix A for all the material used in the experiment.) Except for the transitive SO inanimate condition [Table 4.2(f)], (accusative) verbs were compatible with both inanimate and animate objects. The verbs in condition g (Table 4.2) were only required to select an animate

object. The 640 sentences thus constructed were divided into two lists of 320 sentences such that each list included forty sentences per condition and four sentences from each lexical set. Overall, each list comprised 160 acceptable sentences (of the types in Table 4.1 b/d and Table 4.2 e/f), 80 unacceptable sentences (Table 4.2 g/h) and 80 sentences of potentially degraded acceptability due to a required reanalysis (Table 4.1 a/c). Each list was presented in two different randomised presentation orders and presentation of lists was counterbalanced across participants.

4.8.1.4 Procedure

Sentences were presented word-by-word in the centre of the screen with a presentation time of 600ms per word and an inter-stimulus-interval (ISI) of 200ms [note that adverbs composed of 2 words like *dün gece* ("last night") were presented together]. These presentation times were chosen due to the morphological complexity of Turkish and were perceived as a comfortable reading rate by participants. Each trial began with the presentation of an asterisk (1000ms plus 200ms ISI) and ended with a 1000ms pause, after which the participants completed an acceptability judgement task by pressing one of two push-buttons. Participants were given maximally 3000ms to respond. The acceptability judgement was followed by a probe detection task, in which the participants decided whether the word shown had occurred in the previous sentence (maximal reaction time again 3000ms).

Participants were asked to avoid movements and to only blink their eyes between the onset of the judgement task and the presentation of the asterisk preceding the next sentence. Before the main session, 14 additional sentences were presented as a practice session. The presentation of the critical 320 sentences was then carried out in eight blocks of 40 sentences. A session lasted approximately 3 hours including electrode preparation.

4.8.1.5 EEG Recording

The EEG was recorded by means of 25 AgAgCl-electrodes, which were fixed to the scalp by means of an elastic cap (Electro Cap International). AFZ served as the ground electrode. Recordings were referenced to the left mastoid, but re-referenced to linked mastoids off-line. In order to control for eye-movement artefacts, the horizontal and vertical electro-oculogram (EOG) was monitored. Electrode resistances were kept below 5k. All channels were amplified using a Twente Medical Systems DC amplifier and recorded with a digitization rate of 250 Hz. Data then filtered with a 03-20Hz band-pass filter.

4.8.1.6 Data Analysis

The statistical analyses of the behavioural data for the four critical conditions [Table 4.1 (a-d)] were carried out by means of repeated measures analyses of variance (ANOVAs) comprising the within participants factors AMBiguity (Ambiguous vs. Unambiguous) and ANIMacy (Animate vs. Inanimate).

For the statistical analysis of the ERP data, repeated measures ANOVAs for the four critical conditions [Table 4.1 (a-d)] were calculated for mean amplitude values per time window per condition. Trials for which the probe detection task had not been performed correctly were excluded from the analysis. Analyses additionally included the topographical factor 'region of interest' (ROI). Lateral ROIs were defined as follows: left-anterior: F3, F7, FC1, FC5; left-posterior: CP1, CP5, P3, P7; right-anterior: F4, F8, FC2, FC6; right-posterior: CP2, CP6, P4, P8. For mid-line electrodes, the factor ROI comprised the following six levels: FZ; FCZ; CZ; CPZ; PZ; POZ.

4.8.2 Results

4.8.2.1 Behavioural data

Table 4.3 shows mean acceptability rates and reaction times for the acceptability judgement task and accuracy rates and reaction times for the probe detection task.

The results of the acceptability judgement task supported the prediction that ambiguous initial arguments were initially associated with a subject reading: the ambiguous object-initial conditions gave rise to lower acceptability ratings and higher reaction times than their unambiguous counterparts. This was supported by the statistical analysis of the four critical conditions (a-d), which revealed main effects of AMB ($F_1(1,25)=19.13$, $p < 0.001$; $F_2(1,79)=119.29$, $p < 0.001$) and ANIM ($F_1(1,25) = 24.34$, $p < 0.001$; $F_2(1,79)=16.86$, $p < 0.001$) as well as an interaction of ANIM*AMB ($F_1(1,25) =26.60$, $p < 0.001$; $F_2(1,79)=21.63$, $p < 0.001$) in acceptability ratings. Resolving this interaction by AMB revealed an effect of ANIM for the ambiguous ($F_1(1,25)=28.20$, $p < 0.001$, $F_2(1,79)=20.26$, $p < 0.001$) but not for the unambiguous conditions. Ambiguous animate conditions were rated lower than the ambiguous inanimate conditions. For the reaction times, the analysis revealed main effects of AMB ($F_1(1,25)=43.27$, $p < 0.001$; $F_2(1,79)=75.47$, $p < 0.001$) and ANIM ($F_1(1,25)=10.69$, $p < 0.01$, $F_2(1,79)= 11.30$, $p < 0.01$). Participants took longer to respond in ambiguous and animate conditions.

For the probe detection task, the analysis of the error rates revealed a main effect of AMB ($F_1(1,25)=7.07$, $p < 0.05$, $F_2(1,79)=4.76$, $p < 0.05$). The reaction times showed a main effect of ANIM ($F_1(1,25)=15.90$, $p < 0.001$, $F_2(1,79)=4.01$, $p < 0.05$).

Condition	Acceptability Judgement		Probe Detection	
	Accept. (%)	RT(ms)	Accuracy (%)	RT (ms)
a. AMB-ANIM	76.4 (42.5)	760 (478)	98.2 (13.4)	887 (356)
b. UNAMB-ANIM	98.0 (14.1)	626 (386)	97.8 (14.7)	878 (357)
c. AMB-INANIM	86.8 (33.8)	690 (421)	98.9 (10.2)	840 (328)
d. UNAMB-INANIM	98.6 (11.5)	593 (353)	97.1 (16.7)	860 (323)
e. TRANS. SO ANIM	97.7 (15.0)	682 (414)	95.4 (20.8)	963 (375)
f. TRANS. SO INANIM	94.6 (22.6)	698 (402)	96.9 (17.6)	957 (377)
g. TRANS. OS ANIM	16.7 (37.3)	663 (402)	97.4 (15.9)	872 (328)
h. TRANS. OS INAIM	21.9 (41.4)	703 (450)	96.8 (17.5)	911 (361)

Table 4.3: Mean and standard deviation (sd) of the behavioural measures in Experiment 1.

4.8.2.2 ERP data

Figure 4.1 shows ERPs relative to the onset of the verb in our critical four conditions [Table 4.3 (a-d)].

As is apparent from Figure 4.1, the conditions disambiguated towards an object-initial reading (a/c) engender a broadly distributed positivity between approximately 200 and 600 ms post onset of the verb. Visual inspection suggests that this effect does not differ between the animate and inanimate conditions in 200-600ms window. This impression was confirmed by the statistical analysis, which revealed a main effect of AMB at both lateral ($F(1,25)=29.28$, $p < 0.001$) and midline sites ($F(1,25)=36.64$, $p < 0.001$). The interaction AMB x ANIM did not approach significance (both $Fs < 1$).

In a second step, I examined ERP responses at the position of the initial argument in the 400-600ms time window. As ambiguous arguments were associated with a subject reading (see above), this raised the question of whether the unambiguous initial objects would engender increased processing cost. As Figure 4.2 shows, however, there is neither an effect of ambiguity nor an effect of animacy. This was supported by the statistical analysis, which revealed no significant main effects or interactions.

At the last step, I examined two filler conditions (Table 4.2, e and f conditions) in the 400-550ms time window. These conditions have the same animate object NP2 (second NP following sentence-initial ambiguous NP). In one case,

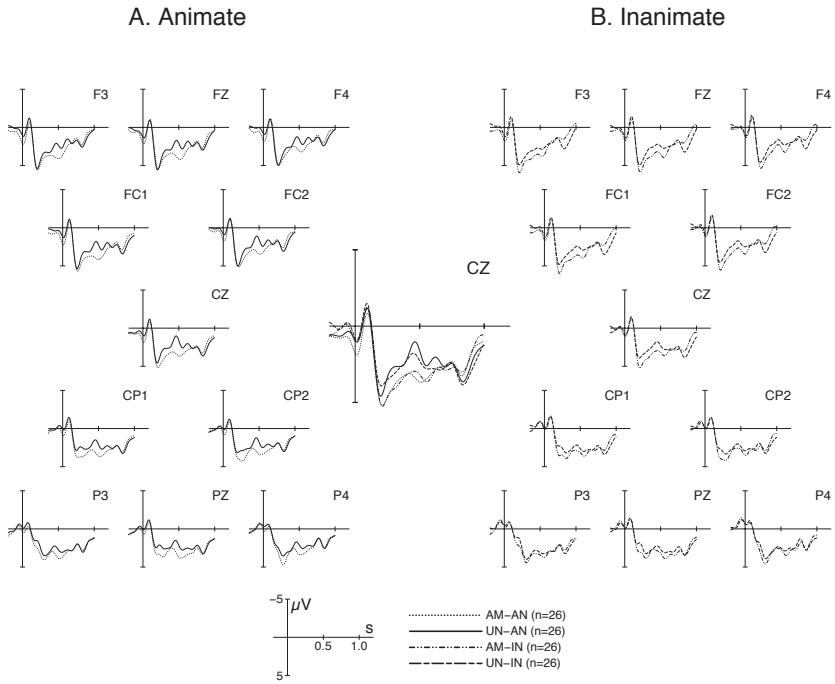

Figure 4.1: ERP measurement on the verbs. The left column (A) shows the animate conditions (Table 4.1 a vs. b conditions) and the right column (B) shows the inanimate conditions (Table 4.1 c vs. d conditions). Dark lines show the unambiguous conditions, dotted lines show the ambiguous conditions.

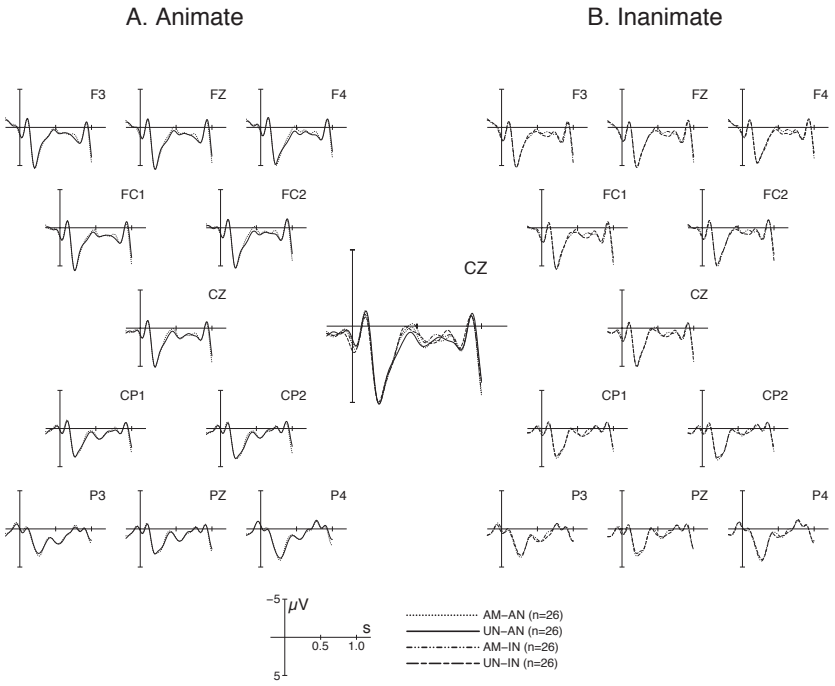

Figure 4.2: ERP measurement on the sentence-initial NPs. The left column (A) shows the animate conditions (Table 4.1 a vs. b conditions) and the right column (B) shows the inanimate conditions (Table 4.1 c vs. d conditions). Dark lines show the unambiguous conditions, dotted lines show the ambiguous conditions.

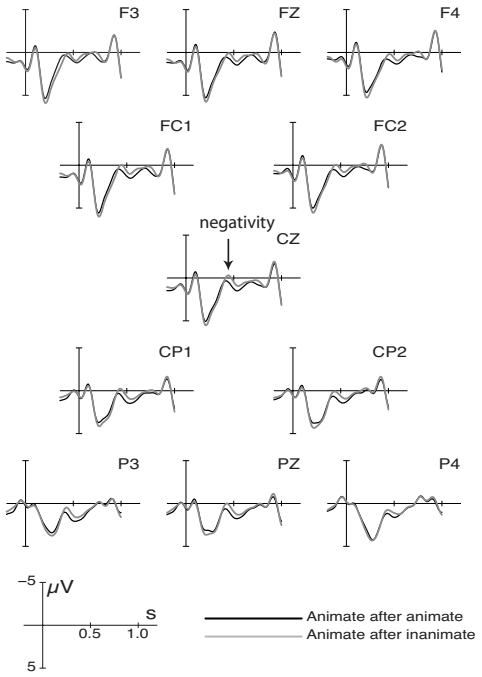

Figure 4.3: ERP measurement on the second NPs (NP2). Dark line shows the animate NP folowing the inanimate NP (Table 4.2 e condition) and grey line shows the animate NP following the inaniamte NP (Table 4.2 f condition).

NP2 follows the animate subject [Table 4.2, e condition], in the other inanimate subject NP1 (Table 4.2, (f) condition). As it is seen in Figure 4.3, these conditions exhibit significant differences relative to each other on NP2. Inanimate conditions shows N400 like negativity when compared to animate conditions. Inanimate conditions are those in which the animate object follows the inanimate subject which creates a conflict between the $+agr > -agr$ and $+animate > -animate$ prominence hierarchies. The visual impression was confirmed by the statistical analysis, which revealed a main effect of ANIMacy at both lateral (F(1,25)=6.69, $p < 0.05$) and midline sites (F(1,25)=4.67, $p < 0.05$) within the time-window of 400-550ms. An animate object NP2 following an inanimate subject NP shows a N400 like component.

4.8.3 Discussion

The present study investigated four questions. Two of them were in the the major focus of the study: (a) whether Turkish, which permits an unmarked

object analysis of an initial ambiguous argument, nonetheless shows a subject preference and, if so, (b) whether this preference is modulated by animacy.

Both the behavioural findings and the ERP effects at the critical verb position indicate that participants indeed initially adopted a subject analysis of the first NP. When this was disconfirmed by the person marking on the verb, a broadly distributed positivity in the ERP measures, higher reaction times and lower acceptability ratings in the judgment task were observed.

Concerning the question of semantic influences, the ERP data suggests that the subject preference is just as strong for inanimate as for animate arguments, as the positive ERP component on the verb was not modulated by animacy of the NP. Despite this absence of a difference in the ERPs, the behavioural data show a higher mean acceptability for the ambiguous inanimate as opposed to the ambiguous animate condition (Table 4.3), thus suggesting that the object reading is more easily reconstructed for inanimate arguments. This observation suggests that, while the initial subject preference and the conflict resulting from a non-confirmation of this preference are the same in both cases, the probability of reaching an acceptable interpretation is influenced by the semantic information, revealing a possible difference in garden-path strength.

Note that, studies in German showed that reaching an acceptable interpretation for a sentence is influenced by the lexical differences between the verb types by using Speed Accuracy Tradeoff (SAT) measures (Bornkessel et al., 2004). In these studies dative object-experiencer verbs influenced the reanalysis process differently than the dative active verbs, thus leading to a more accessible interpretation for the experiencers than actives. The important point here is that, even though the German study did not manipulate the animacy of the inital ambiguous NP, the processing difference is attributed to the garden-path strength. Similar to the SAT measures in German data, the acceptability ratings in the current experiment revealed the animacy information as one of the factors influencing garden-path strength .

No difference was observed on the sentence-initial NPs. There were not any ERP differences between ACC marked vs. ambiguous arguments, providing an answer for one of the questions of this experiment, namely whether the extension (or realization) of the second argument of the sentence leads to processing cost (question (c) mentioned above), where it may be overtly or covertly given in the following portion of the sentence. While in German complement clauses, an ACC case-marked argument yields a scrambling effect, in Turkish it does not. Even though the realization of the existence of the second argument leads to update of the semantic representation (via allowing a representation of an event having both Actor and Undergoer arguments), the ACC marked (unambiguous) argument did not lead to any cost.

eADM interprets the scrambling negativities found in German sentence-initial accusative arguments as follows: When the initial argument is read, category information is being assessed and an NP-V template is formed via structural minimality (because the initial category-formation phase only allows the application of structural minimality). Only after, in Phase 2, is case information processed, yielding an Undergoer assignment via accusative case. This information "predicts" or expects that the Actor must somehow exist in the sentence, thus there must be two GRs in the sentence. This information then conflicts with the current NP-V information because German does not allow Pro-drop and all the GRs must map to the core NPs. Scrambling negativity is the by-product of this conflict/mismatch.

If this hypothesis holds for Turkish, realization of the second GR via accusative case will not conflict with the NP-V template via Pro-Drop. This is the case in this experiment. There is no extension or conflict on NP-V. Since relational minimality is only an ambiguity resolution strategy, realization of another GR does not violate it.

On the other hand, there might be an alternative explanation for not seeing any difference between ambiguous and case-marked unambiguous NPs in Turkish. For instance, object-first structures might be less common in German, while they are more common in Turkish, thus leading to possible object initiality. This is a frequency-based interpretation and in line with the tuning hypothesis proposed by Cuetos and Mitchell (1988). This issue will be dealt with elaborately in the following chapters, particularly in Chapter 6, where I present corpus counts.

My general interpretation about these findings is that, a unique characteristics of Turkish prevents any kind of negativity on the sentence-initial accusative argument (like scrambling negativity observed for German Bornkessel, Schlesewsky, & Friederici, 2002b; Rösler, Pechmann, Streb, Röder, & Hennighausen, 2002), because Turkish allows Pro-Drop structures where OV is one of the minimal templates available to the language system. An ACC marked argument leads neither to the expansion of the initial minimal syntactic template nor causes a cost related to the markedness of the syntactic structure (scrambling). Since German lacks Pro-Drop, it is realized that the sentence is scrambled and must have two overt arguments. The option of having OSV rather than SOV is more marked (and less preferred) and also more costly for the processing system.

Regarding question (d), on prominence hierarchies, as it can be seen in example (58), Frisch and Schlesewsky (2001) showed that the second Nominative inanimate NP *der Zweig* showed an N400 effect when it followed an animate Accusative NP *Lehrer*. The interpretations suggest that this is the case be-

cause the initial accusative animate argument predicted an Actor NP2, but this prediction was not satisfied, leading to N400 (Bornkessel & Schlesewsky, 2006; Roehm et al., 2004).

(58) ...welchen Lehrer der Zweig streifte.
[which teacher]$_{ACC}$ [the twig]$_{NOM}$ brushed
"...which teacher the twig brushed."

Animates are more prominent in the animacy scale, and inanimates are lower. The inital animate argument leads to the prediction that a subject will follow and that it must be at least as prominent as the initial animate argument. When the relational status of the animate and inanimate arguments reverse, e.g., animate is given lower status with the accusative case, while inanimate is given the higher status with the nominative case, the comprehension system recognizes this conflict immediately, and prediction is not satisfied, leading to an N400.

In Experiment 1, the conditions did not make any predictions for the GR status of NP2 at all, because the sentence-initial argument was taken as the subject of the sentence. As mentioned in the previous parts of this chapter, previous findings on German and this finding cannot be explained with a prediction-based approach. Thus, there are two possiblities here. One is that the $+Agr$ (or $Nom > Acc$ Case hierarchy) contrasts with the animacy hierarchy, and this leads to N400. Any conflict between these formal and interpretational hierarchies would produce N400. Under this assumption, eADM may assume that the realization of the mismatch must emerge in the well-formedness step, which must be observed as a late positivity, not in the prominence computation where the prediction-related N400 emerges.[27] This hypothesis also explains German data, but eADM must be modified to have a non-prediction based explanation. The second possibility is that the events in which inanimates acting on animates are few and so the linguistic system quickly recognizes this marked structure on the second argument. This also brings into question whether the frequency of sentences having an inanimate subject and animate object in the language is respectively low. In corpus counts, I will show that this is indeed the case (Chapter 6).

In general, observing the similar effect also for Turkish confirmed the previous hypothesis about the relational nature of the incremental prominence assignment mechanism. This mechanism is incremental and relational. Thus, question (d) developed above is answered in that way.

[27]Linear precedence of low-high prominence may also create a processing cost in the model, but here the main issue is the conflict.

Overall, the ERP experiment supports the subject-preference hypothesis. The positivity observed is similar to the positivities observed in the literature for the (diagnosis and) revisions of initial syntactic preferences (positivity either as a monolithic component or a combination of different components) (beim Graben, Saddy, Schlesewsky, & Kurths, 2000; Friederici, Mecklinger, Spencer, Steinhauer, & Donchin, 2001). On the other hand, there are a number of issues that need to be resolved before we fully accept the subject preference hypothesis. These issues will be introduced and dealt with below.

The first issue is that in the behavioural results, there were not only an acceptability difference between the ambiguous conditions and unambiguous conditions, but also between animate and inanimate ambiguous conditions. I did not find any ERP difference related to the animacy difference in the acceptability task, but for the former one, subject-object revision, the accepetability task and ERPs are corralated. Thus, ERPs may have different degrees of correlation with behavioural measures, where the ERP difference expected for the animacy difference in Experiment 1 can be a subtle one, disappearing under other processes. For instance, some processes (like subject-to-object revision) may influence the ERPs and dominate the components, and override these subtle differences.

On the other hand, ERP effects which I attributed to the subject-object revision may actually be related to the factors embedded in the condition in general. It is possible that the absence of case marking or dropping the pronoun may be the main factors influencing accceptability differences and ERPs.

In order to explore how different types of structures vary with respect to their acceptability, and to have a better understanding of the Turkish speakers' preferences, I conducted a questionnaire study with similar material to what I used in the experiment. This questionnaire study aimed to assess three things: (a) How existence of a pronoun influences the acceptability of the sentence, (b) how absence of case marking influences the acceptability of the sentence, and (c) how animacy influences the subject-object reversal (confirmation of the experimental findings in a different task).

4.9 Experiment 1(b): Questionnaire Study

4.9.1 Materials and Methods

4.9.1.1 Participants

Thirty participants took part in the questionnaire study (12 females and 18 males; mean age: 31.1, range: 16-55). Participants were all native speakers of Turkish and residing in Turkey at the time of the study.

4.9.1.2 Materials

A subset of the materials used in the ERP study (24 lexical sets) was used to create the materials for the questionnaire study. These lexical items were used to create six critical sentence conditions, which were assigned to six lists (including 4 sentences per condition each) according to a Latin square design. In addition to the critical ambiguous conditions from Experiment 1 (Table 4.1 a/c), a minimally differing condition with an unambiguously marked object and a dropped subject and a canonically ordered (subject-before-object) condition without pro-drop were included. All sentence types were realised with either an animate or an inanimate first NP, thus yielding the six critical conditions. The extra conditions not used in Experiment 1, and which were included in the questionnaire study, are exemplified in examples (59) and (60) using animate NPs. Note that the object was morphologically marked for accusative case in half of the sentences in "No ProDrop" Conditions (60) and not marked in the other half of the stimuli. However, due to the presence of an initial unambiguous subject pronoun, there was never any ambiguity with respect to the object interpretation of NP2 even in the morphologically ambiguous cases.

(59) Unambiguous-Animate Condition:
Dün adamı gördüm.
Yesterday man-ACC see-Past-1s
"I saw the man yesterday"

(60) No ProDrop-Animate Condition:
Dün ben adam | adamı gördüm.
Yesterday I man | man-ACC see-Past-1s
"I saw (a) / the man yesterday"

Within each list, the 24 critical sentences were randomly intermixed with 20 ungrammatical fillers, thus yielding a total of 44 sentences per questionnaire.

4.9.1.3 Procedure

Participants rated each sentence on a 4-point scale (4 = "perfect"; 1 = "totally excluded").

4.9.2 Results

Mean acceptability ratings for the questionnaire study are shown in Table 4.4 and 4.5.

Condition	Mean	SD
A. AMB-ANIM	2.52	1.00
B. UNAM-ANIM	3.17	0.88
C. NO PRO-DROP - ANIM	2.68	0.87
D. AMB - INANIM	3.10	0.82
E. UNAM - INANIM	3.29	0.74
F. NO PRO-DROP - INANIM	2.67	0.83
UNGRAM. FILLERS	1.18	0.47

Table 4.4: Mean acceptability ratings and standard deviations for all the conditions in the Questionnaire Study.

I analysed the results for the six critical conditions with a repeated measures ANOVA including the factors ANIMacy (NP being animate or inanimate) and CONDition (Pro-Drop ambiguous, Pro-Drop case marked and No Pro-Drop). Corrections for multiple comparisons were performed using a modified Bonferroni method (Keppel, 1991). The analysis revealed main effects of ANIM (F_1(1,29)=32.17, $p < 0.001$; F_2(1,23)= 5.42, $p < 0.05$) and COND (F_1(2,58)= 28.16, $p < 0.001$; F_2(2,46)= 13.63, $p < 0.001$) and an interaction of the two factors (F_1(2,58)= 9.25, $p < 0.001$; F_2(2,46)= 6.68, $p < 0.01$). Resolving this interaction by ANIM revealed an effect of COND for the animate conditions (F_1(2, 58)= 14.65, $p < 0.001$; F_2(2,46)= 10.69, $p < 0.001$), while this effect was only significant by participants for the inanimate conditions (F_1(2, 58)= 6.27, $p < 0.05$; F_2(2,46)=2.01, $p > 0.16$). Pairwise comparisons between the animate conditions revealed a significant difference between conditions A and B (F_1(1,29)= 22.56, $p < 0.001$; F_2(1,23)= 24.13, $p < 0.001$) and conditions B and C (F_1(1,29)= 12.80, $p < 0.01$; F_2(1,23)= 9.41, $p < 0.01$) but no difference between conditions A and C (F_1(1,29)= 4.02, $p > 0.07$; F_2(1,23)= 1.91, $p > 0.17$). For the inanimate conditions, the difference between conditions D and E only reached significance in the analysis by participants (F_1(1,29)= 6.27, $p < 0.05$; F_2(1,23)= 2.04, $p > 0.16$), while there were significant differences between conditions E and F (F_1(1,29)=47.63, p<0.001; F_2(1,23)= 22.58,

$p < 0.001$) and conditions D and F ($F_1(1,29)= 23.39$, $p < 0.001$; $F_2(1,23)= 10.61$, $p < 0.01$).

Condition	Mean		sd	
	-acc	$-\phi$	-acc	$-\phi$
C. NO PRO-DROP-ANIM	2.65	2.70	0.84	0.76
F. NO PRO-DROP-INANIM	2.68	2.66	0.77	0.85

Table 4.5: Ratings and standard deviations for the subconditions of C and F in the Questionnaire Study

4.9.3 Summary

The results of the questionnaire study can be summarized as follows:

1. Acceptability difference between animate and inanimate ambiguous conditions:

   The questionnaire study replicated the acceptability difference between animate and inanimate ambiguous conditions observed in Experiment 1. Animate ambiguous conditions are less acceptable than the inanimate ones (Experiment 1: 76.4/86.8 and Questionnaire study: 2.52/3.10). From the subject preference perspective, this suggests that subject-to-object revision is more costly for animate objects. Ambiguity of object case marking is costly when the object could also potentially be analysed as a subject, especially when it is animate. This process in which the difficulty arises from assigning objecthood to the animate noun (which is actually a better candidate to be a prototypical subject) must emerge in the later time points (or we cannot observe it via ERPs).

2. No general disadvantage of Pro-Drop:

   Both ambiguous conditions were less acceptable than the unambiguous conditions. Thus, now we can explore why this might be the case. One possibility is dropping the pronoun. Is Pro-Drop less accepted? The simple answer to this question is "No". There is no general disadvantage associated with Pro-Drop: (Canonically ordered) sentences with an overt subject (C/F in Table 4.4) are rated as less acceptable than sentences with an unambiguously marked object and a dropped subject (B/E in Table 4.4) (2.68/2.67 vs. 3.17/3.29). Pro-Drop is a highly preferred option in Turkish and under situations as in the questionnaire study in which the subject is non-emphatic (see Chapter 3), 1st and 2nd person pronouns are generally dropped.

While omitting the pronoun is not costly, having the overt pronoun is. Thus, the questionnaire study raised an interesting point, which, at first glance, is a contradictory pattern to the behavioural findings of Experiment 1. It revealed a less acceptable preference for the sentences (which have SOV word order) with pronouns, while in Experiment 1, control conditions (which had OSV word order) with a pronoun were highly acceptable. My interpretation is as follows: If a pronoun is used in its canonical position and if it is non-emphatic, then this leads to an acceptability drop. People do not need a pronoun and find it uneconomical to use it unnecessarily. Pro-Drop alone is not a problem, neither having a pronoun; when someone can express a sentence without a pronoun then s/he prefers to do so. A pronoun is used in Turkish when one wants to switch the topic or to emphasise the subject. This supports the claim that using an overt pronoun in these cases is redundant (Enç, 1986). In the OSV order, on the other hand, we make topicalization, making the pronoun necessary to use. This does not lead to an acceptability drop.

While, existence of a pronoun in OSV control conditions in the experiment did not lead to acceptability drop, still there might be an effect of the pronoun on the ERPs. For instance, having two overt arguments vs. one overt argument may create more interpretational cost for the system that leads to negativities. If this is the case, existence of a pronoun in the control condition might have influenced ERPs to be more negative, such as deviating the ERP form towards a more negative polarity, while the Pro-Drop conditions are easier to process, and they stay relatively more positive. This issue represents a potential problem, and will be examined in the next study.

3. No main effect of case marking:

   The ambiguity effect reaches significance for the animate conditions (A vs. B in Table 4.4) but not for the inanimate conditions (D vs. E in Table 4.4). This finding indicates that the acceptability disadvantage for A vs. B does not stem from overt case marking alone (which relates to a kind of formal restriction of the grammar). In addition, the questionnaire findings showed that the presence or absence of accusative case marking does not change the acceptability of Turkish sentences when the morphologically noun phrase is clearly in an object position (see Table 4.5, C and F, caseless and case marked conditions).

   As mentioned in Chapter 1, ACC case marking is not obligatory in Turkish, and object-verb relation, for example in the form of object-incorporation, depends on the nature of the NP (its animacy, definiteness etc.). Thus, the effect of case marking surfaces under only certain types

of grammatical structures, but not as a main effect in which a caseless object reduces the acceptability all the time. In the ambiguous conditions, it is easier for the inanimates to be reanalysed, probably because they are taken as less definite than the animates. It might be more difficult to have a non-specific object reading for animates in the verb-neighboring position. Or the inaniate objects are more proto-typical objects than the animates and it is easier to assign objecthood to them.

On the other hand, when there is an overt pronoun in the sentence-initial position, acceptability drops to a level which may override the acceptability changes related to the case status of the object. But, I think that case marking alone is not the main contributor to the finding that the ambiguous conditions are less acceptable than the unambiguous ones in general. Even though its influence is higher for the animate conditions, there is a general acceptability drop for the ambiguous conditions which may indicate that the revision from subject to object creates a processing cost. On the other hand, the possible influence of case on ERPs must be investigated overall.

4.9.4 Discussion

To summarise, the results of the questionnaire study confirmed that the positivity at the position of the verb in the ERP study was not likely engendered by an acceptability decrease due to subject-drop. The behavioural difference between ambiguous conditions (between animate and inanimate conditions) did not reflect on the ERPs on the verb in the experiment. For both cases, ERP deflections were positive and their amplitudes were large for both animate and inanimate conditions showing no animacy difference. Thus, assuming a direct relationship between the ERP data and the acceptability ratings seems to be difficult in some instances, but, these findings do not cancel out this possibility fully.

If subject-to-object reanalyses takes place and this syntactic operation overrides the possible effects of animacy, then only such major processes (reanalysis effect) would be observed via ERPs, not the secondary post-syntactic interprative ones (animacy effect). This does not cancel out the possibility that some acceptability measures may be related to ERPs in some ways, but this proposal requires more sensitive conditions to be inserted into the picture. Another possible interpretation is that the animacy differences may emerge in the later time points that we cannot observe in the ERP time window (which is around 1 second). In order to examine that, I did the same statistical analysis in the later time window (between 1000ms to 1600ms – the time acceptabil-

ity judgment started) after the verb onset, but observed no effect of animacy. Thus, it seems that the influence of animacy is somehow overriden by the reanalysis effect.

Also, the results indicate that the acceptability change cannot be attributed solely to case-marking. ACC case marking is not obligatory for Turkish and it cannot influence acceptability changes observed here alone. Then, the effect of ambiguity reported here might be due to two factors: (a) the presence of a subject-object ambiguity that results in a reanalysis effect, and (b) object-incorporation. Recall from Chapter 3 that an object can go into a constituency formation with the verb, a process called object-incorporation. This process is common for inanimate objects and it is sensitive to verb specific differences. Particular lexical items can go into object-incoporation while for others it is more difficult. Combining this theoretical aspect of object-predicate relation with the findings listed above, it seems that the acceptability drop for ambiguous animates does not fully cancel out the possible influence of the difficulty of obtaining an object-incorporation reading. But, as mentioned in Chapter 3, the experimental material was designed to prevent object-incorporation in a maximal degree. If the only possible way to interpret the non-definite object noun is to take it as a referential noun, then the acceptability drop must be related to the difficulty of assigning the correct specificity level for this animate noun. Another way to put it is that the difficulty in revising the definite reading of the animate noun (as being the subject and being in the sentence-initial position) to indefinite and non-specific object reading might be costly. On the other hand, for inanimates, this revision may not be that difficult, because an initial inanimate subject may not have a very definite reading. Thus, this explanation eliminates the hypothesis that the comprehension system attempts to construct an "incorporated object" structure. But, it brings similar explanations deriven by subject-to-object revision and object prototypicality arguments by assuming the main factor to be the specificity revision.

4.10 General Discussion

Findings revealed answers for seven research questions, four from the ERP experiment (namely (a) subject-preference, (b) effect of animacy in subject-preference, (c) electrophysical effect on sentence-initial accusative argument and (d) electrophysical effect of prominenece mismatch, or infrequent event structure), and three from the questionnaire study (namely (e) effect of case marking (f) effect of pronoun, and (g) effect of animacy on the acceptability ratings of ambiguous and unambiguous structures). In general, initial ERP findings support the subject preference hypothesis independent of animacy

information. Also, processing of the sentence-initial accusative argument was not costly and did not show any ERP effect. On the other hand, an inanimate entity acting on the animate entity seems to be a less likely event, or it is a condition which creates a mismatch between prominence hierarchies.

Initial data derived from acceptability ratings and the questionnaire study showed that animate ambiguous conditions are more difficult to be interpreted as the objects of the sentence. Interestingly, the questionnaire study showed that the principle of "economy" exists at every level of language comprehension. If SOV structure can be easily expressed as an OV structure (Pro-Drop), then it is preferred. This is the most economical way to express the meaning of the sentence. Thus Pro-Drop is not costly, actually it is favored under some cicumstances. Case marking is not a sole determinant of acceptability judgments. Since accusative case marking is also related to pragmatic and referential factors (rather than just a disambiguator), its absence may only surface under some sentential environments in which the referential attribute of the object becomes ambiguous.

One potential caveat arising with respect to the interpretation of the ERP results is that the critical conditions not only differed with respect to the case marking of NP1 but also with respect to the presence or absence of an overt subject pronoun. Thus, only the two ambiguous conditions but not the unambiguous controls involved dropped subjects. One related question is whether the existence of a pronoun in the control conditions created a negativity, making the experimental condition positive. Recall that, in Experiment 1, even though the control conditions were highly acceptable, they contained an overt pronoun. This may not be related to the redundancy claims I made [since in OSV (not in SOV) structure using a pronoun is not redundant], but related to the impact of an overt pronoun.

On the other hand, only the control conditions had case-marked objects, leading to a hypothesis that lack of case marking might have created the positivity I observed. Recall from Chapter 3 that, caseless non-definite objects may incorporate into the verb. Even if the experimental material prevented such biases to a maximal degree, the language comprehension mechanism may have tried to form object-incorporation when a non-definite noun existed in the sentence. Thus, there might be an attempt to incorporate the object, or make the object as non-referential as possible (like *bir kitap*, a book). Maybe, the inanimate non-definite objects are more likely to lose their referentiality and be interpreted close to a non-referential reading so can have an incorporated kind of interpretation easily. These questions necessitate broader ERP investigations as well as corpus counts for the language.

In the following part, I will first explain how the hypothesis on subject preference discussed may explain the data, and then show how these hypotheses can be interpreted according to the current theoretical approaches. Then, I will ask how alternative approaches, like existence of an overt pronoun or frequency of usage can be investigated in a broader study agenda.

4.10.1 Interpretations for the Subject Preference Hypothesis

The present findings, in general, indicate that an initial argument may preferentially be analysed as the subject of the clause even when there is an alternative unmarked structural possibility (namely an object analysis in a sentence with a dropped subject). Thus, while the results support the idea that the subject preference is a cross-linguistically valid processing strategy, it is not easily accounted for in classical accounts of this preference.

For instance, filler-gap-based theories (Frazier & Flores d'Arcais, 1989) do not apply, because both the subject reading of the initial argument and a reading in which this argument is an object of a pro-drop sentence are both associated with a base-generated structure (i.e., a structure without filler-gap dependencies and without any movement operations). On the other hand, a dependency-based account (Gibson, 1998, 2000) also encounters difficulties, because the presence of an initial object does not entail that a subject must follow in a pro-drop language. Subject- and object-initial structures should therefore yield exactly the same amount of prediction (or memory storage) costs as only a verb is required for a grammatical completion of both sentence types. Memory based approaches are not clear about how Pro-Drop languages will be handled.

On the other hand, a minimality-based perspective (Bornkessel & Schlesewsky, 2006) assumes that the subject preference arises as an epiphenomenon of "relational" minimality, which leads to an initial ambiguous argument being analysed as the sole argument of an intransitive verb (hence, the "subject"). When the verb is encountered, this interpretation cannot be upheld because (a) the verb is transitive, and (b) the subject interpretation is ruled out by the agreement information. The revision thus required correlates with the early positivity observed in the present ERP study. This account also supports the absence of an animacy effect: the minimal reading is independent of animacy information.

Finally, a minimality-based conception of processing is also compatible with the results for the first NP, which showed no effect of case marking. Because an

initial accusative rules out an intransitive interpretation, relational minimality (as an ambiguity resolution strategy) cannot apply. Here, two analyses are possible, because the initial object could either have been in a scrambled OSV structure (as it is always the case in German), or it could be the sole argument in a clause with a dropped subject (OV structure). Structural minimality favours the latter analysis, which is simpler. Thus, at the phrase structure level, a sentence with an overt object and a dropped subject has the minimal NP-V template.

In contrast to non-pro-drop languages, in which an initial object always signals a non-minimal phrase structure since a subject must occur at some later point in the sentence, languages such as Turkish therefore allow for structural minimality to be upheld even when the initial NP is clearly an object. I therefore suggest that the difference between the current finding of no increased processing cost for unambiguous initial objects and previous observations of such costs in German (e.g., Rösler, Pechmann, Streb, Röder, & Hennighausen, 2003; Schlesewsky, Bornkessel, & Frisch, 2003) can be accounted for in terms of cross-linguistic differences regarding possible minimal structures.

4.10.2 Effect of Existence of Overt Pronoun

The major outcome of the questionnaire study is that, the existence of an overt subject in certain constructions created acceptability drop. Existence of a pronoun has an impact on the processing system. In general comprehenders seek for "economy." Nonetheless, while the questionnaire study showed that absence of a pronoun did not create acceptability drop in general, it reminded us that existence of an overt pronoun in certain constructions may indeed influence the acceptability of such structures. Thus, such unacceptable structures may create processing problems during language comprehension. At the time when the realization of the violation of the economy contraint emerges, this may create a negative component (N400). Since ERPs are relative measures, the positive component I observed might actually be created by the reverse negative component for the conditions having an overt pronoun. In Experiment 2, I will extend the number of conditions to test this argument.

4.10.3 The role of Frequency of Occurrence

One remaining open question concerns the degree to which the findings correspond to the frequency of occurrence of the different sentence structures under consideration. For instance, take the control condition in Experiment 1. OSV order is an acceptable word order in Turkish, but it may be an infrequent one so

that it may create an N400 effect. But, one potentially problematic point here is why such an effect should reveal itself on the verb, not on the second noun. One answer to this is that, unless the frequency effect is an on-then-off process (being "on" at the subject after the object in OSV sentence, and becoming "off"' at the verb), it may check the general well-formedness and availability of the sentence structure as each item is processed. Thus, the effect of frequency may be a continous effect, not an on-then-off kind of effect.

Like acceptability ratings, frequency counts may also not have any one-to-one relation with ERPs, but again, they may show us the general distribution of the linguistic constructions, and may be indirectly related to ERPs. Linguistic distribution may influence the ERPs. It is possible that in Turkish, SOV or SV structures are more common than OV when the initial NP is ambiguous, and that may also explain the subject preference phenomenon. This issue will be dealt with in Chapter 6 in corpus counts, after Experiment 2.

4.11 Conclusion

The results of Experiment 1(a) (ERP study) and Experiment 1(b) (questionnaire study) showed that subject preference seems to be the strongest hypothesis regarding the findings. Nevertheless, some arguments like existence of an overt pronoun, frequency of certain patterns, relative interpretation of ERPs as well as phenomena like object-incorporation make it difficult to commit to the subject preference hypothesis fully.

In order to evaluate these possible candidates and to examine the frequency of occurrence of the critical sentence structures used in the ERP study more closely, first I have conducted an ERP experiment by manipulating pronoun, case marking and animacy. This study will be presented in Chapter 5. Then, I have scanned five thousand sentences (and picked two thousand sentences) in a Turkish corpus in which I present the results in Chapter 6, to explore the effects of the frequency of distribution. The main motivation of Experiment 2 is to explore the effects of syntax and pragmatics in a diverse number of manipulations, in which I will also seek for answers to the questions raised above.

Chapter 5

Interaction of Syntax and Pragmatics in Turkish

5.1 Introduction

This experiment was designed to systematically examine the effects of (a) the overt subject realization, (b) the presence or absence of accusative case marking and (c) scrambling during on-line processing of Turkish sentences. I explore the ERP components related to these factors, and investigate the linguistic processes with the temporal and functional dimesions provided by ERPs.

The factors under exploration are both syntactic and pragmatic in nature. For instance, accusative case marking is mainly related to the referentiality and specificity of the argument, while the pronoun stands as a referent for the discourse entity, and scrambling is generally used to topicalize the object. Thus, syntax and pragmatics are closely tied with each other, particularly in Turkish.

The secondary goal of Experiment 2 is to replicate and validate the findings observed in Experiment 1, like subject preference and the possible effects of animacy on subject-to-object revision. The findings from Experiment 1 suggested that the hypothesis of a subject preference for Turkish is a strong candidate in the explanation of the ERP data observed. It is highly probable that the initial ambiguous argument is interpreted as the argument holding properties generally attributed to subjects – agreeing with the verb ($+agr$), holding the sentence-initial position, etc. Following this finding, however, as mentioned before, Experiment 1 also contained several potentially confounding factors that cannot be ruled out by the conditions I used. In this experiment, I include a more systematic investigation of a number of additional factors that

could not be teased apart in Experiment 1. This hypothesis will be evaluated along with the main goals of the experiment.

5.2 Main Factors Under Examination

In this section, I start by summarizing the three factors under investigation, namely effects of a pronoun, case marking and scrambling on sentence interpretation and linguistic processes. While presenting these factors, I will remind the reader about the potential confounding factors that emerged in Experiment 1 which relate to these factors. I will seek to unify explanations from the possible outcomes of both experiments.

1. Influence of an Overt Subject Pronoun:

   How the existence of a pronoun influences sentence comprehension is a critical question. Subject pronoun not only refers to a discourse entity, but also clearly disambiguates the sentence by stating that it is the subject unambiguously. In the experiments I conducted for this thesis, I always used 1st person singular (1s) or plural (1p) subject pronouns, thus making the referent accessible to the reader. While the cost related to referentiality is low, it does not fully exclude the possible influence of an overt pronoun.

   In the first experiment, the unambiguous control sentences introduced a subject pronoun whereas the ambiguous experimental sentences did not. Therefore, the existence of the pronoun might have led to a negativity, thereby resulting in the observed ERP difference. This argument suggests that the pronoun might have created a processing cost even though it is a very prominent item in the discourse (1s or 1p). Since ERP components are generally interpreted by comparing two conditions to each other (for instance the experimental condition to the control condition), there is no a-priori means of ruling out that the critical effect might have resulted from a negativity in the control condition.

   On the other hand, the absence of a pronoun, in which the verb signifies the subject by the number and person marking, might have impacted ERP components. Previous findings on discourse processing show that the formation of a new and independent discourse referent leads to an increased integration demand arising from the establishment of an independent discourse referent which leads to late positive component on the referent (Burkhardt, 2006). Ambiguous conditions in Experiment 1 did not include the formation of an independent discourse referent on

the verb. The verb simply pointed to the first person singular and plural, which are very prominent. Thus, this does not seem to be a factor influencing the ERP deflections in Experiment 1.

Interestingly, the questionnaire study [Experiment 1(b)] revealed that the usage of a redundant pronoun in SOV structures decreased the acceptability ratings significantly. In Experiment 2, I wanted to assess the ERP correlates of this pronoun-effect (if possible) in SOV and OSV structures, and explore how redundant and non-redundant usage of a pronoun influences sentence processing. In SOV structures, usage of a pronoun can be redundant most of the time (Enç, 1986), but in OSV structures it is generally considered to be non-redundant via having a topicalized form.

2. Influence of Case Marking:

   Case marking is an informative cue for many languages to reveal a number of functional and thematic properties of the argument it is marked with (i.e., depending on the particular cases used and languages under consideration, accusative case reveals the grammatical function object and semantic macro role Undergoer, and also a specific reading of the object). Particulars about case marking in Turkish are given in Chapter 3. As mentioned in the previous sections, the existence of case is related not only to the syntactic but also the referential and pragmatic status of the object in Turkish. I expect that its pragmatic influence should be refected in the ERPs.

   As mentioned in Experiment 1, it is possible that differences between non-case-marked objects in the ambiguous conditions vs. case-marked objects in the control conditions may be the major contributor of the ERP deflection. This hypothesis claims that the positivity might not have been related to any type of subject preference at all, but rather to the status of the noun being case marked or not (independent of the existence of the pronoun). This might have resulted in the differences between linking the case-marked vs. the non-case-marked arguments to the verb, thus explaining why this effect might have emerged on the verb. Case marking in Turkish generally interacts with animacy as mentioned in Chapter 3. Thus the behaviour of case may also differ depending on the argument's animacy status in the pre-verbal part of the sentence.

   There are two potential reasons for a possible processing difference related to case marking:

(a) Possible Preference for Specific Objects:

First, there may be a general tendency for Turkish speakers to select case-marked and specific objects over non-case-marked non-specific objects. A non-referential or non-specific reading of the object might be somehow unacceptable or difficult. As mentioned in Experiment 1(b) and in Chapter 2, this seems to be less likely because Turkish allows for a non-specific reading of the object, and the accusative (or specificity) marker is used to create a unique interpretation of object-hood. None-the-less, it cannot be ruled out that such an effect might influence on-line processing. In Experiment 2, I used both specific and non-specific objects in order to examine whether specificity affects processing and if so whether this reflects on ERPs.

The most probable ERP component which will be expected in these cases will be the N400 reflecting a difficulty in the integration of the non-specific object vs. the specific object, particularly given that the experimental material is formed to prevent object-incorporation to a maximal degree. This will push the processing system to attribute a level of referentiality to the non-definite object.

(b) Revision of Specificity:

Since the NP-Verb pairs used in Experiment 1 and Experiment 2 generally prevented object-incorporation and non-referential reading of the NP, the most preferred option to interpret the object NP in a [caseless NP]-[verb] pair is to take the NP as "*bir NP*" (an NP), making it an indefinite non-specific object. Thus, if the initial NP is taken as the subject (because it is non-definite, ambiguous and exists in the sentence-initial position), and is given a definite and specific reading via the grammatical function and sentence position, then not only revising its grammatical status from subject to object, but also revising its referential status from definite-specific to indefinite non-specific will create a revision cost. Thus, there should be two revisions on the verb: (a) revision from subject to object, and (b) revision from specific reading to (indefinite and) non-specific reading. These two processes may happen simultaneously and create the positivity observed in Experiment 1. This positivity started earlier than most of the reanalysis-related positivities observed so far (Friederici, Mecklinger, Spencer, Steinhauer, & Donchin, 2001; Frisch, Schlesewsky, Saddy, & Alpermann, 2002).

Theoretically, we do not know whether revision of specificity should be reflected as a negativity (in the form of N400) or a positivity (in the form of P600). One hypothesis about the semantic generalized role revision assumes an early positivity (Bornkessel, Schlesewsky, & Friederici, 2002a). Thus, there is a possible interpretation in which similar positive components may also be observed for definiteness/specificity hierarchy revisions.

Thus, in general, it cannot be fully excluded that case-marked specific vs. caseless non-specific objects might have led to the different parsing behaviour at different levels, thus resulting in the observed ERP deflection in Experiment 1. This interpretation claims that even though specific vs. non-specific (and non-referential) arguments appear left-adjacent to the verb, the status of the noun may still create a processing difference on the verb. But, as mentioned before, in Experiment 1(b), case marking differences did not lead to any acceptability difference in SOV conditions when they were used with a pronoun (Table 4.5 in Chapter 4).

3. Influence of Scrambling and Topicalization:

   In Experiment 1, the control conditions not only included pronouns and case marking but also included scrambled (topicalized) sentences. While these were acceptable structures for Turkish speakers, they are generally considered to be marked. Thus, another possible explanation for the positive deflection might have been that the scrambling engendered a negativity for control conditions (and relatively, experimental conditions engendered positivity) via being a "marked" structure. We do not know the underlying electrophysical differences between OSV structure and SOV structure (which eventually may emerge as an extra processing cost and following that an observed N400 effect).

   Comparison of SOV structures with OSV structures will reveal the possible questions of (a) when and how scrambled structures differ from canonical ones in ERPs and (b) whether ERPs and acceptability ratings may somehow correlate for these structures.

All these constructions may lead to a better understanding of the particulars of incremental sentence processing in Turkish, and the interaction of multiple syntactic and pragmatic elements during incremental processing. I would like to mention, however, that there is a potential frequency-based explanation, in which more frequent structures are assumed to be more preferred (and easier to process), and less frequent ones are less preferred (and more difficult to process). If this is the case, then (a) difficult and problematic conditions must be diagnosed by ERPs (as N400s or P600s) and (b) these conditions must be

correlated with the corpus findings. This kind of exploration of the frequencies will be the topic of the next chapter, Chapter 6.

5.3 Temporal Components of Incremental Sentence Processing

Sentence processing models proposed by Friederici (2002) and Bornkessel and Schlesewsky (2006) assume hierarchically-oriented processing pathways, in which category and template information precedes the thematic-syntactic processes which also precede the well-formedness analysis and re-evaluation. Since these processes are organized in a hierarchical way, they have particular temporal correlates observed in ERPs. When each lexical item is processed, first category and template information emerges/integrates in the 150-300ms time-window after stimulus onset, then thematic-syntactic processes emerge around 400-600ms, and lastly reanalysis and the well-formedness check emerge in the late time windows around 600-1000ms. I will mainly focus on these (or similar) time windows in the analysis of Experiment 1 where I can seek for links to the existing models of incremental sentence processing.

5.4 Experimental Design and Hypotheses

The second experiment was similar to the first in that the critical ambiguous and critical unambiguous (scrambled) conditions were also presented. As mentioned above, however, the two experiments differed in a number of ways such that the filler sentences in Experiment 2 were all acceptable, thus leading to the use of a comprehension task as a behavioural measure rather than an acceptability task. Also, note that Experiment 1(b) revealed the level of acceptability for almost all of the conditions used in Experiment 2, thus provided complementary data.

In addition, the number of critical conditions was extended such that there were ambiguous and unambiguous sentences with and without subject pronouns (which were also canonically ordered).

5.4.1 Design of the Experiment

The experiment employed a $2 \times 2 \times 2$ design manipulating the factors PRO (whether there was a pronoun or not sentence initially[28]), ANIMacy (whether the object of the sentence is animate or inanimate), and CASE (whether the object is accusative case marked or not). The resulting eight experimental conditions are shown in Table 5.1.

Condition	Sentence and Meaning
a. ProDrop-Anim-NoCase:	Dün palyaço gördüm. Yesterday clown saw-1s Yesterday (I) saw (a) clown.
b. ProDrop-Anim-Case:	Dün palyaçoyu gördüm. Yesterday the clown-Acc saw-1s Yesterday (I) saw the clown.
c. Pronoun-Anim-NoCase	Dün ben palyaço gördüm. Yesterday I clown saw-1s Yesterday I saw (a) clown.
d. Pronoun-Anim-Case	Dün ben palyaçoyu gördüm. Yesterday I the clown-Acc saw-1s Yesterday I saw the clown.
e. ProDrop-Inanim-NoCase	Dün kale gördüm. Yesterday castle saw-1s Yesterday (I) saw (a) castle.
f. ProDrop-Inanim-Case	Dün kaleyi gördüm. Yesterday the castle-Acc saw-1s Yesterday (I) saw the castle.
g. Pronoun-Inanim-NoCase	Dün ben kale gördüm. Yesterday I castle saw-1s Yesterday I saw (a) castle.
h. Pronoun-Inanim-Case	Dün ben kaleyi gördüm. Yesterday I the castle-Acc saw-1s Yesterday I saw the castle.

Table 5.1: Critical conditions in Experiment 2.

In order to prevent any possible bias towards an object-initial reading of the ambiguous non-case marked nouns in sentences without an overt subject (Pro-Drop conditions), I also inserted filler conditions in which the initial ambiguous noun turned out to be the subject of either an intransitive sentence (50% of

[28]The conditions with the overt pronoun will be coded as Pronoun, while the conditions without the pronoun will be coded as ProDrop.

the sentences) [see Table 5.2(a)], or a transitive sentence (50% of the sentences) [see Table 5.2(b)]. Note that the verbs used in these filler conditions were different than the ones used for the experimental conditions. I included two other filler conditions [see Table 5.2 (c/d)], in which the initial accusative case marked noun was followed by the subject pronoun [causing an Object-Subject-Verb (OSV) reading] as in the control conditions of Experiment 1 so that initial objects would not always signal ProDrop. All the objects in the filler conditions were accusative marked.

Condition	Sentence
a. Intransitive-NoCase	Dün [palyaço|kale] [ağladı|çöktü] . Yesterday the [clown|castle] [cried|collapsed].
b. Transitive-NoCase	Dün [palyaço|kale] çocuğu [eğlendirdi|korkuttu]. Yesterday the [clown|castle] [amused|scared] the kid.
c. Transitive-Scram-Anim	Dün palyaçoyu ben gördüm. Yesterday I(emphasis) saw the clown.
d. Transitive-Scram-Inanim	Dün kaleyi ben gördüm. Yesterday I(emphasis) saw the castle.

Table 5.2: Filler conditions.

5.4.2 Hypotheses

- If the subject preference hypothesis holds, then I will observe positive deflection on the verb in the locally ambiguous sentences compared to all other unambiguous sentences (similar to Experiment 1). Since both pronoun and case marking create unambiguous sentential contexts, I will observe positive deflection for the ambiguous sentences [Table 5.1 (a/e)] in comparison to both pronoun conditions [Table 5.1 (c/d/g/h)] and case marked conditions [Table 5.1 (b/d/f/h)].
- If the existence of an extra overt argument independently creates negativity, then I will observe a difference between Pro-Drop conditions (a/b/e/f) and Pronoun conditions (c/d/g/h).
- If scrambling or topicalization is the sole cause of the ERP differences in Experiment 1, then I must first observe an ERP difference between SOV conditions [Table 5.1 (d/h)] and OSV conditions [Table 5.2 (c/d)], where OSV structures will be negative, and second, I will not observe positivity for the ambiguous conditions [Table 5.1 (a/e)] in comparison to canonical SOV conditions [Table 5.1 (c/d/g/h)], assuming SOV should be processed similarly to the OV structures.

- If case marking surfaces as an independent effect, then I will observe a difference between case-marked vs. non-case-marked conditions particularly in Pronoun conditions (unambiguous conditions) [Table 5.1 (c/g) vs. (d/h)] where case marking will signal the pure effects of object-incorporation and/or specificity. This will also test the hypothesis emerged from the questionnaire study, seeking to answer whether or not object-incorporation created a parsing difference.

These hypotheses assume the independent influence of each factor, but the interaction of multiple factors is also very possible. For instance, the existence of a pronoun may interact with case marking and animacy, because all these factors can be used to define the pragmatic status of the object. These interactions will be explored as much as the experimental design permits.

5.5 Materials and Methods

5.5.1 Participants

After giving informed consent, twenty-four participants (12 females and 12 males) from the Turkish community of Berlin took part in the experiment. Their mean age was 28 years with a range from 20 to 35. Twenty of them were native speakers of Turkish (10 females and 10 males) and 4 of them were bilinguals of Turkish-German (family language Turkish but learned German simultaneously during early phases of their childhood). All participants were right handed and had normal or corrected-to-normal vision. Another six participants were excluded due to excessive EEG artefacts.

5.5.2 Materials

Sentences were constructed from 72 adverb - pronoun (I/we) - noun (animate) - noun (inanimate) - noun (animate) - verb (1s/1p) - verb (3s -intransitive/ transitive) combinations, which were used to generate sentences as in Table 5.1 and Table 5.2. This material is the subset of the material used in Experiment 1 (see Appendix A). All adverbs were sentential-temporal [e.g., *dün* (yesterday), *dün gece* (last night)]. The pronouns were first person singular or first person plural. The animate nouns were human common nouns [e.g., *koşucu* (runner), *ressam* (painter), *adam* (man)], while inanimate nouns were nouns like *tren* (train), *mektup* (letter), *çamaşır* (laundry) etc. All verbs were in the past tense. Verbs such as *astı* (hung), *aradı* (looked for), *gizledi* (hid), *gördü* (saw) were chosen since they allowed both animate and inanimate arguments as

objects, yet required animate arguments as subjects. Verbs were identical for all of the conditions in Table 5.1 and condition (c) of Table 5.2. Intransitive verbs (used in the filler condition in Table 5.2) were also in the past tense and were verbs like *sıkıldı* (bored), *uyudu* (slept), *kaçtı* (ran away), *kırıldı* (broke). Only the transitive verbs in the filler conditions [Table 5.2 (b)] took inanimate nouns as subjects.

Eight hundred sixty four (864) sentences were formed which were then divided into two lists of 432 sentences such that each list included 36 sentences per condition. A total of six sentences were shown from each lexical set. Each list was presented in two different randomized presentation orders and presentation of lists was counterbalanced across participants.

5.5.3 Procedure

The procedure was similar to Experiment 1, except, after the completion of the reading of the sentence, participants completed a comprehension task. In the comprehension task, a question about the sentence was presented to the participant. Questions were balanced such that half of them were correct and half of them were incorrect. Participants answered the question by pressing one of two buttons (yes/no) and they were given 3500ms to respond. Assignment of left and right buttons to "yes" and "no" responses were counter-balanced across participants.

Participants were asked to avoid eye movements and only blink their eyes between the onset of the comprehension task and the presentation of the asterisk preceding the next sentence. Before the main session, 14 additional sentences were presented as a practice session. The presentation of the sentences was carried out in eight blocks of 54 sentences. A session lasted approximately 3.5 hours including electrode preparation.

5.5.4 EEG Recording

The EEG recordings and preprocessing of the EEG data were carried out in an identical manner to Experiment 1.

5.5.5 Data Analysis

The statistical analyses for the comprehension task (accuracies and reaction times) were carried out by means of repeated measures analyses of variance

(ANOVA) comprising the within participants factors PRO (pronoun presents sentence initially or not), ANIMacy (animate or inanimate object), and CASE (object is accusative case marked or not). Only correct responses entered the reaction time analysis. Participants (F_1) and items (F_2) were included as random factors in all the analyses.

Trials in which the comprehension task was not performed correctly were excluded from the analysis. Grand avarage ERPs were calculated on the basis of averages per participant per condition from 0 to 1000 ms post onset of each of the critical words (NP, Verb). Regions of interest were defined as in Experiment 1 (Lateral ROIs: Right-frontal (F4, F8, FC2, FC6); Right-posterior (CP2, CP6, P4, P8); Left-frontal (F7, F3, FC5, FC1); Left-posterior (CP5, CP1, P7, P3) and Mid-line ROIs: FZ, FCZ, CZ, CPZ, PZ, POZ). For the statistical analysis of the ERP data, repeated measures ANOVAs were calculated for mean amplitude values per time window per condition for the lateral and the mid-line electrodes separately.

5.6 Results

5.6.1 Behavioural Results

Table 5.3 shows means and standard deviations of the accuracy rates and reaction times for the comprehension task.

Condition	Mean(standard deviation)	
	Accuracy (%)	RT (ms)
a.ProDrop-Anim-NoCase	96.1(19.2)	1451(491)
b.ProDrop-Anim-Case	97.1(16.5)	1421(452)
c.Pronoun-Anim-NoCase	96.6(18)	1419(466)
d.Pronoun-Anim-Case	94.7(22.2)	1392(454)
e.ProDrop-Inanim-NoCase	97.5(15.5)	1408(462)
f.ProDrop-Inanim-Case	95.8(19.8)	1454(494)
g.Pronoun-Inanim-NoCase	97.7(14.7)	1384(453)
h.Pronoun-Inanim-Case	97.7(15)	1372(441)

Table 5.3: Mean and standard deviation (sd) of the accuracy rates and reaction times for the comprehension task.

For the accuracy rates, even though statistical analysis showed a main effect of ANIMacy for the analysis by participants ($F_1(1,23)=9.48$, $p < 0.01$), it was only marginally significant for the item analysis ($F_2(1,71)=3.33$, $p = 0.072$). Inanimate conditions were more accurate.

For the reaction times, a repeated measures ANOVA revealed a main effect for PROnoun ($F_1(1,23) = 13.36$, $p < 0.01$, $F_2(1,71)$=8.68, $p < 0.01$). Comprehension questions for the sentences with the pronouns were answered faster (mean= 1392ms) than the ones without the pronoun (mean= 1433ms).

5.6.2 ERP Results

In the following section, I will present the results of the ERPs. Since the most critical position in the experiment, in which I test the influences of multiple elements is the verb position, I will start by presenting ERP effects on the verb. Then I will present the ERP effects on the NPs. Investigation of NPs will be two-fold: First I will investigate the sentence-initial NPs in conditions a, b, e and f of the critical sentences in Table 5.1. Second I will investigate all the NPs (in the first position of the sentences as well as the in the second position of the sentences: all conditions of the critical sentences in Table 5.1) to see the influence of the pronoun on the NP in the pre-verbal part of the sentence.

5.6.2.1 Investigation of the Verbs

I computed a repeated measures ANOVA including the factors PROnoun (having a pronoun or not), ANIMacy (having an animate or an inanimate object) and CASE (case marked vs. non-case marked NPs) on the verb. All the verbs in the critical conditions are taken into the analysis. Visual inspection on all eight conditions (Figures 5.1 for the caseless and Figure 5.2 for the case-marked versions) revealed that there are ERP deflections in the time windows of 400-600ms and 750-900ms. There is another deflection in the time window of 150-300ms for the posterior electrodes. Note that particular combinations of the factors PRO and CASE resulted in a condition being ambiguous (Pro-drop and non-case-marked conditions included ambiguity).

Window 150-300ms: A repeated measures ANOVA showed a $ROI \times PRO$ interaction for the lateral (F(1,23)=3.56, $p < 0.05$) and mid-line (F(1,23)=7.84, $p < 0.001$) electrodes. Resolving this interaction by ROI revealed the effect of PRO in PZ (F(1,23)=4.47, p>0.05) and POZ ($F(1,23)$= 6.28, p<0.05) of mid-line electrodes and in the Left-Posterior site ($F(1,23)$= 5.1, <0.05) of the lateral electrodes. Note that Pronoun conditions were canonically ordered (Pro-O-V) and they were more positive than the ProDrop conditions (as shown in Figure 5.3 for the posterior electrode POZ. Note that CASE and ANIM did not reach any significance for any ROIs in this time window).

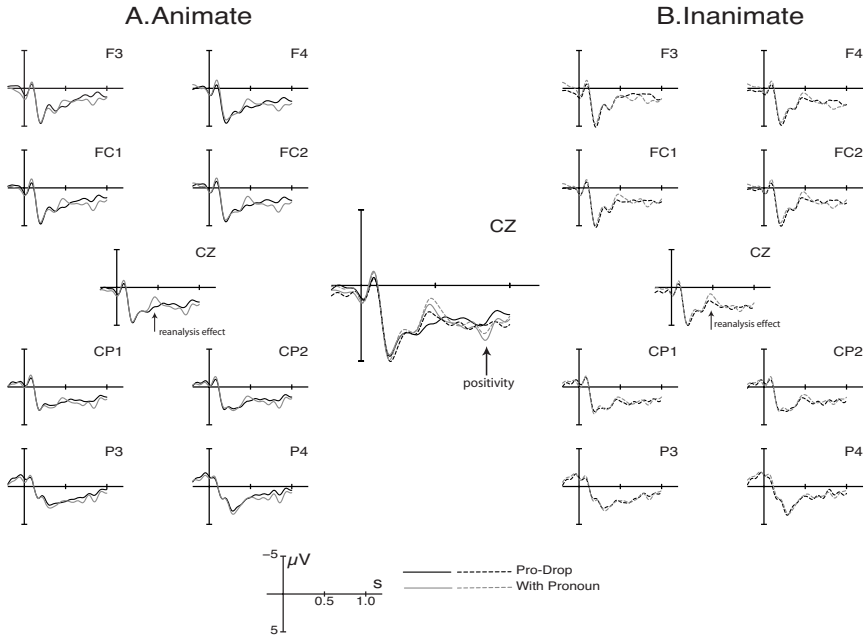

Figure 5.1: ERPs on the verb for the ***non-cased-marked conditions****; (a, c, e and g) conditions in Table 5.1. The right column represents the inanimate conditions (e and g), and the left column represents the animate conditions (a and c).*

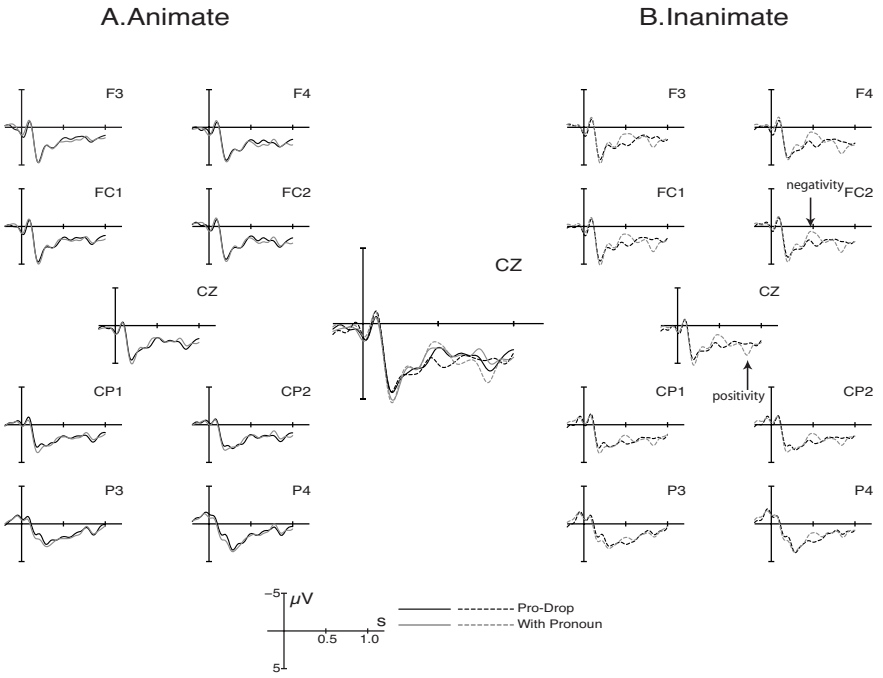

Figure 5.2: ERPs on the verb for the ***case-marked conditions****; (b, d, f and h) conditions in Table 5.1. The right column represents the inanimate conditions (f and h) and the left column represents the animate conditions (b and d).*

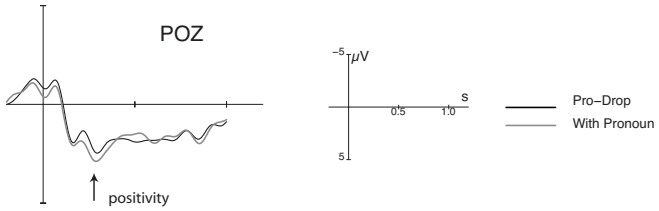

Figure 5.3: Early ***effect of pronun*** *on the verb. Case and animacy conditions are collapsed over pronoun.*

Window 400-600ms: The analysis revealed an interaction between ROI and ANIM for lateral (F(1,23)=13.27, $p < 0.001$) and mid-line electrodes (F(1,23)=6.87, $p < 0.005$). Resolving this interaction revealed a main effect of ANIM for FZ (F(1,23)=15.10, $p < 0.001$) and for FCZ (F(1,23)=4.5, $p < 0.05$) for mid-line ROIs, and left-frontal (F(1,23)=7.57, $p < 0.05$) and right-frontal electrodes (F(1,23)=20.51, $p < 0.001$) for the lateral ROIs. Inanimate conditions are more negative than the animate conditions, an effect which is frontally distributed.

The analysis also revealed a significant interaction between ROI and PRO for the lateral electrodes (F(1,23)=3.40, $p < 0.05$) and for the mid-line electrodes (F(1,23)=6.38, $p < 0.005$). Resolving this interaction revealed main effects of PRO for FZ (F(1,23)= 8.37, $p < 0.01$), FCZ (F(1,23)=15.76, $p < 0.001$), CZ (F(1,23)= 12.5, $p < 0.005$) and CPZ (F(1,23)= 7.14, $p < 0.05$) for the mid-line electrodes and a marginal main effect for right-frontal electrodes (F(1,23)= 3.43, $p = 0.076$) for the lateral ROIs. Conditions having a pronoun are more negative in the frontal electrode sites.

The analysis also revealed a marginally significant interaction between ANIM and PRO for the lateral electrodes (F(1,23)=3.46, $p = 0.075$) and mid-line electrodes (F(1,23)= 3.71, $p = 0.066$). The effect of PRO was only significant for the inanimates (F(1,23)= 5.69, $p > 0.05$) for lateral and (F(1,23)=15.78, $p > 0.001$) for mid-line electrodes. (Compare Figures 5.1 and 5.2). Also, there was a marginal interaction between CASE and ANIM for the mid-line electrodes (F(1,23)=4.05, $p = 0.055$) but not for lateral electrodes. Resolving this marginal interaction showed a marginal effect of ANIM ($F(1, 23) = 4.02, p = 0.057$) for the non-cased marked conditions, but not for the case marked conditions ($F < 1$). Inanimate non-cased marked conditions were more negative than the animate conditions.

On the other hand, the analysis revealed a significant interaction between ANIM, PRO and CASE (F(1,23)=5.56, $p < 0.05$) for lateral but not for mid-line electrodes (Figures 5.1 and 5.2). This 3-way interaction was resolved by CASE. This allowed for a direct examination of whether the effects of Experiment 1 would be replicated for the non-case marked conditions by comparing the ambiguous conditions with the unambiguous ones (containing a pronoun). Also, additionally, this way we can show whether these effects can be attributed solely to ambiguity or to the presence or absence of a pronoun.

Resolving the interaction by CASE revealed that the sentences with case (Figure 5.2), but not the sentences without case (Figure 5.1), showed an interaction of ANIM*PRO for the lateral electrodes (F(1,23)=5.90, $p < 0.05$). Resolving the ANIM*PRO for the case-marked conditions by ANIM showed that, for the inanimate conditions, there was a very significant effect of PRO

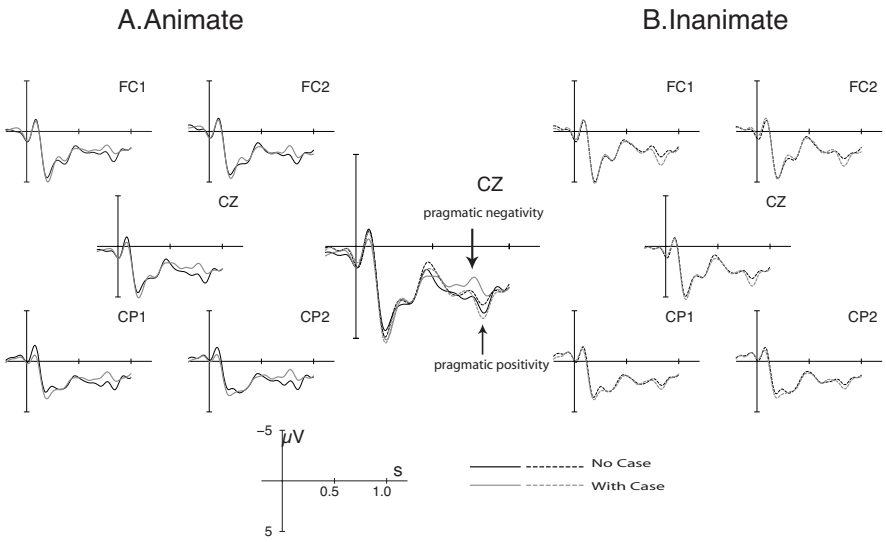

Figure 5.4: ERP measurement on the verb for ***conditions with pronouns****; (c, d, g and h) conditions in Table 5.1.*

(F(1,23)=15.02, $p < 0.001$) (see Figure 5.2, right column). Pronoun conditions were more negative than the Pro-Drop conditions in inanimate sentences when they are case marked. This interaction is observed in the lateral electrodes, while the main effect of PRO was mainly observed in the frontal electrodes (and marginally right-frontal electrodes, see above). Thus, the negativity observed here cannot be the sole effect of pronoun, but some other effect emerged from the case marking of the inanimate noun in the sentence-initial position.

Window 750-900ms: For the lateral electrodes, an ANOVA revealed an interaction of PRO*ROI (F(1,23)=3.48, $p < 0.05$). Resolving this interaction showed that the effect is significant for the left-frontal ($F(1, 23) = 9, p > 0.01$) and right-frontal ($F(1, 23) = 5.7, p < 0.05$) electrodes (Figures 5.1 and 5.2). The general impact of pronoun emerged as frontally distributed positivity in the late time window.

$PRO \times ANIM \times CASE$ interaction also reached significance for lateral electrodes in this time window (F(1,23)=4.73, $p < 0.05$). Resolving this interaction via CASE revealed that sentences with case-marked objects, but not non-case marked objects showed an ANIM*PRO interaction (F(1,23)=5.12,$p < 0.05$). Resolving this interaction further for ANIM showed that inanimate conditions had a main effect for PRO (F(1,23)=6.74 $p < 0.05$) but animate ones did not (Figure 5.2, right column).

For mid-line electrodes, a repeated measures ANOVA revealed an interaction of $PRO \times ROI$ (F(1,23)=6.34, p<0.005). Resolving this interaction revealed that the effect of PRO is significant for FZ and FCZ (Figure 5.2). The ANOVA also revealed the interaction of $ROI \times ANIM \times PRO$ for the mid-line electrodes (F(1,23)=4.48, p<0.01) but no ROIs reached significance for the interaction of $ANIM \times PRO$. The ANOVA also revealed a 3-way interaction of $PRO \times ANIM \times CASE$ (F(1,23)=10.66, p<0.01). Resolving this interaction via CASE revealed that sentences with case showed a significant interaction of $ANIM \times PRO$ for the mid-line electrodes (F(1,23)= 7.34, $p < 0.05$) but non-case marked conditions did not reveal any interaction smilar to the lateral electrodes. Resolving the $ANIM \times PRO$ interaction by ANIM for the case marked conditions revealed an effect of PRO for inanimate conditions (F(1,23)= 6.74, $p < 0.05$) but not for animate conditions.

Similar to the lateral electrodes, in the midline electrodes, case-marked inanimate condition is more positive in the Pronoun condition than the Pro-Drop condition. On the other hand, case-marked animate pronoun condition clustered with Pro-Drop conditions (see Figure 5.2). Interestingly, this condition shows a very different deflection than the other Pronoun conditions in the late time window (compare Figures 5.4 with 5.1 and 5.2). All pronoun conditions, except the case-marked animate one, clustered together, and emerged as a positive component. In order to see whether this observation in this time window holds statistically, I resolved the $ANIM \times PRO$ interaction observed for the case-marked conditions (see above) by PRO. For the lateral electrodes there was a marginal effect of Animacy for the Pronoun conditions (F(1,23)= 3.72, $p = 0.06$), but not for the Pro-Drop conditions (F<1). For the mid-line electrodes there was an effect of Animacy for the Pronoun conditions (F(1,23)= 7.012, $p < 0.05$), but not for the Pro-Drop conditions (F<1). Thus, case-marked animate pronoun conditions differed from other conditions and shifted to negative polarity, and this effect mainly emerged in the central electrodes, whereas the main late positive effect of Pronoun was more frontally distributed.

5.6.2.2 Scrambling Effect On The Verb

Since the critical control conditions in Experiment 1 were scrambled, another possible cause of the positivity I observed might be the result of the scrambling effect. Thus, I conducted an analysis for the scrambling vs. non-scrambling conditions [(d) and (h) conditions of the critical sentences shown in Table 5.1 and the (c) and (d) filler sentence conditions as shown in Table 5.2] by manipulating SCRambling and ANIMacy. As seen in Figure 5.5, these conditions revealed a very pronounced effect of scrambling in the early time-window of

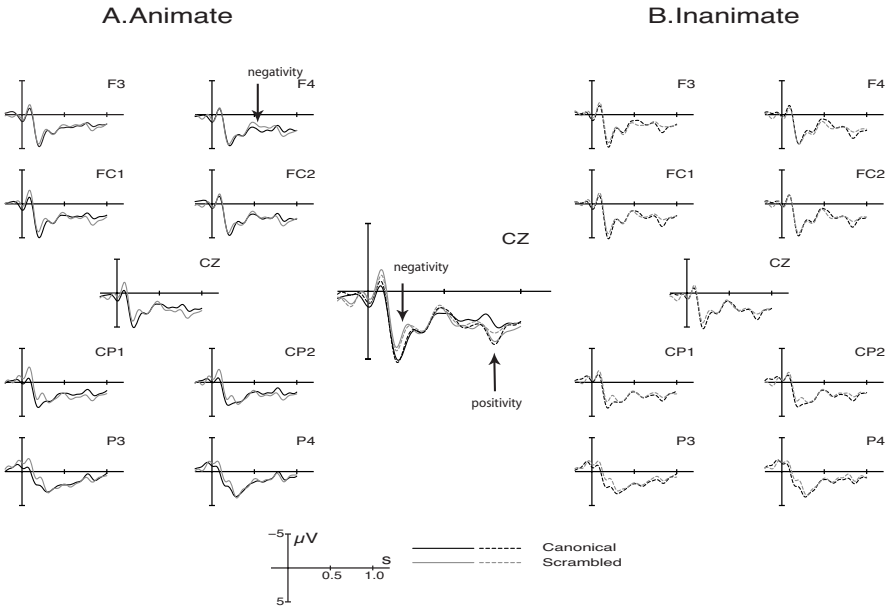

Figure 5.5: ***Scrambling effects.*** *ERP differences observed on the verb between SOV vs. OSV structures (having case marked objects); (d) and (h) conditions of 5.1 and (c) and (d) conditions of 5.2.*

150-300ms as well as complex interactions for SCR and ANIM for the time windows of 450-600ms and especially 720-850ms.

Window 150-300ms: The analysis revealed an interaction between ROI and SCR for lateral electrodes (F(1,23)=5.78, $p < 0.01$) and mid-line electrodes (F(1,23)=5.12, $p < 0.05$). Resolving this interaction revealed a main effect for SCR on CZ (F(1,23)=6.2, $p < 0.05$), CPZ (F(1,23)=10.82, $p < 0.005$), PZ (F(1,23)=10.12, $p < 0,005$) and POZ (F(1,23)=10.94, $p < 0.005$) for mid-line electrodes. Left-posterior electrodes reached significance among the lateral ROIs (F(1,23)=12.1, $p < 0.005$). This effect mainly resulted from the negativity for the scrambled conditions (OSV relative to SOV word order). Thus, Pro-O-V word order is more positive in this time window than the O-Pro-V, particularly in the posterior sites. Note that, for the posterior electrodes, OV conditions in this time window are also more negative than the SOV conditions (see Figure 5.3) . Thus, the early difference observed in Experiment 1 between the SOV and OV conditions is not likely to be a result of a scrambling effect.

Window 450-600ms: A repeated measures ANOVA revealed a significant interaction between ANIM and SCR ($F(1,23)= 6.43$, $p < 0.05$) and a significant 3-way interaction between ROI, ANIM and SCR in this time window for the lateral electrodes ($F(1,23)= 4.43$, $p < 0.05$). Resolving this interaction by ROI revealed the interaction between ANIM and SCR for right frontal electrodes ($F(1,23)= 14.45$, $p < 0.001$). Resolving this interaction by ANIM for right-frontal electrodes revealed a main effect for SCR for the animate conditons ($F(1,23)=2.16$, $p < 0.01$). Scrambled sentences were more negative for the animate conditions. Also there was a marginal effect for SCR for the inanimate conditions ($F=3.98$, $p=0.058$). For the inanimates, the scrambled conditions were slightly positive, opposite of the animate conditions. The most important point here is that, scrambled conditions did not generally differ from the canonical conditions in this time window. Thus, the deviation observed between OSV and OV conditions in Experiment 1 was not likely to be caused solely by scrambling.

Window 720-850ms: An ANOVA revealed a significant interaction between ANIM and SCR ($F(1,23)=6.71$, $p < 0.05$) and between ROI, ANIM and SCR for the mid-line electrodes ($F(1,23)=4.48$, $p < 0.05$) but not the lateral electrodes. Resolving this interaction revealed an interaction of ANIM and SCR for FZ ($F(1,23)= 9.7$, $p < 0.005$), FCZ ($F(1,23)=10$, $p < 0.005$), CZ ($F(1,23)= 9.5$, $p < 0.01$) and CPZ ($F(1,23)=5.04$, $p < 0.05$). Resolving this interaction for these ROIs by ANIM revealed the effect of SCR for the animate conditions on FZ ($F(1,23)= 6.57$, $p < 0.05$), FCZ ($F(1,23)=7.82$, $p < 0.05$), CZ ($F(1,23)= 13.1$, $p < 0.005$) and CPZ ($F(1,23)= 7.21$, $p < 0.05$) and also for the inanimate conditions for FZ ($F(1,23)= 4.91$, $p < 0.05$) and FCZ ($F(1,23)= 4.47$, $p < 0.05$). The effect for the animate conditions was mainly due to the positivity that resulted from the scrambled conditions. On the other hand, the positivity observed for the inanimate conditions was mainly caused by the canonical ordering.

While early negativity is related to the pure effect of scrambling, the late effects of scrambling differ for animates and inanimates. Interestingly, when the pronoun precedes the argument, the case marked animate argument differs from all other Pronoun conditions in this time window (compare Figures 5.4 and 5.5) as a negative component on the verb. But, this does not hold when the arguments are scrambled. Thus, the influence of the pronoun on the case-marked animate condition observed as negativity (Figure 5.4) must be related to the canonical ordering (SOV) which might be related to the redundancy status of the pronoun (not just the existence of a pronoun as in OSV in which the object is topicalized and the pronoun cannot be considered redundant).

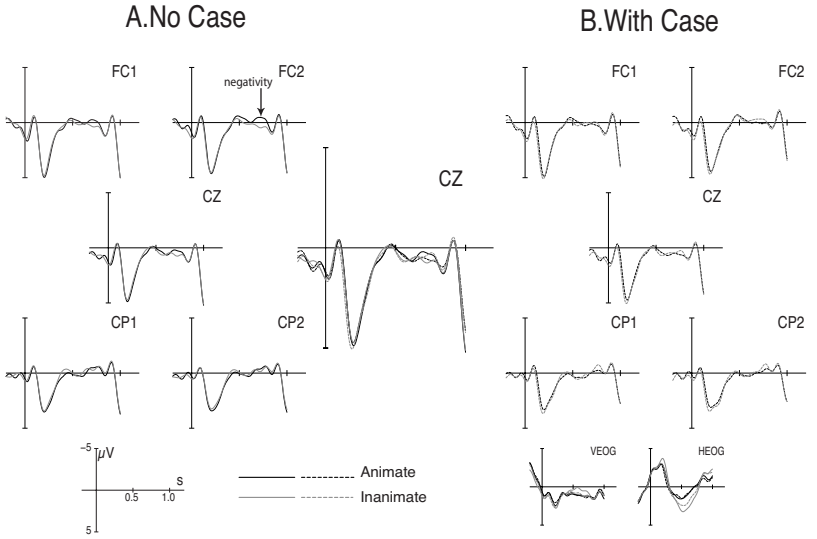

Figure 5.6: ERP effects on the ***sentence-initial NPs*** *(conditions a, b, e and f in Table 5.1). The left column (A) shows the non-case-marked NPs; the right cloumn (B) shows the case-marked NPs.*

5.6.2.3 Investigation of NPs

Sentence Initial NPs Visual inspection (Figure 5.6) revealed that there is an ERP deflection observed in the time window 650-800ms for the sentence inital NPs. A 2 way ANOVA ($CASE \times ANIM$) was used to examine the significance of this deflection.

Window 650-800ms: For the lateral ROIs there was a $ROI \times ANIM \times CASE$ interaction (F(1,23)=3,55, $p < 0.05$). This interaction was valid for Right-Frontal electrodes (F(1,23)=5.32, p<0.05). Resolving this interaction by Case revealed the effect of ANIM for Non-Cased marked nouns in Right-Frontal electrodes (F(1,23)=8, $p < 0.01$) but not for the case-marked nouns (Figure 5.6, the left column). Animate conditions were more negative than the inanimate conditions. Also note that, similar to Experiment 1, there was not an effect of ANIM or CASE in the time window of 200-600ms. After this finding, I analysed the data from Experiment 1 again, and I did not observe any effect in the 650-800ms time window.

Vertical and horizontal EOGs are also shown in the figure. The ERP deflection on the NP in the frontal sites seems not to be the result of any electrophysical change related to eye movements.

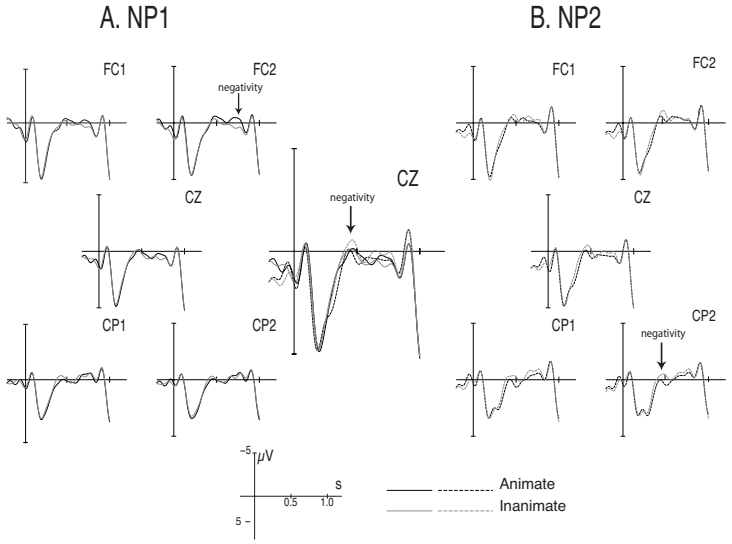

*Figure 5.7: ERP effects on **all non-case marked NPs** in NP1 and NP2 positions (conditions a, c, e and g in Table 5.1). The left column (A) shows the Pro-Drop cases where NPs are in NP1 positions; the right column (B) shows the NPs in NP2 positions (coming after the pronoun).*

All NPs with and without a Pronoun In order to examine possible processing differences between sentence-initial NPs and NPs following the pronoun, a repeated measures ANOVA was conducted by considering the factors ANIMacy (whether the NP is animate or not), CASE (whether it is case marked or not) and POSition (whether the NP is the NP2 following the pronoun or it is the NP1 in the first position in the sentence). For this analysis, NPs of all the critical conditions in Table 5.1 were taken into the analysis. Figures 5.7 and 5.8 show the grand average ERPs at the non-case marked and case-marked NPs respectively. As is apparent in the figures, ERP patterns differ around 380-500ms and 600-750ms time windows. There seems to be an interaction between CASE, ANIM and POS. Inanimate conditions tend to shift towards negativity when they were NP2.

Window 380-500ms: The analysis for the lateral electrodes revealed an interaction of ROI and ANIM ($F(1,23)=5.05$, $p < 0.01$) (Figure 5.7). Resolving this interaction for ROIs revealed that ANIM is significant for Left-Posterior ($F=5.79$, $p < 0.05$) and Right-Posterior electrodes ($F(1,23)=4.19$, $p < 0.05$). Overall, inanimate conditions were more negative than animate conditions. Even though the ROI and CASE interaction was found to be significant ($F(1,23)=4.69$, $p < 0.05$), no ROIs showed a main effect of CASE. Sim-

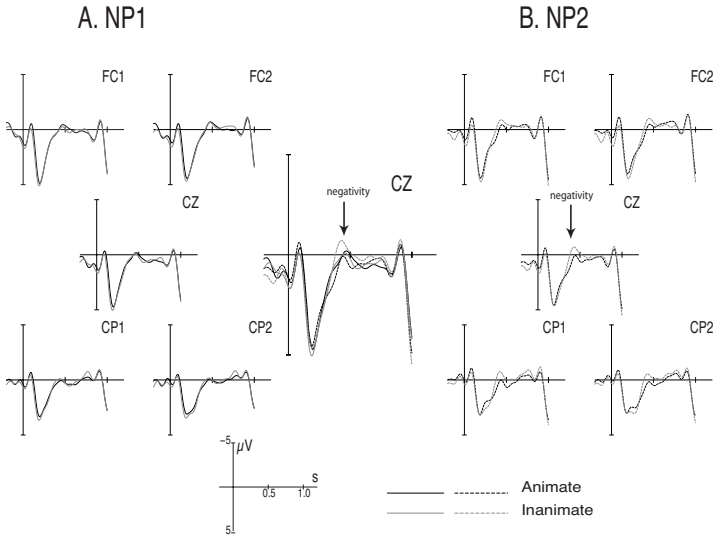

Figure 5.8: ERP effects on ***all case marked NPs*** *in NP1 and NP2 positions; (conditions b, d, f and h in Table 5.1). The left column (A) shows the Pro-Drop cases where NPs are in NP1 positions, the right column (B) shows the NPs in NP2 positions coming after the pronoun.*

ilarly there was a marginal interaction of $ROI \times POS \times CASE$ (F(1,23)=2.52, $p = 0.066$). But, again, no ROIs showed an interaction of $POS \times CASE$.

The analysis for the mid-line electrodes revealed an effect of ANIM (F(1,23)= 0.52, $p < 0.005$) (Figure 5.8). There was an interaction of $ROI \times ANIM$ (F= 5.22, $p < 0.01$). Resolving this interaction revealed effects of ANIM on CZ (F(1,23)= 11.91, $p < 0.005$), CPZ (F(1,23)=11.72, $p < 0.005$), PZ (F(1,23)= 14.67, $p < 0.001$) and POZ (F(1,23)=18.76, $p < 0.001$). Inanimate conditions were more negative. While the $ROI \times POS \times CASE$ interaction was significant (F(1,23)=4.46, $p < 0.05$), no ROIs showed an interaction. POS*ANIM interaction reached significance (F(1,23)= 5.34, $p < 0.05$). Resolving this interaction by POS revealed the effect of ANIM for the Pronoun conditions (F(1,23)=15.12, $p < 0.001$), but not for the Pro-Drop conditions (F<1). Inanimates are more negative than animates in conditions with Pronouns independent of case marking.

Since I did not observe any negativity for the sentence inital inanimate NPs in this time window, the negativity observed for the inanimate nouns in this time window thus turned out to depend on the existence of the pronoun. Inanimate NPs coming after the pronoun were more negative independent of their case

marking. This is similar to the effect of pronoun observed on the verb for the case marked inanimate conditions (see above).

Window 600-750ms: The analysis in this time window revealed a marginal effect for POS for the lateral electrodes (F81,23)=4.1, $p = 0.054$) and a main effect for POS for the mid-line electrodes (F(1,23)=4.3, $p < 0.05$). This time window revealed effects of POS independent of CASE and ANIMACY. The effect observed here is due to the negativity for the Pronoun conditions. Existence of a pronoun might have created a late negative ERP component on the following noun. Visual inspection revealed that this effect is more pronounced on the inanimate nouns but the interaction $ANIM \times PRO$ did not reach significance.

Overall, there is an effect of pronoun on the following NP either in the 380-500ms window or the 650-800ms late window. Generally this effect first emerges on the inanimate NPs as a negativity in 380-500ms, and then continues for all types of NPs in the late window.

5.6.3 Summary of the ERP Findings

In this section, I will summarize the ERP effects in three time windows: Early, middle and late. First the findings for the verbs in the canonical [Pronoun-Object-Verb] conditions as well as in the scrambled [Object-Pronoun-Verb] conditions will be summarized. Then the findings for the nouns (both in NP1 and NP2 positions) will be summarized.

5.6.3.1 Verbs

The influence of the pronoun on the verb in SOV conditions starts very early (around 200ms) as a positive waveform relative to the conditions having no pronoun (conditions c, d, g, and h vs. a, b, e, and f). But note that, this effect was confined to a very small region of posterior electrodes (CPZ and POZ electrodes and left-posterior electrodes) as well as to a very small time-window.

For the time-window 400-600ms, the main effect of PRO continued, and created negativity for all the conditions confined to the frontal and right frontal electrodes. Even though visual inspection revealed that this difference is more pronounced for caseless conditions (which also included the ambiguous conditions (Figure 5.1) as mentioned above), there was not a CASE and PRO

interaction. Similarly, there was a main effect of ANIM for the frontal electrodes as well. Inanimate conditions were more negative.

Particularly, the findings of Experiment 2 in this time window confirm two findings of Experiment 1: (a) the subject preference hypothesis (syntactic revision) and (b) the impotency of animacy information on subject preference. But, this time the revision-related effect is confined to a smaller region (frontally distributed) and in a smaller time-window. In this part, I will explain how this interpretation is derived from the analysis of the data. In the discussion part, on the other hand, I will mention why topographic and temporal differences emerged between the experiments.

The case-marked inanimate condition in Experiment 2 interacted with pronoun, yielding a positive deflection for the ProDrop conditions for all the lateral electrodes (broadly distributed). $ANIM \times PRO$ interaction only reached significance in the inanimate case-marked conditions, but not in the animate case-marked conditions (as seen in Figure 5.2). Animate conditions (left column) showed no effect of pronoun whereas the inanimates (right column) did in lateral electrodes. As seen in Figure 5.1, on the other hand, the effect of PRO was more pronounced for both animate and inanimate conditions in caseless conditions (and also not distributed laterally, only confined to frontal electrodes). Thus, visual inspection of these two levels of the Factors ANIM and PRO (effect of animacy and pronoun in case-marked and caseless conditions) indicated that the interaction is an "ordinal interaction," suggesting that we can interpret the main effect of PRO. Recall that the Pro-Drop conditions bore also ambiguous conditions (by caseless conditions). Thus, the main effect of PRO, which was observed only on the frontal sites, might then actually be the by-product of the ambiguity (non-case marked conditions), not just the existence of the pronoun per se. Possibly, the interaction on the case-marked inanimate condition prevented a possible $CASE \times PRO$ interaction which might have revealed the effect of ambiguity clearly (i.e., by observing the effect of PRO only on caseless conditions). Then, one possible interpretation for the influence of PRO in the caseless condition would be that the effect of PRO observed for these conditions might have emerged from the ambiguous conditions in which subject-to-object revision may take place.

Thus, this finding supports the subject preference hypothesis. If this is the case, then, positivity in the 400-600ms window, which I atributed to the reanalysis from subject-to-object reading, is frontally distributed. Pronoun, on the other hand, interacts with CASE and ANIMacy to varying degrees in larger scalp distributions. While the existence of a pronoun has a general influence in the 400-600ms time window, it does not seem to be an independent factor by itself to create the broadly distributed negativity observed in Experiment

1. Also, some Pro-Drop conditions were negative (i.e., Pro-Drop case-marked animates), eliminating the pure effect of the pronoun reflected as the sole source of the negative component.

Experiment 2 also supports another finding from Experiment 1, namely the animacy effect in subject preference. Animacy differences neither influence subject preference nor subject-to-object revision in ERPs, contrary to the off-line behavioural findings. Even though the visual inspection on Figure 5.1 suggests a possible difference between ambiguous animate and ambiguous inanimate conditions, this difference does not reach significance. This also provides supporting evidence that the acceptability ratings may not have a direct relationship with ERPs under certain circumstances.

Another important finding of Experiment 2 is that it revealed an ERP difference for the case-marked inanimate conditions in Pro-Drop situations in the middle-time window. Thus, pronoun, case-marking and animacy interacted to yield very different ERP waveforms that cannot be predicted solely by behavioural tasks (like comprehension or acceptability tasks). This issue needs more elaborate investigation and will be considered in the discussion section in detail.

For the time-window 750-900ms, there was a significant main effect of PRO in the frontal electrodes. Pronoun influenced all the conditions (towards positivity) except the case-marked animate condition which showed a deviant waveform in the lateral (marginally) and the mid-line electrodes (see Figure 5.4, left column). This is an interesting point, because only the animate case-marked condition sticks out while all other three conditions show a kind of late positivity in the pronoun conditions. If I assume that the straight forward influence of a pronoun normally reflects as a positive component in SOV conditions, then the negative peak emerging at the case-marked animate component should have a functional interpretation, because this negative peak diverges from all other conditions (even from the Pro-Drop conditions with which it clusters at first glance). Something prevented the case-marked animate condition to be influenced by pronoun (like other conditions were).

I will call the positivity related to the general influence of the pronoun "pragmatic positivity" which is related to the well-formedness of the linguistic expression and the referential status of the object. This component emerges on the frontal electrode sites. On the other hand, I will name the particular deflection produced by the combination of the pronoun and the case-marked animate noun in the canonical (Pro-O-V) conditions "pragmatic negativity." This component emerges moreon the central electrodes. Like the possible coexistence of N400 with P300, these components may be similarly emerging in the same time window, but topographically differ. It was previously reported

that in some cases, two components may emerge simultaneously and influence each other in the same time window (Roehm, Bornkessel-Schlesewsky, Rösler, & Schlesewsky, 2007). In my study, pragmatic negativity might have blocked the redundancy evaluation and the referentiality interpretation of the object, thus preventing the pragmatic positivity.

I will seek for convincing answers for the existence of such components, and why such deflections may emerge only under particular conditions (like Pronoun-Object-Verb word order), in the discussion part of this chapter as well as in the following sections of the thesis. Redundancy, pragmatics, well-formedness and referentiality of the object, and properties of the subject may be evalutated together, and this evaluation may reflect in the late ERP time-window. Case-marked animate objects might have a highly referential status, while other type of objects (e.g., caseless nouns) may not have a clear referential staus and lead to a "search" for assignment of a pragmatic function.

5.6.3.2 Verbs in Scrambled Conditions

The analysis for the scrambling conditions revealed that scrambling is handled very early (around 250ms). Scrambled O-Pro-V structures are more negative than the canonical Pro-O-V structures in the early time-window on the central-posterior and left-posterior electrodes (see Figure 5.5).

This finding has some consequences for the relationship between Experiment 1 and Experiment 2. Since, the difference between O-Pro-V and Pro-O-V structures is similar to the difference between Pro-O-V and O-V structures in the early time window in the posterior electrodes (compare Figure 5.5 and 5.3), it is difficult to assume that the difference between O-Pro-V vs. O-V structures observed in Experiment 1 in the early time window was due to the pure effect of scrambling.

Thus, Experiment 2 revealed that pronoun (as shown above) and scrambling (as shown now) might not be responsible for the possible effects of the ERP deflections observed in Experiment 1. This leaves us with the other potential effects which will be investigated in the discussion.

In the middle-time window there were minor effects of animacy with scrambling in a very small frontal region. Scrambled animate conditions [Table 5.2 (c)] were more negative than the canonical animate conditions [Table 5.2 (d)] in the right-frontal electrodes. On the other hand, for the inanimate conditions, the pattern was opposite: more positive for the scrambled ones than the canonical ones in the same scalp location.

For the late time-window, 720-850ms, a similar kind of reversal was observed for the mid-line electrodes. But this time, for the animate conditions, the effect was mainly due to the positivity for the scrambled conditions. On the other hand, for the inanimates, the effect was mainly due to the positivity for the canonical conditions. Scrambling interacted with animacy in that time window particularly reflected on the centro-frontal electrodes.

The important point here is that the pragmatic negativity (as described above) disappears under scrambling. Thus, this effect cannot be related to the sole influence of the existence of the pronoun, but must be related to a general evaluation of both the existence of the pronoun (redundantly in SOV order) as well as the specificity status of the object.

5.6.3.3 Sentence-inital NPs

For the ambiguous NPs there was a late effect of animacy which reached significance in the right-frontal ROI in the time window of 650-800ms [conditions (a) vs. (e) in Table 5.1]. Animate conditions were more negative than inanimate conditions for the ambiguous NPs (Figure 5.6).

5.6.3.4 All the NPs

When I investigate the NPs used in the critical conditions (whether they appear with and after the Pronoun or without the Pronoun), I see that the inanimate conditions appear to be more negative than the animate conditions in the time window 380-500ms when the inanimate noun follows the pronoun. Since animacy did not reach significance for the sentence-initial NPs in this time-window (see Figure 5.7), as mentioned above, pronoun seems to be the main cause of this negativity observed on the inanimate argument.

The effect of animacy was accentuated by the existence of the pronoun. The interaction of ANIM and PRO for the mid-line electrodes confirms this interaction. Inanimate NPs turn out to be more negative in these situations, and this negativity resembles an N400 effect as it was in the centro-posterior region emerging around 450ms (see Figures 5.7 and 5.8).

For the late time window, 600-750ms, there was an effect of pronoun for the mid-line electrodes, such that conditions with pronoun were more negative than conditions with ProDrop independent of case and animacy. Existence of the pronoun is continuing its influence, but this time it is a pure effect, and does not interact with animacy. These results indicate that for the conditions with pronoun, there is a negativity starting around 400ms, which is more

pronounced for the inanimate objects [conditions (g/h) vs. (c/d)]. Later on, the effect generalizes over all the NPs (c), (d), (g) and (h) conditions vs. (a), (b), (e) and (f).

5.7 Discussion

In this part, I will first discuss behavioural findings. Then, I will discuss the ERP results. Discussion of the ERPs will be presented in two sections. In the first, I will evaluate the findings of Experiment 1 and Experiment 2, and show similarities and differences between the two experiments. In the second part, I will evaluate the additional effects and issues provided by Experiment 2.

5.7.1 Behavioural Results

Behavioural results revealed that participants were more accurate in their comprehension when the arguments are distinct (animate-inanimate). Even though participants showed higher accuracy rates for the inanimate conditions in general, this finding cannot be generalized to all of the items used in the experiment since this effect was marginal in the item analysis. It may be difficult for participants to interpret the who-is-doing-what-to-whom relation when two animate entities exist. This process may create difficulty for comprehension, but this generalisation only holds for some of the items used in the experiment. The exact reason for this tendency may be the status of the event coded by different types of verbs. Note that the accuracy rates are very high (around 95%) which means that the task was easy to handle.

On the other hand, behavioural results also revealed that the reaction times were higher for ProDrop sentences. Existence of the overt pronoun slightly decreased the reaction times. In the case-maked ProDrop sentences [(b) and (f) conditions in Table 5.3], the subject of the sentence reveals itself at the end of the verb as an agreement marker. Thus, realization of the incorrectness of the initial subject preference and finding the real subject for the non-case marked ProDrop sentences on the verb [(a) and (e) conditions in Table 5.3] caused delays in processing. This, in turn, might have affected the timing or the processing of the preperation of the answer for the comprehension question.

5.7.2 ERP Results

There are two general hypotheses that will be helpful to evaluate the ERP data. The first is the "subject preference - universal parsing" hypothesis which mainly supports a minimality-based interpretation. The second is the "general economy - redundancy" hypothesis which presupposes that language seeks for the non-redundant structures (and consecutively, minimality in all levels, including pragmatics and discourse). Other issues about the interaction of case, animacy and scrambling as well as compositional, interpretational, relational and task-related constraints will also be investigated. In the two sections below, I will evaluate the findings in line with these issues and hypotheses.

5.7.3 Similarities and Differences Between Experiment 1 and Experiment 2

The ERP observation on the 400-600ms time window on the verb in Experiment 2 supports the previous interpretations made about the ambiguous conditions in Experiment 1; namely subject preference related subject-to-object revision interpretation (observed as a positive shift in ERPs), and the impotency of the animacy information of the ambiguous noun on this preference (or revision of this preference observed as the absence of the ERP difference between animate and inanimate ambiguous conditions). The findings of Experiment 2 showed that positivity related to the revision from subject-to-object is frontally distributed and independent of the pronoun and case marking effects.

The question arises why this effect is not broadly distributed as in Experiment 1. Why is it confined to fronto-central electrodes? Why did it emerge in a shorter time-window? Also, why did it start later than in Experiment 1? The earlier posterior distribution observed in Experiment 1 totally disappeared in Experiment 2.

One quick answer to these questions might be that the difference emerged simply because the control conditions used in the two experiments differed, thus, the potential effects (as introduced in the introduction of Experiment 2 like the existence of case marking, or scrambling etc.) produced the observed deflection in Experiment 1. While providing more refined conditions to test the existence of the subject preference, Experiment 2 also revealed the effects of pronoun, scrambling and case marking to varying degrees which made it possible to track the effects of these factors in Experiment 1.

As mentioned in the summary section above, scrambling and pronoun do not appear to be the sole effects of the ERP deflection observed in Experiment

1. Particularly for the deflections in the earlier time windows and posterior negativities in Experiment 1. Scrambling appears as an ERP deflection on the verb, shortly after the verb onset, even though it was a possible parsing preference for the language system to understand the existence of scrambling and resolve it before the verb. Scrambling cannot be the main cause of the ERP deflections observed in Experiment 1, because the scrambled conditions (O-Pro-V) are more negative than the canonical (Pro-O-V) conditions (compare SOV and OSV in Figure 5.5), and very similar to the Pro-Drop (OV) conditions (compare OV and SOV in Figure 5.3). Also this early effect is only observed in the posterior sites. In other words, scrambling seems not to be sole cause of the early and large ERP differences in Experiment 1 alone.

On the other hand, absence of an effect of a pronoun observed on the case-marked animate condition suggests that pronoun cannot be the sole determinant of the ERP difference between the control and the experimental conditions in the overall scalp in Experiment 1. Also, the late effects of pronoun emerge after 600ms which was not within the 200-600ms window chosen in Experiment 1. Thus, the assumption that the two experiments would reveal similar effects under different experimental task conditions becomes questionable.

In order to see whether the conditions of Experiment 1 will reveal the same effects in Experiment 2, I created the plot of the ambiguous OV and OSV conditions of Experiment 2 (as they were the experimental and control conditions in Experiment 1). I have plotted the conditions (a) and (e) of the critical sentences (Table 5.1) and (c) and (d) conditions of the filler conditions (Table 5.2) of Experiment 2. This plot is given in Figure 5.9.

The same conditions yielded different waveforms. Now, there is a narrower difference between OV and OSV conditions, in which the early posterior positivity is almost lost. The positivity for ambiguous conditions shifted towards frontal electrodes, where the posterior positivity almost disappears. This raises the question of why Experiment 2 differed from Experiment 1 even though I compared the same conditions. One possible interpretation is that in Experiment 1, I used an acceptability judgement task in which people had to decide on the status of the stimulus. On the other hand, in Experiment 2, subjects did not have to handle such a task, and used different strategies.

Most probably, in Experiment 1, when people read a critical sentence, they figured out that the sentence is acceptable (made a task relevant decision or realized the appropriate task relevant item) as soon as they read the verb coming after the sentence-initial ambiguous NP. On the other hand, when they read the control conditions (as well as fillers), they figured out the acceptability status of the sentence "before" they read the verb, probably on the pronoun. In Experiment 2, there was no requirement to stimulate the decision-making

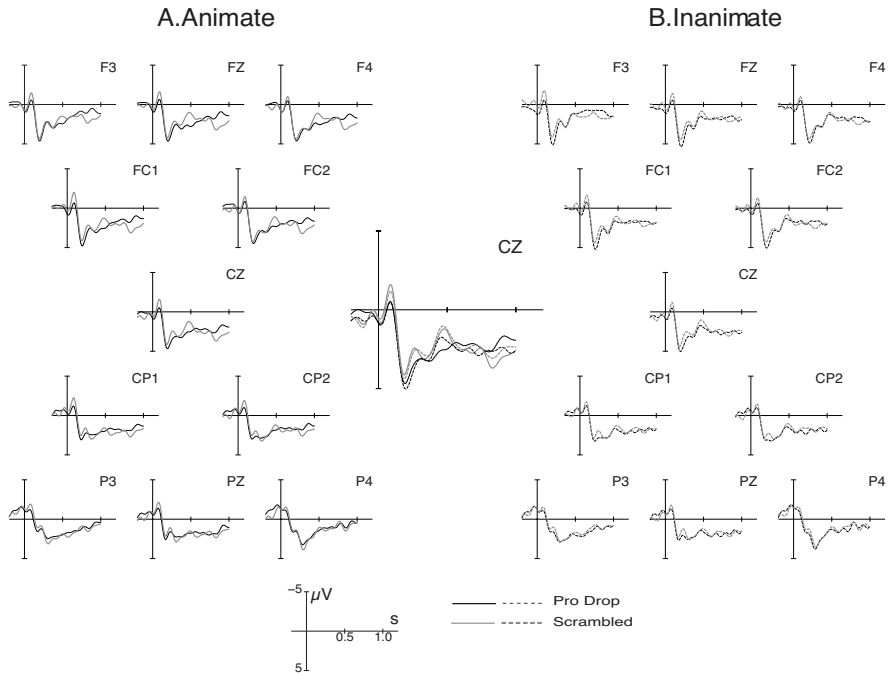

Figure 5.9: ERP ***comparison*** *of Experiment 2 to Experiment 1(a): Conditions (a) and (e) of Table 5.1 and condition (c) and (d) of Table 5.2 are included in the figure.*

process, and relatedly, I did not observe any components in the ERPs such as P3.

It has been suggested in the psycholinguistic and physiology literature that task identification and task categorization, as well as the predictability of the target, may create the P3 component (known as P3b) which has centro-posterior distribution (Coulson, King, & Kutas, 1998; Kok, 2001; Swainson, Jackson, & Jackson, 2006; Verleger, 1988). While the main goal of the thesis is not to go into much detail about the underlying physiological mechanisms of the P3 component, it requires attention at this point. I believe that such task-related effects may influence the ERP coponents similar to the previous findings in psycholinguistic experiments comparing plausibility judgements with the comprehension tasks (Geyer, Holcomb, Kuperberg, & Perlmutter, 2006; Kuperberg, 2007; Kolk, Chwilla, van Herten, & Oor, 2003). Note that, these findings showed late positivities, while the positivity in Experiment 1 was earlier. Thus, my findings are much more similar to the P300 component reported for the realization of the task-related (and predicted) item in the study by Roehm et al. (2007). In Experiment 1, P3b and syntactic-revision postitivity might have summed up to yield the ERP deflection. Temporal latency of the P3b component fits well with the findings of the experiment.

Another finding that Experiment 2 provided is that animacy does not influence subject preference or subject-to-object revision. I observed a small difference between animate and inanimate ambiguous (pro-drop) conditions on the verb in Experiment 2 (Figure 5.1) which may indicate that the disambiguation towards object reading may be more pronounced (more positive) for the animate conditions than inanimate conditions. But this did not reach significance, providing evidence that animacy is impotent to influence ERP components related to revision. So, the correlation between acceptability task and revision of the syntactic preference in ERPs must be investigated under different experimental conditions which may tap more about animacy information.

On the NP1, Experiment 1 and Experiment 2 were almost identical except for the late negative frontal ERP deflection observed for the animate ambiguous NPs in Experiment 2. Animate ambiguous arguments were more negative than the inanimate counterparts in a small frontal area. Topographical distribution of this effect suggests that this effect might be similar to the effects of pronoun observed on the NPs (frontally distributed). Also, the latency of the effect might have some consequences with the ERP findings on the verb (revealing late positive effects for pragmatically oriented components in frontal electrodes, see below).

5.7.4 Other Issues Brought about by Experiment 2

Overall, Experiment 2 showed that there is a pronounced effect of pronoun on the following items in the sentence. Both on the noun, and on the verb, the influence of the pronoun continued. ERPs on the verbs showed an earlier effect (150-300ms) of pronoun. This may just be a carry over effect from the NP preceding the verb. On the nouns, the existence of the pronoun starts as a negativity in the frontal electrodes for the inanimate nouns, and after the 500ms range it becomes independent of case and animacy. The effect of pronoun on the verb, on the other hand, emerges very early as a positive component in the posterior sites which interacts with multiple factors in the middle- and late-time windows.

As mentioned above, the existence of the pronoun influences the animate nouns differently than the inanimate nouns in the 380-500ms window. There might be two reasons for the effects in the 380-500ms time window: The first is that in pronoun conditions (where pronoun exists sentence-initially and takes a subject grammatical function), the NP is clearly in the verb-neighbouring position where it is given a pragmatic focus function. In that position, assignment of a pragmatic function to an animate NP may require a different type of processing than for an inanimate noun, because as mentioned in Chapter 3, animates are inherently more specific then inanimates. This assumption proposes that the semantic-pragmatic role assignment happens at around 400ms on the noun, but pragmatic evaluation and re-analysis is handled later. The second possibility introduces frequency effects. If OV structures in which the object is inanimate is more frequent then SOV structures in which the object is inanimate, then OV would be preferred over SOV, and the infrequent SOV option will lead to a frequency based N400. I will explore this possibility in the next chapter in corpus counts (Chapter 6).

Also, the effect observed on the second arguments may be "economy violation and reformulation" of the syntactic template having 3-elements (NP-NP-V). Following the redundancy preferences that emerged on the NP, the processing system may see no reason or necessity to have an overt pronoun. An extra pronoun is redundant (Enç, 1986). Most probably, late analysis (well-formedness check) on the NP2 before the verb emphasizes the "redundancy" of the pronoun, and mismatch between the economy constraint and the 3-element template emerges. I assume that there might be a "structural minimality check" in the early time window on the verb. Thus, this mismatch and the preference for the "2-element template" show up on the early phases of the onset of the verb. This interpretation is in-line with the processing model eADM, where the late time window temporally corresponds to the well-formedness check, and the tempate is formed in the early time-window.

Experiment 2 also revealed the deviant behaviour of the case-marked inanimates in the Pro-Drop conditions. As can be seen in Figure 5.2 (right column), sentence-initial case-marked inanimate conditions are more positive in the middle-time window than its pronoun counterpart. There are three potential reasons for this positivity: (a) some kind of reanalysis (similar to the subject-to-object analysis because of the similar positive deflection) even though nouns in these conditions are not syntactically ambiguous, and (b) different comprehension-related preferences for case-marked inanimates for OV structures exist, or (c) case-marked inanimate OV conditions are very frequent (leading to the reduction of N400 if frequency of structure has anything to do with the N400 component in this case).

Regarding the item (a), positivity may be similar to the reanalysis related positivity: Sentence initial case marked inanimates might have initially been interpreted differently, and so required a reanalysis when the verb emerged. Their syntactic status might have been revised for a certain reason. But note that, the physical form of this positivity looks different and it may be a different component related to a different function. This "eyeballing" method may not be very indicative under this situation, and since the inanimate argument is not syntactically ambiguous (grammatical function is assigned to it unambiguously), this hypothesis seems to be less likely to explain the data.

Regarding the item (b), the semantic composition of OV might be less costly for the case-marked inanimate conditions. This assumption suggests that the difference between SOV and OV inanimate conditions cannot be attributed solely to the influence of pronoun, but to the interpretational differences of the inanimate noun under particular sentential environments. Figure 5.5 indicated that the SOV and OSV case-marked inanimate conditions did not differ in the middle-time window. The effect, then, must be a unique interpretation emerging only from OV structure. Most probably, an interpretational cost emerges for all the animate as well as all the SOV and OSV conditions, but not for the case-marked inanimate OV structure. But interestingly, the behavioural results indicated that the case-marked inanimate OV conditions [(f) condition in Table 5.3] are less accurate and take longer to respond to compared to most of the other conditions. Thus, this hypothesis seems to be less likely.

The last item assumes that the structural frequency may influence ERPs. If this is the case, we must observe that in the corpus of Turkish, this preference must hold and OV must be preferred over SOV particularly when the object is inanimate and case-marked. The corpus study presented in Chapter 6 will help to develop some hypotheses about the status of the sentence-inital objects and their relation with the other arguments.

Experiment 2 provided multiple ERP effects in the later time-window (750-900ms) on the verbs of the Pronoun-O-V structures. In this time window, these findings suggest that redundancy, pragmatics, well-formedness and referentiality of the object (all of the subject and object properties) may be evalutated together, and this evaluation may reflect in the late ERP time-window. As mentioned in the summary above, I will call the late positive deflections under situations like Pronoun(1s)-NP-Verb "pragmatic positivity." I hypothesize that the well-formedness of the linguistic expression is evaluated here. Redundancy/minimality leads to a general positive component. It may be a more common processing preference to have a Pro-Drop construction preceding the verb when the subject is 1st person singular or plural. Thus, in this time window, the comprehension system still evaluates the pragmatic and syntactic well-formedness (as it might have done on the NP2). But the question emerges why and how the animate case-marked NPs in SOV can manage to "escape" from this pragmatic positivity, and lead to a negative peak as observed in Figure 5.4.

Animate and inanimate object NPs (with their case marking) may show differences with respect to their referentiality (as shown in Chapter 3). Under the SOV condition, the pure effect of referentiality of the object on ERPs can be observed, because there is no ambiguity-related cost. Thus, if interpretational differences emerge from the difference in the specificity and referentiality alignment of the objects in SOV sentences, this may lead to pragmatic differences which reflect on the late ERP components. For instance, interpretation and referentiality assignment for the bare object NP can be *bir NP* (an NP) under the hypothesis that this NP is taken as indefinite non-specific. As mentioned in the chapter on Turkish, animate and inanimate nouns differ with respect to their specificity levels. An animate case-marked object [(d) condition in Table 5.1] might be interpreted as more specific than the inanimate case marked object [(h) condition in Table 5.1]. Then, the hypothesis emerges such that the processing system may group caseless (and non-definite) NPs and casemarked (but indefinite) inanimate NPs together, and treat cased-marked animate NPs differently (as a more specific object) (Figure 5.4, left column). This pragmatic evaluation leads to late ERP effects which is in-line with the well-formedness and evaluative processes in which existence of pronoun may not be that redundant if the object is very prominent and definite. As mentioned above, this assumption suggests that the existence of a pronoun, specificity of the object, and the word order all emerge as one component in the late time-window. Note that, such late effects emerge after the linking of the arguments to the verb. Another explanation for the deviant behaviour of the case-marked animate object conditions might be that the specific animate objects might have a "clear" referential status. They may be considered as specific and highly

referential entities. On the other hand, caseless objects, and the case-marked inanimate entities might not have a clear referential status, thus leading to a search for the consolidation of their referential status during linking. Late frontal pragmatic positivities may reflect such a search process.

The last issue related to the redundancy issue is that, in the questionnaire study [Experiment 1(b)], SOV orders with an overt pronoun were found to be less acceptable. They were costly, probably because the pronoun was in its canonical position and it was non-emphatic (see Chapter 3) in-line with the redundancy issue. But, this finding must be compared and tested with other experiments in which proper nouns, common nouns etc. are used in the subject position in order to test whether the effects observed here are the result of the overt pronoun or overt subject of any kind. Also, ERP results can be compared to see whether the effects similar to the existence of a pronoun emerge when different types of nouns are used.

5.7.5 Alternative Explanations

One alternative explanation suggests that the interaction observed on the case-marked conditions might have resulted from case-marked animates, but not from case-marked inanimates. Specific animate objects might have created negativities (as the pronoun conditions do) independent of whether they emerge in Pro-Drop sentences or not. Since they are highly specific and referential, they may require more processing demands, which may create frontal negativity in turn. Interestingly, case-marked animate conditions always behaved similarly in Pronoun and Pro-Drop conditions both in 400-600ms and 750-900ms time windows. This explanation suggests that the effect of a pronoun on the verb exists for every condition on the frontal electrodes as well as the effect of specificity of the animate object.

This explanation has some fatal consequences for the subject preference hypothesis. It basically explains the differences on the caseless conditions as an effect of the pronoun, not as the by-product of subject preference (and reanalysis). But, note that, there was no difference for the case-marked animates on NPs. Thus, this alternative explanation must also assume that the referential assignments on the nouns must be made during linking, but not before.

In the 400-600ms window, case-marked animate argument might be treated as highly referential, and in the late time window, its pragmatic status (as being a specific animate object having clear referential status) may block the pragmatic interactions observed in the pronoun conditions. These possible explanations must be tested in future research, by replacing the subject with the other types of noun (e.g., common nouns etc.) to eliminate the redundancy

claim and the pure effect of pronouns. Another suggestion might be that very referential objects (e.g., my father etc.) can be used in Pro-Drop and Pronoun conditions in order to see whether very discourse prominent items also behave similarly or not.

5.8 Conclusion

In general, the findings indicate that the subject preference hypothesis is a strong candidate to explain the animate and inanimate ambiguous conditions. In Experiment 2, the reanalysis effect is mainly confined in the centro-frontal region due to the better control conditions created. In general, the major findings of the experiment are that (a) experimental task influences the ERP components to a great extent, (b) early time windows are related to structural (template) and categorical processes (where scrambling is observed), (c) the middle-time window is related to semantic and pragmatic role assignment (as observed by animacy-pronoun interaction differences on the noun and verb) and (d) the late time window is related to pragmatic and semantic evaluation of, not only the current argument, but also all the sentence items available at that point in general. Thus, all information is combined in the late time windows (after 500ms stimulus onset) for evaluative purposes.

Existence of the pronoun, when it is redundant to use, leads to the pragmatic evaluation (emerging as late positivities). Investigations also revealed that under certain cases, the existence of an overt pronoun influenced the interpretation of animacy and case marking of the object differently, and made the processing more complicated. For instance, ERP deflection on the verb in the case-marked animate condition in the canonical sentences could escape the pragmatic positivity. Interestingly, these effects disappeared under scrambling (where in OSV the pronoun is not redundant), indicating that redundancy of the existence of pronoun in SOV, rather than the sole existence of the pronoun, is one of the main factors for the pragmatic evaluation. This supports the hypothesis made so far, suggesting that redundancy and the status of the object influences pragmatic evaluation.

Global level factors, such as frequency, may still be one of the factors influencing the ERP components as mentioned in the discussion of the ERP findings on NP2s and verbs in the case-marked inanimate Pro-Drop conditions. In the next chapter, I will briefly investigate the frequency of the distributions of the linguistic forms in Turkish. I would like to focus on distribution of the ambiguous sentence-initial NPs and the distribution of the animate vs. inanimate accusative NPs (particularly in the sentence-initial positions). I will ask how

often people prefer an ambiguous sentence inital NP as the subject, and how animacy influences this preference. Also, the second major investigation will be to observe how animacy and case marking are distributed within and out of the ProDrop conditions, answering the question about the potential for an interaction between animacy, case and word order.

Chapter 6

Exploration of the Turkish Corpus

6.1 Introduction

Experiment 1 and 2 raised a number of questions that can be partially answered with a questionnaire study and comparison of different types of experimental conditions. One of the questions that emerged after these experiments was whether the frequency of the linguistic distributions in a language can have an influence on the ERP components or not. Even though I may not be able to find a correlation between the corpus findings and the ERP findings, this attempt to explore the Turkish corpus will extend our knowledge about the lingustic forms frequently used in this language.

My goal is to investigate four issues that are relevant for the thesis:

(a) **Subject preference issue:** A sentence-initial ambiguous NP is preferably chosen as the subject of the sentence where the reanalysis and the resolution of the ambiguity is observed as a positive deflection (shifted to more frontal areas and got smaller in amplitude in Experiment 2). Thus, the first question is: Shall we observe such a preference as a high frequently option in the corpus? How often is the initial ambiguous argument of the sentence the subject of the sentence? How does animacy of the subject influence this distribution?

(b) **Effects of pronoun and redundancy:** A pronoun interacts, influences and changes ERP deflections on the following noun and the verb to differing degrees. These interactions in general reveal core information about the preference of the parser towards minimal structures. How often the definite subject or a pronoun is used in the sentence-initial position

may be informative to understand whether this tendency has anything to do with the frequency of usage.

(c) **Specificity and definiteness:** Animate and inanimate arguments following the pronoun show different deflections as observed in Experiment 2. Inanimate nouns are more negative when they follow the pronoun, independent of case (see Figures 5.7 and 5.8 in Chapter 4). Specific deflections for different conditions having different objects occur on the verb. For instance, the conditions having a case-marked inanimate noun differs from all three other conditions in the middle time-window (around 400ms) such that they are more positive, while others are more negative (see Figure 5.2 in Chapter 4). On the other hand, conditions with an animate accusative case marked object in this position differed from all three other conditions in the late time-window (around 700ms) (see Figure 5.4 in Chapter 4), such that the pronoun pulls the ERP component towards a more positive deflection, while it has a very different impact on the case-marked animate conditions. Thus, it is possible that such structures are less preferred or less frequent in the corpus (which may correlate with ERP deflections). N400 effects are generally related to frequency of usage of the linguistic form (Van Petten, 1990), thus, I expect effects of the frequency in the middle time window. Late effects may be related to the pragmatics of the sentence and referential status of the arguments.

(d) **Prominence hierarchies:** I investigate whether there is a general preference for prominence hierarchies in the Turkish corpus or not. Remember that in Experiment 1, I showed that there is a negative component on the animate object when it follows an inanimate subject. Thus the question emerges: How often does an inanimate subject precede an animate object? Or how often does a definite subject precede an indefinite object or vice versa? The main idea is to realize the most general relational and interpretational animacy and definiteness prominence hierarchies of the arguments in a transitive sentence. If this also falls under the predicted prominence hierarchy relations, then the hypothesis about the existence of prominence hierarchies in Turkish will be supported.

Thus, in general, my goal in this study is to answer a number of questions: Is it possible that these interactions have emerged from the "frequency" of structures in which animacy and case marking played a role? Especially, how are animacy and case marking related to the distribution of the linguistic structures and preferences? Regarding article (a) above, what is the probability of choosing the initial ambiguous argument as the subject vs. the object of the sentence? May subject preference be the most frequent option in Turkish even though

Pro-Drop is another possible unmarked option? Regarding article (b) above, how frequently do people drop the pronoun, leading to a Pro-Drop structure? How often do they use it, and in which structures? How often and under which conditions do they prefer a one-argument structure to a two-argument structure? Regarding article (c) above, how often do people use case-marked animate vs. inanimate NPs in sentence-initial positions? And what is the distribution of definiteness and animacy of the object NP neighbouring to the verb? How are definiteness and animacy related? Regarding the last question, how are the arguments of the transitive sentence ordered?

In the counts, main emphasis is given to ambiguous (non-specific, non-definite) and ACC case-marked (specific) NPs in ProDrop and non-ProDrop sentences, since the experiments I conducted used these types of constructions.

6.2 Material Selection

Corpus counts are taken from the Turkish METU-SabancıTreebank (Atalay, 2003; Oflazer, Say, Hakkani-Tür, & Tür, 2003).[29] While existing counts from different sources give us a general idea about the distribution of structures in Turkish (e.g., Çakıcı, 2005 counts), the tagging of the corpus in Treebank did not involve animacy and definiteness information. Also, there is no existing computer program that extracts the distribution of case marking. Thus, I read through approximately 5000 sentences in the METU-Sabancı Treebank and counted the structures by hand. In this study, the following sentence types were eliminated and not considered in the counting:

1. Sentences including imperatives:
   Eve git, çabuk ol!
   Home-DAT go, quick be!
   Go home, be quick!

2. Short sentences like yes/no answers.

3. Sentences without any overt arguments:
   gittim.
   go-PAST-1s
   I went.

[29]The METU-SabancıTurkish Treebank is a morphologically and syntactically annotated treebank corpus (see http://www.ii.metu.edu.tr/ corpus/treebank.html). It is a subcorpus of the METU Turkish Corpus, which is a 2 million word corpus of post-1990 written Turkish including text samples from newspapers, magazines and books.

4. Sentences starting with verbs:
   Öldürdüler adamı...
   Kill-PAST-3p man-ACC
   (They) killed the man.

5. Wh-questions:
   Neden geldin?
   Why come-PAST-2s?
   Why did you come?

6. Sentences which had heavy NPs:

   Yıllardır neler olup bittigini bir türlü anlayamadığım yerler gördüm.
   For many years things happen-DER:Noun-ACC somehow understand-POT-NEG-PAST-REL-1s places see-PAST-1s
   For many years, I saw many places that I couldn't figure out what was happening inside.

7. Sentences with arguments derived from verbs (either as gerunds or subordinate clauses):
   Koştuğunu görmediler.
   Run-PAST-POSS-2s-ACC see-NEG-PAST-3p
   They did not see you running.

After filtering out such sentences, a total of 1993 sentences were analysed. These sentences were similar in structure to the experimental sentences in the thesis such that the sentences mainly started with non-definite, definite, case-marked and non-case marked arguments. The main emphasis, among the case-marked NPs, was given to the accusative NPs.

Before giving a brief summary of the findings, I will define the expressions used in this counting:

Subject: The noun phrase (NP) that agrees with the verb, e.g., *the girl* in "The girl runs after the boys."

Object: The NP that can take overt case marking, and the other NPs rather than subject in a transitive or ditransitive sentence, e.g., *The book* in "The man sold the book yesterday."

Definite subject: An NP that is highly referential (as defined in Chapter 3) and cannot be used as an object NP without an accusative marker, e.g., *Annem* (my mother) in *Annem eve geldi* (My mom came home). The subject is definite and cannot be used without an accusative marker in the object position, e.g., $*$*Annem gördüm* (I saw (a) my mom). Since an accusative case marker is obligatorily used for the definite object NPs, it is used as one of

the diagnostic tools to define definite subjects (by using the subject as an object in an examplar sentence). Some examples of definite subjects include nouns attributed to relatives: *Amcam* (my uncle); heads of relative clauses: *Aldığım kitap* (the book that I bought); and proper names: Hasan (Hasan) etc. All other subjects [*bir adam* (a man), *birkac kişi* (a number of people)] were considered as indefinite.

Definite object: Definite objects are the NPs which can never be used without case marking, e.g., *arkadaşımı* (my friend) in *Arkadaşımı ittim* (I pushed my friend) which cannot occur as $*$*Arkadaşım ittim.* (I pushed (a) my friend).

6.3 Summary of the Findings

A very brief summary of the counts can be given as follows:

- **Unambiguous NPs:** 1547 of the sentences (77.5%) started with unambiguous NPs (they were either case marked or highly definite, thus revealing that the NP is clearly a subject or an object). Among those 1547 sentences, 688 sentences (44% of this group and 34.5% of all the sentences) started with an object NP, and 859 sentences (56% of this group and 43% of all the sentences) started with a subject NP (a definite NP which must be case marked if it was an object). Thus, it seems like it is a general tendency to have unambiguous NPs in the sentence inital position, while sentence-initial unambiguous NPs are preferred to be subjects in most of the cases.

- **Ambiguous NPs:** 446 of the sentences (22.5%) started with ambiguous NPs. Among those, in 140 sentences (31% of this group and 7.2% of all the sentences), the NP turned out to be the object of the sentence. The number of sentences in which the initial ambiguous NP turned out to be the subject of the sentence was 306 (69% of this group and 15.3% of all the sentences). Thus, under local ambiguity, the majority of the NPs are the subjects of the sentences. This shows that subject preference has a frequency based correlate.

- **Subject Initiality:** 1165 sentences (58.3%) started with a subject NP (either ambiguous or unambiguous). Thus, in general, there is a subject initiality revealing that the SOV or SV order in Turkish is a highly common word order and subject preference applies to all ambiguous and unambiguous cases.

- **Pro-Drop:** The number of Pro-Drop sentences was 783 sentences (39.2%). As expected, Pro-Drop is an unmarked[30] and frequent option. Also, if the object in the Pro-Drop OV structure is ambiguous (Table 6.2), then most of these NPs are inanimate nouns. This leads to an assumption that if the initial ambiguous NP is animate and it is selected as the subject of the sentence, it may be more difficult to revise it, since there is a higher tendency to have animate as subjects, not as objects, in the sentence-initial positions. It may be easier for the inanimate NP to be reanalysed as the object in Pro-Drop sentences, because both subject and object readings are equally frequent. Thus, ease of revision on inanimate objects also has a frequency correlate.

Thus, overall, the major impression is that (a) most of the sentence-initial NPs are unambiguous (either by case marking or being highly definite), (b) among the sentence-initial ambiguous NPs, most of the NPs were subjects (69% of sentences starting with ambiguous NPs or 15.3% of all the sentences), (c) most of the unambiguous NPs were subjects (43% of all the sentences), (d) SV (or SOV) structure is a more common option than OV (or OSV) structure (but OV is also very frequent as seen in Pro-Drop), and (e) ambiguous inanimate NPs are equally likely to be the subject or object of the sentence, but ambiguous animates are more likely to be the subject of the sentence.

I will show the details (animacy, case and definiteness interactions) of the corpus count in the following section. I will stick to the three main issues (ProDrop, animacy-case-sentence position interaction, and subject preference under ambiguity) as mentioned above while summarizing the data.

6.4 Sentences Starting with Specific Object NPs

My first analysis is on the sentences starting with an unambiguous object NP. These sentences started with an object NP and they were either scrambled (as topicalization: OSV or as extrapositon: OVS), Pro-Drop (OV), or ditransitive Pro-Drop (OOV) sentences. The counting is summarized in Table 6.1.

[30]To see the interesting relations between markedness and other terms used in linguistics, as well as the twelve senses of this term, see Haspelmath (2006). In this chapter, I will use only three senses of markedness. First is "markedness as a deviation from default parameter setting" where OV and SOV word orders will be the default word order parameters and other word orders will be deviant. Thus I will refer to such structures in the language as "marked". Second, markedness is textual markedness which more or less relates to the corpus counts. It defines the rarity in texts. Thus, I will call such structures in the corpus as "infrequent." Third is the markedness as restricted distribution, like the existence of object-incorporation which occurs only with/under a particular context. I will call such structures "restricted."

		SENTENCE INITIAL OBJECT NPs												
		Obj-Oblique				**Obj- Dat**				**Obj-Acc**				
		Definite		**Indef**		**Definite**		**Indef**		**Definite**		**Indef**		
		A	**I**	**A**	**I**	**A**	**I**	**A**	**I**	**A**	**I**	**A**	**I**	Total
Fol.	**S**ubject	1	3			5	15		5	5 (1p)	9		2	45
Cont.	**P**.D. Obj.	6 (3p)	13		5	38 (18p)	15 (1p)	3	3	22 (13p)	26 (2p)	2	11	144
	ProDrop	15 (5p)	13	1	11	34 (15p)	84	2	56	83 (48p)	142	8	50	499
Total		22 (8p)	29	1	16	77 (33p)	114 (1p)	5	64	110 (62p)	177 (2p)	10	63	688

Table 6.1: Sentences starting with case marked objects.

The top rows represent the type of sentence-initial object NP. Obj-Oblique stands for objects having abative (-ABL) or instrumental (-INST) case markers. Obj-Dat means the object was case marked for dative (-DAT). Obj-Acc means the object was case marked for accusative (-ACC). "Definite" means that the sentence-initial object was definite and could not exist without an accusative case when it is used as an object. "Indef"means that the object was indefinite and could exist without the accusative case when it is used as an object. "A" stands for "Animate" meaning that the initial object NP was animate. "I" stands for "Inanimate" meaning that the initial NP was inanimate.

The left columns show the status of the context following the initial object. "Fol. Cont." means Following Context. "Subject" means that the subject appeared later in the sentence following the object (either in OSV or OVS order). "P.D. Obj." means that another object followed the sentence-initial object (oblique or a core object) in a subject-drop (Pro-Drop) sentence (OOV). "Pro-Drop" means that the object was followed by the verbal predicate (OV). The abbreviation "p" in the cells represents the pronominals and it shows the number of pronominal objects. For instance the cell with "6 (3p)" in the cell intersecting the Animate-Definite-Oblique object column with Obj. with Pro-Drop row means that there were a total of 6 sentences starting with oblique case-marked definite animate NP followed by another object in a Pro-Drop context, and 3 of these sentences had a pronominal rather than a nominal initial object. Then, total numbers of each column and row are also shown.

6.4.1 Summary of Table 6.1

The results from Table 6.1 that are relevant for the thesis are summarized below. I will focus on the -acc case-marked sentences, since throughout the experiments, I used -acc case-marked objects:

1. Pro-Drop is a very common option in object-initial sentences. Most of the unambigious object initial sentences tend to be Pro-Drop (see the lowest two rows in Table 6.1).

2. On the other hand, OSV or OVS word order is not a highly preferred word order option in Turkish. Sentences in which the subject is following a sentence-initial object are less than 1% of the unambiguous object initial sentences. Thus, OSV can be considered as infrequent as well as a marked (deviant) word order.

3. In object initial structures, the object is predominantly definite. Thus, sentence-initial NPs generally tend to be definite (they must be very prominent, specified or highly referential). The ratio of the definite objects to indefinite objects in -acc marked cases is around 4:1. Thus, this confirms the finding from Chapter 3 that Turkish seeks initial arguments to be definite.

4. Among sentence-initial -acc case marked (specific) NPs, the ratio of definite-animate objects to indefinite-animate objects is 11:1 (105/10), while the ratio of the definite-inanimate objects to the indefinite-inanimate objects is around 3:1 (168/61). Also, most of the indefinite objects are inanimate – almost six times more than the animate objects 61:10. Similar tendencies also exist in dative and oblique case-marked NPs. Thus, there is a tendency of case-marked animate NPs also to be definite. Animacy, case and definiteness go hand in hand. Animates are generally definite and they are case marked when they are objects. This does not hold for inanimates as much as for animates.

   This shows that when speakers of Turkish refer to a specific human object, this object is generally definite and very referential. Note that, half of the definite animate NPs are pronouns, supporting the finding that animacy and definiteness are correlated. For the inanimates, the status of the object in this position is generally not (exclusively) definite. But, note that this is a verb-neighbouring region in mostly Pro-Drop constructions.

5. Most of the sentence-initial unambiguous NPs are inanimate. The ratio of inanimate objects to animate objects is more than 2:1 in -acc marked cases.

6.4.2 Discussion

The corpus count revealed that, in Turkish, generally the sentence-initial position tends to be definite. Pro-Drop in the object initial sentences turned out to be very common, and OSV or OVS options are rare.

Animacy has an impact on definiteness when the object is case marked. Case-marked animates are generally definite, but case-marked inanimates are not (see the lowest row Pro-Drop). The cases in which animate NPs are used as specific (but indefinite) are rare. It is equally likely to have definite or indefinite sentence-initial inanimate NPs. Thus, animacy entails definiteness, but definiteness does not entail animacy.

6.5 Sentences Starting with Caseless Object NP

My second analysis is on the investigation of the sentences starting with an ambiguous NP which turns out to be the object of the sentence. Since definite objects are case marked, these objects are non-definite. Table 6.2 shows the distribution of such cases. The abbrevations are similar to the first table.

		Sentence Initial Bare Object NPs	
		A	I
Following Contex	S	–	–
	Obj. with PrDrop	–	1
	ProDrop	2	137

Table 6.2: Sentence initial caseless non-definite (ambiguous) objects.

6.5.1 Summary of Table 6.2:

The general observation from the counts in Table 6.2 is that ambiguous sentence-initial non-definite objects tend to be exclusively inanimate and almost all of these types of sentences are Pro-Drop. The caseless non-definite argument was in the verb-neighbouring position and, similar to the theoretical claims made on Turkish in Chapter 3, caseless objects cannot easily exist in the verb-distant position. They are exclusively located in the verb-neighbouring location.

Also, caseless non-definites are exclusively inanimate. Animate objects do not generally exist in the verb-neighbouring or verb-distant positions when

they are caseless non-definite. Non-definite objects are very infrequent. This means thatthe grammatical function attributed to non-definite animate NPs is generally subject in SOV or SV structures as will be seen in the section discussing subjects.

6.6 Discussion of Tables 6.1 and 6.2

A general preference for Pro-Drop structures exists both for the sentences starting with case-marked (specific, Table 6.1) vs. non-case-marked (non-specific, Table 6.2) objects. In both instances, the majority of the initial objects are inanimate, located in the verb-neighbouring region. When the case-marked (specific) object conditions are taken into account, most of the objects also tend to be definite in the sentence-initial position (whether they are verb-neighbouring or not).

Among sentences starting with specific animate objects, the most common structure is one in which the animate object is also definite. The number of cases in which an indefinite specific object emerges in the sentence-inital position is much fewer for the animate conditions than the inanimate conditions. Animate objects are biased to be definite, but inanimate objects are not that strongly biased to be definite. Animacy entails definiteness.

Interestingly, animate objects do not generally exist in a verb-neighbouring region when they are caseless non-definite. This leads to the assumption that if a caseless non-definite animate argument exists in the sentence-initial position, it most probably will be interpreted as the subject rather then the object of the sentence, because it is the only possible option left for it.

In the next section, I will explore the sentences starting with subject NPs.

6.7 Sentences Starting with Subject NPs

The next analysis investigates sentences starting with a subject (either in SV, SOV or SVO order and with verbal, nominal or existential predicates). In Turkish, subjects are not overtly case marked. That is why the ambiguity of its status is resolved only by definiteness and there will be only one section, different than the investigation of the object in the previous sections. The counts are summarized in Table 6.3. The top rows show the definiteness and the animacy status of the subject similar to the previous tables. An indefinite subject NP is one in which the NP is caseless, non-definite and ambiguous.

			SENTENCE INITIAL SUBJECT NPs						
			Definite				**Indefinite**		
			A		I		A	I	Total
Following Context	**A**cc. Obj.	A	50	(18p)	19		4	2	75
		I	82	(19p)	31		11	16	140
	Dat. Obj.	A	27	(9p)	11		2	4	44
		I	83	(17p)	34		8	20	145
	Null Obj.	A	4	(2p)	7		2	3	16
		I	29	(9p)	5	(1p)	2	2	38
	Other Transitive		25	(5p)	7		1	8	41
	Intrans. Pred.	**V**erbal	156	(77p)	161	(9p)	13	135	465
		Nominal	39		59		5	27	130
		Existential	9		21		8	33	71
Total			504	(156p)	355	(10p)	56	250	1165

Table 6.3: Sentences starting with subjects

The left columns show the case marking and animacy status of the item following the initial subject. Note that in this table the animacy of the following argument is also shown. "p" shows the number of pronominal subjects among all others in question.

6.7.1 Summary of Table 6.3:

1. In general, there is a tendency to have a definite subject in SOV structures. These subjects are very specific, many times pronominal subjects, proper names, or definite NPs like "my car" or "my uncle."

2. The general tendency in SOV structures having definite subjects is as follows:

   Definite animate subject followed by an inanimate object >

   Definite animate subject followed by an animate object >

   Definite inanimate subject followed by an inanimate object >

   Definite inanimate subject followed by an animate object >

   Indefinite inanimate subject followed by an inanimate object.

   Most of the subjects in SOV sentences are animate NPs which are followed by inanimate NPs. If there are two overt arguments (and the subject is not dropped), the most natural flow of animacy information

is *animate* > *inanimate*. The number of sentences in which an animate subject is followed by an inanimate object is more than twice the sentences in which an animate subject is followed by an animate object (ratio of 5:2). This is in-line with the assumption that the prominence relations $+animate > \mp animate$ and $+definite > \mp definite$ hold in the corpus counts, especially when there is an SOV order having two overt arguments. This is in parallel to the previous finding that if the sentence-initial argument is definite, animate and caseless, it more frequently tends to be the subject of the sentence.

3. More than half of the subject-initial sentences having a verbal predicate are intransitive (SV). Like Pro-Drop (OV), the intransitive SV structure is also common in Turkish. If the initial NP is the subject, it can be followed by an object to yield SOV, or more likely a verb to yield SV.

4. If the sentence-initial subject is a pronoun, then it is most likely followed by a verb in an intransitive sentence or an object (particularly inanimate object) in a transitive sentence. The cases in which the pronoun is followed by the verb are as many as the cases in which the pronoun is followed by another object.

5. Animate subjects of the transitive or intransitive sentences are generally definite (10:1 ratio between definite and indefinite animates). This is similar to the status of the acc-marked animate objects in Pro-Drop cases (Table 6.1) in which animate arguments tend to be definite. Thus, animate arguments tend to be definite either in the sentence inital subject or object position. This confirms the general tendency of animates to be biased towards being definite.

6. Similar to the previous cases on objects, sentences bearing inanimate subjects are equally likely to be definite or indefinite. But, the definite-indefinite distinction is more pronounced for the inanimates when they exist as subjects in intransitive structures. In intransitive structures inanimates are more likely to be indefinite.

7. The ratio of inanimates to animates of the ambiguous NPs which turn out to be the subject is 5:1. The sentence-initial ambiguous NPs which turned out to be the object (as examined in the previous sections) were exclusively inanimate. If the sentence-initial NP is caseless, animate and non-definite, then it is most likely to be the subject of the sentence.

6.8 Discussion

In the discussion, I will put forward the main findings that are related to the questions that emerged from Experiment 1 and 2. Also issues like prominence and precedence relations (the topics of Experiment 3) will be summarized. As mentioned in the introduction of this chapter, I will focus on the subject preference issue, the effect of animacy on subject preference, the status of the sentence-initial objects and subjects, the tendency to have Pro-Drop sentences, the preference to have overt specification of the pronoun, and the prominence hierarchies in general.

Subject-preference is shown to be more frequent than object-preference in corpus counts. If frequency is effective on ERP deflections, then subject preference might have been an outcome of this statistical distribution. The ratio of sentences starting with an ambiguous NP which turns out to be the subject (columns of indefinite subjects in Table 6.3) to the number of sentences starting with an ambiguous NP which turns out to be the object of the sentence (Table 6.2) is around 2:1.

On the other hand animacy does not influence the inital subject preference on the non-definite items. The number of (animate or inanimate) non-definite NPs which turn to be subjects are more than the number of non-definite NPs which turn out to be objects. Interestingly, non-definite animate NPs are almost non-existent in the corpus. This animacy difference in corpus counts has some parallelism with the questionanire study. Recall that the acceptability of the [bare animate object NP–Verb] constituent was smaller than the [bare inanimate object NP–Verb]. I did not observe any difference in the ERPs in Experiment 1, and there was a minor difference in Experiment 2 on the verb (which was not significant) in the 400-600ms time window. It was hypothesised that the ERP components related to the garden-path strength cannot be easily observed by ERPs. In corpus counts, ambiguous NPs generally turn out to be inanimates in the object position. Thus, this difference might also have contributed to the revision difficulty: It is possible that the initial parsing preference is to choose the ambiguous argument as the subject independent of the animacy, and the revision from subject-to-object becomes costly for the ambiguous animate objects (which is a less frequent option), but not the inanimate objects (which is a highly frequent option), as it is revealed both by the questionnaire study and corpus counts. Thus, frequency of the linguistic data may show the initial parsing preferences as well as may reveal the cues related to the possible problems emerging from the revision of this preference.

On the other hand, seeing subject preference in the corpus as a preference does not mean that the subject preference I observed in the experiments resulted

from the frequency, but may mean that subject preference is probably the most economical or minimal and, therefore easier option under certain conditions, which may reflect on the distribution of the linguistic structures.

Recall that, when an NP followed a pronoun, inanimate arguments were more negative in the 400-600ms time window. Can this effect have a correlation with corpus counts? If the Pro-Drop preference is strong for the objects of any kind (particularly inanimate objects), can the absence of Pro-Drop (and existence of the overt pronoun) cause a negative ERP component on the following NP? The number of OV sentences starting with ACC case-marked or bare initial objects (Table 6.1 right-most columns and Table 6.2) is much larger than the the number of sentences in which the accusative object follows a pronoun (Table 6.3), particularly when the object is inanimate. This indicates that accusative or bare objects are generally used without a pronoun in the sentence-initial position. Thus, the effect observed on the NPs following the pronoun may have a frequency-related interpretation, in which the redundancy of the pronoun is realized and the non-conventional Pro-NP reading causes negativity. Note that, this ERP effect was observed on the posterior electrodes, and it is similar to an N400 effect. Also, this explanation is in parallel to the observation made on the case-marked inanimate Pro-Drop conditions in Experiment 2. Recall that case-marked inanimate conditions showed a N400-P600 like pattern on the verb when the pronoun existed compared to Pro-Drop conditions. Thus, for the case-marked inanimate conditions, redundancy of the pronoun may be more pronounced than the animate conditions, and its influence may continue on the verb.

Pro-Drop is a very frequent option. Corpus counts revealed that under a limited number of cases, definite subjects exist as pronouns (25% of the sentences having a definite subject). Thus, dropping the pronoun is a very common option, but this does not totally eliminate the overt usage of the pronoun, as expected. Unless there is a strong requirement, pronouns are dropped.

The different ERP deflections on the verb for conditions having case marked animate vs. non-case marked and inanimate conditions are most probably related to the pragmatic and contextual evaluation of the sentences, rather than the frequency-related effects. Thus, while corpus counts provide frequency-based explanations for subject preference and alternative subject-to-object revision effects for the animate vs. inanimate NPs, they cannot fully explain all of the on-line findings I observed in the ERP data. Most probably frequency-related effects appear on the second argument or on the verb, when a deviation from a minimal and economical form emerges. These effects generally show in the 400-600ms time window. Frequency-related effects may be short-lived, and on the verb, when the linking of the arguments happens. Frequency-related

effects may disappear and other syntactic, semantic and pragmatic issues may dominate parsing, generally emerging in the late time window.

Another important finding of the corpus counts is that definiteness and animacy hierarchies hold in Turkish. If there are two overt arguments, the animate and definite argument generally precedes the other argument of the sentence, leading to $+animate > \mp animate$ and $+definite > \mp definite$ precedence relations. One thing to be noted here is that the definiteness of the object argument in SOV in the corpus study was not investigated. Thus, while the precedence relation strongly shows that $+animate$ and $+definite$ arguments precede the inanimate argument, it is not totally clear whether the arguments are always distinct in terms of definiteness.

In general, prominence flow, specificity of subjects, correlation of animacy and definiteness observed in corpus counts all point to one fact that cognitive processes related to language processing prefer particular structures probably to ease the mental effort, and this is reflected in the frequency counts as the most natural linguistic forms. In the next chapter (Experiment 3), I will investigate how arguments are linked to the verb. Animacy and definiteness will be two of the prominence information types used in this study. As will be shown, the precedence relations of the arguments combined with the argument structures of the verbs will lead to observable ERP differences, which may reveal the on-line preference of the language comprehension mechanism.

Part III

Empirical Issues II: Semantics and Linking

Chapter 7

Effects of Semantics, Prominence Hierarchies and Argument Structure on Linking

7.1 Introduction

In the previous sections, the main emphasis was to understand how the language processing mechanism acts under local ambiguities, as in the exploration of the subject preference and Pro-Drop paradigms, and how case marking, animacy and the existence of a pronoun influence incremental language processing, as explored in Experiment 2. The major concern was to figure out the nature of the morphosyntactic composition of the elements of the sentence and to relate the findings to the statistical, semantic and pragmatic aspects of incremental linguistic behaviour. Remember that, the basic manipulation of the experimental conditions contained the overt or covert existence of the pronoun, case marking, or scrambled vs. canonically ordered sentences without any change on the type of sentence-final verb. The main outcome of this (morphosyntactic) exploration is that word order (syntax) and case marking (morphology) show closely tied patterns with semantic and pragmatic information (like animacy and referentiality) in Turkish, and complex interactions of these factors emerge as by-products of the human language processing mechanism. These interactions more or less correlate with the ERP deflections starting by the onset of the critical item under investigation.

In the second part of the thesis, the main emphasis will be given to a number of other important information types which play crucial roles in incremental sentence processing. In this exploration, only the sentences which have two

overt arguments will be used, and simultaneous interactions of different prominence information types (animacy, definiteness, case and word order) on the arguments as well as on the verbs will be investigated. On the other hand, different types of verbs are constructed in order to explore how different (i.e., marked) argument structures (h.f. *a-structure*) influence the linking of the arguments to the verb.

In the chapters on incremental processing (Chapter 1), Turkish grammar (Chapter 3) and the Corpus study (Chapter 6), I discussed the prominence relations of the arguments, particularly pre-verbal "animacy and definiteness precedence relations." These hierarchies are assumed to be constructed before the verb is processed. I explored how the existence of these prominence hierarchies are valid grammatically, statistically and pragmatically. Except for one part of Experiment 1 (Chapter 5, where the conflict between animacy and case hierarchies was investigated), the thesis has not yet evaluated how relational prominence hierarcies work and interact with each other in detail.

Thus, there are three main issues that I will examine in this section:

(a) Formation (and the conflict) of prominence hierarchies in the pre-verbal part of the sentence (formation of pre-GRs as it was named in Chapter 2),

(b) Nature of the linking of the arguments to the logical structure (LS, which is the main determinant of linking in an a-structure as defined in Chapter 1) of the verb; investigation of linking proper, importance of position vs. case marking in linking to the LS, and

(c) Effects of deviant (marked) linking (marked via deviant word-order or deviant a-structure) on comprehension; how pre-verbal grammatical constructions are processed differently for different types of verbs having different a-structures, and how does the interaction between all the information types emerge during linking.

Regarding (a), the formation and the conflict of prominence hierarchies in the pre-verbal part of the sentence, it is assumed that various information types like animacy, definiteness, position, and case marking form a relational structure in an environment with more than one argument. A relational interpretation of the arguments is relevant for understanding the underlying event structure which the sentence is about. Arguments of the verb have certain causal, perceptual or volitional aspects. These asects are part of the meaning of the verb.

As mentioned in Chapter 1, generalized role (GR) assignment is dependent on the LS of the verb in semantics-to-syntax linking. There is a link or "general-

ization" derived from the position of the arguments of the verb in the LS, and the GRs. Thus, in incremental language comprehension (syntax-to-semantics linking), a similar idea can be used to yield the pre-verbal GRs, to have at least partial composition of the sentence.

Regarding (b) the linking process, the position of the arguments in the a-structure, their case and positional coding, and the pre-verbal GR assignments are very important determinants of the quality of the linking of the arguments to the verb. In the following section, I will describe the roots of this linking mechanism within the concept of "Argument Selection". It is important to understand how the language comprehension mechanism uses relational pre-verbal GR assignments during linking.

Languages may differ with respect to the basic mechanism of how linking is achieved, such as what kind of linking-interface (strategy) is used. For instance, some languages like German may assume a close connection between the morphological case marking and the argument positions in the a-structure. Linking from semantics to syntax generally considers case information (i.e., when both NOM and ACC arguments exist in the sentence, NOM maps to the left-most argument in the LS and ACC maps to the other argument). On the other hand, a position-based language like English may have a close connection between the position of arguments in the sentence and the positions in the LS (i.e., POS1 of sentence maps to the left-most argument in the LS). This may be a unique preference for each language to achieve the standard (unmarked) linking of syntax-to-semantics (which may be the most natural and cognitively less effortful processing preference).

The last thing to mention is how the deviation from an unmarked (or standard) a-structure influences comprehension. The LS structure (or similarly the event structure) defines the aspectual and eventual form of the verb. It influences the linking process by deriving the main syntactic functions (Grimshaw, 1990; Tenny, 1994; Van Valin, 2005) [and even in some theories it defines the syntactic phrase of the sentence (Travis, 1994)]. But, on the other hand, the LS is just one part of the argument structure. The argument structure of the verb also includes the thematic roles attributed to the arguments by the verb. While the LS determines the syntax-to-semantics linking, the thematic structure of the verb may influence the comprehension process by supporting (or constraining) the final semantic interpretation of the arguments. Thus, I will use the term "standard argument structure" for the verbs having the most prototypical thematic roles leading to an unmarked transitive event structure, in which the event is a causative event and has an Agent-Theme thematic distribution. Here, unmarked transitive event representation encoded in the a-structure of the verb is treated differently than a number of unmarked transi-

tivity proposals made in the literature concerning and focusing on the animacy and definiteness of the arguments without considering the a-structure of the verb (e.g., Comrie, 1989). An unmarked transitive event (or standart LS) lies in the verb's a-structure, and any deviation from it causes the verb to be treated as marked.

I will synthesize these three interpretational and relational properties listed above, and explore the nature of incremental sentence processing on the pre-verbal arguments as well as during linking in the next section.

7.2 Pre-GR Assignment and Incremental Cues

Cues in the sentence are informative to differing degrees in different languages (MacWhinney et al., 1982). For example, if we come up with an ACC case marked argument in the sentence-initial position in German, we predict that there must be a NOM case-marked argument coming later in the sentence, because the ACC marked argument is dependent on the existence of the NOM argument. It cannot be used alone, and a NOM marked argument must be specified overtly. Also, under many instances, we also make predictions about the semantic nature of this argument. The general tendency is that the NOM argument will be semantically more prominent than the ACC marked argument, because it acts on the ACC marked argument to differing degrees. For instance take the sentence:

(61) Ich sagte dass den Tisch ...
I said that the_{ACC} Table ...

As soon as you encounter the "the table," you predict a subject (NOM argument) will appear later, and also this entity should most likely be the one who is able to act on the table. In terms of eADM, this is to say that the *den Tisch* is assigned the Undergoer semantic role first via case marking (since it is inanimate and accusative), then assigned the grammatical object role (by attributing $-Agr$). Then, $-Agr$ creates a prediction for an $+Agr$ argument, because it depends on the existence of the Subject. The subject argument must be more prominent than the "table." This condition creates a prominence hierarchy that does not conflict with the $\pm Agr$ hierarchy.

Thus, incremental sentence processing makes on-line decisions and predictions. The processing system expects, assigns roles and evaluates words on-line. Incremental sentence processing provides usage of cues to make one able to interpret the sentence. Pre-GR assignment in this regard uses the interpretive (animacy, referentiality, GR) and formal ($\pm Agr$) prominence hierarchies which

are dependent, thus relational in nature. The conflict in these hierarchies will cause processing costs in the pre-verbal region, depending on the strength of these cues and predictions.

7.3 Argument Selection: The window broke the ball with a man

The process of how the appropriate positions of a sentence, the syntactic functions of arguments, or the case assignment for the participants of the event, are allocated is known as "Argument Selection" (Levin & Rappaport Hovav, 2005). Typologically, even though there are cross-linguistic differences in this alignment, arguments of the verb (or the participants of the event) are given particular syntactic positions or are marked with particular morphological cases in a very principled manner in a language. For instance, when there is more than one participant in an event, the one which has more causative, possesive, or volitional status is given the more prominent status over the other entity. The second entity is either affected by the event (and being changed physically), or very static (and does not change) during the event denoted by the verb.

In languages like English, German, and Turkish, the participant which has higher priority is given a higher argument status [privileged argument in RRG (Van Valin, 2005), or external argument in Chomskyan tradition (Chomsky, 1981)] and is selected as the "Subject" of the sentence (also assigned the Nominative case in German and Turkish). This argument goes into an agreement relation with the verb. The other argument stays in the object position which is generally structurally close to the verb.

I will give an example here to describe how argument selection works. Then, I will define how the LS and thematic role hierarchies are related to this cognitive operation.

In the example, an event occurs, in which a golf ball hits the window and breaks it. I will use the transitive version of the verb "break" to describe this event. Naturally, when I want to explain this event in English I say "A golf ball broke the window", or in Turkish *Bir golf topu camı kırdı*, or in German *Eine Golfball brach das Fenster*. Even though these languages differ with respect to their word order (and word order flexibility) and case marking options, there is one common mechanism, namely argument selection, in which the noun "ball" is assigned the higher grammatical status (i.e., assigned subject) and given the $+agr$ status, and/or stays in the inital position in the sentence before the verb, or is marked with the nominative case depending on the language

at hand. There is no grammatical possibility of forming a sentence like "The window broke a golf ball" to describe this event (i.e., in English where there must be a particular word-order). Now let's explore why this might be the case.

The event in which the ball flies and hits the window and breaks it is a causative event. The ball is not and cannot be volitional, but it causes the window to be broken. Thus the LS (as in the SMR approach, Van Valin, 2005) of the verb is:

(62) *do'* (x) CAUSE [BECOME *broken'* (y)]

Here, **do'**(x) indicates that "x" does something (on some entity). This leads to the final form of the LS:

(63) *do'* (ball) CAUSE [BECOME *broken'* (window)]

For now, I will follow such an LS representation, but note that there are a number of other versions to represent the argument structure of the verb with an event representation using "activity" and "state" as the basic predicates (Grimshaw, 1990; Pustejovsky, 1991). The *do'* activity predicate happens to be before the CAUSE operator. Causer "x" precedes the entity "y" (window) that undergoes a change. The order of the **do'**, CAUSE and BECOME is fixed and cannot be changed. In a causative event CAUSE always precedes BECOME. Therefore, accordingly, the left-most (or hierarchically more external) argument in the LS is given the ACTOR role (ball) and the other (more embedded) argument is given the Undergoer role (window). Thus, the relationship between the arguments is reflected on their relative and hierarchical position within the LS.

Now, let us assume that suddenly we saw a golf player walking towards the window, scratching his head, and looking for the owner of the house. The main causer of the event turns out to be the golf player, not the golf ball anymore. This man somehow caused the ball to fly and hit the window, and caused the window to be broken. Now I say "The golf player broke the window with a golf ball." The LS of the verb has to be extended. "The ball" is no longer the subject of the sentence:

(64) *do'* (golf player) CAUSE [[*do'*(ball)] CAUSE [BECOME *broken'* (window)]]

Note that depending on the context and the event, the LS changes. There is not a unique LS structure to describe the transitive form of the verb "break." The LS in the above example shows that the golf player caused the ball to break

the window. The ball became the instrument, and the golf player became the Agent. The Undergoer (window) did not change its original position in the LS (within the BECOME broken' operator). In the LS, there are two CAUSE operators. One of them is embedded within the other one. They follow the do' predicate.[30] Most generally, arguments that are more deeply embedded are lower-ranking than arguments that are less deeply embedded. When there is no embedding, the argument on the left-hand side of a two place predicate is analysed as higher-ranking than the argument on the right-hand side.

The important point here is that, when an agent emerges in the event, the cognitive mechanism automatically puts this Agent into the higher position in the LS (consequently taking the subject position after linking), and "the ball" is given the lower prominence status. "Ball" becomes the Instrument. The living entity is hierarchically superior to the non-living entity (or Agents are superior to Instruments) in taking the higher position in the LS, since they are the main initiator of the event. Thus, there is a hierarchical rule within the cognitive system which assigns particular grammatical functions (or a particular morphosyntactic case) to the participants of the event depending on their positions in the LS (or alternatively their position in the prominence hierarchy or in the thematic hierarchy). This notion is known as "argument selection."

Argument selection can also similarly be driven by the thematic role hierarchy. The LS and thematic structure together form the a-structure, and thematic roles of the arguments must be in-line with (compatible with) the LS: both thematic structure and LS must align the arguments in a similar fashion. Thus thematic structure can also provide some bases for linking.[31] I assume that the most simple thematic role hierarchy, as shown below, exists, and it can be used to derive the thematic nature of the arguments, particularly the thematic distance of the arguments (a concept which will be described in the following sections):

$Agent > Instrument > Experiencer > Stimulus > Theme/Patient$

[30]Note that the first activity predicate *do'* is a "small" do'. This shows that "'The golf player" in (64) or "The ball" in (63) did this action unintentionally. For other types of verbs which have volitionality represented in their LS like "murder," big DO' operator is used:

- Psycho murdered the girl.
  DO' (Psycho) CAUSE [BECOME *die'* (girl)]

The initial do' predicate now becomes DO', indicating that the action is volitional.

[31]Similarly, there is an overlap in the RRG approach between particular thematic roles and the SMRs in some ways (Van Valin, 2005, p. 58). The thematic relations constitute a continium in the LS. Thus, thematic relations can basically be read from the LS (Bierwisch, 1988; Kiparsky, 1989; Wunderlich, 1997).

As with the SMR derivation from the LS, the Actor-Undergoer hierarchy can also be driven from the thematic role hierarchy: the Actor is chosen following from left-to-right and the Undergoer is chosen following from right-to-left. Thus, when the "golf player" emerged in the example above, it gets the Agent thematic role. It is in the higher (left-most) position in the thematic hierarchy than the instrument "golf ball" which gets the Instrument role. Therefore, it is chosen as the Subject. The Undergoer "the window" was the Theme and remained as the Object.

Note that the hierarchy of thematic roles or the embedding of the arguments in the LS follow from certain cognitive regularities; they are not arbitrary selections. Why CAUSE precedes BECOME, or why Instrument precedes Patient has cognitive reasons. In general, an implicit assumption in the LS structure is that the positions of the arguments are derived from the high level cognitive understanding of the events like causal chains, perceptions, volitions, intentions etc. This is given by operators like DO, BECOME, CAUSE in the LS.

Overall, the LS may determine argument linking but it must be compatible and in parallel with the thematic structure. Both of them must make the same predictions for argument linking. Thematic structure is required to determine the final semantic attribution of the arguments after the LS handles linking.

7.3.1 Argument Structure of Object Experiencer Verbs

Some object-experiencer verbs may not obey the general unmarked linking behaviour. For instance, "true-object experiencer verbs" (Jackendoff, 1972) are this type. For these type of verbs, the subject does not outrank the object and thus cannot be passivized. According to this passivization rule, in order to passivize the sentence, object argument must be thematically lower than the subject of the sentence. Thus, some verbs can be considered as "marked" and deviate from standart a-structure, since their logical and thematic nature prevents the syntactic operation "passivize."

The object-experiencer verbs selected in Experiment 3 of the thesis cannot undergo passivization, thereby they can be considered as true-experiencer verbs. Thus, according to Jackendoff's theory, all experiencer verbs I am using here must have a non-causative reading. Assuming a causative reading would obey the subject outranking the object.

On the other hand, it is questionable whether the verbs used in Experiment 3 actually call for a reversal in the hierarchy (in the sense that the object is actually thematically higher ranking than the subject), because the verbs I

used in the experiment have a causative meaning, either by bearing causative morphological marking overtly (-dir/tir-) or having the possibility that the subject can cause the event externally. Even though passivization had been the major test to filter out the marked verbs in English, I suggest that this theoretical motivation for the explanation of such types of verbs may not hold for all languages, particularly for Turkish. Thus, I will keep Jackendoff's (1972) theory as one possible theoretical explanation for the markedness of the object-experiencer verbs in this study. But, what if the object-experiencer verbs I used in Experiment 3 have similar LSs with the active verbs? For instance, both verb tyes allow for a causative reading and can have a similar causative LS structure. Can object-experiencer verbs still be considered as marked? I assume that even though they share similar LS forms, object-experiencer verbs are marked in their "thematic structure." Thus, markedness for these verbs may not be drived from the LS, but from the thematic structure.

Another theory which might be closer to the theoretical claims I make in this chapter comes from Grimshaw (1990). According to her theory, there are two modules in the a-structure (thematic and aspectual modules) in which the aspectual module is dominant if there is a causative reading of the arguments. For instance, the verb "annoy" has an argument structure in which the thematic module has <Stimulus, Experiencer>, and the aspectual module does not have any cause operator. The syntactic operations are then defined according to the thematic module. On the other hand, the verb "frighten" has an aspectual Cause reading which overrides all other thematic hierarchies available for this verb (i.e., <Stimulus, Experiencer>). Thus, the object (Experiencer) is more prominent in the case of "annoy" with respect to the thematic structure which defines the final linking.

Here, I also take the a-structure composed of two modules, similar to Grimshaw (1990), namely the LS module and the Thematic-Role Module. The a-structure of active and object-experiencer verbs will be as follows:

LS: *do'* (x) CAUSE [BECOME *verb'* (y)] for causative reading, and

be' (x, [*verb'*(y)]) for non-causative reading

Thematic Role Module: verb' (Agent, Theme) for active verbs, and

verb' (Agent,Experiencer) or (Stimulus,Experiencer) for experiencer verbs.

I propose that if the verbs under investigation fall under the same aspectual class (i.e., Causative) or have a similar LS, then the thematic difference between the arguments define the linking and linking quality. This will be investigated under $\theta - distance$ theory below.

7.4 Comprehension and Argument Linking

Can the Argument Selection principles be applied during language comprehension? As mentioned above, eADM assumes a similarity and proposes that prominence hierarchies, as mentioned in the previous sections, are used to assign generalized semantic roles (GRs) in language comprehension. GRs then lead to the assignment of $\mp agr$ status to the arguments. The GR precedes agreement assignment. While an argument in the sentence-initial position of a sentence in English is assigned a GR role (i.e., an Actor) which then leads to the assignment of $+agr$ status, the case ambiguous argument in the same position for German only leads to agreement $+agr$ assignment without a GR. The standard assignment of agreement for unambiguous arguments happens such that the Actor is assigned the $+agr$, and the Undegoer is assigned the $-agr$. For instance for German, if the initial argument is unambiguously Nom marked, then it is assigned an Actor role. Position or (unambiguous) case marking is directly used to assign GRs.

7.4.1 Benefits of GR Assignment

There are a number of reasons why GRs are assigned before the verb in an incremental fashion. I think that the general assumption for the existence of GR assignment is that, in most cases, the existence of unmarked linking is assumed. For instance, in most cases (probably as a statistical distribution), arguments of a sentence are thematically very different. Each entity takes a separate role in the transitive event. Objects are generally Patients, or affected entities, and subjects are Agents and in many cases cause certain things to happen. Thus, the most unmarked transitive structure is the one which has separate and distinct thematic attributes for the arguments. Incremental sentence processing may not wait until the verb emerges to make (at least partial) interpretational decisions.

Related to that, another reason for GR assignment may be to help use memory resources efficiently. GRs may help to link arguments to the verb in a better way. Thus I propose that *"GRs may construct distinctive properties of the arguments before the verb in order to aid the simultaneous linking of these arguments."* If we assume that the linking process happens simultaneously in a verb final language, formal (case marking, position), and interpretive (animacy, definiteness) prominence hierarchies will be extensively used to extract the most distinct representation of the arguments in order to prevent interference and confusion.

Thus, there are a number of benefits for using GRs during incremental comprehension. If GRs are assigned to yield maximum aid for linking, I propose that under certain environments, tasks, or discourse contexts, the cognitive mechanism may presuppose that the sentence is favoring a particular event (i.e., causative event) and assigns GRs accordingly. This is to assume that the top-down cognitive mechanism may construct and propose a possible event schema even before the verb is processed. That leads to a process where the GRs are assigned in-line with an unmarked linking situation such that Nom/position1 is assigned the Actor role, and Acc/position2 is assigned the Undergoer role. Unmarked linking is the straight-forward linking of case/position information to the GRs. The LS of the verb matches this assignment such that the right (or most embedded) argument position is allocated to the lowest GR (object) and the leftmost argument is allocated to the highest GR (subject), and these positions also correlate with the position and case marking of the corresponding arguments in the sentence.

7.4.2 Previous Studies on Prominence Hierarchies

Previous electrophysiological measures of sentence processing showed that when the cross-reversal of linking occurs (i.e., Undergoer is assigned the Nominative case on the verb and reverses the pre-GR Actor assignment), an early positivity emerges (Bornkessel et al., 2003) (see Chapters 1 and 2.1). Also, there are a number of fMRI studies where the mismatches between prominence hierarchies in the pre-verbal part of the sentence creates an increased BOLD response in the pars opercularis of the left inferior prefrontal cortex (LIFG) and Superior Temporal Sulcus (STS) with varying degrees of sensitivity to the case, animacy and position of the arguments (Bornkessel, Zysset, Friederici, von Cramon, & Schlesewsky, 2005; Chen, West, & Caplan, 2006; Grewe, Bornkessel, Zysset, von Cramon, & Schlesewsky, 2006). In the following section, I will describe these studies and define what they propose for the incremental interpretation of prominence relations and linking.

Electrophysical evidence for the reversal of standard linking comes from Bornkessel et al. (2002a, 2003) as an early positive component. These types of positivities are related to the "revision of hierarchies" and observed around 300ms post onset of the verb following "unambiguously" marked arguments (see Chapter 2.1). Verbs showing such a non-standard linking in German are dative object-experiencer verbs, in which the object is the experiencer of the

event, and has a higher prominence status.[32] Now let us take a close look at the stimuli used in the Bornkessel et al. (2002a) study:

(65) Ich glaube, dass der Priester dem Gärtner folgt und ...
I believe that the_{NOM} priest the_{DAT} gardner follows and ...

(66) Ich glaube, dass der Priester dem Gärtner imponiert und ...
I believe that the_{NOM} priest the_{DAT} gardner impress and ...

The dative object experiencer verb *imponieren* (to impress) assigns experiencer status to the object (Dat) of the sentence, and makes it more prominent than the subject (Nom) argument, while the active verb *folgen* (to follow) allows for a standard linking where the subject has the higher prominence status. Thus, they deviate from the standard linking options.[33] In their study, Bornkessel, Schlesewsky and Friederici (2002a) observed an early parietal positivity for the dative-object experiencer verbs relative to the dative active verbs and interpreted their result as "revision of hierarchies" during linking of the arguments to the verb. They used both OS and SO orders, but the positivity did not differ with respect to word order. No such effect for case ambiguous arguments was observed. Thus, case marking was the main determinant of the linking.

Thus, the linking condition for the active verbs can be shown as:

$[Actor_{Nom}]$

Note that this representation is not LS representation. It refers to the nature of linking of the LS to the morphosyntax. It is a linking-proper. On the other hand the linking condition for the object experiencer verbs can be shown as:

$[Undergoer_{Nom}]$[34]

[32]Note that, in German, there are also accusative object experiencer verbs which still follow the standard (unmarked) linking. These verbs most probably have a causative component which proposes that the causer (Agent) should be given a subject status. Dative object experiencers are treated differently from accusative object experiencer verbs, because they are considered real object experiencers and they cannot be passivized (Jackendoff, 1972) as mentioned above.

[33]In the recent versions of the model markedness for the dative verbs is expressed as if they have only one Macro Role (Van Valin, 2005) where experiencer verbs revise only the Macro role of the subject from Actor reading to Undergoer reading, because the dative experiencer verb blocks the assignment of Actor to the nominative argument. Dative arguments do not take SMR.

[34]DAT argument is not shown in the linking condition because it does not take SMR (as the RRG approach suggests, Van Valin, 2005). This is a unique condition for the oblique arguments. On the other hand, ACC argument takes an SMR.

In experiencer verbs, the subject is switched in the GR hierarchy, suggesting a marked linking. When the prominence relations between the arguments (that are formed before the verb is processed on the basis of the arguments' lexical properties in combination with case marking) can be straightforwardly mapped onto the argument hierarchy in the LS (which considers case as the linking proper in the example above), then the linking of argument-to-predicate is easier and costless. By contrast, when there is a conflict between the different hierarchies, linking cost increases.

Also note that for languages (like English) in which relative ordering of the arguments is more important for the LS, linking is established via positional information. Thus, the LS might have a linking condition like:

$[Actor_{Pos1}, Undergoer_{Pos2}]$

Even though Turkish uses case marking extensively, SOV word order is the basic and preferred word order. Word order information might be the main determinant of argument linking. Such possibilities (position vs. case marking determining the linking proper) were investigated for different languages, and it was shown that either position or case determines the assignments of prominence features onto the arguments (Bornkessel & Schlesewsky, 2006). I will investigate such possibilities in the coming sections.

Furthermore, a series of experiments using functional magnetic resonance imaging (fMRI) has revealed increased activation in the pars opercularis of the left inferior frontal gyrus (LIFG) (i.e., a core subregion of Broca's area) as well as the Superior Temporal Sulcus (STS) when the relative prominence of two arguments did not correspond to their linear order or case marking, i.e., when the less prominent argument preceded the more prominent argument or nominative argument is used for the lower ranked argument. This pattern had been observed for all of the prominence hierarchies individually: animate $>$ inanimate (Grewe et al., 2006);[35] specific/definite $>$ non-specific/indefinite (Bornkessel-Schlesewsky, Schlesewsky, & von Cramon, submitted); $+Actor > -Actor$ (Bornkessel et al., 2005); +agrt $>$ - agrt (e.g., Röder, Stock, Neville, Bien, & Rösler, 2002). These findings suggest that both linear order and case marking can be important determinants of language comprehension and linking, and the brain may use both to differing degrees. For instance, the LIFG may consider linear order and unmarked word order options in a language, while the posterior STS may be responsible for language-particular information (i.e.,

[35]In this study unambiguous NPs were used in which the subject was either animate or inanimate while the object was always animate as it was the case in Experiment 3. When the inanimate subject preceded the animate object, the pars opercularis (LIFG) showed an increased activity relative to the animate object preceding the inanimate subject.

case marking). Thus, all the prominence hierarchies, case marking and positional information must be taken into account when a sentence is processed.

Finally, recent neuroimaging results from English suggest that the application of prominence hierarchies during sentence comprehension is not restricted to languages with a relatively free word order. Chen, West, and Caplan (2006) observed a modulation of the activation difference for object- vs. subject-relative clauses in the pars opercularis as a function of the animacy hierarchy. In their study, they compared sentences (a) in which the subject of the relative clause turns out to be inanimate and the object is animate (e.g.,, "The golfer that the lightning struck ...") to sentences (b) in which the object turns out to be the inanimate and subject is animate (e.g.,, "The wood that the man chopped ..."). There were also sentences (c) in which the non-relativized versions of these sentences were used (e.g.,, "The lightning struck the golfer ..."). Chen et al. found that sentences as in (a) showed higher BOLD activation than the sentences in (b) and (c) conditions in the left inferior frontal gyrus (LIFG). The main processing cost here is not the sole assignment of grammatical subject role (or $+agr$) to the inanimate argument, but a conflict between $\mp agr$ and $\mp animacy$ hierarchies in the "pre-verbal" part of the sentence. The relational information between two arguments may either ease the linking or create a processing cost for linking. Interestingly, this finding might indicate that holding marked structures in working memory (which may be responsible for the final linking on the verb) is costly. If the linking of the pre-GRs and agreement information to the verb is simultaneous, then the pre-verbal marked forms (either as OSV or prominence mismatch) may make linking more effortful.

In fMRI studies, the temporal resolution is very low, and the BOLD activation is generally measured within a 5-6 second time window. Thus, it is very difficult to figure out exactly when in the sentence the processing cost emerges. It may be either before the verb is processed or during the linking. Thus, ERP studies provide a better temporal resolution and polarity information which have functional relevance in the interpretation of the experimental findings.

7.4.3 What is Missing in the Picture: New Questions and the Influence of Animacy

While the application of the different prominence hierarchies during sentence comprehension appears well established, the precise way in which these hierarchies interact during argument linking is presently not clear. For example, it is possible that all relevant hierarchies interact directly. It may also be the case, however, that the different information types apply in a hierarchically ordered way. Previous ERP studies used one type of hierarchy (word order or

case marking) at the same time, and did not manipulate multiple hierarchies simultaneously. The present study aimed to shed further light on this question by examining the interaction of different prominence hierarchies during on-line sentence comprehension in Turkish. For instance, animacy, word order and definiteness are included in this study to understand how arguments linked to verbs having different a-structures.

On the other hand, previous studies which used unambiguous arguments only questioned the crosslinking (and reversal of the hierarchies) of the arguments on the verb. There is no study showing what happens if there is no reversal of hierarchies but a new arrangement of thematic attributes of the arguments is required (because of a deviation from the standard Agent-Patient thematic role assignment). In this study, the thematic structure of the arguments was varied. I manipulated the thematic distance (within the thematic hierarchy) between the arguments of the verb in order to understand how linking may be influenced by the thematic distance between the arguments of the verb. Thus, the object experiencer verbs can be regarded as having marked a-structures, either because they have reversed GR assignment (in-line with Jackendoff's (1972) proposal classifying these verbs as having opposite GR alignment, and hence cannot be passivized), or they are causative but differ with respect to their thematic structures which deviate from unmarked Agent-Theme form.

7.4.4 $\theta - Distance$ Theory

As mentioned above, the standard thematic structure will be taken as the one in which the arguments are positioned as Agent-Theme. Thematic structure coded in the a-structure deviating from this standard allocation will be considered marked to varying degrees. I develop a theory called "θ-Distance Theory," in which distance represents the thematic distance (or θ-Distance) between the arguments in the thematic hierarchy as shown above. The closer the distance, the more marked the verb becomes and the linking becomes more difficult. For instance, Agent-Theme has longer θ-Distance from the Agent-Experiencer because in the former, Theme is lower than (falls on the right of) the Experiencer in the thematic hierarchy.

In the θ-Distance theory, there are two possibilities for expressing object experiencer verbs. One is to use Agent-Experiencer thematic structure (67), giving rise to a Causative reading, and the other is to use Experiencer-Stimulus thematic structure (68), giving rise to an Experiencer reading. Both representations have smaller θ-Distances compared to Agent-Theme form. Thus, (67) is only thematically marked, while (68) is both logically and thematically marked. Agent-Experiencer does not require reversal (since Agent is Subject/Nom and

Theme is Object/Acc). On the other hand, an unmarked linking situation (69) for active verbs is one in which the Agent-Theme is dominant, and has longer θ-Distance. Thus, this a-structure is totally unmarked. Note that, the thematic distance in the unmarked argument structure may be responsible for a "distinct" representation between the arguments which may ease the linking process. Thus, argument structure of the verbs may involve processing-related cost emerging from their underlying θ-Distance.

(67) Object-Experiencer Verbs having Agent-Experiencer (Causative) Thematic structure (Marked only via thematic distance):

Agent > Experiencer > Stimulus > Theme /Patient
Actor <———>Undergoer

(68) Object-Experiencer Verbs having Stimulus-Experiencer (Experiencer) Thematic structure (Marked via both thematic distance and crossed linking). Note that this time a-structure also requires the LS to be non-causative:

Experiencer > Stimulus > Theme /Patient
Undergoer<———>Actor

(69) Active Verbs having Agent-Theme (Causative) structure (Unmarked linking):

Agent > Experiencer > Stimulus > Theme /Patient
Actor <————————————————->Undergoer

Thus, in the marked linking situation, pre-GRs are reversed and/or the θ-Distance between the arguments is close, thus making the linking costly, probably because it is not easy to differentiate the relation between the argument which causes interference, or structuring of the GRs is difficult. If θ-Distance is the final determinant of linking when LSs are the same for both verb types, then posterior negativity (N400) will be observed for the object experiencer verbs for all conditions. Existence of N400 will also support the θ-Distance theory (with or without a crossed linking situation). If cross-linking happens, N400 and early positivity may emerge simultaneously.

7.4.5 Turkish as a Test Case for the Interaction of Prominence Hierarchies

In parallel with the previous findings on Turkish grammar and the place of different prominence hierarchies (definiteness, animacy and word order as was shown in the Corpus counts (Chapter 6) and the Turkish chapter (Chapter 3), in this section I would like to summarize the main assumptions about Experiment 3. Turkish is particularly interesting for the investigation of prominence hierarchies because it has a clear morphological reflex of the definiteness/specificity hierarchy.

As mentioned in the previous sections of the thesis, Turkish shows a direct morphological manifestation of the definiteness/specificity prominence hierarchy. As example (70) (from Erguvanlı, 1984, p. 22) shows, pre-verbal argument order is free when the object is highly referential and specific, i.e., an object-before-subject word order is possible:

(70) Kitabı Murat okuyor
book-ACC Murat read-PROG
Murat is reading the book

By contrast, word order permutations are not permitted with unmarked objects:

(71) (a) Mutluluk huzur getirir
happiness peace-of-mind bring-aor
Happiness brings peace of mind. (∗Peace of mind brings happiness)

(b) Huzur mutluluk getirir
peace-of-mind happiness bring-aor
Peace of mind brings happiness. (∗Happiness brings peace of mind) (from Erguvanlı, 1984, p. 5)

At first glance, preference for a default word order might appear to stem from an ambiguity effect, i.e., such that order is used to indicate which argument is the subject and which is the object when case marking is not available to fulfill this function. However, example (72) shows that this is not the case: here, an object-initial order is impossible despite the accusative case marking of the object. In contrast to example (70) above, the object in (72) is indefinite as indicated by the marker *bir* (i.e., it is interpreted in the sense of "a certain book").

(72) ∗Bir kitabı Murat ok-uyor
one book-ACC Murat read-PROG
(from Erguvanlı, 1984, p. 22)

Example (72) therefore shows that word order freezing is not a function of (the absence of) case marking. Rather, this phenomenon occurs when the definiteness/specificity hierarchy is not respected, i.e., when the initial object is not both definite and specific.

Also, Turkish shows an interesting interdependence between definiteness/specificity and animacy. Animate (or at least +human) nouns are inherently interpreted as specific, whereas inanimate nouns are not (Çağrı, 2005; Erguvanlı, 1984; see the specificity hierarchy in Chapter 3). This is also reflected in word order facts: whereas inanimate indefinite subjects (are not inherently specific and) must be left-adjacent to the verb (73b), animate indefinite subjects (are inherently specific and) show no such positional restriction (73d). Example (73a) further shows that the unacceptability of (73b) must be due to word order.

(73) (a) Gökyüzünden bir yıldız kaydı.
sky-ABL one star slid
A star slid through the sky.

(b) *Bir yıldız gökyüzünden kaydı.
one star sky-ABL slid
A star slid through the sky.

(c) Merdivenden bir kadın kaydı.
stair-ABL one woman slid
A woman slid from the stairs.

(d) Bir kadın merdivenden kaydı.
a woman stair-ABL slid
A woman slid from the stairs.

As the examples in (73) show, order restrictions applying to indefinite subjects can be overridden by animacy. Thus, definiteness/specificity and animacy are closely intertwined in Turkish. It might therefore be the case that these two hierarchies reinforce one another, thereby becoming a particularly important source of prominence information during on-line comprehension.

In summary, given the exceptional status of definiteness/specificity in Turkish and its interaction with animacy, I propose that this language is optimally suited to an examination of how different prominence hierarchies interact in on-line comprehension. The present study was therefore designed to examine the interaction of definiteness/specificity and animacy with the agreement and the actorhood hierarchies in determining argument linking at the position of the verb.

7.5 Experiment 3(a): ERP Study

In accordance with the main question of the present study (i.e., How do prominence hierarchies affect argument linking at the position of the verb?), I employed a $2 \times 2 \times 2$ design involving the factors word order (ORDER; subject-before-object vs. object-before-subject), verb type (VERB; active vs. object-experiencer), and animacy (ANIM; $subject = animate$ vs. $subject = inanimate$). The eight critical conditions resulting from this design are shown in Table 7.1. As is apparent from the table, all of the critical structures in the study were verb-final, thereby allowing for the examination of the interaction of the different prominence hierarchies at the position of the verb, i.e., at the point of argument linking. Below, I will describe how the experimental design manipulates the prominence hierarchies of interest. Note that as a reference, I will use word-order to describe whether a certain prominence hierarchy holds.

First, the word order manipulation in Table 7.1 essentially corresponds to a manipulation of the agreement hierarchy, i.e., in the nominative-initial sentences (A-D), the hierarchy $+agrt > -agrt$ is respected (the argument that agrees with the verb precedes the non-agreeing argument), while this is not the case in the accusative-initial sentences (E-H).

Second, the variation of verb type leads to a manipulation of the actorhood hierarchy. Whereas the active verbs (A, B, E, F) call for a prototypical Actor-Undergoer (Agent-Theme) relation in which the accusative argument is physically affected by an action of the nominative argument. The object-experiencer verbs (C, D, G, H) depart from this hierarchy because of the Experiencer status of the accusative argument (either by the Stimulus-Experiencer reversed/marked hierarchy or the Agent-Experiencer shorter/marked thematic structure as explained above).

Third, animacy was varied such that either both arguments were animate (A, C, E, G) or the nominative argument was inanimate and the accusative argument was animate (B, D, F, H). In the first case, the animacy hierarchy (animate $>$ inanimate) does not hold and the arguments are semantically very

Condition	Sentence and Meaning
A. Subj-initial anim-active	Dün kız adamı destekledi. Yesterday the girl supported the man. Yesterday girl man-Acc supported-3s
B. Subj-initial inanim-active	Dün firma adamı destekledi. Yesterday the company supported the man. Yesterday company man-Acc supported-3s
C. Subj-initial anim-object-exp	Dün kız adamı cezbetti. Yesterday the girl pleased the man. Yesterday girl man-Acc pleased-3s
D. Subj-initial inanim-obj-exp	Dün firma adamı cezbetti. Yesterday the company pleased the man. Yesterday the company man-Acc pleased-3s
E. Obj-initial anim-active	Dün adamı kız destekledi. Yesterday the girl supported the man. Yesterday man-Acc girl supported-3s
F. Obj-initial inanim-active	Dün adamı firma destekledi. Yesterday the company supported the man. Yesterday man-Acc company supported-3s
G. Obj-initial anim-obj-exp	Dün adamı kız cezbetti. Yesterday the girl pleased the man. Yesterday man-Acc girl pleased-3s
H. Obj-initial inanim-obj-exp	Dün adamı firma cezbetti. Yesterday the company pleased the man. Yesterday man-Acc company pleased-3s

Table 7.1: Critical conditions in the present study

similar (sharing similar animacy features). In the sentences with an animacy distinction, the animacy hierarchy is respected only in the sentences with an accusative-initial order (F, H) ($Anim_{Acc} > Inanim_{Nom}$) but not in the sentences with a nominative-initial order (B, D) ($Inanim_{Nom} > Anim_{Acc}$).

Finally, because of the close relation between animacy and definiteness /specificity in Turkish, the definiteness / specificity hierarchy mirrored the animacy hierarchy in the present experiment. This was the case because the marking of accusative objects (and thereby their specificity) could not be manipulated directly in the current materials, as accusative object-experiencer verbs require a referential and specific (i.e., case marked) object (Çağrı, 2005). Only the animacy of the nominative argument was manipulated because the object-experiencer verbs used require an animate accusative argument. Thus, as motivated by the animacy manipulation above, a full crossing of all factors in grammatical sentences was only possible with overtly case-marked accusatives. The definiteness/specificity hierarchy is therefore respected whenever the animacy hierarchy is respected (i.e., when an animate, specific accusative object precedes an inanimate, indefinite nominative subject; F, H) and violated whenever the animacy hierarchy is violated (i.e., when an inanimate, indefinite-specific nominative subject precedes an animate, specific accusative object; B, D).[36] When there was no distinction in animacy, there was also no distinction in specificity because of the inherent +specific interpretation of human arguments (A, C, E, G), both arguments are considered definite. Given this parallelism between animacy and definiteness/specificity in the critical conditions, I may expect these two hierarchies to reinforce one another, thereby leading to a particularly strong effect. The distribution of the different prominence hierarchies in the critical stimuli is summarised in Table 7.2.

I will follow the notation where position (or precedence) will be used to indicate the mapping between the prominence hierarchies. For instance, in the $\mp$ anim and $\mp$ agrt columns, a "+" indicates that the hierarchy is respected in the sentence condition in question (i.e., that the more prominent argument according to the hierarchy precedes the less prominent argument in terms of linear order), whereas a "−" indicates that the hierarchy is not respected. A ϕ signals that the two arguments do not differ with respect to the prominence hierarchy under consideration. "Unmarked linking" refers to whether verbs call for a prototypical argument linking situation ($subject \equiv actor > object \equiv undergoer$; active verbs) or diverge from this type of unmarked linking (object-experiencer verbs).

[36]Note that I did not use the *bir* indefinite marker for any of the NPs. Thus, in the sentence-initial position, inanimate subjects without *bir* will be more specific than the ones having *bir* but both will be less specific than the following case marked animate argument.

Condition	∓anim/ ∓def/spec	∓agrt	unmarked linking
$A.NOM_AACC_AV_{ACT}$	ϕ	+	+
$B.NOM_IACC_AV_{ACT}$	−	+	+
$C.NOM_AACC_AV_{OEXP}$	ϕ	+	−
$D.NOM_IACC_AV_{OEXP}$	−	+	−
$E.ACC_ANOM_AV_{ACT}$	ϕ	−	+
$F.ACC_ANOM_IV_{ACT}$	+	−	+
$G.ACC_ANOM_AV_{OEXP}$	ϕ	−	−
$H.ACC_ANOM_IV_{OEXP}$	+	−	−

Table 7.2: Predicted distribution of prominence information in the critical conditions. Note: In Table 7.2, the abbreviations are as follows: NOM: nominative (subject); ACC: accusative (object); A: animate argument; I: inanimate argument; ACT: active verb; OEXP: object-experiencer verb; ∓ anim: animacy prominence hierarchy (+animate > -animate); ∓ def/spec: definiteness/ specificity prominence hierarchy (+definite/specific > -definite/specific); ∓ agrt: agreement prominence hierarchy (+agreement > -agreement).

As outlined above, the positions of interest in all critical sentences were preverbal prominence hierarchy mismatch points and the clause-final verb, because the impact of the prominence hierarchies upon argument linking should manifest itself at the verbal position. In addition, as the sentence status with respect to unmarked linking critically depends upon the a-structure of the verbs, the impact of this information only becomes apparent when the verb is linked to the arguments. One potential problem arising in this regard is that differences with respect to linking may be associated with lexical differences. The main effects of verb could therefore either be indicative of a main effect of linking difficulty or could simply reflect lexical differences (semantics, frequency etc.). In order to control for the latter, I introduced additional sentence conditions with a verb-initial order (which is also possible in Turkish), which would allow comparison of ERP responses to active and object-experiencer verbs at a point in the sentence at which no arguments have been processed. Two verb-initial conditions are illustrated in (74) using subject-initial sentences with two animate arguments (VS_AO_A). Note, however, that word order and animacy were also counterbalanced in these structures (the Materials section describes this in detail).

(74) (a) Dün destekledi kız adamı.
Yesterday support-PST-3s girl man-Acc
Yesterday the girl supported the man.

(b) Dün cezbetti kız adamı.
Yesterday please-PST-3s girl man-Acc
Yesterday the girl pleased the man.

7.5.1 Assumptions and Hypotheses

I will summarize a number of assumptions that were made in the previous sections in this chapter. Then, I will develop particular hypotheses that depend on these assumptions.

7.5.1.1 GRs are Assigned to Ease Linking

As mentioned above, the main function of pre-GRs might be to ease linking. On the other hand, when there are semantically distinct arguments (animate vs. inanimate), pre-GR assignment may not be the determinant for the ease of linking, since the animacy difference will be a good enough cue to provide easy linking. Here the main assumption is that the linking of the arguments is not only initialized by the LS of the verb, but also with the thematic structure of the verb. This is possibly the case, because overlapping semantic features may make it difficult for the comprehension system to differentiate the arguments from each other. Case marking and position may provide ways to establish linking with the LS to locate the arguments, but the LS does not contain the thematic roles that are eventually mapped to the arguments. Thus, interactions will only be observed for the conditions in which two animate entities exist.

7.5.1.2 θ-Distance may cause a negative component, while Crossed-Linking may cause a positive component

Most generally, I expect to observe a modulation of ERP effects at the position of the verb when argument linking becomes more difficult. This should be the case when different prominence hierarchies are in conflict with one another as well as when the argument structure of the verb proposes a marked linking (deviation from typical Agent-Theme thematic structure or reversed LS). The contrast between active and object-experiencer verbs can be used as a diagnostic tool for this type of linking difficulty, because the latter calls for a linking that deviates from a prototypical (subject)-Actor and (object)-Undergoer interpretation as reflected on the deviation from standard transitive structure as described above.

By contrast, if these verbs call for a reversal of the thematic hierarchy [i.e., such that the (object) experiencer outranks the (subject) stimulus], I expect to observe an ERP correlate of an argument dependency reversal, namely an early (200-600 ms) parietal positivity in-line with the hypothesis developed in previous studies (Bornkessel et al., 2002a, 2003). This will support crossed LS represenatation for the object-experiencers, but the $\theta - Distance$ is still short (by $Experiencer - Stimulus$ thematic role assignment by the argument structure) and can still influence linking. If the object-experiencer verbs lead to increased linking costs (with or without a GR reversal), I should observe N400 modulations via marked thematic structure which proposes shorter $\theta - Distance$. As mentioned in the previous sections, I expect these verbs may not show reversal of GRs, because the causative reading is possible.

Note that, in this experiement I use unambiguous arguments, manipulate the thematic distance of the arguments, and assume that the verbs have similar LSs. Also, I manipulate the animacy of the subject argument which was not the case in the previous studies (Bornkessel et al., 2003).

The effects of the different prominence hierarchies on argument linking should be expected to manifest themselves as modulations of the verb type effect. Here, the question of which information types interact will be informative with respect to the relative importance of the different prominence hierarchies in on-line comprehension in Turkish.

One thing to note here is that it has been observed that under canonical word order (SOV) in German complement clauses, accusative object-experiencer verbs showed an N400 like component relative to the active accusative verbs (Bornkessel, 2002). Accusative object-experiencers in German imply dominantly causative meaning, in which the Actor causes an effect on the Undergoer argument. On the other hand, these verbs can also be used as non-causative (like dative object experiencers), thus are ambiguous between Agent-Experiencer vs. Experiencer-Stimulus readings. The negativity observed for the accusative object-experiencers in this study was independent of the previous context biasing causation. It was hypothesised that the cause of the negativity was the ambiguity these verbs bore. Turkish accusative object experiencer verbs used in this study imply causative meaning dominantly, but it is also possible that they may have non-causative meaning (as mentioned above, by having Experiencer-Stimulus arguments).

I think rather than an ambiguity-related explanation, $\theta - Distance$ theory can explain this finding more accurately. First, the N400 effect on the accusative experiencer verbs was independent of the causative context. $\theta - Distance$ theory suggests that, independent of the causative LS structure (or causative reading of the verb), the thematic structure of these verbs would be marked

(and would have shorter theta distance). This will cause N400 during linking. Second, in the German study, the lexical differences between the verb types were not controlled, where such differences might have also caused the ERP difference. In Experiment 3, I am manipulating the position of the verb (putting the verbs in the sentence-initial vs. final position), thus it is possible for me to evaluate the effects related to the linking independent of the lexical factors. Only if the negativity persists independent of word order and verb position for the experiencer verbs in Experiment 3, can I claim that the ambiguity might be one of the possible explanations for the effect observed for these verb types.

7.5.1.3 Testing Case-Marking vs. Word-Order Based Linking Options for Turkish

The last section before the presentation of Experiment 3 will be about linking-proper. Default linking-proper in German is case marking. The linking condition is formed as:

$[Actor(x)_{NOM/+Agr}, Undergoer(y)_{ACC/-Agr}]$

Only when the arguments are ambiguous, position based linking is the default option. If dependency relations in Turkish are established extensively on the basis of case marking (i.e., if nominative arguments are always analysed as more prominent than accusative arguments), I expect to observe a main effect of VERB independent of word order and animacy. In all conditions having experiencer verbs, there will be a linking cost, either as early positivity or N400.

In this case, it may not matter which order the arguments are aligned, because the case may be the major determinant of linking. Thus, object-experiencer verbs should always lead to additional processing cost (either in the form of an early positivity or an N400) because they invariably call for a deviation from the case-based prominence relations established prior to the verb (thematically or logically or both). This effect should be distinguishable from any (lexically-driven) main effects of VERB observable for the verb-initial sentences (74). Then any word order (SO and OS conditions in Table 7.2) will equally show the same effect on the verb.

Even though Turkish uses case marking exclusively, it has SOV default word order which indicates that word order may play a crucial role in LS representation and constructing prominence hierarchies. If both word order and case are

effective, SO and OS orders will have different impacts on linking. If the first argument (in terms of linear order) is always analysed as more prominent than the second argument (via position), we should observe an interaction between VERB and ORDER. Linking proper of the active verb will be as follows:

$[Actor(x)_{Pos1/+Agr}, Undergoer(y)_{Pos2/-Agr}]$

Thus, scrambled word orders will reveal (a) whether word order has an impact on linking, and (b) whether different processing preferences exist for different types of verbs under such conflicting and complex environments.

7.6 Materials and Methods

7.6.1 Participants

After giving informed consent, twenty-four participants (13 females and 11 males) from the Turkish community of Berlin took part in the experiment. Their mean age was 27.5 years with a range of 20-40. Nineteen of them were native speakers of Turkish (9 females and 10 males) and 5 of them were bilinguals of Turkish-German (family language Turkish but learned German simultaneously during early phases of their childhood). All participants were right handed and had normal or corrected-to-normal vision. One further participant was excluded due to excessive EEG artefacts.

7.6.2 Materials

Sentence materials were constructed on the basis of 72 adverb - noun(animate) - noun (animate/inanimate) - verb (agentive/object-experiencer) combinations, which were used to generate sentences as in Table 7.1 . All adverbs were sentential-temporal [e.g., *dün*, yesterday; *dün gece* last night]. The animate nouns were human common nouns (e.g., *yüzücü*, swimmer; *ressam*, painter), while the inanimate nouns were nouns like *şirket* (company), *radyo* (radio), and *rüşvet* (bribery). A total of 9 different active and 9 different object-experiencer verbs were used. Repetitions of individual verbs was thus kept constant across verb types and across conditions. All verbs were in the past tense. For the active verbs (which can be passivized), I used verbs *bayılttı* (caused to faint), *destekledi* (supported), *durdurdu* (stopped), *engelledi* (prevented), *korudu* (protected), *kışkırttı* (provoked), *sakatladı* (injured), *susturdu* (silenced) and *zehirledi* (poisoned), while the object-experiencer verbs (which

cannot be passivized) were *bıktırdı* (bored), *bezdirdi* (annoyed), *usandırdı* (sickened), *cezbetti* (pleased), *coşturdu* (enthused), *dertlendirdi* (made sorrowful), *hislendirdi* (made emotional), *şaşırttı* (surprised) and *bunalttı* (frustrated). Translations of all other experimental material can be seen in Appendix B. All verbs were compatible with both an animate and an inanimate subject, but object verbs required an animate object. Some of the active verbs could also be used with inanimate objects (e.g., "silenced the room" or "prevented an accident") but they were preferenially used with animate objects in the experiment.

In addition, verb-initial sentences were constructed on the basis of the same lexical materials. Four verb-initial conditions were created: (a) active verb, VSO order; (b) object-experiencer verb, VSO order; (c) active verb, VOS order; (d) object-experiencer verb, VOS order. Within each of these conditions, animacy was manipulated as a subfactor, i.e., half of the sentences included two animate arguments and the other half included an inanimate nominative and an animate accusative. These manipulations of order and animacy in the verb-initial sentences were undertaken in order to ensure that the ratio of subject-initial to object-initial sentences and of sentences with and without animacy distinctions would remain balanced (i.e., 1:1 in each case).

576 verb-final sentences (72 item sets x 8 conditions) and 576 verb-initial sentences (72 item sets x 8 conditions) were generated. 4 lists were created such that in each list there were a total of 432 sentences: 288 sentences from verb-final conditions (72 item sets x 4 conditions) and 144 sentences from verb-initial conditions (36 item sets x 4 conditions). Two lists had the same verb-final sentences as the other two had the rest, but each list had different verb-initial sentences so that the items and the conditions were equally distributed among subjects. Each list was presented in randomised order and the presentation of lists was counterbalanced across participants.

7.6.3 Procedure

Sentences were presented word-by-word in the centre of the screen with a presentation time of 600 ms per segment and an inter-stimulus-interval (ISI) of 200ms [note that adverbs composed of two words like *dün gece* (last night) were presented as one segment]. These presentation times were chosen due to the morphological complexity of Turkish and were perceived as a comfortable reading rate by participants. Each trial began with the presentation of an asterisk (1000ms plus 200ms ISI) and ended with a 1000ms pause, after which participants completed a comprehension task. This task involved judging whether a comprehension question correctly described the content of the

preceding sentence or not. Questions required the answer yes in 50% of trials and the answer no in the other 50%. Incorrect questions involved a substituted lexical item (subject, object, adverb or verb). Participants answered the question by pressing one of two buttons and they were given 3500ms to respond. The assignment of the left and right buttons to yes and no responses was counterbalanced across participants.

Participants were asked to avoid eye movements and only blink their eyes between the onset of the comprehension task and the presentation of the asterisk preceding the next sentence. Before the main session, 14 additional sentences were presented as a practice session. The presentation of the sentences was carried out in eight blocks of 54 sentences. A session lasted approximately 3.5 hours including electrode preparation.

7.6.4 EEG Recording

The EEG was recorded by means of 25 AgAgCl-electrodes, which were fixed to the scalp by means of an elastic cap (Electro Cap International). AFZ served as the ground electrode. Recordings were referenced to the left mastoid, but re-referenced to linked mastoids offline. In order to control for artefacts resulting from eye movements, the horizontal and vertical electro-oculogram (EOG) was monitored from electrodes at the outer canthi of the eyes and from electrodes above and below the participant's right eye. Electrode resistances were kept below 5kΩ. All EEG and EOG channels were amplified using a Twente Medical Systems DC amplifier and recorded with a digitization rate of 250 Hz.

7.6.5 Data Analysis

For the critical verb-sentences, the statistical analyses for the comprehension task (accuracies and reaction times) were carried out by means of repeated measures analyses of variance (ANOVA) comprising the within-participant factors word ORDER (subject-before-object vs. object-before-subject), ANIMacy (animate vs. inanimate subject) and VERB (active vs. object-experiencer). Participants and items were included in the analysis as random factors (F1 and F2, respectively). Additional analyses for the verb-initial sentences are also reported in the section following the verb-final conditions.

The EEG data were filtered off-line with a 0.3-20 Hz bandpass filter. Trials containing ocular or other artefacts were excluded from further analysis as were trials for which the comprehension task had not been performed correctly. ERPs were calculated from -200 to 1000ms relative to critical stimulus onset

per condition and participant, before grand average ERPs were calculated over all participants. For the statistical analysis of the ERP data, repeated measures ANOVAs comprising the factors ORDER, ANIM and VERB were calculated for the critical verb position for mean amplitude values per time window per condition. Also, similar analyses were conducted for the NP1 and NP2 of the verb-final sentences as well as for the verbs in the verb-initial conditions. These analyses were reported after the analysis of verb-final conditions. Lateral and midline electrodes were analysed separately, with each analysis including the additional topographical factor region of interest (ROI). For the lateral electrodes, ROIs were defined as follows: left-anterior: F3, F7, FC1, FC5; left-posterior: CP1, CP5, P3, P7; right-anterior: F4, F8, FC2, FC6; right-posterior: CP2, CP6, P4, P8. For the mid-line electrodes, the factor ROI comprised the following six levels: FZ; FCZ; CZ; CPZ; PZ; POZ.

7.7 Results

7.7.1 Behavioural Results

7.7.1.1 Verb-final Conditions

Table 7.3 shows by-participant means and standard deviations for the error rates and reaction times for the comprehension task for the verb-final conditions. For the error rates, the statistical analysis revealed a main effect of ANIM ($F1(1,23) = 15.25, p < 0.001, F2(1,71) = 6.16, p < 0.05$), which was due to higher error rates for the conditions with two animate arguments. For the reaction times, the statistical analysis showed a main effect of ORDER ($F1(1,23) = 18.30, p < 0.001, F2(1,71) = 6.58, p < 0.05$): object-initial conditions engendered longer reaction times than subject-initial conditions.

7.7.1.2 Verb-Initial Sentences

Mean error rates and reaction times elicited by the behavioural task by the verb-initial sentences are shown in Table 7.4. For both the error rates and the reaction times, a repeated measures ANOVA revealed no significant effects.

7.7.2 ERP Results

In this section I have three subsections. In accordance with the main hypotheses, I examined ERP responses at the position of the verb in the verb-final

Condition	Accuracy (%)	RT (ms)
$A.NOM_AACC_AV_{ACT}$	93.5(24.4)	1494 (473)
$B.NOM_IACC_AV_{ACT}$	95.0(21.7)	1490(457)
$C.NOM_AACC_AV_{OEXP}$	92.5(26.3)	1479(470)
$D.NOM_IACC_AV_{OEXP}$	93.8(24.0)	1514(476)
$E.ACC_ANOM_AV_{ACT}$	93.0(25.4)	1543(503)
$F.ACC_ANOM_IV_{ACT}$	93.6(24.5)	1514(488)
$G.ACC_ANOM_AV_{OEXP}$	91.3(28.0)	1569(498)
$H.ACC_ANOM_IV_{OEXP}$	94.5(22.7)	1520(469)

Table 7.3: Mean accuracy rates (%) and reaction times (ms) for the comprehension task in the present study. Standard deviations (by participants) are given in parentheses.

Condition	Accuracy (%)	RT (ms)
$A.V_{ACT}NOM_AACC_A$	93.2(25.1)	1518 (493)
$B.V_{ACT}NOM_IACC_A$	92.2(26.7)	1550(505)
$C.V_{OEXP}NOM_AACC_A$	92.0(27.0)	1591(511)
$D.V_{OEXP}NOM_IACC_A$	92.8(25.8)	1517(480)
$E.V_{ACT}ACC_ANOM_A$	95.1(21.6)	1596(555)
$F.V_{ACT}ACC_ANOM_I$	95.1(21.5)	1512(490)
$G.V_{OEXP}ACC_ANOM_A$	93.9(23.8)	1562(522)
$H.V_{OEXP}ACC_ANOM_I$	94.5(27.3)	1549(492)

Table 7.4: Mean accuracy rates (%) and reaction times (ms) for the comprehension task in the verb-initial sentences. Standard deviations (by participants) are given in parentheses.

sentences to explore linking. This analsysis is reported in the first section. ERP effects for active vs. object-experiencer verbs in the verb-initial sentences are reported in the second section in order to investigate whether the differences between the verb types were not lexically driven. ERP responses to other positions (NP1, NP2) in the verb-final conditions are reported in the last section in order to analyse prominence mismatches in the pre-verbal part of the sentence. Note that the experimental design was not fully crossed prior to the verb (e.g., at NP1, the factor animacy can only be examined for the subject-initial conditions, whereas the factor case marking (nominative vs. accusative) can only be examined for animate arguments), thus it constrains the hypothesis related to the pre-verbal prominence processing.

7.7.2.1 Verbs in the Verb-final Conditions

Grand average ERPs at the position of the clause-final verb are shown for sentences with two animate arguments and sentences with inanimate subjects in Figures 7.1 and 7.2, respectively.

Figure 7.1 shows the grand average ERPs at the position of the verb (onset at the vertical bar) for sentences with two animate arguments (conditions A, C, E and G in Table 7.1). The figure contrasts ERP responses to active verbs and object-experiencer verbs for sentences with a subject-before-object order (Panel A) and sentences with an object-before-subject order (Panel B). The enlarged electrode provides a direct comparison of all four animate conditions. Negativity is plotted upwards. Abbreviations used in this figure are as follows: SO: subject-before-object; OS: object-before-subject; ACT: active verb; EXP: object-experiencer verb.

Figure 7.2 shows the grand average ERPs at the position of the verb (onset at the vertical bar) for sentences with an inanimate subject and an animate object (conditions B, D, F and H in Table 7.1). The figure contrasts ERP responses to active verbs and object-experiencer verbs for sentences with a subject-before-object order (Panel A) and sentences with an object-before-subject order (Panel B). The enlarged electrode provides a direct comparison of all four inanimate conditions. Abbreviations used in this figure are as follows: SO: subject-before-object; OS: object-before-subject; ACT: active verb; EXP: object-experiencer verb.

Visual inspection of Figures 7.1 and 7.2 suggests that there are two different types of effects at the position of the verb. First, in the animate conditions (Figure 7.1), active verbs show an early negativity in the sentences with object-initial order which reached almost equal amplitudes (peak values) later on. On the other hand, object-experiencer verbs engender a negativity in the subject-

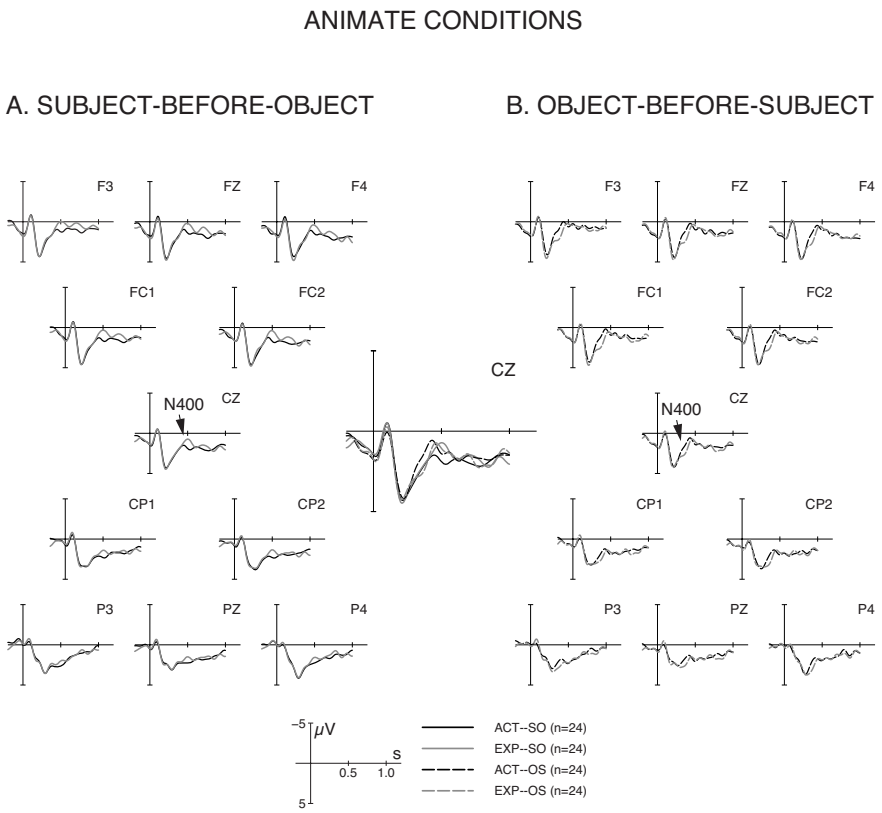

Figure 7.1: Grand average ERPs at the position of the verb (onset at the vertical bar) for sentences with ***two animate arguments*** *(conditions A, C, E and G in Table 7.1) in the verb-final conditions.*

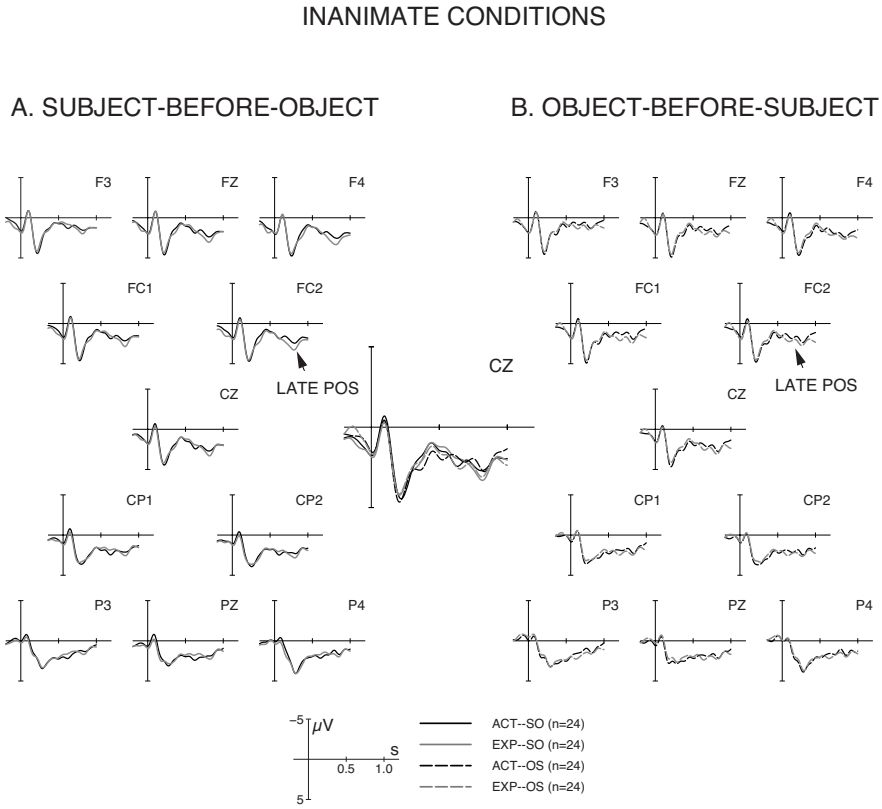

Figure 7.2: Grand average ERPs at the position of the verb (onset at the vertical bar) for sentences with an ***inanimate subject and an animate object*** *(conditions B, D, F and H in Table 7.1) in the verb-final conditions.*

initial sentences that is shifted from the negativity observed for the scrambled word order. Both effects fall into a typical N400 time window (approximately between 300 and 600ms post verb onset). Second, for the inanimate conditions, Figure 7.2 shows a late positivity for object-experiencer verbs in both word orders. For the statistical analysis of these effects, I chose a time window from 300-600ms for the negativities and a time window from 650-850ms for the late positivity.

Negativities: 300-600ms In the 300-600ms time window, a repeated measures ANOVA for the lateral electrodes revealed interactions of $ANIM \times ORDER$ ($F(1,23)$= 4.95, p $<$ 0.05) and $ANIM \times ORDER \times VERB$ ($F(1,23)$= 4.50, p $<$ 0.05). Resolving these interactions by ANIM showed no significant effects for the inanimate conditions ($Fs < 1$), while the $ORDER \times VERB$ interaction reached significance for the animate conditions ($F(1,23) = 8.11$, p $<$ 0.01). Resolving this interaction further by ORDER revealed marginal effects of VERB for both the subject-initial ($F(1,23) = 3.83$, p $<$ 0.07) and the object-initial conditions ($F(1,23) = 3.98$, p $<$ 0.06). These resulted from a negativity for the object-experiencer verbs in the subject-initial structures and a negativity for the active verbs in the object-initial structures.

The analysis of the midline electrodes showed interactions of $ROI \times ORDER$ ($F(1,23)$= 4.21, p $<$ 0.05), $ANIM \times ORDER$ ($F(1,23)$= 5.06, p $<$ 0.05) and a marginal three-way interaction $ANIM \times ORDER \times VERB$ ($F(1,23)$ = 3.75, p $<$ 0.07). Resolving the latter by ANIM revealed no significant effects for the inanimates ($F < 1$), but an interaction of $ORDER \times VERB$ for the animates ($F(1,23) = 7.48$, p $<$ 0.05). Single comparisons for the two word orders showed no significant effects.

Visual inspection of Figure 7.1 suggests that the marginal effects for the final single comparisons may have been due to a shift in the latency of the effect for subject- as opposed to object-initial conditions. To examine this, I conducted these comparisons in two smaller time windows that appeared more appropriate for the individual effects, namely from 300-450ms for the object-initial and for 450-600ms for the subject-initial conditions.

For the earlier time window (300-450ms), object-initial conditions showed a significant effect of VERB for the animate conditions for both lateral ($F(1,23) = 11.64, p < 0.005$) and midline electrodes ($F(1,23) = 8.45, p < 0.01$). For the subject-initial order, by contrast, no effects of VERB were observable (both $Fs < 1$).

For the second time window (450-600ms), the analysis revealed a significant effect of VERB for the subject-initial animate conditions for the lateral

($F(1,23) = 6.34, p < 0.02$) and midline ($F(1,23) = 4.11, p = 0.05$) electrodes, but no such effect for the object-initial animate conditions (both $Fs < 1$).

Late Positivity: 650-850ms: For the lateral electrodes, the analysis of the 650-850ms time window revealed a main effect of ANIM ($F(1,23) = 8.24, p < 0.01$), an interaction $ANIM \times VERB$ ($F(1,23) = 4.85, p < 0.05$), and an interaction $ANIM \times VERB \times ROI$ ($F(1,23) = 3.50, p < 0.05$). Resolving the three-way interaction by ROI showed that the interaction of ANIM and VERB only reached significance in the right frontal region ($F(1,23) = 12.00, p < 0.001$). Planned comparisons for each level of the factor ANIM showed an effect of VERB for inanimate ($F(1,23) = 5.01, p < 0.05$) but not for animate conditions ($F(1,23) = 1.50, p > 0.2$).

The analysis of the midline electrodes revealed a very similar result, namely a main effect of ANIM ($F(1,23) = 22.83, p < 0.001$) and an interaction between VERB, ANIM and ROI ($F(1,23) = 3.98, p < 0.05$). Resolving this interaction by ROI showed an interaction of VERB and ANIM at electrodes FZ ($F(1,23) = 12.07, p < 0.01$) and FCZ ($F(1,23) = 7.77, p < 0.05$). Further resolution by ANIM at these two electrodes revealed significant effects of VERB for the inanimate conditions ($FZ: F(1,23) = 4.70, p < 0.05$; FCZ: $F(1,23) = 5.06, p < 0.05$), but not for the animate conditions ($FZ: F(1,23) = 1.20, p > 0.27; FCZ: F < 1$).

7.7.2.2 Verbs in the Verb-initial Conditions

Figure 7.3 shows ERP responses to active and object-experiencer verbs in the clause-initial position and contrasts these with the ERPs elicited by the verbs in the corresponding verb-final sentences.

As is apparent from Figure 7.3, active verbs in the clause-initial position show a negativity in comparison to object-experiencer verbs between approximately 450 and 550ms. By contrast, when the verbs occur clause-finally, this effect appears to reverse, i.e., object-experiencer verbs show a negativity in comparison to active verbs. Visual inspection also suggests that object-experiencer verbs elicit a late positivity in comparison to active verbs in both positions.

Verb-type differences in 450-550ms In a time window from 450 to 550ms, the statistical analysis of the verbs in the clause-initial position (including only the condition factor VERB: active vs. object-experiencer) revealed a significant effect of VERB for the midline ($F(1,23) = 6.74, p < 0.05$) but not the lateral

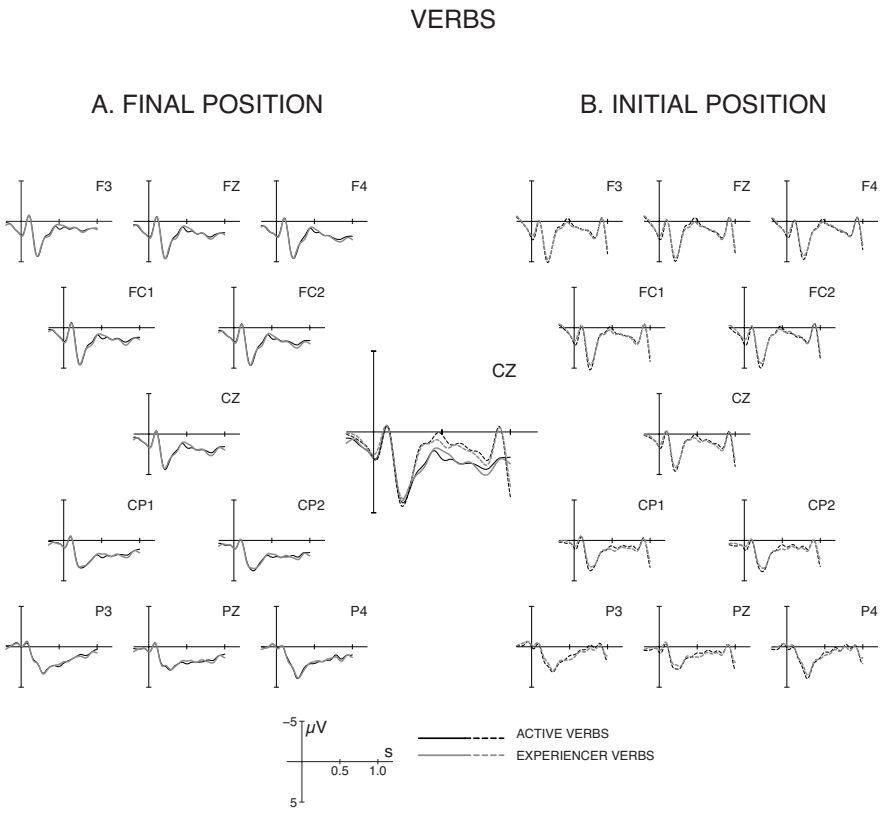

Figure 7.3: Grand average ERPs for active vs. object-experiencer verbs. This comparison is shown for both ***verb-final*** *(Panel A)* ***and verb-initial sentences*** *(Panel B). The enlarged electrode provides a direct comparison of verbs in the sentence-final and sentence-initial positions.*

electrodes. Active verbs were more negative than object-experiencer verbs in this time window.

A similar analysis for the clause-final verbs also showed a significant effect of VERB for both midline ($F(1,23) = 6.11, p < 0.05$) and lateral ($F(1,23) = 6.41, p < 0.05$) electrodes. In this case, however, object-experiencer verbs engendered a larger negativity than active verbs.

Verb-type differences in 700-850ms The late positivity effects apparent in the figure did not reach statistical significance (neither in a time window from 700-850ms nor from 750-850ms).

7.7.2.3 Summary of the Results for the Verbs

In summary, the comparison of active and object-experiencer verbs in a position preceding the arguments did not reveal any ERP effects that could account for the critical data pattern for the clause-final verbs. The effect on the verb in sentence-final position therefore cannot be attributed to pure lexical differences between the two verb types.

In the 300-600ms time window, ERP effects were only observed for the two animate conditions. There are two main regions that the interactions were observed. In 300-450ms, the active verbs were more negative than the experiencer verbs in the scrambled conditions. This difference disappears as both verb types show equal or similar amplitudes around 450ms. Thus it seems that while both verb types show similar linking cost later on, active verbs start showing linking costs earlier than the experiencer verbs for the marked word order (scrambled sentences). In the later time window, 450-600ms, experiencer verbs are more negative than the active verbs in the canonical conditions. Except canonical active conditions, all three conditions show similar negativities indicating that the main linking costs (emerging either from marked LS, or word order) were handled in the 450-600ms time window.

Overall, the findings indicate that (a) the lexical- and linking-related effects of the verbs are differentiated such that linking effects cannot be accounted for by lexical differences, (b) linking for the object-experincer verbs are more costly and independent of any pre-verbal manipulations, (c) the θ-Distance theory holds true by showing that negative ERP components emerge for experiencers in the overall ERP data on the verb-final sentences, (d) there is no GR reversal as expected to emerge as a positive component, (e) Experiencer verbs have a Causative reading as predicted, (f) the effect on linking only emerges when both arguments are animate which shows that animacy plays a crucial role for

comprehension in Turkish, (g) difficulty in linking emerges in different time-windows for different verb types, showing that particular structures are dealt with earlier/before the others and there might be a hierarchical preference in processing, and (h) case marking is not the sole predictor for linking but word order and animacy are.

7.7.2.4 NP1 and NP2 in the Verb-final Conditions

In the following, I report the ERP effects observed at the clause-initial verbs and at the remaining positions (NP1, NP2) in the critical verb-final sentences.

NP1 in the the verb-final conditions Figure 7.4 shows grand average ERPs for the first argument in the verb-final sentences. At this position, only three types of arguments can be contrasted: animate nominative-marked arguments, animate accusative-marked arguments and inanimate nominative-marked arguments. This is due to the fact that the animacy manipulation in the sentence materials only varied the animacy of the subject.

Visual inspection of Figure 7.4 indicates that inanimate (nominative) initial arguments engender a centro-parietal negativity between approximately 350 and 500ms (N400) followed by a late frontal positivity. There also appears to be a slight positivity (between approximately 500 and 700ms post onset) for the accusative (animate) arguments.

Because of the absence of a case manipulation for the inanimate arguments, I conducted two separate analyses for the position of NP1: the first compared animate and inanimate nominative arguments. The second compared nominative- and accusative-marked animate arguments.

Animacy effect for initial nominative arguments (animate vs. inanimate):

380-500ms:

The statistical analysis of the nominative arguments (involving the factor ANIM: animate vs. inanimate) revealed a main effect of ANIM for the midline electrodes ($F(1,23) = 6.22, p < 0.05$) and an interaction of $ANIM \times ROI$ for the lateral electrodes ($F(1,23) = 3.33, p < 0.05$). Resolving this interaction by ROI showed that the effect of ANIM reached significance in the left-posterior region ($F(1,23) = 5.40, p < 0.05$) and was marginally significant in the right-posterior region ($F(1,23) = 3.74, p < 0.07$). This effect resulted from more negative going ERPs for the inanimate nouns compared to animate nouns.

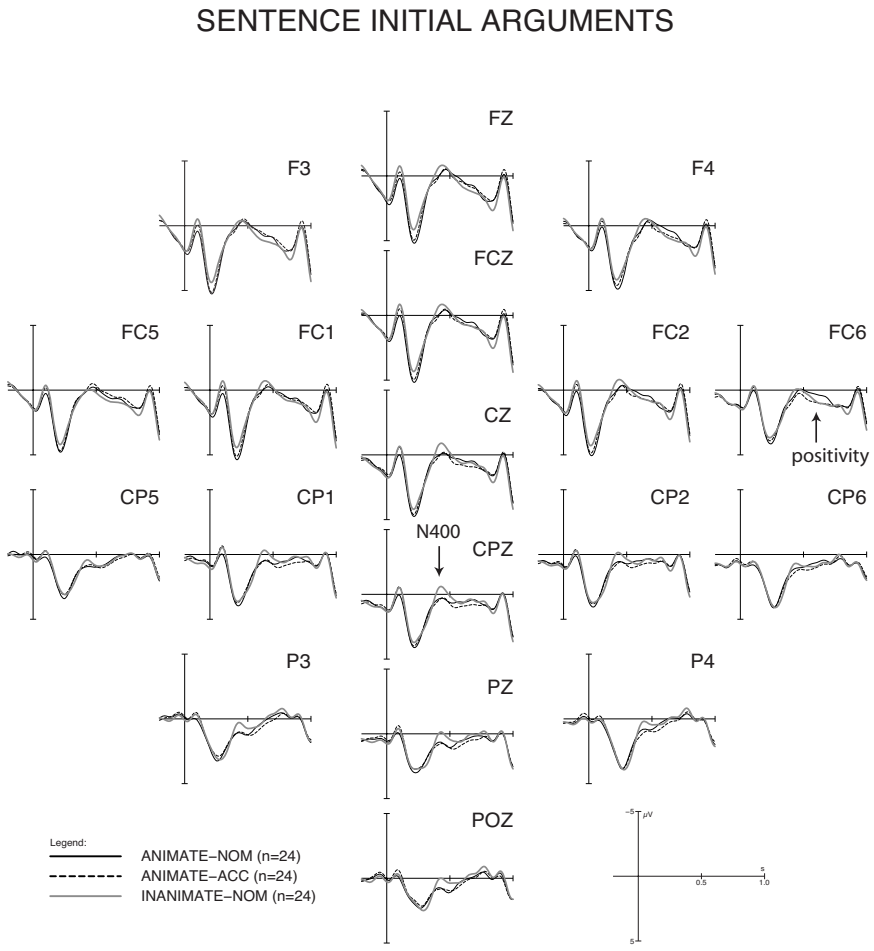

Figure 7.4: Grand average ERPs at the position of the ***first argument*** *(onset at the vertical bar) in the critical verb-final sentences.*

550-700ms:

In this time window, the ANOVA revealed an interaction of ANIM and ROI for both the midline ($F(1,23) = 5.00, p < 0.05$) and the lateral electrodes ($F(1,23) = 7.14, p < 0.01$). Planned comparisons for individual ROIs did not show a significant effect at any of the midline sites, but showed a significant effect of ANIM in the right-anterior region for the lateral electrodes. This effect resulted from a positivity for the inanimate nouns.

Case effect for initial animate arguments (Nom vs. Acc.):

500-700ms:

Between 500 and 700ms, an analysis of the initial animate arguments (involving the factor CASE: nominative vs. accusative) showed a marginal effect of CASE ($F(1,23) = 3.61, p < 0.07$) for the midline electrodes and an interaction of CASE and ROI in the time window for the lateral electrodes ($F(1,23) = 2.41, p < 0.05$). Resolving this interaction by ROI revealed effects of CASE in the right-anterior ($F(1,23) = 7.22, p < 0.05$) and right-posterior regions ($F(1,23) = 4.61, p < 0.05$). These effects were due to a positivity for the accusative-marked animate arguments.

NP2 in the verb-final conditions Figure 7.5 shows grand average ERPs for the second argument in the verb-final sentences.

Visual inspection of the figure reveals an N400 effect for inanimate second arguments (as for the first arguments). There also appear to be some late differences between conditions in a time window from 600 and 800ms.

The statistical analysis for the second argument position employed the condition factors ORDER (subject-before-object, SO vs. object-before-subject, OS) and ANIMACY (both arguments animate vs. inanimate subject and animate object). Thus, the factor animacy is defined as: animate indicating that there was no animacy distinction between the arguments and inanimate indicates that there was an inanimate subject, and arguments were distinct.

N400 time window for second arguments: 380-500ms

The analysis for this time-window revealed a main effect of ANIM for both the midline ($F(1,23) = 11.38, p < 0.005$) and lateral electrodes ($F(1,23) = 9.93, p < 0.01$) electrodes. There was also an effect of ORDER at both midline ($F(1,23) = 9.46, p < 0.01$) and lateral sites ($F(1,23) = 8.61, p < 0.01$). Finally, the analysis showed an interaction of $ROI \times ANIM \times ORDER$ for the midline ($F(1,23) = 3.79, p < 0.05$) and lateral electrodes ($F(1,23) = 6.30, p < 0.05$). Resolving this interaction by ROI did not reveal any sig-

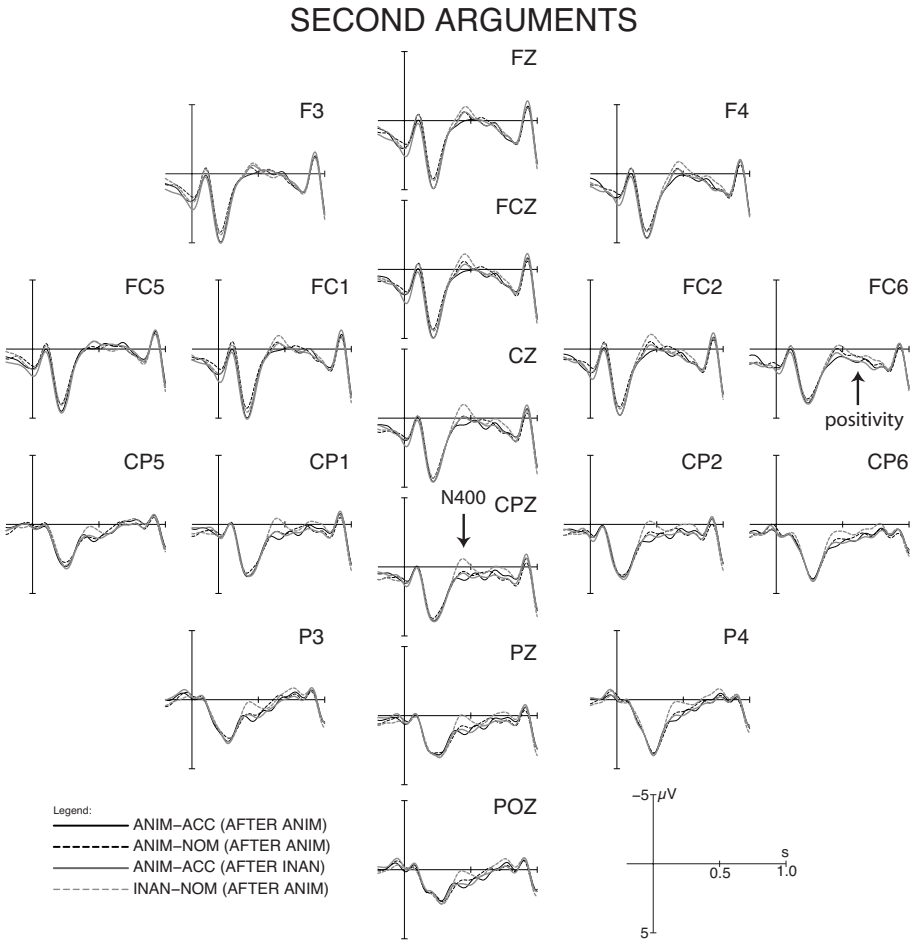

Figure 7.5: Grand average ERPs at the position of the ***second argument*** *(onset at the vertical bar) in the critical verb-final sentences.*

nificant effects for any of the midline electrodes but showed an interaction of $ANIM \times ORDER$ in the left-posterior ($F(1,23) = 6.00, p < 0.05$) and (marginally) the right-posterior region ($F(1,23) = 4.27, p < 0.06$).

Resolving the $ANIM \times ORDER$ interaction by ORDER within these two regions revealed an effect of ANIM for object-initial conditions (left-posterior: $F(1,23) = 15.00, p < 0.001$; right-posterior: $F(1,23) = 11.49, p < 0.005$). By contrast, there was no effect of ANIM for the subject-initial conditions. This pattern of results was due to a negativity for the inanimate condition with an object-initial order (i.e., for an inanimate subject following the animate object).

Late time window for second arguments: 600-800ms

In this time window, I observed only an interaction of ORDER and ROI for the lateral electrodes. Separate analyses for each region revealed effects of ORDER in the left-anterior ($F(1,23) = 4.47, p < 0.05$), right-anterior ($F(1,23) = 4.86, p < 0.05$) and right-posterior regions ($F(1,23) = 8.62, p < 0.01$). These effects all resulted from more positive-going waveforms for the subject-initial conditions.

7.7.2.5 Summary of the Results for NPs

The analysis of the ERPs for NP1 and NP2 positions in the critical verb-final conditions revealed an N400 for inanimate (nominative) arguments in the centro-parietal region for both positions. In the late time window, initial inanimate NPs were more positive than nominative animate NPs in the frontal region. Also there was a positivity for the initial case marked animate NPs vs. nominative animate NPs in the right-frontal region and right-posterior regions. In the second position, the case marked animate NPs were more positive than all other conditions.

The basic finding is that an N400-like ERP component emerged for the nominative inanimate arguments (independent of its position) which was missing in the previous experiments. Also, no N400 effect was observed on the animate case-marked argument following the inanimate subject argument (an effect which was observed in Experiment 1). Thus, the prominence conflict hypothesis does not hold in this case. Possible reasons for these findings will be evaluated in the discussion section.

7.8 Experiment3(b): Questionnaire Study on the Sentences Used in the Study

In order to test the level of acceptability of the verb final sentences used in Experiment 3, I conducted a questionnare study similar to the one in Experiment 1(b).

7.8.1 Participants

Thirty-two participants attended the study. Five of them were excluded from the analysis since they did not pay enough attention to the task and could not complete the study (i.e., giving 1 point to all of sentences, or not rating some sentences at all). A total of twenty-seven participants (11 females and 16 males; mean age 25.4, range 23-28) were included in the final sample. Participants were all native speaker of Turkish and were studying at a university in Ankara, Turkey at the time.

7.8.2 Materials

I used a subset of 8 active and 8 experiencer verbs and prepared 32 sets containing NP (Animate/Inanimate) - NP (Animate) - Verb (Active/Experiencer) to form SOV or OSV sentences as in Experiment 3. Then I prepared 8 lists each containing 32 sentences collected from these 32 sets, each having 4 different versions of each of the 8 conditions according to a Latin square design. I also added 24 grammatical and 12 ungrammatical filler sentences leading to total of 68 sentences for each list.

7.8.3 Results

Analyses revealed a main effect of ANIMacy both for participants ($F_1(1,26)=$ 12.99, p<0.005) and for items ($F_2(1,31)=10, p < 0.005$). Analysis also revealed a two way interaction between $ANIM \times VERB$ for participants ($F_1(1,26)=$ $11.37, p < 0.005$) and for items ($F_2(1,31)=$ $4.94, p < 0.05$). When this interaction was resolved by VERB, for active verbs, but not for experiencer verbs, there was an effect of ANIM, for participants ($F_1(1,26)=$ $27, p < 0.001$) and for items ($F_2(1,31)=$ $22, p < 0.001$). Active verbs with inanimate subjects were less acceptable than sentences with inanimate subjects.

Condition	Mean	Sd
$A.NOM_AACC_AV_{ACT}$	2.34	0.88
$B.NOM_IACC_AV_{ACT}$	1.88	0.77
$C.NOM_AACC_AV_{OEXP}$	2.17	0.92
$D.NOM_IACC_AV_{OEXP}$	2.09	0.83
$E.ACC_ANOM_AV_{ACT}$	2.09	0.73
$F.ACC_ANOM_IV_{ACT}$	1.92	0.83
$G.ACC_ANOM_AV_{OEXP}$	2.08	0.77
$H.ACC_ANOM_IV_{OEXP}$	2.34	0.75

Table 7.5: Means and standard deviations for the questionnaire study. Ratings are given between 1-4, 1 indicating not acceptable, and 4 indicating very acceptable.

There was also a marginal interaction of $ANIM \times ORDER$ for participants ($F_1(1, 26) = 4, p = 0.055$). Resolving this interaction by ANIM revealed that for animate conditions, but not inanimate conditions, the effect of ORDER was significant ($F_1(1, 26) = 6, p < 0.05$). For some participants, non-canonical OSV sentences in animate conditions were less accepted.

7.8.4 Discussion

In general, people have difficulty in assigning the causer role to the inanimate entity when an active verb is used. Thus, it is more acceptable to have an animate or inanimate causer for the experiencer verbs, but for active verbs it is less acceptable to have an inanimate subject.

7.9 Discussion of ERP Findings

I will start by discussing the ERP results on the NPs first. Then I will discuss ERP results on the verbs. Regarding the ERP effects on the NPs in positions NP1 and NP2, there are two possible interpretations. The first suggests lexical differences between animates and inanimates. The second suggests a general task-related cognitive bias towards an assignment of inanimate argument as the causer of the event.

NPs:

The first assumption suggests that the centrally distributed N400 observed on the inanimate NPs and the late right-frontal positivity observed for the accusative animate as well as the inanimate NPs (compared to nominative animate NPs) in NP1 position might be interpreted as lexical or morphological

(case-marking) rather than as related to sentence-level processing. Similarly, late frontal positivity on the accusative animate NP in the NP2 position (compared to all other conditions) can also be a case marking effect. In Experiment 1(a) I observed no negativity or positivity related to animacy for the sentence-initial arguments. In Experiment 2, there was a very late negativity (after 700ms) for the nominative animate NP compared to the nominative inanimate NP in right-frontal electrodes in the NP1 position. Note that there was not any difference between case-marked animates and inanimates in the NP1 position. However, the experiments differed with respect to the lexical material used. Thus, this ERP difference between the experiments might have resulted from lexical differences with regard to the inanimate nouns used: the object-experiencer verbs employed in the present study led to the inclusion of inanimate nouns like "company," "announcement," "publication" and "bribery" (see Appendix B for the stimuli used), which were not included in the previous experiments. It may therefore be the case that the nouns of this type engendered a lexical effect which was not present in the earlier studies.

As for the N400 effect observed, one view suggests that the concreteness (and abstractness) of the nouns might have played a role. Concrete words (or words with high imaginability) are known to generate different ERP deflections. The research on the effects of concreteness shows that concrete nouns show more negativity than abstract words around 400-600ms (Kanske & Kotz, 2007; Kounios & Holcomb, 1994; West & Holcomb, 2000). However, the negative ERPs are observed for the inanimate nouns in this study, which had a more abstract nature (and less imaginability) than the animates. Thus, if the concreteness was the main reason for the lexical differences, then the animates would show negativity, not the inanimates.

Another lexically driven explanation for the N400-like difference for the inanimate NPs might be the frequency of the items used in the experiment. As shown in Appendix B, the word frequency data counted from around 1 million words taken from Göz (2003) shows that, inanimate NPs in the sentence-initial position are less frequent (0.018 %) than animate NPs in the same position (0.028 %). On the other hand, for the NP2, animate NPs are less frequent (0.015 %). Thus, it seems that the frequency cannot be the sole determinant of the negativity. If this were the case, then at NP2, the animate NPs would be more negative than the inanimate NPs.

On the other hand, late positivity was observed on both the nominative inanimate NP as well as the accusative animate NP (compared to animate nominatives) in the NP1 position, making it very hard to claim that this is purely a lexical difference. If this were the case, then the animate nominative and animate accusative NPs should have clustered together (since they are the

same items). I observed late frontal positivity for the case marked animate noun in NP1 and NP2 positions, thus morphology (case-marking) can still be considered a factor creating the ERP difference. Thus, while maintaining the possible effects of lexical and morphological influences, I claim that these differences might actually be related to more global processes that are related to functional and sentence level processing.

For instance, one possibility for the N400 effect might be that the task might have demanded the assignment of an Actor GR (particularly "Causer" role) to the inanimate argument immediately. All the experimental sentences I used had causative meaning. There were not any filler sentences biasing other types of contexts or other types of sentences. Thus, it is possible that the readers automatically assigned the Nom argument a causative role (Actor), and for the inanimates, this led to the N400, since they are not the prototypical causers of the events in life. I assume different degrees of causation types exist, like causation via "purposeful design" (e.g.,, the traffic lamps are supposed to control the traffic and start/stop the traffic and have an impact on the pedesterians) or causation via "volition" (e.g.,, "A man hits the door purposefully" and breaks it). Design type of causation is different than volitional causation. Thus, it is possible that only the nominative inanimate arguments (irrespective of word order and relational status with the other argument, at both NP1 and NP2 positions) showed N400 because they fell into design-related causation. This assumption requires the acceptance of the more general top-down influence of the cognitive sources in sentence processing: whenever comprehenders are faced with an inanimate in a causative context (in this case, very causative environment provided by the experiment), somehow they are biased to form the causative attribute of the inanimate NP instantly (which leads to a cost). Interestingly, the negativity observed on the inanimates in the study by Wickerly and Kutas (1999) was similarly interpreted as the difficulty of assigning subject role to the inanimate noun (which is a non-prototypical subject). I believe that, probably not the assignment of subjecthood to the inanimate per se, but the causative attribute given to the inanimates might have been the main reason for this finding.

On the other hand, this explanation is also in parallel with the late positivities observed in the (right-)frontal electrodes. Assignment of causation to the inanimates (making them non-prototypical subjects) as well as the assignment of Experiencer/Theme to the animate object might have similar processing costs for the system which reflected as the deviation from a prototypical subject (animate) and object (inanimate) distribution. Interestingly, in Experiment 2, frontal late positivity was related to the pragmatic evaluation of the arguments. The well-formedess evaluation happened on the late window particularly in the frontal electrodes on the verb. These temporal and topographic

similarities reveal that the late ERP effects on the NPs might be pragmatic in nature. Thus, the case marking (morphology) effect observed on the accusative animate nouns in Experiment 3 might actually be related to such pragmatic processes. The language comprehension mechanism may evaluate not only prototypicality but also the referential status of the animate object. Causativity, GR assignments, and prominence hierarchy conflict might reflect as N400, while pragmatics and redundancy related evaluations, and alignment of the referential status of the argument might reflect as late frontal positivities in Turkish.

Verbs:

The experiment revealed that there are ERP differences between verbs in the initial position vs. verbs in the final position. In the sentence-initial position, active verbs were more negative, while in the sentence-final position object experiencer verbs were more negative in the 450-550ms time-window. Thus, the finding suggests that linking influences the ERP deflection independent of lexical factors. While the frequency differences between verb types shows that the object experiencer verbs are less frequent than the active verbs (Appendix B), other lexical, orthograpic and psychological properties these verbs bear are very similar. For instance, these verbs have similar emotional valence, a similar word length and similar number of syllables. Thus, psychological and physical properties do not seem to lead the ERP differences in both sentence-initial and final positions.

The ERP change at the sentence-final verb suggested that the linking condition is more costly (and reflected as an N400) for the object experiencer verbs, as predicted by the $\theta - Distance$ theory. This result is independent of the animacy and word order for the verb-type comparison. Thus, the linking situation is more constrained for the verbs having shorter theta distance.

Interactions at the position of the clause-final verb revealed an early N400 (300-450ms) for object-initial sentences with active verbs and a later N400 effect (450-600ms) for subject-initial sentences with object-experiencer verbs only for animate conditions. Thus word order plays an important role in linking. Note that, these interactions were only possible when the arguments were both animate, thus leading to the idea that animacy is a very distinctive element for linking in Turkish (see MacWhinney, Osmàn-Sàgi, & Slobin, 1991, for similar hypotheses). The distinctness of arguments in the pre-verbal region helps to ease the linking. Thus, by using two animate arguments, it pushed the processing mechanism to the limit, where fine-grained processing preferences could be observed.

Results also support that the cost is not related to the GR reversal, but related to a number of factors in which thematic structure of the a-structure and word order are the major ones. When the sentence has two animate arguments and a scrambled word order (thus providing a very complex environment –a bottle neck– for linking), the standard thematic structure automatically initializes linking (and acts quite earlier than when the verb has a marked argument structure) to reformulate the pre-verbal scrambled (marked) form to ease linking. Note that the earlier negativity for the active verb in the scrambled order becomes equal or similar in amplitude for both types of verbs in the 450-600ms time window. Thus, while thematic closeness seems to be a main cost in linking, treatment of word order is different for the two types of verbs.

On the other hand, in the conditions having inanimate subjects, I observed a late anterior positivity (650-850ms) for sentences with object-experiencer verbs. The temporal structure and the uniqeness of this ERP deflection for experiencer verbs with inanimate subjects must be treated carefully. Interestingly, this positivity resembles the positivities observed in Experiment 2, in which the positive deviation was attributed to the pragmatic nature of the grammatical object. Strikingly, the positivity on the inanimate noun was located in the anterior sites too, suggesting a hypothesis that the pragmatic and prototypical role evaluations in Turkish can be observed in the late time window mainly on the anterior electrode sites in ERPs. In Experiment 2, the effect of the redundant usage of pronoun and the referential status of the object on the verb was also observed on the anterior sites as late frontal positivities. This supports the evidence that pragmatic evaluations (like redundancy and referentiality evaluaitons) are observed on the anterior sites. In the following, I will discuss these two types of effects (the N400 effects and the late positivity) on the verbs in detail.

7.9.1 N400 Effects

First, the finding of N400 effects as opposed to early positivities for increased linking costs at the position of the verb suggests that the object-experiencer verbs examined here do not require a true reversal of the thematic hierarchy. Thus, rather than calling for an argument hierarchy in which the object (the Experiencer) outranks the subject, they project a causative thematic structure in which the subject outranks the object. However, as the object is not a prototypical Undergoer (Theme), linking costs are increased for these verbs, thus yielding an N400. This favors the $\theta - Distance$ theory, in which the distance is smaller for experiencer verbs by having Agent-Subject and Experiencer-Object, while it is Agent-Subject and Theme-Object for the active verbs.

The two conditions, having two animate arguments and changing the thematic distance help to test whether Turkish exclusively depends on case marking or not during linking. Findings indicate that case marking is not the sole determiner of linking. If this were the case, difficulty would be similar for all SOV and OSV conditions. The distribution of the N400 differences between active and object-experiencer verbs, thus, reveal that word order and argument structure interact quite interestingly. This interaction can be used to diagnose which of the information types (thematic information of the verb or word order information) under examination take precedence during linking under complex sentence structures.

Table 7.6 summarises the application of the different prominence hierarchies within our critical sentence conditions as well as the ERP effects observed.

Condition	∓ anim/spec order	∓ agrt order	Unmarked thematic S.	N400	LFP
$A.NOM_AACC_AV_{ACT}$	ϕ	+	+	ε	
$B.NOM_IACC_AV_{ACT}$	−	+	+		ε
$C.NOM_AACC_AV_{OEXP}$	ϕ	+	−	450-600	
$D.NOM_IACC_AV_{OEXP}$	−	+	−		650-850
$E.ACC_ANOM_AV_{ACT}$	ϕ	−	+	300-450	
$F.ACC_ANOM_IV_{ACT}$	+	−	+		ε
$G.ACC_ANOM_AV_{OEXP}$	ϕ	−	−	ε	
$H.ACC_ANOM_IV_{OEXP}$	+	−	−		650-850

Table 7.6: Distribution of prominence information in the critical conditions and the ERPs observed in the present study. ε shows the reference condition in comparison to which the ERP effect was observed. LFP stands for late frontal positivity.

Prominence information is coded as in Table 7.6. Note that, positional (precedence information) is taken as a reference for all the prominence hierarchies in order to compare their relative match/mismatch. Also note that, since I did not observe any early positive deviation, the name of the unmarked linking column changed to unmarked thematic structure (assuming that theta structure creates the marked linking, not LS). The N400 and late positivity columns show the latency of the N400/late positivity effects observed, with a diagonally crossed cell indicating that no N400 / late positivity occurred in the condition in question. N400 effects occurred when two conditions were met: (a) the two arguments did not differ in terms of animacy, and (b) there was a mismatch between the agreement hierarchy and the unmarked linking status. Thus, when the agreement hierarchy was not respected in a sentence with a verb calling for unmarked linking, I observed an N400 effect between 300 and 450ms (condition E). Conversely, when the agreement hierarchy was

respected, but there was no unmarked linking, the results revealed an N400 effect between 450 and 600ms (condition C).

These results indicate a hierarchical application of different prominence information types. First, a difference in animacy between the two arguments overrides all other information types such that increased processing costs were not observed for a violation of the agreement-hierarchy nor for a deviation from unmarked linking. Notably, it appears more important for the arguments to be distinct in terms of animacy than for the animate argument to precede the inanimate argument. This finding provides converging support for the assumption that animacy/specificity may play a particularly important role in the comprehension of language.

When there was no animacy distinction between the arguments, a mismatch between the agreement hierarchy and the argument linking status of the verb was reflected in an N400. The latency of this effect depended upon which of the two information types engendered the processing problem: when there was a marked word order (condition E), the effect occurred earlier (300-450ms) than in the case of a deviation from unmarked thematic structure (condition C; 450-600ms) in canonical word order. This finding further supports the notion of a hierarchical application of different information types such that unmarked thematic structure is taken as a basis (and strongly favored) to initialize linking. Thus, an earlier attempt is made by the language processor to initialize the best linking condition for an unmarked thematic form. Early negativity may indicate the most general parsing preference relevant to the unmarked argument structure under a very complex sentential environment.

Taken together, these findings therefore suggest that the animacy information is of primary importance in Turkish sentence processing, as it can override all other distinctions during argument linking. Under a very complex sentential environment, where the arguments are not distinct, the standard argument structure takes an earlier step than the word-order, making the linking process earlier for the Agent-Theme verbs.

These findings show an interesting contrast to previous results from German, in which the word order did not have a major influence on argument linking at the position of the verb. Bornkessel et al. (2003) observed main effects of verb type (i.e., of verb-specific linking considerations) but no interaction between verb type and word order in an ERP study contrasting active and object-experiencer verbs in German. (Note that the effects observed in that study were interpreted as early positivities rather than N400s.) Word order thus appears to play a much stronger role in Turkish than in German, a finding that is not unexpected given the order restrictions displayed by Turkish under certain circumstances. These are completely absent in German.

7.9.2 Late Frontal Positivity (Pragmatic Positivity)

The second effect observed in the present study was a late frontal positivity for sentences with inanimate subjects and object-experiencer verbs. Late positive effects have not been implicated as ERP correlates of increased linking difficulty by any previous studies.

Rather, I propose that the late positivity observed here results from the required interpretation of an inanimate argument as the higher-ranking Causer of the event. Recall that the verbs used here do not impose any animacy restrictions on the higher-ranking argument in the a-structure. Thus, assuming that the preferred interpretation of a causer is that it acts volitionally (i.e., is an agent), an inanimate argument induces a mismatch with respect to this preference. From a similar perspective, it has been proposed that animate effectors (i.e., causers) are preferentially interpreted as agents via a pragmatic inference (Holisky, 1987). Assuming therefore that the association between a causer and volitionality is also pragmatic in nature, a processing cost, induced by an inanimate subject, emerges.

This interpretation raises the question of why this effect is restricted to the object-experiencer verbs, seeing that the active verbs also call for an interpretation of the inanimate subject as the higher-ranking argument. Interestingly, the positivity I observed is not centro-parietal positivity. It is confined to frontal regions, which resembles the positivites observed (and labeled as "pragmatic positivity") in Experiment 2 (Chapter 5). Recall that the main contributor of that positivity was not the sole existence of the pronoun but the animacy and case status of the object. Thus, similarly, here the positivity may not be the result of the sole pragmatic evaluation of the inanimate subject, but from an evaluation of the inanimate subject with an animate object (which differs from the prototypical object of a causative relation, namely a Theme which undergoes a physical change). For object experiencer verbs, the object shows a psychological and emotional status. Status of the object and status of the subject are both evaluated. This positivity falls into the same topographic region observed in Experiment 2, and it is similarly influenced by the status of both the subject and object.

This type of pragmatic evaluation may even start on the arguments before the verb is read. If the experimental context biases a causative reading for inanimate NPs, N400 may emerge for these NPs as Experiment 3 revealed. Pragmatic evaluation continues on each argument until the end of the sentence as frontal late positivity on the verb may reflect the general evaluation of the sentence.

One possible functional interpretation of this late frontal positivity might be the ill-formedness of the linguistic expression. But, recall that the active verbs were less acceptable than the experiencer verbs with inanimate subjects in the questionnaire study. Thus, it is less likely to accept an active sentence with an inanimate subject, indicating that if any problem of well-formedness of the sentence were the main cause of the positivity, then the active verbs would show positivity not experiencer verbs. Because of that reason, frontal late positivities found in this study cannot be attributed either to any type of ill-formedness or syntactic reanalysis related effects. On the other hand, I think that the late frontal positivity may show that the sentence can somehow be interpreted (and comprehended) in a certain way in the final stage of processing after syntactic, semantic, and pragmatic cues of arguments and the verb are combined. Future studies may reveal the true nature of the frontal late positivities.

7.10 Conclusion

The findings suggest that the $\theta - Distance$ theory holds, and the application of the prominence hierarchies takes place in a hierarchical fashion. First, independent of the word order and animacy information, object-experiencer verbs showed an N400 effect at the verb-final position, which is independent of any lexical effects as the effect differed from the verb-initial position. Thus, this finding shows that the cost observed as N400 is related to linking, which in turn, might be connected to the theta structure of the verb. Second, the animacy (also definiteness and specificity) appears to be of primary importance for linking, as it overrides other prominence hierarchies. This findings supports the hypothesis that the major goal of constructing pre-verbal interpretational and formal relations is to provide a simultaneous and easy linking. Holding two items in memory is probably not difficult for the memory system, but having a distinctive and clear representation of the items is required for a successful linking for the comprehension system. This makes sentence processing and argument interpretation a little bit more complex – more than just holding items in memory. Similarly, an animacy difference provides distinctiveness to ease linking for the comprehension system. When the arguments have different animacy information, word order and verb type did not show any interaction. Interestingly, previous studies in Turkish aphasics also support the view that with limited cognitive sources, Turkish speakers depend on the animacy information to a great extent (MacWhinney, Osmàn-Sàgi, & Slobin, 1991). Similar findings also come from Hindi (Vaid & Pandit, 1991), in which animacy was shown to be a major contributor to comprehension. All these findings point

to one fact that the comprehension system depends on the pre-verbal cues to a high extend in order to make linking costless and easy.

In sentences with two animate arguments a bottle-neck situation emerges in which linking gets more costly. Under these situations, N400 effects were observed when the agreement hierarchy and the linking requirements of the verb were in conflict. Furthermore, I observed a latency shift of the component depending on which of the hierarchies were not respected. It seems like the comprehension system uses different strategies to overcome such linking problems. When the conflict arose due to the agreement hierarchy (scrambled order), the effect reached significance between 300 and 450ms post verb onset, while it was observable between 450 and 600ms when it was engendered by a deviation from unmarked thematic structure. When animacy and word order make the comprehension more difficult, verbs with unmarked thematic structure start dealing with this type of deviation earlier than the verbs having a marked thematic structure. This might be a natural outcome of the unmarked thematic structure since such forms are more common and induce quick solutions for the linking problems.

Finally, the present study also revealed a late frontal positive ERP response (Pragmatic Positivity) for sentences with object-experiencer verbs and inanimate subjects, which I attribute to the pragmatic evaluation of a causer interpretation of the inanimate argument in the presence of a non-ideal (experiencer) undergoer. This positivity was frontally distributed, a similar component observed in Experiment 2 for the conditions having a pronoun and less referential objects. On the other hand, attributing casuation to an inanimate noun emerged as N400 on the noun, which indicated that GR assignments or general prominence-related costs emerge as N400, while pragmatic (and possibly episodic) evaluations of the arguments and the a-structure of the verb emerge as late frontal positivities.

In general, this study revealed a number of findings which are promising for future research. Many of the hypotheses made here must be tested with new experiments. For instance, the main reason for the negativity observed on the nominative inanimate argument must be investigated in an experiment where the experimental conditions do not favor one particular reading of the verbs (such that all causative, non-causative and other types of readings should be given). By using the same nouns used in this experiment, differential effects of experimental environment can be tested.

Also, it must be clarified from what the effect on the inanimates resulted. While I showed in the previous sections that the lexical differences due to concreteness and frequency cannot be the sole determinants of the negativity on the inanimate arguments, but it is possible that, not the frequency of usage

(which can be extracted from the corpus) but the number of items from the same class in an experiment (i.e., ratio of the number of inanimate nouns to animate nouns) might have led to the negativity in this experiment.

On the other hand, late frontal positivity on the nouns and on the object-experiencer verbs must also be tested in future experiments, in order to support the claim that these positivities are related to the pragmatic and episodic evaluation of the content of the sentence.

Processing differences, such as linking differences, for different classes of verbs (having different LSs) must be investigated in order to see whether the effect of thematic distance on linking differs for different classes of verbs. All the verbs in this study were causative. By using verbs from, say causative class with $< Agent, Theme >$ thematic structure, and verbs from, say perception class with $< Experincer, Stimulus >$ thematic structure, it is possible to differentiate what kind of information dominates linking. This will test $\theta - Distance$ theory in a more complete way. I suggest for future research to specify different verbs types in which the LS (event structure) as well as $\theta - Distance$ are manipulated in sentences having two animate arguments. Any observation made on such verb types will reveal whether the LS or the theta structure dominates linking.

Another point to mention is the evaluation of the questonnaire study with the ERPs. In Experiment 1(b), I found that the animacy effects observed in the questionnaire study were not observed on the ERPs. In Experiment 2, the centro-frontal positivity between the verbs of the ambiguous animate and inanimate conditions was not significant. In Experiment 3, inanimate active conditions in the questionnaire study was less acceptable, but this finding did not reflect on the ERPs. Thus, my observations on the relation between behavioural and on-line measures suggest that ERPs cannot be fully correlated with the acceptability ratings, at least in the studies I conducted.

Chapter 8

Conclusion

This thesis explored incremental argument processing in Turkish sentence comprehension. The main motivation was to understand how this language behaves under local ambiguities, under redundant and non-minimal environments, how it handled arguments having differing degrees of specificity, animacy and case marking features, and how lexical information influenced ambiguity resolution and re-analysis of the initial preferences.

The core investigation was how pre-verbal semantic and syntactic information was processed and how it was linked to the verb at the end of the sentence. Thus, the thesis explored all the possible levels of parsing (syntactic, pragmatic, morphological, and semantic) in which the incremental sentence processing principles applied. The findings were then used to make connections with the findings from research on other languages, which show differing degrees of overlap with Turkish grammar. For instance, the findings on the subject preference phenomenon, the ERP effects on the sentence-initial unambiguous argument, and the relational nature of the animacy and prominence information between the subject and object have paved the way to compare Turkish data with the other cross-linguistic findings coming from German, English and Italian.

Basic Sentence Processing Mechanism in Turkish

Overall, the explorations made in the thesis suggest that the incremental sentence comprehension and argument interpretation in Turkish takes into consideration both bottom-up (lexical information, word-order and case marking) as well as top-down information (like pragmatic evaluation, formal and interpretational relations between the arguments) on-line. Briefly, I will summarize how comprehension of a very simple sentence, which has only one or two arguments and no complex clauses, happens. Then, I will provide additional

information from the thesis, which supports these claims. I will also suggest possible future studies related to these hypotheses.

If the sentence-initial argument is not case marked, it is taken as the argument bearing the +Agr (subject). Unless there is a strong contextual or pragmatic bias to assign a particular prominence attribute (like attributing Causation to the inanimate subject argument in a causative experimental context), there is no need to assign any pre-verbal generalized semantic role (pre-GR) to this item, because this item can be either an Actor or an Undergoer. In fact, pre-GRs are used to construct relational information between the arguments to ease linking of the arguments to the verb, thus they are assigned only when there are at least two arguments in the sentence. If the sentence-initial argument is case marked, it is assigned -Agr (Object) as well as an Undergoer pre-GR, because objects are generally the entities on which certain actions are made, and the existence of the object reveals the existence of the subject (overt or covert), where pre-GR assignment is required in order to have a relational structure used for linking. Since there is a Subject-Drop possibility, no prediction for an overt subject is made. The simplest NP-V template is assumed for the sentence.

If the second argument exists, then the interpretational prominence relations (animacy, definiteness etc.) and the formal prominence relations (Agr) are evaluated. An animate (Actor) subject and an inanimate (Undergoer) object will be the standard preference. Any deviation from, or a conflict between prominence assignment(s), may reveal itself on the second argument. Sometimes, this deviation may even emerge before the second argument if there is a high top-down influence indicating a deviant assignment on the first argument (i.e., the inanimate argument is given a causative role).

Conflicts of causation and prominence emerge as N400, while all other pragmatic, referentiality and well-formedness evaluations fall onto a late positive component (which is generally frontally distributed, and which is called "pragmatic positivity" in the thesis). Except the case-marked animate objects, which are highly referential, all other caseless non-definite objects and inanimate objects are treated similarly; they do not have a well-defined referential status. This may lead to late frontal positivity, which may indicate a "search" for a well-formed pragmatic status for these objects. Maybe for such objects, constructing a referent (which is not very clear) is more costly.

When the verb is processed, the pre-verbal prominence relations map to the (aspectual) logical structure (LS) and the thematic structure of the verb. Pre-GRs and the LS are mapped and the thematic roles are assigned to the arguments by the verb. Pre-GRs are assigned to ease linking by providing separate and distinct representations of the arguments (which provides a simultaneous

linking possibility without any interference). Animacy information of the arguments, on the other hand, may also cause interference during linking (i.e., both of the arguments are animate). Thus, even though pre-GR assignments are made before the verb on the animate arguments, this may not be enough of a cue to provide successful linking, and animacy may override all other prominence information. Also, as introduced in the thesis, $\theta - distance$ theory, claims that if the thematic roles that the verb assigns are close in the theoretical thematic role hierarchy, the linking can similarly get more difficult, probably because an interference may emerge which creates an N400 effect. Under very complex sentential environments (i.e., scrambled word-order, two animate arguments etc.) verbs may prefer different linking options depending on their argument structure. The most general way for a verb to have a standard argument structure is to create an unmarked linking situation quickly (maybe by re-arranging the scrambling order) which might be costly and may reflect as an early negativity. Also, pragmatic positivity may emerge when all the pragmatic and referential status of the arguments are evaluated together with the argument structure of the verb. This is reflected in the late time-window on the frontal electrodes of the scalp.

In the following part, I will evaluate the contributions of the thesis to the psycholinguistic research as well as what it offers for future work. I will also evaluate the findings, which led to the hypotheses about the sentence processing mechanism mentioned above.

Subject Preference

One major contribution of the thesis to the psycholinguistic literature is that it found supporting evidence for the existence of subject-preference in Turkish for the very first time. This preference is found both in the on-line measures (as observed by ERP data) and in the off-line measures (as observed in the corpus data). Strikingly, the thesis put forward that this preference is independent of the animacy information of the initial ambiguous noun, as revealed by the indifference in the ERP data between the animate and inanimate conditions (observed on the disambiguating verb). The tendency for subject-preference for all non-definite arguments (irrespective of their animacy) was also confirmed in the corpus study. The corpus findings showed that non-definite animate and inanimate arguments are more likely to be the subject.

On the other hand, the acceptability ratings and the questionnaire study suggested that the degree of garden path effect resulting from subject-to-object revision is less pronounced for the inanimate arguments. The revision is more costly for animate objects, leading to an acceptability drop. In parallel to these findings, the corpus study also showed that the possibility of having a non-definite animate object is very less likely in Turkish, which may cause pro-

cessing problems when the animate argument is assigned an object role during revision.

Interestingly, ERPs on the verb did not reveal any difference between animate and inanimate conditions during revision. This may indicate that the ERPs may not fully overlap with the predictions made in the acceptability ratings. More importantly, the lack of any difference between those conditions might be related to the clustering of this effect with the general revision effect in the very frontal regions of the scalp. As Experiment 2 showed, many syntactic and pragmatic processes in Turkish are observed in the frontal regions in ERPs.

One suggestion that arose from the thesis for future research might be to explore the behaviour of the ambiguous NP-V pairs that also allow object-incorporation. The material used in the thesis prohibited object-incorporation to a maximal degree. But, object-incorporation may be selected as a default processing preference on the verb when the existence of the non-definite object is realized. Not only the initial subject preference must be revised, but also the referential status of the sentence-initial item (which is now the object) must be revised. Thus the problem (that is attributed to revision above) may also be related to the difficulty related to possible object-incorporated reading. This may also explain the acceptability ratings. By providing material (both allowing and not allowing object-incorporation), the possible processing differences can be explored in future research.

Redundant Existence of the Pronoun and Pragmatic Positivity

Subject preference represents only one level of minimality/economy in Turkish. Another very important economy constraint found in the thesis is the redundant existence of the pronoun, which led to processing differences to differing degrees. Corpus counts revealed that Pro-Drop is a very frequent option. There are cases where the overt subject emerges as a pronoun, but the number of these cases is limited. ERP results showed that the existence of the overt pronoun influences the ERP deflections on the items following the pronoun, which might be related to the continuous pragmatic evaluation of the redundancy of the pronoun. Strikingly, the pragmatic evaluation of the arguments, combined with the processes related to the assignment of referential status to these arguments, reflected as a positive ERP component in the late time window on the verb. This late positivity observed on the verb in the SOV conditions was named pragmatic positivity. Thus, the thesis brings supporting evidence to the current psycholinguistic theories which interpret the late positivity as a well-formedness related component. All sorts of information (e.g., referential level of the object, non-minimal usage of the subject etc.) are evaluated with respect to each other and final revisions are made (both syntactically and pragmatically) in the late time window. In future research, this

hypothesis must be tested by using common nouns, proper nouns etc. in the subject position. This may help to differentiate the pronoun-related redundancy effects from the general interpretational costs that emerge from having two overt arguments.

Referential Status of the Specific Animate Objects

On the other hand, there is the question of why animate case-marked objects differed from all other conditions and escaped from pragmatic positivity. This finding actually supports one of the theoretical claims that the thesis brings to the linguistic literature. Case marking and animacy interaction does not lead to symmetric and linear positioning of the objects in the referentiality scale as mentioned in the chapter on Turkish grammar. Interestingly, animate objects tend to be more referential and more specific when they are case marked. Thus, case-marked common animate nouns may have clearer referentiality status. They differ from all other types of objects pragmatically, and they can be assigned a definite reading without any other possibility.

On the other hand, inanimate objects and the non-definite animate objects are ambiguous with respect to their referentiality status: their referential status is not clear. The language processing mechanism evaluates and seeks to find the most possible referential status for those objects. Note that, object-incorporation is not possible, which makes the non-referential reading of the caseless objects totally impossible. Thus, I attribute pragmatic positivity (frontal late positivity) as a reflection of a "search" mechanism for the referential status for the arguments (as observed in Experiment 2), or a rearrangement of the pragmatic status and the thematic roles of the arguments (which was observed on the object experiencer verbs in Experiment 3).

Methodological Concerns and Task-Related Effects

Another contribution of the thesis to the psycholinguistic literature is that it provided evidence for the effect of task-related factors on the ERPs. Under certain experimental conditions, depending on the point of measurement, the experimental task, particularly the acceptability task, creates a cognitive process that can dominate the ERP waveform. This effect mainly arises from the realization of the task-related item (i.e., making a yes/no decision as soon as the task relevant item appears), so it does not mean that the acceptability task affects all the points in the sentence in which the observations are made to the same degree. But, this issue represents a very important point in the evaluation of the ERPs and should be controlled for in any ERP study.

Prominence Mismatch and Experimental Context

In a similar way, the experimental context may also have an impact on the ERPs. For example, the N400 effect observed on the inanimate nouns in Experiment 3 may not be totally attributed to the lexical differences. Interestingly, while the inanimate subject–animate object conditions showed N400 on the second argument in Experiment 1 (which was interpreted as the prominence hierarchy mismatch), the same effect is missing in Experiment 3. Thus, the cognitive system may understand that the experiment has a causative context. It may attribute causation to the inanimate argument in Experiment 3 "before" it reaches the second argument. If incremental processing is to assign all possible semantic and syntactic properties to arguments as soon as possible, conceptual and contextual information can also play a role. Here, processing costs emerge from attributing causation to an inanimate argument (which is not a prototypical subject and generally does not bear causation). In Experiment 1, understanding that the possible reading of the inanimate argument is acting on the animate argument happens on the second argument, which may reveal processing cost on the second argument. But, in future research, lexical factors should be controlled and similar sentences should be presented with and without a causative experimental context.

Frequency Information

The thesis also provided a small but informative sample of the Turkish corpus in which animacy, definiteness and case marking were shown together. Previous corpus studies show case morphology and grammatical rules but they do not provide animacy and definiteness information. In addition, currently there is no software available for automatically counting case marking and grammatical function distribution throughout the corpus. Thus, the counts made in the thesis provide a distribution of the interaction of these factors together. I hope that in future corpus studies, animacy and definiteness information will also be provided. Hopefully, a software will be created, which can extract the case, definiteness and animacy distribution automatically.

Theoretical Contributions: $\theta - Distance$ Theory

When it comes to linking arguments to the verb, the thesis provided a new theory, in which the thematic distribution of the arguments plays a role during linking. This theory was named $\theta - distance$ theory. The experiments conducted on the object-experiencer verbs and the active verbs provided evidence that factors related to the linking of the arguments to the verb played a major role during parsing. It has been hypothesised that the main determinant of the linking is the logical structure of the verb, but that the thematic structure comes into play when the logical structures of the verbs are similar. Particu-

larly when the sentential context does not provide sufficient distinctive features about the lexical-semantic properties of the arguments, thematic structure becomes more dominant in linking. Theta-distance theory suggests that the experiencer verbs have Agent-Experiencer thematic structure, which is shorter in $\theta - distance$ than the active verbs, which have longer $\theta - distance$. Theta-Distance theory brings a new explanation to why object experiencer verbs can be considered as a marked argument structure.

Word-Order, Animacy and Linking

Strikingly, Experiment 3 also suggested that, Turkish takes word order as a basic linking-proper step, rather than exclusively depending on case marking. Most possibly, as the corpus study revealed, the flow and the precedence of the prominence relation of the arguments in Turkish (definite > indefinite, animate>inanimate, subject>object) provides a general frame for linking. Since (i) accusative case marking is mostly related to the referential status of the arguments, (ii) it is not obligatorily used, and (iii) the nominative is a null element, Turkish may depend on SOV word order during linking. The corpus study, similarly, showed that OV, SOV, and SV are very frequent word orders and OSV and SVO orders are very infrequent, supporting the general tendency of Turkish to have SOV as a basic linking-proper.

The thesis also provides evidence that during language comprehension, people use pre-verbal cues to ease linking. Holding two items in memory is probably not difficult for the memory system, but it may be problematic for the comprehension system (especially when these arguments are from the same class semantically or in a non-canonical order). Thus, the main problem for the comprehension system is linking, and the main goal of assigning pre-verbal GRs, and interpretive and formal prominence relations is to ease linking. Animacy is one of the most informative and distinctive features in this regard. Animacy differences ease the linking. Following that, the argument structure with higher $\theta - distance$ and then the word-order (which has SOV word order) comes into play during linking.

These hypotheses about linking must be tested in future studies. For instance, verbs with different logical structures (which do not require GR reversal) must be tested to compare how linking is affected from LS differences. Similarly, findings of this thesis must be confirmed with other verb types having a similar LS, but different thematic structures. One problem in the study in this thesis was that I used a limited number of verbs in Experiment 3. Thus, the number of tokens from each verb type must be increased to yield a better evaluation of the data.

In general, I believe that the findings in this thesis provide a positive contribution to the psycholinguistic understanding of verb-final languages. These findings should not be confined to diagnose or describe Turkish only: They must be evaluated from a cross-linguistic perspective, and should be used to construct bridges with the linguistic and psycholinguistic research. Turkish provides a platform for many more research explorations than what could be presented in the thesis. I believe that the morphological and syntactic properties of Turkish provide very feasible ways to test and compare current psycholinguistic studies on morphosyntactic violations, discourse processing, memory sources in language comprehension (effects of overt and covert arguments), coercion like effects (which can be observed by object-incorporation), linking differences between different verb types, and investigation of a-structure.

References

Aissen, J. (2003). Differential object marking. *Nature Language and Linguistic Theory, 21*, 435-483.

Aoshima, S., Phillips, C., & Weinberg, A. (2004). Processing filler-gap dependencies in a head-final language. *Journal of Memory and Language, 51*, 23-54.

Atalay, N. B. (2003). The annotation process in the Turkish Treebank. In *Proceedings of the eacl workshop on linguistically interpreted corpora.* Hungary, Budapest.

Başar, E. (1980). *Eeg-brain dynamics relation between eeg and brain evoked potentials.* Amsterdam: Elsevier.

Bader, M., & Lasser, I. (1994). German verb-final clauses and sentence processing: Evidence for immediate attachment. In C. Clifton, L. Frazier, & K. Rayner (Eds.), *Perspectives on sentence processing* (p. 225-243). Hillsdale, NJ:Lawrence Erlbaum Associates.

beim Graben, P., Saddy, J., Schlesewsky, M., & Kurths, J. (2000). Symbolic dynamics of event-related potentials. *Physical Review E, 62*(4), 5518-5541.

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

Bierwisch, M. (1988). On the grammar of local prepositions. In M. Bierwisch, W. Motsch, & I. Zimmermann (Eds.), *Syntax, semantik und lexikon* (p. 1-65). Berlin:Akademie Verlag.

Bornkessel, I. (2002). *The argument dependency model: A neurocognitive approach to incremental interpretation.* Vol:28. Leipzig: MPI Series in Cognitive Neuroscience.

Bornkessel, I., McElree, B., Friederici, A., & Schlesewsky, M. (2004). Multi-dimensional contributions to garden path strength: dissociating phrase structure from case marking. *Journal of Memory and Language, 51*, 495-522.

Bornkessel, I., & Schlesewsky, M. (2006). The extended argument dependency model: A neurocognitive approach to sentence comprehenson across languages. *Psychological Review, 113*, 787-821.

Bornkessel, I., Schlesewsky, M., & Friederici, A. (2002a). Beyond syntax: Language-related positivities reflect the revision of hierarchies. *Neuroreport*, *13*, 361-364.

Bornkessel, I., Schlesewsky, M., & Friederici, A. (2002b). Grammar overrides frequency: Evidence from the online processing of flexible word order. *Cognition*, *85*, B21-B30.

Bornkessel, I., Schlesewsky, M., & Friederici, A. (2003). Eliciting thematic reanalysis effect: The role of syntax-independent information during parsing. *Language and Cognitive Processes*, *18*, 268-298.

Bornkessel, I., Zysset, S., Friederici, A., von Cramon, D., & Schlesewsky, M. (2005). Who did what to whom? The neural basis of argument hierarchies during language comprehension. *NeuroImage*, *26*, 221-233.

Bossong, G. (1985). *Differentielle objectmarkierung in den neuiranischen sprachen*. Gunter Narr Verlag, Tübingen.

Bresnan, J. (2000). *Lexical-functional grammar*. Oxford:Basil Blackwell.

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

Çağrı, I. (2005). *Minimality and Turkish relative clauses*. Unpublished Doctoral Dissertation, University of Maryland College Park.

Çakıcı, R. (2005). Automatic induction of a CCG grammar for Turkish. In A. for Computational Linguistics (Ed.), *Proceedings of the ACL student research workshop* (p. 73-78). Ann Arbor, MI.

Caplan, D., Alpert, N., & Waters, G. (1998). Effects of syntactic structure and prepositional number on patterns of regional blood flow. *Journal of Cognitive Neuroscience*, *10*, 541-552.

Caplan, D., Alpert, N., & Waters, G. (1999). PET studies on syntactic processing with auditory sentence presentation. *NeuroImage*, *9*, 343-351.

Caplan, D., Alpert, N., Waters, G., & Olivieri, A. (2000). Activation of Broca's area by syntactic processing under conditions of concurrent articulation. *Human Brain Mapping*, *9*, 65-71.

Caplan, D., Vijayan, S., Kuperberg, G., West, C., Waters, G., Greve, D., et al. (2001). Vascular response to syntactic processing: Event-related fMRI study of relative clauses. *Human Brain Mapping*, *15*, 26-38.

Chen, E., West, G., W.C. Waters, & Caplan, D. (2006). Determinants of bold signal correlets of processing object-extracted relative clauses. *Cortex*, *42*, 591-604.

Chomsky, N. (1981). *Lectures on government and binding*. Dordrecht, the Netherlands:Kluwer.

Comrie, B. (1989). *Linguistic universals and language typology (2nd ed.)*. Oxford:Blackwell.

Cooke, A., Zurif, E., DeVita, C., Alsop, D., Koenig, P., Detre, J., et al. (2002). Neural basis of sentence comprehension: Grammatical and short term memory components. *Human Brain Mapping, 15*, 80-94.

Coulson, S., King, J., & Kutas, M. (1998). Expect the unexpected: Event-related brain response to morphosyntactic violations. *Language and Cognitive Processes, 13*(1), 21-58.

Crocker, M. (1994). On the nature of pinciple-based sentence processor. In C. Clifton & L. Frazier (Eds.), *Perspectives on sentence processing* (p. 245-266). Hillsdale:Erlbaum.

Croft, W. (2003). *Typology and universals.* Cambridge:Cambridge University Press.

Cuetos, F., & Mitchell, D. (1988). Cross-linguistic differences in parsing: Restricions on the use of late closure strategy in Spanish. *Cognition, 30*, 73-105.

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

de Vincenzi, M., Job, R., Di Matteo, R., Angrilli, A., Penolazzi, B., & Ciccarelli, L. (2003). Differences in the perception and time course of syntactic and semantic violations. *Brain and Language, 85*, 280-296.

Demiral, Ş., Schlesewsky, M., & Bornkessel-Schlesewsky, I. (2007). On the universality of language comprehension strategies: Evidence from Turkish. *Cognition, doi:10.1016/j.cognition.2007.01.008.*

Dowty, D. (1979). *Word meaning and montague grammar.* Dordrecht:Reidel.

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

Enç, M. (1986). Topic switching and pronominal subjects in Turkish. In D. I. Slobin & K. Zimmer (Eds.), *Studies in Turkish Linguistics* (p. 195-208). Amsterdam,Philadelphia: John Benjamins Publishing Company.

Enç, M. (1991). The semantics of specificity. *Linguistic Inquiry, 2*, 1-26.

Enfelberg, S. (2000). *Verben, ereignisse und das lexikon.* Tübingen:Niemeyer.

Erguvanlı, E. (1984). *The function of word order in Turkish grammar.* University of California Press, Berkeley.

Ferreira, F., & Clifton, C. (1986). The independence of syntactic processing. *Journal of Memory and Language, 25*, 348-368.

Ferretti, T., Kutas, M., & McRae, K. (2006). Verb aspect and the activation of event knowledge. *Journal of Experimental Psychology: Learning, Memory and Cognition.*

Fodor, J. (1979). Superstrategy. In W. Cooper & E. Walker (Eds.), *Sentence processing.* Hillsdale, NJ:Erlbaum.

Fodor, J. (1998). Learning to parse. *Journal of psycholinguistic research, 27*, 285-319.

Fodor, J., & Sag, I. (1982). Referential and quantificational indefinites. *Linguistics and Philosophy*, *5*, 355-398.

Ford, M. (1983). A method for obtaining measures of local parsing complexity through sentences. *Journal of Verbal Learning and Verbal Behavior*, *22*, 203-218.

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

Frazier, L., & Clifton, C. (1996). *Construal*. Cambridge, MA:MIT Press.

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

Friederici, A. (1999). The neurobiology of language comprehension. In A. Friederici (Ed.), *Language comprehension: A biological perspective* (p. 263-301). New York:Springer.

Friederici, A. (2002). Towards a neural basis of auditory sentence processing. *Trends in Cognitive Sciences*, *6*(2), 78-84.

Friederici, A., Mecklinger, A., Spencer, K., Steinhauer, K., & Donchin, E. (2001). Syntactic parsing preferences and their on-line revisions: A spatio-temporal analysis of event-related potentials. *Cognitive Brain Research*, *47*, 193-221.

Friederici, A., & Meyer, M. (2004). The brain knows the difference: Two types of grammatical violations. *Brain Research*, *1000*, 72-77.

Frisch, S., Kotz, S., von Cramon, Y., & Friederici, A. (n.d.).

Frisch, S., & Schlesewsky, M. (2001). The N400 reflects problems of thematic hierarchizing. *NeuroReport*, *12*(15), 3391-3394.

Frisch, S., Schlesewsky, M., Saddy, D., & Alpermann, A. (2002). The P600 as an indicator of syntactic ambiguity. *Cognition*, *85*, B83-B92.

Geyer, A., Holcomb, P., Kuperberg, G., & Perlmutter, N. (2006). Plausibility and sentence comprehension: An ERP study. *Cognitive Neuroscience. Supplement. Abstract.*

Gibson, E. (1998). Linguistic complexity: Locality of syntactic dependencies. *Cognition*, *68*, 1-76.

Gibson, E. (2000). The dependency locality theory: A distance-based theory of linguistic complexity. In Y. Miyashita, A. Marantz, & W. O'Neil (Eds.), *Image, language, brain* (p. 95-126). Cambridge, MA: MIT Press.

Gibson, E., Desmet, T., Grodner, D., Watson, D., & Ko, K. (2005). Reading relative clasues in English. *Cognitive Linguistics*, *16*, 313-353.

Göksel, A. (1998). Linearity, focus and the postverbal positions in Turkish. In L. Johanson, A. Csato, V. Locke, & A. Menz (Eds.), *The Mainz Meeting*. Wiesbaden:Otto Harrossowitz.

Gorell, P. (1996). Parsing theory and phrase-order variation in German V2 clauses. *Journal of Psycholinguistic Research*, *25*(1), 135-156.

Gorell, P. (2000). The subject-before-object preference in German clauses. In B. Hemford & L. Konieczny (Eds.), *German setence processing* (p. 25-63). Kluwer Academic Publishers.

Göz, I. (2003). *Yazılı Türkçe'nin Kelime Sıklığı Sözlügü*. Ankara: Atatürk Kültür Dil ve Tarih Yüksek Kurumu.

Grewe, T., Bornkessel, I., Zysset, R., S. Wiese, von Cramon, D., & Schlesewsky, M. (2006). Linguistic prominence: The linearization principles on Broca's area. *Journal of Cognitive Neuroscience Supplement*.

Grimshaw, J. (1990). *Argument structure*. MIT Press, Cambridge,Mass.

Gunter, T., Friederici, A., & Schriefers, H. (2000). Syntactic gender and semantic expectancy: ERPs reveal early autonomy and late interaction. *Journal of Cognitive Neuroscience*, *12*(4), 556-568.

Gunter, T., Stowe, L., & Mulder, G. (1997). When syntax meets semantics. *Psychophysiolgy*, *34*, 660-676.

Hagoort, P., & Brown, C. (2000). ERP effects of listening to speech compared to reading: The P600/SPS to syntactic violations in spoken sentence and rapid serial visual presentation. *Neuropsychologia*, *38*, 1531-1549.

Hahne, A., & Friederici, A. (1998). ERP evidence for autonomous first-pass parsing process in auditory language comprehension. *Journal of Cognitive Neuroscience, Supplement*.

Hahne, A., & Friederici, A. (1999). Electrophysiological evidence for two steps in syntactic analysis: Early automatic and late controlled processes. *Journal of Cogitive Neuroscience*, *11*(2), 199-212.

Hahne, A., & Friederici, A. (2002). Differential task effects on semantic and syntactic processes as revealed by ERPs. *Cognitive Brain Research*, *13*, 339-356.

Hahne, A., & Jescheniak, J. (2001). What is left if the jabberwock gets the semantics? An ERP invetigation into semantic and syntactic process during auditory sentence comprehension. *Cognitive Brain Research*, *11*, 199-212.

Hankamer, J. (1971). *Constraints on deletion in syntax*. PhD. Thesis, Yale university.

Haspelmath, M. (2006). Against markedness (and what to relace it with). *Journal of Linguistics*, *42*, 25-70.

Holisky, D. (1987). The case of intransitive subject in Tsova-Tush (Batsbi). *Lingua*, *71*, 103-132.

Hopper, P., & Thompson, S. (1980). Transitivity in grammar and disourse. *Language*, *56*(2), 251-299.

Hsiao, F., & Gibson, E. (2003). Processing relative clauses in Chinese. *Cognition*, *90*, 3-27.

Inoue, A., & Fodor, J. (1995). Information-paced parsing of Japanese. In R. Mazuka & N. Nagai (Eds.), *Japanese sentence processing* (p. 9-63).

Hillsdale, NJ: Lawrence Erlbaum.

Jackendoff, R. (1972). *Semantic interpretation of generative grammar*. Cambridge, MA: MIT Press.

Jackendoff, R. (2007). A parallel architecture perspective on language processing. *Brain Research*, *1146*, 2-22.

Jackendoff, R., & Culicover, P. (2005). *Simpler syntax*. Oxford University Press.

Just, M., & Carpenter, P. (1992). A capacity theory of comprehension: Individual differences in working memory. *Psychological Review*, *99*(1), 122-149.

Just, M., Carpenter, P., & Keller, T. (1996). Brain activation modulated by sentence comprehension. *Science*, *274*(5284), 114-116.

Kaan, E. (2000). The P600 as an index of syntactic integration difficulty. *Language and Cognitive Processes*, *15*, 159-201.

Kamide, Y., & Mitchell, D. (1999). Incremental pre-head attachment in Japanese parsing. *Language and Cognitive Processes*, *14*(5).

Kanske, P., & Kotz, S. (2007). Concreteness in emotional words: ERP evidence from a hemfield study. *Brain Research*, *1148*, 138-148.

Kim, A., & Osterhout, L. (2005). The independence of combinatory semantic processing: Evidence from Event-Related Potentials. *Journal of Memory and Language*, *52*, 205-225.

King, J., & Just, M. (1991). Individual differences in syntactic processing: The role of working memory. *Journal of Memory and Language*, *30*, 580-602.

King, J., & Kutas, M. (1995). Who did what and when? Using word- and clause-level ERPs to monitor working memory usage in reading. *Journal of Cognitive Neuroscience*, *7*, 376-395.

Kiparsky, P. (1989). *Agreement and linking theory*. Unpublished manuscript, Stanford University, Stanford, CA.

Knecht, L. (1986). *Subject and object in Turkish*. PhD Dissertation, MIT.

Kok, A. (2001). On the utility of P3 amplitude as a measure of processing capacity. *Psychophysiology*, *38*, 557-577.

Kolk, H., Chwilla, D., van Herten, M., & Oor, P. (2003). Structure and limited capacity in verbal working memory: A study with event-related potentials. *Brain and Language*, *85*, 1-36.

Kornfilt, J. (1997). *Turkish*. Routledge, New York.

Kounios, J., & Holcomb, P. (1994). Concreteness effects in semantic processing: ERP evidence supporting dual-coding theory. *Journal of Experimental Psychology: Learning, Memory and Cognition*, *20*.

Kuperberg, G. (2007). Neural mechanisms of language comprehension: Challenges to syntax. *Brain Research*, *1146*, 23-46.

Kutas, M., & Federmeier, K. (2000). Electrophysiology reveals semantic memory use in language comprehension. *Trends in Cognitive Sciences*, *4*(12),

463-470.

Kutas, M., & Hillyard, S. (1980). Reading senseless sentences: Brain potentials reflect semantic incongruity. *Science*, *207*, 203-205.

Kutas, M., & Hillyard, S. (1984). Brain potentials during reading reflect word expectancy and semantic association. *Nature*, *307*, 161-163.

Kutas, M., Van Petten, C., & Kluender, R. (2006). Psycholinguistics electrified II (1994-2005). In M. Gernbacher & M. Traxler (Eds.), *To appear: Handbook of Psycholinguistics, second edition.*

Kwon, N., Polinsky, M., & Kluender, R. (2006). Subject preference in Korean. In D. Baumar, D. Montero, & M. Scanlon (Eds.), *Proceedings of the 25th west coast conference on formal linguistics.* Somersville, MA: Cascadilla Proceedings Project.

Levin, B., & Rappaport Hovav, M. (1994). A preliminary analysis of causative verbs in English. *Lingua*, *92*, 35-77.

Levin, B., & Rappaport Hovav, M. (2005). *Argument realization.* Cambridge; Cambridge University Press.

Lewis, R., Vasishth, S., & Van Dyke, J. (2006). Computational principles of working memory in sentence comprehension. *Trends in Cognitive Sciences*, *10*, 447-454.

Li, Y. (1995). The thematic hierarchy and causativity. *Natural Language and Linguistic Theory*, *13*, 255-282.

Lin, C., & Bever, T. (2006). Subject preference in the processing of relative clasues in Chinese. In D. Baumar, D. Montero, & M. Scanlon (Eds.), *Proceedings of the 25th west coast conference on formal linguistics.* Somersville,MA: Cascadilla Proceedings Project.

Lyons, J. (1977). *Semantics I, II.* Cambridge University Press.

MacWhinney, B. (1982). Basic syntactic processes. In S. Kuczaj (Ed.), *Language acquisition: Syntax and semantics* (p. 65-114). Erlbaum, Hilsdale, NJ.

MacWhinney, B., Bates, L., & Kliegl, R. (1982). Cue validity and sentence interpretation in English, German and Italian. *Journal of Verbal Learning and Verbal Behavior*, *23*, 127-150.

MacWhinney, B., Osmàn-Sàgi, J., & Slobin, D. (1991). Sentence comprehension in aphasia in two clear case-marking languages. *Brain and Lnguage*, *41*, 234-249.

Mak, W., Vonk, W., & Schriefers, H. (2002). The influence of animacy on relative clause processing. *Journal of Memory and Language*, *47*, 50-68.

McRae, K., Hare, M., Elman, J., & Ferretti, T. (2005). A basis for generating expectancies for verbs from nouns. *Memory and Cognition*, *33*(7), 1174-1184.

Mecklinger, A., Schriefers, H., Steinhuer, K., & Friederici, A. (1995). Processing relative clauses varying on syntactic and semantic dimensions:

An analysis with even-related potentials. *Memory and Cognition, 23*(4), 477-494.

Miyamoto, E., & Nakamura, M. (2003). Subject/object asymetries in the processing of relative clasues in Japanese. In G. Garding & M. Tsujimura (Eds.), *Proceedings of the 22th west coast conference on formal linguistics.* MA: Somerville.

Neville, H., Mills, D., & Lawson, D. (1992). Fractioning language: Different neural subsystems with different sensitive periods. *Cortex, 2*, 244-258.

Oflazer, K., Say, B., Hakkani-Tür, D., & Tür, G. (2003). Building a Turkish Treebank. In A. Arbeille (Ed.), *Treebanks: Building and using parsed corpora* (p. 261-277). Dordrecht:Kluwer.

Osterhout, L. (1997). On the brain response to syntactic anomalies: Manipulations of word position and word class reveal individual differences. *Brain and Language, 59*, 494–522.

Osterhout, L., & Hagoort, P. (1999). A superficial resemblance does not necessarily mean you are part of the family: Counterarguments to Coulson,King and Kutas (1998) in the P600/SPS-P300 debate. *Language and Cognitive Processes, 14*(1), 1-14.

Osterhout, L., & Holcomb, P. (1992). Event-related potentials elicited by syntactic anomaly. *Journal of Memory and Language, 31*, 785-806.

Osterhout, L., & Mobley, L. (1995). Event-related brain potentials elicited by failure to agree. *Journal of Memory and Language, 34*, 739-773.

Ott, M. (2004). *Verarbeitung von variierenden animatheitsmerkmalen: Eine studie zum animatheitseinfluss bei nicht ambig kasusmarkierten w-fragen im deutchen: Processing varying animacy features: A study on the influence of animacy in unambiguous wh-questions in german.* Unpublished master's thesis, University of Potsdam, Potsdam, Germany.

Özgören, M., Başar-Eroğlu, C., & Başar, E. (2005). Beta oscillations in face recognition. *International Journal of Psychophysiology, 55*(1), 51-59.

Phillips, C. (2003). Linear order and constituency. *Linguistic Inquiry, 34*, 37-90.

Pickering, M. (1991). Sentence processing without empty categories. *Language and Cognitive Processes, 6*(3), 229-259.

Picton, T., Bentin, S., Berg, P., Donchin, E., Hillyard, S., Johnson, R., et al. (2000). Guidelines for using human event-related potentials to study cognition: Recording standarts and publication criteria. *Psychophysiology, 37*, 127-152.

Pollard, C., & Sag, I. (1994). *Head-driven phrase structure grammar.* University of Chicago Press.

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

Pritchett, B. (1988). Garden path phenomena and the grammatical basis of language processing. *Language, 64*, 539-576.

Pritchett, B. (1991). Head position and parsing ambiguity. *Journal of Psycholingistic Research, 20*(3), 251-270.

Pustejovsky, J. (1991). The syntax of event structure. *Cognition, 1991*(41), 47-81.

Röder, B., Stock, O., Neville, H., Bien, S., & Rösler, F. (2002). Brain activation modulated by the comprehension of normal and pseudo-word sentences of different processing demands: A functional magnetic resonance imaging study. *Neuroimage*, *15*, 1003-1014.

Roehm, D., Bornkessel-Schlesewsky, I., Rösler, F., & Schlesewsky, M. (2007). To predict or not to predict: Influences of task and strategy on the processing of semantic relations. *Journal of Cognitive Neuroscience*, *19*(8), 1-16.

Roehm, D., Schlesewsky, M., Bornkessel, I., Frisch, S., & Haider, H. (2004). Fractioning language comprehension via frequency characteristics of the human EEG. *Neuroreport*, *15*, 409-412.

Rösler, F., Pechmann, T., Streb, J., Röder, B., & Hennighausen, E. (2002). Parsing of sentences in a language with varying word order: Word-by-word variations of processing demands are revealed by event-related brain potentials. *Journal of Memory and Language*, *38*, 150-176.

Rösler, F., Pechmann, T., Streb, J., Röder, B., & Hennighausen, E. (2003). Parsing sentences in a language with varying word order: Word-by-word variations of processing demands are revealed by event-related brain potentials. *Journal of Memory and Language*, *38*, 150-176.

Rugg, M., & Coles, M. (1997). *Electrophysiology of mind.* Oxford University Press.

Sapir, E. (1921). *Language: An introduction to the study of speech.* New York: Harcourt, Brace Company.

Schlesewsky, M., Bornkessel, I., & Frisch, S. (2003). The neuropsycholoical bases of word order variations in German. *Brain and Language*, *86*, 116-128.

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

Schriefers, H., Friederici, A., & Kühn, K. (1995). The processing of locally ambiguous relative clauses in German. *Journal of Memory and Language*, *1995*(34), 499-520.

Scott, G. (1978). *The fore language of papua new guinea.* Canberra, australia: Pasific Linguistics.

Slobin, D., & Bever, T. (1982). Children use canonical sentence schemas: A crosslinguistic study of word order and inflections. *Cognition*, *12*, 229-265.

Smolensky, P., & Legendre, G. (2006). *The harmonic mind.* MIT Press.

Stromswold, K., Caplan, N., D. Alpert, & Rauch, S. (1996). Localization of syntactic comprehension by positron emission tomography. *Brain and Language*, *52*, 452-473.

Swainson, R., Jackson, S., & Jackson, G. (2006). Using advance information in dynamic cognitive control: An ERP study of task-switching. *Brain Research*, *1105*, 61-72.

Taylor, W. (1953). 'Cloze procedure': A new tool for measuring readability. *Journalism Quarterly*, *30*, 415-433.

Tenny, C. (1987). *Grammaticalizing aspect and affectedness.* Doctoral Dissertation, MIT.

Tenny, C. (1994). *Aspectual roles and the syntax-semantics interface.* Dordrecht:Kluwer Academic Publishers.

Tenny, C., & Pustejovsky, J. (2000). A history of events in linguistic theory. In C. Tenny & J. Pustejovsky (Eds.), *Events as grammatical objects* (p. 3-37). CSLI Publications.

Thompson, S. (1978). Modern english for a typological point of view: Some implications of the function of word order. *Linguistische Berichte*, *54*, 19-36.

Travis, L. (1991). Parameters and phrase structure and verb-second phenomena. In R. Freidin (Ed.), *Principles and parameters in comparative grammar* (p. 339-364). Cambridge,MA:MIT Press.

Travis, L. (1994). Event phrase structure and a theory of functional categories. In P. Koskinen (Ed.), *Preceedings of the 1994 annual conference of the Canadian Linguistic Society* (p. 559-570). Canadian Linguistic Society.

Traxler, M., Morris, R., & Seely, R. (2002). Processing subject and object relative clauses: Evidence from eye movements. *Journal of Memory and Language*, *47*, 69-90.

Vaid, J., & Pandit, R. (1991). Sentence interpretation in normal and aphasic Hindi speakers. *Brain and Cognition*, *41*, 250-274.

Van Herten, M., Chwilla, D., & Kolk, H. (2006). When heuristics clash with parsing routines: ERP evidence for conflict monitoring in sentence perception. *Journal of Cognitive Neuroscience*, *18*(7), 1181-1197.

Van Berkum, J., Brown, C., Zwitserlood, P., Kooijman, V., & Hagoort, P. (2005). Anticipating upcoming words in discourse: Evidence from ERPs and reading times. *Journal of Experimental Psychology: Learning, Memory and Cognition*, *31*(3), 443-467.

Van Petten, K. M., C. (1990). Interactions between sentence context and word frequency in event-related brain potentials. *Memory and Cognition*, *18*(4), 380-393.

Van Valin, R. (2005). *Exploring the syntax-semantics interface.* Cambridge University Press.

Vendler, Z. (1967). *Linguistics in philosophy.* Ithaca:Cornell University Press.

Verleger, R. (1988). Event-related potentials and memory: A critique of the context updating hypothesis and an alternative interpretation of P3. *Behavioral and Brain Sciences*, *11*, 343-356.

von Heusinger, K., & Kornfilt, J. (2005). The case of direct object in Turkish: Semantics, syntax and morphology. *Turkic Languages*, *9*, 3-44.

Vosse, T., & Kempen, G. (2000). Syntactic structure assembly in human parsing: A computational model based on competitive inhibition and lexicalist grammar. *Cognition*, *75*, 105-143.

West, W., & Holcomb, J. (2000). Imaginal, semantic, and surface-level processing of concrete and abstract words: An electrophysiological investigation. *Journal of Cognitive Neuroscience*, *12*(6), 1024-1037.

Wickerly, J., & Kutas, M. (1999). An electrophysiological analysis of animacy effects in the processing of object relative sentences. *Psychophysiology*, *36*, 559-570.

Wunderlich, D. (1997). Cause and the structure of verbs. *Linguistic Inquiry*, *28*, 27-68.

List of Figures

List of Tables

Appendix A

Experimental stimuli used in Experiment 1 and Experiment 2. The sets marked with "*" are excluded in Experiment 2 to yield 72 sets rather than 80. Also, note that Experiment 1 had a fewer number of experimental and control conditions leading to a fewer number of stimuli constructed from this material. Here, I show all the lexical material used in Experiment 2.

The English translations will be presented under each lexical item. Frequencies (f) of the animate and inanimate NPs are also provided and written under the NPs. Frequencies show the number of occurences in the 1 million word corpus provided by Göz (2003). The material is presented in the following order for each set:

Set No.	Adverb	Pronoun	Anim. NP1	Inanim. NP1	
			f of Anim. NP.	f of Inanim. NP	
	Main Verb	Filler	Filler	Filler	Filler
		(Obj. NP)	(V1)	(V2)	(V3)

01	Bugün	ben	kadın	salıncak	
	Today	1s	woman	swing	
			1898	1	
	salladım	bebeği	sakatladı	yoruldu	devrildi
	to swing	baby	to injure	to get tired	to be collapsed
02	Dün	biz	doktor	altın	
	Yesterday	1p	doctor	gold	
			523	168	
	aradık	hemşireyi	şaşırttı	susadı	bulundu
	to look for	nurse	to surprise	to get thirsty	be found
03	Bu sabah	biz	adam	çamaşır	
	This morning	1p	man	cloth	
			1169	52	
	astık	mahkumu	sıktı	sıkıldı	kırıştı
	to hang	criminal	to make uneasy	to get bored	to be crumbled
04	Az önce	ben	öğrenci	soru	
	A while ago	1s	student	question	
			407	588	
	cevapladım	öğretmeni	susturdu	uyudu	soruldu
	to answer	teacher	to silence	to sleep	to be asked
05	Dün	ben	tamirci	tren	
	Yesterday	1s	repairman	train	
			16	83	
	bekledim	ustayı	ezdi	çalıştı	devrildi
	to wait for	chief repairmen	to run over	to work	to be collapsed
06	Dün	ben	tutuklu	kutu	
	Yesterday	1s	prisoner	box	
			8	126	
	taşıdım	muavini	yaraladı	üşüdü	kırıldı
	to carry	co-pilot	to wound	to be cold	to be broken
07	Dün akşam	ben	öğretmen	makas	
	Yesterday night	1s	teacher	scissors	
			311	11	
	buldum	hademeyi	sevindirdi	koştu	aşındı
	to find	sch. personel	to make happy	to run	to be torn
08	Bu sabah	ben	asistan	otobüs	
	This morning	1s	assitant	bus	
			22	213	
	ayarladım	doktoru	sürükledi	öfkelendi	bozuldu
	to arrange	doctor	to take with	to get angry	to be broken

09	Geçen gün	biz	ahçı	toprak	
	Days ago	1p	cook	sand	
			6	379	
	eledik	stajyeri	yuttu	sinirlendi	kurudu
	filter	prac. student	to swallow	to get angry	to dry
10	Bugün	biz	temsilci	mektup	
	Today	1p	representative	letter	
			93	240	
	gönderdik	müdürü	aldattı	üzüldü	gecikti
	to send	sch. president	to cheat	to get upset	to become late
11	Dün gece	ben	piyanist	çığlık	
	Last night	1s	pianist	scream	
			10	74	
	duydum	kızı	korkuttu	güldü	yankılandı
	to hear	girl	to scare	to laugh	to reverbarate
12*	Az önce	biz	koşucu	ırmak	
	While ago	1p	runner	river	
			11	49	
	geçtik	kadını	yuttu	düştü	bulandı
	to pass	woman	to swallow	to fall	to be corrupted
13	Geçen ay	ben	mülteci	silah	
	Last month	1s	immigrant	gun	
			3	182	
	gizledim	çocuğu	yaraladı	kaçtı	bozuldu
	to hide	kid	to injure	to run away	to be broken
14	Geçen ay	biz	asker	hazine	
	Last month	1p	soldier	treasury	
			181	19	
	gömdük	pilotu	şaşırttı	hastalandı	kayboldu
	to burry	pilot	to surprise	to get sick	to be lost
15	Bu sabah	ben	şarkıcı	şarkı	
	This morning	1s	singer	song	
			43	224	
	dinledim	sunucuyu	etkiledi	öksürdü	yazıldı
	to listen	speaker	to influence	to caugh	to be written
16	Dün akşam	biz	palyaço	mahzen	
	Last night	1p	clown	cellar	
			2	10	
	gördük	cambazı	korkuttu	güldü	yandı
	to see	clown	to frighten	to laugh	to burn

17	Bugün	ben	hırsız	buğday	
	Today	1s	thief	wheat	
			49	51	
	dövdüm	köylüyü	sevindirdi	kaçtı	kurudu
	to beat	villager	to make happy	to run away	to dry
18	Geçen ay	ben	yolcu	yemek	
	Last month	1s	traveller	food	
			159	1511	
	götürdüm	şairi	zehirledi	öldü	bayatladı
	to carry	poet	to poison	to die	to get old
19	Dün	biz	usta	taksi	
	Yesterday	1s	chief repairman	taxi	
			165	56	
	çağırdık	kalfayı	ezdi	susadı	kaydı
	to call	jun. repairman	to run over	to get thirsty	to slide
20	Dün akşam	ben	dansöz	maç	
	Last night	1s	belly dancer	game	
			12	237	
	seyrettim	seyirciyi	kışkırttı	oynadı	bitti
	to watch	spectator	to provoke	to play/dance	to end
21	Geçen gün	biz	hostes	elmas	
	Two days ago	1p	crew	diamond	
			11	15	
	kaçırdık	çocuğu	şaşırttı	bayıldı	parladı
	to run away	child	to decieve	to faint	to shine
22	Bu sabah	biz	oyuncu	oyun	
	This morning	1p	player	game	
			159	463	
	kaybettik	menejeri	eğlendirdi	sakatlandı	durakladı
	to lose	meneger	to entertain	to be injured	to stop
23	Geçen ay	biz	müzisyen	ses	
	Last month	1p	musician	sound	
			27	1113	
	kaydettik	piyanisti	durdurdu	hastalandı	yankılandı
	to record	pianist	to stop	to get sick	to reverberate
24*	Az önce	ben	balıkçı	gaz	
	While ago	1s	fisherman	gas	
			48	181	
	kokladım	dilenciyi	zehirledi	boğuldu	tutuştu
	to smell	begger	to poison	to drown	to burn

25	Dün	biz	sanatçı	orman	
	Yesterday	1p	artist	forest	
			219	217	
	koruduk	yönetmeni	korkuttu	güldü	yandı
	to protect	rejisor	to scare	to laugh	to burn
26	Geçen yıl	ben	ajan	bıçak	
	Last year	1s	spy	knife	
			11	100	
	kullandım	sekreteri	yaraladı	ağladı	kırıldı
	to use	secretary	to injure	to cry	to breake
27	Bugün	biz	asker	otobüs	
	Today	1p	soldier	bus	
			181	213	
	naklettik	yolcuyu	korkuttu	uyudu	devrildi
	to transport	traveller	to scare	to sleep	to side down
28	Dün gece	ben	kız	bayrak	
	Last night	1s	girl	flag	
			1088	55	
	öptüm	avukatı	kışkırttı	kaçtı	dalgalandı
	to kiss	attorney	to provoke	to run away	to wave
29	Dün	biz	yazar	kanun	
	Yesterday	1p	writer	law	
			312	185	
	destekledik	ressamı	etkiledi	rahatsızlandı	reddedildi
	to support	panter	to influence	to feel bad	to be rejected
30	Geçen yıl	ben	casus	para	
	Last year	1s	spy	money	
			7	1046	
	sakladım	garsonu	susturdu	konuştu	kayboldu
	to hide	waiter	to silence	to talk	to get lost
31*	Dün	biz	polis	kamyon	
	Yesterday	1p	police	truck	
			278	84	
	ittik	memuru	ezdi	üşüdü	yandı
	to push	staff	to run over	to get cold	to burn
32	Geçen ay	biz	avukat	bomba	
	Last month	1p	lawyer	bomb	
			65	50	
	getirdik	savcıyı	parçaladı	bunadı	patladı
	to bring	prosecutor	to torn apart	to get old	to explode

33	Geçen yıl	ben	sanık	şehir	
	Last month	1s	criminal	town	
			33	370	
	savundum	adamı	bunalttı	konuştu	küçüldü
	to defend	man	to frustrate	to speak	to get smaller
34	Dün akşam	biz	pilot	elbise	
	Last night	1p	pilot	cloth	
			51	120	
	seçtik	hostesi	sıktı	geldi	kırıştı
	to choose	hostess	to tighten	to come	to wrinkle
35*	Bu sabah	ben	polis	çanta	
	This morning	1s	police	bag	
			278	108	
	tuttum	şöförü	güldürdü	ağladı	kayboldu
	to hold	driver	to make laugh	to cry	to get lost
36	Dün akşam	ben	çocuk	araba	
	Last night	1s	child	car	
			2326	422	
	yıkadım	bebeği	korkuttu	bağırdı	devrildi
	to wash	baby	to scare	to shout	to fall aside
37	Bu sabah	biz	memur	taş	
	This morning	1p	staff	stone	
			191	275	
	attık	sekreteri	bayılttı	gecikti	yarıldı
	to throw	secretary	to faint	to get late	to breake
38	Bugün	biz	başkan	maden	
	Today	1p	president	mine	
			269	34	
	belirledik	elçiyi	şaşırttı	sinirlendi	çöktü
	to select/detect	representative	to surprise	to get nervous	to collapse
39	Geçen ay	biz	işçi	petrol	
	Last month	1p	worker	petrol	
			192	150	
	çıkardık	adam	zehirledi	üşüdü	bulundu
	to fire/take out	man	to poison	to get cold	to be found
40	Geçen ay	ben	çocuk	kalem	
	Last month	1s	kid	pen	
			2326	142	
	düşürdüm	hemşireyi	çizdi	kayboldu	kırıldı
	to drop	nurse	to draw	to get lost	to be broken

41	Geçen gün	biz	çocuk	beşik	
	Two days ago	1p	kid	cradle	
			2326	19	
	salladık	kızı	sakatladı	koştu	devrildi
	to swing	girl	to get injured	to run	to fall aside
42	Bu sabah	ben	avukat	define	
	This morning	1s	attorney	treasure	
			65	6	
	aradım	yargıcı	şaşırttı	koştu	kayboldu
	to look for	jufge	to surprise	to run	to get lost
43	Dün	biz	kadın	halat	
	Yesterday	1p	woman	rope	
			1898	5	
	astık	mahkumu	sıktı	hastalandı	koptu
	to hang	criminal	to frustrate	to get sick	to break
44	Bu sabah	biz	müşteri	mektup	
	This morning	1p	customer	letter	
			37	240	
	cevapladık	satıcıyı	susturdu	bayıldı	geldi
	to answer	seller	to silence	to faint	to come
45	Dün akşam	ben	kapıcı	otobüs	
	Last night	1s	house master	bus	
			21	213	
	bekledim	çırağı	ezdi	öldü	sarsıldı
	to wait for	assistant	to run over	to die	to shake
46	Geçen ay	biz	asker	silah	
	Last month	1p	soldier	gun	
			181	182	
	taşıdık	mühendisi	yaraladı	vuruldu	bozuldu
	to carry	engineer	to injure	to be hit	to be broken
47	Dün	ben	şoför	kolye	
	Yesterday	1s	driver	necklace	
			106	19	
	buldum	yolcuyu	sevindirdi	kayboldu	kayboldu
	to find	traveller	to make happy	to get lost	to get lost
48	Geçen yıl	biz	öğretmen	konser	
	Last month	1p	teacher	concert	
			311	88	
	ayarladık	hademeyi	eğlendirdi	yoruldu	planlandı
	to arrange	school master	to entertain	to get tired	to plan

49	Dün gece	biz	piyanist	kum	
	Last night	1p	pianist	sand	
			10	75	
	eledik	şarkıcıyı	yuttu	esnedi	kaydı
	to filter	singer	to swallow	to yawn	to slide
50	Az önce	ben	polis	mesaj	
	While ago	1s	police	message	
			278	158	
	gönderdim	tutukluyu	aldattı	koştu	geldi
	to send	prisoner	to cheat	to run	to come
51	Dün gece	ben	şarkıcı	ses	
	Last night	1s	singer	voice	
			43	1113	
	duydum	adamı	korkuttu	üzüldü	yankılandı
	to hear	man	to scare	to get upse	to reverberate
52*	Az önce	ben	yüzücü	deniz	
	While ago	1s	swimmer	sea	
			2	509	
	geçtim	balıkçıyı	yuttu	boğuldu	duruldu
	to pass by	fisherman	to swallow	to drawn	to calm
53	Geçen gün	biz	casus	tüfek	
	Two days ago	1p	spy	rifle	
			7	24	
	gizledik	mülteciyi	yaraladı	kaçırıldı	bulundu
	to hide	immigrant	to injure	to be taken away	to be found
54	Geçen yıl	biz	denizci	sandık	
	Last year	1p	seaman	box	
			27	17	
	gömdük	kaptanı	şaşırttı	kayboldu	kırıldı
	to bury	captain	to amaze	to get lost	to be broken
55	Dün akşam	ben	şair	radyo	
	Last night	1s	poet	radio	
			125	140	
	dinledim	gitaristi	etkiledi	öfkelendi	satıldı
	to listen	guitarist	to influence	to get frustrated	to be sold
56	Dün gece	ben	kasap	balta	
	Last night	1s	butcher	axel	
			28	13	
	gördüm	çırağı	korkuttu	sakatlandı	kırıldı
	to see	jun. repairman	to scare	to get injured	to be broken

57	Dün	ben	memur	mısır	
	Yesterday	1s	staff	guest	
			191	41	
	dövdüm	çiftçiyi	sevindirdi	hastalandı	ekildi
	to beat	farmer	to make happy	to get sick	to be planted
58	Az önce	ben	doktor	ilaç	
	While ago	1s	doctor	medicine	
			523	233	
	götürdüm	hemşireyi	korkuttu	geldi	bitti
	to take with	nurse	to scare	to come	to finish
59	Geçen gün	ben	tamirci	ambülans	
	Some tme ago	1s	repairman	ambulans	
			16	30	
	çağırdım	postacıyı	ezdi	bayıldı	devrildi
	to call	postman	to run over	to faint	to fall aside
60	Dün sabah	ben	ressam	kavga	
	Yesterday morn.	1s	painter	fight	
			53	99	
	seyrettim	boksörü	kışkırttı	yoruldu	başladı
	to watch	bokser	to provoke	to get tired	to start
61	Bugün	biz	bankacı	heykel	
	Today	1p	banker	statue	
			16	69	
	kaçırdık	tüccarı	şaşırttı	bayıldı	kırıldı
	to take away	salesman	to surprise	to faint	to break
62	Bu sabah	ben	usta	kitap	
	This morning	1s	repairmen	book	
			165	816	
	kaybettim	kalfayı	eğlendirdi	düştü	kayboldu
	to lose	j. repairman	to entertain	to fall	to get lost
63	Bugün	biz	kemancı	şarkı	
	Today	1p	violinist	song	
			3	224	
	kaydettik	şarkıcıyı	durdurdu	hastalandı	bestelendi
	to record	singer	to stop	to get sick	to be composed
64*	Geçen gün	ben	köylü	çiçek	
	Some time ago	1s	peasant	flower	
			102	177	
	kokladım	bebeği	zehirledi	ağladı	soldu
	to smell	baby	to poison	to cry	to dry

65	Bu sabah	biz	hakim	banka	
	This morning	1p	judge	bank	
			100	643	
	koruduk	avukatı	korkuttu	kaçtı	çöktü
	to protect	lawyer	to scare	to run away	to collapse
66	Geçen ay	biz	asistan	keser	
	Last month	1p	assistant	hammer	
			22	1	
	kullandık	tamirciyi	yaraladı	yoruldu	kayboldu
	to use	repairmen	to injure	to get tired	to get lost
67	Dün	biz	hemşire	paket	
	Yesterday	1p	nurse	pack	
			33	128	
	naklettik	hastayı	korkuttu	düştü	kayboldu
	to transfer	patient	to scare	to fall	to get lost
68	Dün akşam	ben	dansöz	mektup	
	Last night	1s	danser	letter	
			12	240	
	öptüm	doktoru	kışkırttı	bayıldı	geldi
	to kiss	doctor	to provoke	to faint	to come
69	Geçen yıl	biz	öğrenci	anlaşma	
	Last year	1p	stuent	agreement	
			407	56	
	destekledik	işçiyi	etkiledi	kayboldu	imzalandı
	to support	worer	to affect	to get lost	to be signed
70	Geçen gün	biz	kuyumcu	yüzük	
	While ago	1p	goldsmith	ring	
			15	50	
	sakladık	hırsızı	susturdu	kaçırıldı	çalındı
	to hide	thief	to silence	to be kidnapped	to be stolen
71*	Dün akşam	biz	yolcu	araba	
	Last night	1p	traveller	car	
			154	422	
	ittik	hostesi	ezdi	sinirlendi	bozuldu
	to push	hostess	to run over	to get nervous	to be broken
72	Geçen gün	ben	teknisyen	makine	
	Two days ago	1s	tecnician	machine	
			13	239	
	getirdim	stajyeri	parçaladı	yoruldu	bozuldu
	to take with	prac. student	to tear apart	to get tired	to be broken

73	Dün	ben	yazar	kale	
	Yesterday	1s	writer	castle	
			312	72	
	savundum	danscıyı	bunalttı	öldü	çöktü
	to defend	danser	to frustrate	to die	to collapse
74	Dün	biz	kaptan	forma	
	Yesterday	1p	captain	uniform	
			59	17	
	seçtik	oyuncuyu	sıktı	hastalandı	yırtıldı
	to select	player	to frustrate	to get sick	to be torn
75*	Dün sabah	ben	bekçi	bisiklet	
	Yesterday morning	1s	guard	bicycle	
			33	64	
	tuttum	köylüyü	güldürdü	sinirlendi	kaydı
	to hold	villager	to make laugh	to get nervous	to slide
76	Dün sabah	biz	kız	çarşaf	
	Yesterday morning	1p	girl	cloth	
			1088	21	
	yıkadık	hastayı	korkuttu	korktu	kayboldu
	to wash	patient	to scare	to be scared	to get lost
77	Geçen ay	ben	hizmetçi	çöp	
	Last month	1s	server	trash	
			28	126	
	attım	ahçıyı	bayılttı	hastalandı	toplandı
	to fire/throw away	cook	to faint	to get sick	to be gethered
78	Dün	biz	gözetmen	kopya	
	Yesterday	1p	inspector	copy	
			23	36	
	belirledik	hakemi	şaşırttı	ayrıldı	bulundu
	to detect	refree	to surprise	to leave	to be found
79	Geçen yıl	biz	görevli	kömür	
	Last year	1p	personel	coal	
			117	44	
	çıkardık	madenciyi	zehirledi	geldi	tüketildi
	to get rid of	miner	to poison	to come	to be consumed
80	Geçen gün	ben	oyuncu	şişe	
	Two day ago	1s	player	bottle	
			159	117	
	düşürdüm	kaleciyi	yaraladı	sakatlandı	kırıldı
	to drop	goalkeeper	to wound	to be injured	to be broken

Appendix B

Experimental stimuli used in Experiment 3. Translations of the 18 verbs are given below. The adverbials are the same adverbials used in Experiment 1 and 2, so they will not be repeated here. Translations of the nouns are provided in the list showing experimental sets under each noun.

The frequencies (f) of the nouns are also provided accordingly, under the noun. Frequencies show the number of occurences in the 1 million word corpus provided by Göz (2003).

The translations and the frequencies of the active and experiencer verbs are as follows:

Active verbs: *bayılttı* (caused to faint) (4), *destekledi* (supported) (98), *durdurdu* (stopped) (50), *engelledi* (prevented) (159), *korudu* (protected) (341), *kışkırttı* (provoked) (15), *sakatladı* (injured) (4), *susturdu* (silenced) (15), and *zehirledi* (poisoned) (7).

Object-experiencer verbs: *bezdirdi* (annoyed) (7), *bıktırdı* (bored) (1), *bunalttı* (frustrated) (10), *cezbetti* (pleased) (6), *coşturdu* (enthused) (6), *dertlendirdi* (made sorrowful) (4), *hislendirdi* (made emotional) (only *hissettirmek* (to make feel) was available in the counts: 25), *şaşırttı* (surprised) (41), and *usandırdı* (sickened/frustrated) (1).

The presentation of the material in each set will be as follows:

Set No.	Adverb	Active Verb	Experiencer Verb
	Inanim. NP	Anim. NP1	Anim. NP2
		Translations of the NPs	
		f of the NPs	

01	Dün	bayılttı	bıktırdı
	dayak	kız	adam
	beating	girl	man
	76	1088	1169
02	Dün gece	bayılttı	coşturdu
	piyango	şef	amele
	lottery	chief	worker
	3	70	3
03	Geçen ay	bayılttı	usandırdı
	ameliyat	hekim	hemşire
	operation	judge	nurse
	109	37	33
04	Geçen gün	bayılttı	usandırdı
	hastahane	teknisyen	doktor
	hospital	technician	doctor
	209	13	523
05	Geçen yıl	destekledi	bezdirdi
	dava	sanık	avukat
	case	suspected	attorney
	151	33	65
06	Dün akşam	destekledi	bunalttı
	ferman	vezir	asker
	decree	vizir	soldier
	24	10	181
07	Bu sabah	destekledi	coşturdu
	yayın	seyirci	spiker
	broadcasting	spectator	announcer
	197	85	7
08	Geçen ay	destekledi	hislendirdi
	sergi	ressam	gitarist
	exhibition	painter	guitarist
	71	53	2
09	Geçen yıl	durdurdu	bezdirdi
	mafya	mühendis	patron
	mafia	engineer	boss
	22	108	102
10	Dün sabah	durdurdu	coşturdu
	ilaç	atlet	öğrenci
	medicine	athlete	student
	233	18	407

11	Geçen ay	durdurdu	usandırdı
	sendika	işçi	terzi
	trade union	work	tailor
	47	192	21
12	Dün	durdurdu	şaşırttı
	tabela	sürücü	polis
	signboard	driver	police
	29	200	278
13	Geçen gün	engelledi	bezdirdi
	işkence	tutuklu	kadın
	torture	arrested	woman
	67	8	1898
14	Dün akşam	engelledi	bunalttı
	sis	şoför	muavin
	smoke	driver	co-driver
	26	106	12
15	Geçen ay	engelledi	bıktırdı
	yasa	sporcu	hakem
	law	sportsman	refree
	233	91	51
16	Dün	engelledi	hislendirdi
	fırtına	denizci	mühendis
	storm	sailor	engineer
	84	27	108
17	Geçen gün	korudu	bunalttı
	banka	emlakçı	veznedar
	bank	real estate man	cashier
	643	8	10
18	Geçen yıl	korudu	bunalttı
	mahkeme	savcı	yargıç
	court	public prosecutor	jufge
	155	44	39
19	Geçen ay	korudu	bıktırdı
	yasa	vatandaş	bakan
	law	citizen	minister
	233	212	211
20	Dün sabah	korudu	cezbetti
	yelek	avcı	bekçi
	vest	hunter	guard
	13	25	33

21	Geçen gün	kışkırttı	dertlendirdi
	makale	filozof	editör
	article	philosopher	editor
	35	32	14
22	Dün	kışkırttı	dertlendirdi
	türkü	şarkıcı	seyirci
	folk song	singer	spectator
	79	43	85
23	Geçen gün	kışkırttı	hislendirdi
	yazı	sanatcı	gazeteci
	writing	artist	journalist
	579	219	208
24	Bu sabah	kışkırttı	şaşırttı
	mesaj	casus	katil
	message	spy	murderer
	158	7	68
25	Geçen ay	sakatladı	bıktırdı
	yük	hamal	işçi
	load	porter	worker
	147	10	192
26	Dün	sakatladı	cezbetti
	traktör	çiftçi	ağa
	tractor	farmer	landowner
	9	28	51
27	Geçen gün	sakatladı	cezbetti
	tır	çocuk	memur
	truck	kid	officer
	11	2326	191
28	Dün gece	sakatladı	usandırdı
	otobüs	yolcu	şoför
	bus	traveller	driver
	213	154	106
29	Dün akşam	susturdu	bezdirdi
	küfür	futbolcu	muhabir
	curse	soccerplayer	correspondent
	36	83	27
30	Dün sabah	susturdu	dertlendirdi
	haber	adam	piyanist
	news	man	pianist
	598	1169	10

31	Geçen gün	susturdu	şaşırttı
	bıçak	kapıcı	çöpcü
	knife	doorman	garbage collector
	100	21	5
32	Dün gece	susturdu	şaşırttı
	masal	çocuk	kız
	story	kid	girl
	97	2326	1088
33	Geçen ay	zehirledi	cezbetti
	şerbet	kadın	kemancı
	sherbet	woman	violinist
	14	1898	3
34	Dün	zehirledi	coşturdu
	içki	bakkal	çırak
	drink	store	assistant
	141	54	27
35	Dün akşam	zehirledi	dertlendirdi
	çeşme	köylü	muhtar
	fountain	villager	village head
	27	102	64
36	Geçen gün	zehirledi	hislendirdi
	şarap	artist	senarist
	wine	artist	scenarist
	169	13	5
37	Bu sabah	bayılttı	coşturdu
	teklif	şair	doktor
	proposal	poet	doctor
	98	125	523
38	Dün	bayılttı	dertlendirdi
	fatura	amir	çaycı
	invoice	head	tea maker
	114	24	9
39	Geçen ay	bayılttı	dertlendirdi
	haber	manken	modacı
	news	model	fashion designer
	598	58	8
40	Dün akşam	bayılttı	hislendirdi
	müjde	hizmetçi	bahçıvan
	surprise	servant	gardener
	15	28	7

41	Geçen yıl	destekledi	bıktırdı
	ofis	sekreter	postacı
	office	secretary	postman
	67	82	16
42	Geçen gün	destekledi	dertlendirdi
	okul	çocuk	öğrenci
	school	child	student
	565	2326	407
43	Geçen ay	destekledi	usandırdı
	hastahane	cerrah	hasta
	hospital	operator	patient
	209	9	370
44	Dün sabah	destekledi	şaşırttı
	firma	yüzücü	vekil
	firm	swimmer	representative
	304	2	21
45	Dün akşam	durdurdu	bezdirdi
	emir	asker	subay
	command	soldier	officer
	142	181	31
46	Dün	durdurdu	bunalttı
	şikayet	öğretmen	hademe
	complaint	teacher	school personel
	120	311	4
47	Geçen gün	durdurdu	cezbetti
	ışık	boyacı	ressam
	light	paintman	painter
	476	4	53
48	Dün akşam	durdurdu	hislendirdi
	poster	oyuncu	senarist
	poster	player	scenarist
	8	159	5
49	Geçen gün	engelledi	bunalttı
	sel	köylü	muhtar
	flood	villager	village head
	37	102	64
50	Bu sabah	engelledi	cezbetti
	kayalık	yolcu	denizci
	rocky	traveller	seaman
	26	154	27

51	Dün sabah	engelledi	hislendirdi
	yağmur	adam	bakkal
	rain	man	store
	160	1169	54
52	Geçen yıl	engelledi	usandırdı
	gümrük	turist	falcı
	custom	tourist	future teller
	47	67	2
53	Geçen ay	korudu	bezdirdi
	mahalle	kız	öğretmen
	street	girl	teacher
	273	1088	311
54	Geçen yıl	korudu	bıktırdı
	devlet	atlet	hakem
	nation	athlete	refree
	902	18	51
55	Dün	korudu	bıktırdı
	hükümet	yurttaş	müşavir
	government	citizen	counsellor
	304	33	15
56	Dün akşam	korudu	coşturdu
	şirket	işçi	müdür
	company	worker	head
	558	192	183
57	Dün gece	kışkırttı	bezdirdi
	mahkeme	savcı	yargıç
	court	prosecutor	judge
	155	44	39
58	Geçen ay	kışkırttı	coşturdu
	radyo	vatandaş	hatip
	radio	citizen	priest
	140	212	11
59	Dün gece	kışkırttı	usandırdı
	küfür	futbolcu	hakem
	curse	soccerplayer	refree
	36	83	51
60	Bu sabah	kışkırttı	şaşırttı
	anons	eylemci	artist
	announcement	activist	artist
	16	5	13

61	Geçen gün	sakatladı	bezdirdi
	yarış	sporcu	antrenör
	race	sportsman	trainer
	101	91	23
62	Dün akşam	sakatladı	coşturdu
	makine	mühendis	teknisyen
	machine	engineer	technician
	239	108	13
63	Dün	sakatladı	hislendirdi
	dekor	şarkıcı	bestekar
	decor	singer	composer
	27	43	6
64	Dün	sakatladı	şaşırttı
	tramvay	mimar	grafiker
	tram	architect	grafiker
	22	53	5
65	Geçen ay	susturdu	bunalttı
	mektup	memur	müfettiş
	letter	staff	inspector
	240	191	33
66	Geçen yıl	susturdu	bıktırdı
	şikayet	hemşire	hekim
	complaint	nurse	doctor
	120	33	37
67	Dün gece	susturdu	cezbetti
	rüşvet	tanık	avukat
	bribery	witness	lawyer
	37	28	65
68	Dün sabah	susturdu	dertlendirdi
	ayrılık	kadın	kız
	separation	woman	girl
	35	1898	1088
69	Dün sabah	zehirledi	bunalttı
	ikram	tamirci	misafir
	presentation	repairman	guest
	19	16	66
70	Bu sabah	zehirledi	cezbetti
	kahve	patron	kalfa
	coffee	boss	assistant
	172	102	9

71	Geçen ay	zehirledi	usandırdı
	yemek	aşçı	garson
	food	cook	waiter
	1511	28	90
72	Dün gece	zehirledi	şaşırttı
	hediye	nöbetçi	komiser
	gift	guard	police chief
	88	21	28

Bibliographic Information

Demiral, Şükrü Barış

Incremental Argument Interpretation in Turkish Sentence Comprehension

Universität Leipzig

257 pages, 165 references, 24 figures, 21 tables

Curriculum Vitae

Name:	Şükrü Barış Demiral
Date of Birth:	29.01.1975
Place of Birth:	Merzifon, Türkiye
04/2005 – 10/2007	PhD. Student in Max Planck Institute for Cognitive and Brain Sciences, Leipzig
2002 – 2005	Research Scholar, Carnegie Mellon University, Department of Psychology
1998 – 2001	MSc. Student, Middle East Technical University, Department of Cognitive Science
1998 – 2002	Research Assistant, Middle East Technical University
1993 – 1998	Bs. Student, Middle East Technical University, Department of Physics Education
1993	Diploma, Nışantaşı Anatolian High School

Brief Summary of the Thesis

"Incremental Argument Interpretation in Turkish Sentence Comprehension"

This thesis explores how interpretational and formal relations between the arguments of a sentence are established, and how these pre-verbal relations are linked to the sentence-final verb. The language under investigation is Turkish, which is a Subject-Object-Verb language, providing a unique environment to explore preverbal argument-argument relations. The main goal is to understand bottom-up and top-down mechanisms on incremental sentence processing. Bottom-up mechanisms include lexical (e.g., animacy and category information), morphological (e.g., case marking) and syntactic (e.g., word-order) information. Top-down mechanisms include relational (e.g., prominence hierarchies) and evaluative (e.g., pragmatic and referential status of the arguments, general structural and relational economy constraints) mechanisms. Three ERP experiments and three off-line experiments (2 questionnaire studies and 1 corpus study) are conducted. High temporal resolution of the ERP method provided information about the exact timing of on-line processing differences on the lexical items. Off-line measures provided comparison measures.

Findings indicate that the sentence-initial ambiguous argument is taken as the subject of the sentence (agreeing with the verb) independent of the animacy of the argument. Acceptability ratings and corpus counts supported subject preference, but also revealed an effect of animacy, which indicated that animate non-definite argu-

ments are less likely be the object of the sentence. In other words, subject-to-object reading for animate non-definite arguments seems to be more costly and less acceptable.

Economy of using a minimum number of representations emerges in multiple levels (structural, relational, referential). These economy constraints reflected on subject preference, treatment of the sentence-initial object, and the redundant usage of the pronoun. No N400 or scrambling effect is observed on the sentence-initial object, indicating that subject drop (in which the subject is not specified overtly, but coded on the agreement marker on the verb) might be preferred. No prediction to have an extra representation for the subject is required, and a minimal structure is preferred.

On the other hand, late frontal positivities are observed on the verb, which might be related to the pragmatic evaluation of the arguments. This effect emerges either when the subject's or object's referential and pragmatic status is not clear, or when there is a shift in the prototypical properties of the argument (i.e., the subject is an animate Agent and the object is an inanimate Theme). When the verb is recognized, thematic and referential status of the arguments must be clarified to yield a fluent linking and a better comprehension.

The findings also indicate that the relational evaluation of the arguments take part on the second argument unless there is a strong contextual (or environmental) bias. When a conflict exists between the prominence hierarchies (e.g., an inanimate subject is followed by an animate object), an N400 effect is observed on the second argument.

During linking, not only the logical structure of the verb, but also the thematic structure of the verb is taken into consideration. The thesis revealed that the main goal of constructing pre-verbal relational information is most probably to ease linking. In parallel to this hypothesis, when there is no animacy difference between the

arguments, linking becomes more difficult. N400 effects are observed under interactions with word order and verb type. A theory, called theta-distance theory is developed, indicating that when the thematic roles attributed to the argument by the verb are closer, this may lead to an interference and cause linking problems. Similarly, object-experiencer verbs showed an N400-like effect during linking (but not before linking) independent of their lexical status. Word order and argument structure interactions are observed which revealed that Turkish uses subject-object-verb order and standard (unmarked) argument structure as a basic linking proper.

The thesis also contributes to the statistical investigation of the linguistic utterances in Turkish by revealing the animacy and definiteness status of the arguments for the very first time. Another important finding of the thesis is that it revealed the effects of experimental tasks on ERPs. Acceptability and comprehension tasks are found to show different effects on different parts of the sentence. Depending on the realization of the task relevant item, ERPs may show a P3 component for the acceptability task.

Overall, the thesis investigated multiple issues of incremental sentence processing, issues that are unique to Turkish (e.g., subject drop, object-incorporation, optional case marking of direct argument etc.) as well as issues that are considered universal (e.g., subject preference, garden-path effects, garden-path strength, task related effects, interference, and argument selection and linking).

Zusammenfassung der Dissertationsschrift

"Incremental Argument Interpretation in Turkish Sentence Comprehension"

Gegenstand der Arbeit war die Untersuchung von Satzverarbeitungsprozessen im Türkischen mittels ereigniskorrelierter Potentiale. Die so erhobenen "on-line"-Befunde wurden mit Akzeptabilität- bzw. Korpusdaten verglichen und interpretiert. Im Mittelpunkt der sprachlichen Manipulationen standen Eigenschaften des Türkischen, die diese Sprache von anderen bisher untersuchten Sprachen unterscheiden. Insbesondere die Möglichkeit der Weglassbarkeit von Argumenten in einer Sprache mit Verbfinalität ist für die Beschreibung klassischer psycholinguistischer Phänomene, wie Ambiguitätsresolution (Subjektspräferenz), von besonderem Interesse. Insofern beschäftigt sich die vorliegende Dissertation mit der Echtzeitverarbeitung initial mehrdeutiger Nominalphrasen und deren Einfluss auf nachfolgende Argumente (Argument-Argument-Relation) bzw. auf das satzfinale Verb (Argument-Verb-Relation).

Die daraus resultierenden Forschungsfragen lassen sie wie folgt zusammenfassen:

(a) Lässt sich im Türkischen Evidenz für inkrementelle Verarbeitung, d.h. die unmittelbare Interpretation eines mehrdeutigen Argumentes, finden? (Experiment 1 und 2)

(b) Gibt es im Gegensatz zum Deutschen einen unmittelbaren Einfluss der Belebtheit des Argumentes hinsichtlich der Art der inkrementellen Interpretation (Experiment 1 und 2)

(c) Welche Rolle spielen Belebtheit und Kasusmarkierung bei der Verarbeitung eines eindeutigen Objektes? (Experiment 2)

(d) Inwieweit beeinflusst die overte Realisierung von Pronomen und die dadurch entstehende Verdoppelung der pronominalen Information auf dem Argument selbst und auf dem satzfinalen Verb das Verarbeitungsverhalten? (Experiment 2)

(e) Wie lassen sich die Linkingprozesse zwischen der logischen Struktur des Verbs und den in dieser determinierten Argumente erfassen und beschreiben? Welchen zeitlichen Parameter sind charakteristisch für diesen Prozess? (Experiment 3)

(f) In welchem Zusammenhang stehen Vorkommenshäufigkeit und on-line zu beobachtende Effekte? Korreliert die Akzeptabilität einer Struktur eher mit der Vorkommenshäufigkeit oder lassen sich Modulationen der Akzeptabilität eher auf die Verarbeitungsnachteile während der inkrementellen Verarbeitung zurückführen? (Korpusstudie)

(g) Welche EKP-Komponenten lassen sich beobachten und wie verändern diese unser Verständnis über die zugrunde liegende Funktionalität?

(h) Welche typologischen Generalisierungen lassen sich aufgrund der Beobachtungen im Türkischen ableiten?

Konsequenterweise beschäftigt sich Experiment 1 der Dissertation mit der Verarbeitung und Interpretation satzinitial mehrdeutiger Argumente im Türkischen. Diese Struktur ist insofern bedeutsam, da sich durch die spezifischen Eigenschaften der Sprache zwei zentrale Prinzipien der Sprachverstehensforschung sehr elegant überprüfen lassen. Unter der Annahme, dass es eine sprachübergreifende Tendenz zur inkrementellen Interpretation besteht und,

dass damit verbunden, ein initiales Argument als Subjekt interpretiert wird, sollte das Türkische einen Verarbeitungskonflikt zeigen, wenn das Verb eine Reinterpretation zum Objekt erzwingt. Andererseits sollte die im Türkischen sehr häufig zu beobachtende Tendenz zur Weglassbarkeit des Subjektes einer Objektsinterpretation zumindest keine Nachteile aus einer Verarbeitungsperspektive entstehen lassen. Letztere sollte insbesondere dann zum Tragen kommen, wenn das initiale Argument unbelebt ist, und somit einen nicht-prototypischen Handlungsverursacher realisiert. Das Experiment ergab zwei zentrale Befunde. Erstens zeigte sich auf dem die Mehr deutigkeit auflösenden Verb ein Verarbeitungsnachteil in Form einer Positivierung für die Objektsinterpretation des initialen Argumentes, welche unabhängig von der Belebtheit der Nominalphrase war. Demgegenüber zeigte sich in den Akzeptabilitäten ein Vorteil für die Disambiguierung zu einem unbelebten Objekt. Beide Befunde zeigen – so die Interpretation der Daten – unterschiedliche Aspekte der Konfliktresolution. Während sich in den EKPs das Auftreten des Konfliktes (Zurückweisung der Subjektsinterpretation) widerspiegelt, zeigen die finalen Beurteilungen die Einfachheit der Reanalyse zu einer Objektinterpretation des overt realisierten Argumentes.

Experiment 2 untersuchte darüber hinausgehend den Einfluss von Kasusmarkierung bei der Verarbeitung von Objekten mit unterschiedlichem Belebtheitsstatus. Im Gegensatz zu Experiment 1 wurde nicht allein durch die Kasusmarkierung, sondern auch durch die Anwesenheit eines Subjektspronomen die Struktur und damit die grammatischen Funktionen zum Teil eindeutig kodiert. Dadurch sollte die Beobachtung einer Subjektspräferenz einerseits repliziert werden, andererseits sollten aber Prozesse der Pronomenverarbeitung (pragmatische Referenz) und der die Definitheit verändernden Kasusmarkierung erfasst werden. Das Experiment zeigte eine Reihe von unterschiedlichen EKP-Effekten. Wie in Experiment 1 zeigte sich für die Bedingung mit belebtem

Argument eine Positivierung, die als Korrektur einer initialen Subjektszuweisung interpretiert werden kann. Interessanterweise scheinen die unterschiedlichen Kontrollaufgaben einen Einfluss auf die Latenz der Komponente zu besitzen. So verschiebt sich der Onset des Effektes um ca. 200 ms, was auf eine zumindest partielle Beteiligung von P300-Anteilen in Experiment 1 hindeutet. Das Ausbleiben eines analogen Effektes bei Sätzen mit unbelebtem Argument geht, wie die entsprechenden Vergleiche zeigen, im Wesentlichen auf einen ebenfalls in den kasusmarkierten Strukturen induzierten Effekt zurück, dessen Herkunft ohne weitere Untersuchungen momentan nicht eindeutig bestimmt werden kann. Zusätzlich zu den bisher berichteten Mustern zeigt sich in allen Bedingungen, in denen ein Pronomen vorhanden war, eine späte Positivierung. Diese wird im Sinne einer pragmatisch induzierten Kontextevaluation interpretiert. Zusammenfassend zeigt sich, dass auch das Türkische über eine Verarbeitungsstrategie verfügt, die im Sinne einer minimalen Struktur dem ersten Argument die Rolle des höchsten grammatischen Argumentes zuweist und dabei Eigenschaften wie pro-drop und Belebtheit zumindest initial ignoriert.

In einem nächsten Schritt wurde in Experiment 3 die Relation zwischen der Belebtheit der Argumente und der Argumentstruktur (logischen Struktur) des Verbs untersucht. Dazu wurde der Verbtyp (Aktivverben vs. Experiencerverben) systematisch variiert. Die beiden Verbtypen unterscheiden sich dadurch, dass im Falle der Experiencerverben die thematische Distanz zwischen den Argumenten markiert, d.h. abweichend von einer prototypischen Relation, ist. Unter der Annahme, dass während der inkrementellen Verarbeitung bereits eine Hierarchie zwischen den beiden Argumenten aufgebaut wird, sollten im markierten Fall erhöhte Verarbeitungskosten auftreten, die die Korrektur zu einer unerwarteten, thematisch-markierten Struktur darstellen. Das Experiment zeigte die folgenden Ergebnisse. Wenn die beiden präverbalen Argumente sich hin-

sichtlich der Belebtheit unterschieden, zeigten sich auf dem Verb keine Einflüsse des Verbtyps. Unterschieden sich die Argumente jedoch nicht, waren sie also beide belebt, dann zeigte sich im Vergleich zu den jeweiligen Kontrollstrukturen eine Negativierung für die OS-Abfolge bei Aktivverben und eine Negativierung für die SO-Abfolge bei den Experiencerkonstruktionen. Beide Negativierungen unterschieden sich hinsichtlich der Latenz, wobei die Negativierung für die Aktivstrukturen der anderen zeitlich vorausging. Die Akzeptabilitätsdaten bestätigen das generelle Muster eines Vorteils bei Belebtheitsvariation, da sich bei zwei belebten Nomen eine höhere Fehleranfälligkeit zeigte. Das vorliegende Datenmuster ist die Grundlage einer in der Arbeit vorgeschlagenen Theorie der "thematischen Distanz". Dabei wird angenommen, dass die Abbildung zwischen Form und Bedeutung über eine intermediäre Ebene der thematischen Markiertheit erfolgt. Dieses thematische Modul geht der Zuweisung der Argumentrollen in der logischen Struktur (logisches Strukturmodul) voraus und greift im Fall markierter Abfolgen zumindest in Bezug auf die overte lineare Abfolge ein. Demnach ist das Linking von der syntaktischen Struktur auf die Ebene der logischen Argumentstruktur des Verbs dann einfacher, wenn die beiden Argumente eine größere Distanz hinsichtlich eines Kontinuums zwischen Agens und Thema besitzen. Verändert sich die Distanz insofern, dass beide Argumente thematisch näher zueinander geordnet sind, steigen die Linkingkosten. Mit Hilfe dieses Ansatzes können die beobachtbaren Kosten abgeleitet werden, auch wenn beide hier untersuchten Verbtypen zugrunde liegend kausativ sind und damit zumindest hinsichtlich der relativen Anordnung innerhalb der LS identisch sind. Dass dabei nicht nur der Verbtyp entscheidend ist, sondern dass die lineare Abfolge für das Linking ebenfalls von entscheidender Bedeutung ist, wird sichtbar, wenn man Experiment 2 und 3 zusammenfasst.

Zur Vervollständigung der Dateninterpretation führte ich eine Korpusanalyse zum Türkischen durch, bei der die Faktoren

"Belebtheit", "Wortstellung", "Spezifität" und "pro-drop" der Analyse zugrunde lagen. Dabei zeigte sich, dass sich zwar wesentliche Aspekte des vorliegenden Datenmusters in den Vorkommenshäufigkeiten wieder finden lassen, dass aber die Gesamtheit der Datenlage mit der Korpushäufigkeit nicht korrespondiert. Im Korpus sichtbar werden Vorteile für initiale (mehr- und eindeutige) Subjekte, für initiale belebte Argumente und für initial spezifisch/definite Argumente. Die mit der overten Realisierung von Pronomen einhergehende Positivierung bzw. die Interaktion zwischen Kasus und Belebtheit bei der Verarbeitung von Objekten finden sich hingegen in den Korpusdaten nicht wieder. Damit zeigt sich, ein bereits sprachübergreifendes Muster, dass Korpusfrequenzen zwar einen Teil der experimentell erhobenen Muster in der Psycholinguistik zu erklären gestatten, dass sie aber in der Gesamtheit nicht erklärungsadäquat sind.

Die vorliegende Arbeit liefert somit einen entscheidenden Beitrag im Bereich der Satzverstehensforschung. Mit ihr wird zum ersten Mal in einer "reinen" SOV-Sprache die inkrementelle Verarbeitung und die dieser zugrunde liegenden Interaktionen zwischen Wortstellung, Belebtheit und Definitheit untersucht. Sie zeigt einerseits, dass universelle Strategien zur Argumentinterpretation motivierbar sind, auch wenn diese Strategien aus einer kognitiven "Belastungsperspektive" keinen Vorteil besitzen. Zum anderen bestätigt sie die universelle Applikation von Faktoren wie Belebtheit und Spezifität für die on-line-Verarbeitung.

MPI Series in Human Cognitive and Brain Sciences:

1 Anja Hahne

Charakteristika syntaktischer und semantischer Prozesse bei der auditiv Sprachverarbeitung: Evidenz aus ereigniskorrelierten Potentialstudien

2 Ricarda Schubotz

Erinnern kurzer Zeitdauern: Behaviorale und neurophysiologische Korrelate einer Arbeitsgedächtnisfunktion

3 Volker Bosch

Das Halten von Information im Arbeitsgedächtnis: Dissoziationen langsamer corticaler Potentiale

4 Jorge Jovicich

An investigation of the use of Gradient- and Spin-Echo (GRASE) imaging for functional MRI of the human brain

5 Rosemary C. Dymond

Spatial Specificity and Temporal Accuracy in Functional Magnetic Resonance Investigations

6 Stefan Zysset

Eine experimentalpsychologische Studie zu Gedächtnisabrufprozessen unter Verwendung der funktionellen Magnetresonanztomographie

7 Ulrich Hartmann

Ein mechanisches Finite-Elemente-Modell des menschlichen Kopfes

8 Bertram Opitz

Funktionelle Neuroanatomie der Verarbeitung einfacher und komplexer akustischer Reize: Integration haemodynamischer und elektrophysiologischer Maße

9 Gisela Müller-Plath

Formale Modellierung visueller Suchstrategien mit Anwendungen bei der Lokalisation von Hirnfunktionen und in der Diagnostik von Aufmerksamkeitsstörungen

10 Thomas Jacobsen

Characteristics of processing morphological structural and inherent case in language comprehension

11 Stefan Kölsch

Brain and Music
A contribution to the investigation of central auditory processing with a new electrophysiological approach

12 Stefan Frisch

Verb-Argument-Struktur, Kasus und thematische Interpretation beim Sprachverstehen

13 Markus Ullsperger

The role of retrieval inhibition in directed forgetting – an event-related brain potential analysis

14 Martin Koch

Measurement of the Self-Diffusion Tensor of Water in the Human Brain

15 Axel Hutt

Methoden zur Untersuchung der Dynamik raumzeitlicher Signale

16 Frithjof Kruggel

Detektion und Quantifizierung von Hirnaktivität mit der funktionellen Magnetresonanztomographie

17 Anja Dove

Lokalisierung an internen Kontrollprozessen beteiligter Hirngebiete mithilfe des Aufgabenwechselparadigmas und der ereigniskorrelierten funktionellen Magnetresonanztomographie

18 Karsten Steinhauer

Hirnphysiologische Korrelate prosodischer Satzverarbeitung bei gesprochener und geschriebener Sprache

19 Silke Urban

Verbinformationen im Satzverstehen

20 Katja Werheid

Implizites Sequenzlernen bei Morbus Parkinson

21 Doreen Nessler

Is it Memory or Illusion? Electrophysiological Characteristics of True and False Recognition

22 Christoph Herrmann

Die Bedeutung von 40-Hz-Oszillationen für kognitive Prozesse

23 Christian Fiebach

Working Memory and Syntax during Sentence Processing.
A neurocognitive investigation with event-related brain potentials and functional magnetic resonance imaging

24 Grit Hein

Lokalisation von Doppelaufgabendefiziten bei gesunden älteren Personen und neurologischen Patienten

25 Monica de Filippis

Die visuelle Verarbeitung unbeachteter Wörter.
Ein elektrophysiologischer Ansatz

26 Ulrich Müller

Die katecholaminerge Modulation präfrontaler kognitiver Funktionen beim Menschen

27 Kristina Uhl

Kontrollfunktion des Arbeitsgedächtnisses über interferierende Information

28 Ina Bornkessel

The Argument Dependency Model: A Neurocognitive Approach to Incremental Interpretation

29 Sonja Lattner

Neurophysiologische Untersuchungen zur auditorischen Verarbeitung von Stimminformationen

30 Christin Grünewald

Die Rolle motorischer Schemata bei der Objektrepräsentation: Untersuchungen mit funktioneller Magnetresonanztomographie

31 Annett Schirmer

Emotional Speech Perception: Electrophysiological Insights into the Processing of Emotional Prosody and Word Valence in Men and Women

32 André J. Szameitat

Die Funktionalität des lateral-präfrontalen Cortex für die Verarbeitung von Doppelaufgaben

33 Susanne Wagner

Verbales Arbeitsgedächtnis und die Verarbeitung ambiger Wörter in Wort- und Satzkontexten

34 Sophie Manthey

Hirn und Handlung: Untersuchung der Handlungsrepräsentation im ventralen prämotorischen Cortex mit Hilfe der funktionellen Magnet-Resonanz-Tomographie

35 Stefan Heim

Towards a Common Neural Network Model of Language Production and Comprehension: fMRI Evidence for the Processing of Phonological and Syntactic Information in Single Words

36 Claudia Friedrich

Prosody and spoken word recognition: Behavioral and ERP correlates

37 Ulrike Lex

Sprachlateralisierung bei Rechts- und Linkshändern mit funktioneller Magnetresonanztomographie

38 Thomas Arnold

Computergestützte Befundung klinischer Elektroenzephalogramme

39 Carsten H. Wolters

Influence of Tissue Conductivity Inhomogeneity and Anisotropy on EEG/MEG based Source Localization in the Human Brain

40 Ansgar Hantsch

Fisch oder Karpfen? Lexikale Aktivierung von Benennungsalternative bei der Objektbenennung

41 Peggy Bungert

Zentralnervöse Verarbeitung akustischer Informationen
Signalidentifikation, Signallateralisation und zeitgebundene Informationsverarbeitung bei Patienten mit erworbenen Hirnschädigungen

42 Daniel Senkowski

Neuronal correlates of selective attention: An investigation of electro-physiological brain responses in the EEG and MEG

43 Gert Wollny

Analysis of Changes in Temporal Series of Medical Images

44 Angelika Wolf

Sprachverstehen mit Cochlea-Implantat: EKP-Studien mit postlingual ertaubten erwachsenen CI-Trägern

45 Kirsten G. Volz

Brain correlates of uncertain decisions: Types and degrees of uncertainty

46 Hagen Huttner

Magnetresonanztomographische Untersuchungen über die anatomische Variabilität des Frontallappens des menschlichen Großhirns

47 Dirk Köster

Morphology and Spoken Word Comprehension: Electrophysiological Investigations of Internal Compound Structure

48 Claudia A. Hruska

Einflüsse kontextueller und prosodischer Informationen in der auditorischen Satzverarbeitung: Untersuchungen mit ereigniskorrelierten Hirnpotentialen

49 Hannes Ruge

Eine Analyse des raum-zeitlichen Musters neuronaler Aktivierung im Aufgabenwechselparadigma zur Untersuchung handlungssteuernder Prozesse

50 Ricarda I. Schubotz

Human premotor cortex: Beyond motor performance

51 Clemens von Zerssen

Bewusstes Erinnern und falsches Wiedererkennen:
Eine funktionelle MRT Studie neuroanatomischer Gedächtniskorrelate

52 Christiane Weber

Rhythm is gonna het you.
Electrophysiological markers of rhythmic processing in infants with and without risk for Specific Language Impairment (SLI)

53 Marc Schönwiesner

Functional Mapping of Basic Acoustic Parameters in the Human Central Auditory System

54 Katja Fiehler

Temporospatial characteristics of error correction

55 Britta Stolterfoht

Processing Word Order Variations and Ellipses: The Interplay of Syntax and Information Structure during Sentence Comprehension

56 Claudia Danielmeier

Neuronale Grundlagen der Interferenz zwischen Handlung und visueller Wahrnehmung

57 Margret Hund-Georgiadis

Die Organisation von Sprache und ihre Reorganisation bei ausgewählten, neurologischen Erkrankungen gemessen mit funktioneller Magnetresonanztomographie – Einflüsse von Händigkeit, Läsion, Performanz und Perfusion

58 Jutta L. Mueller

Mechanisms of auditory sentence comprehension in first and second language: An electrophysiological miniature grammar study

59 Franziska Biedermann

Auditorische Diskriminationsleistungen nach unilateralen Läsionen im Di- und Telenzephalon

60 Shirley-Ann Rüschemeyer

The Processing of Lexical Semantic and Syntactic Information in Spoken Sentences: Neuroimaging and Behavioral Studies of Native and Non-Native Speakers

61 Kerstin Leuckefeld

The Development of Argument Processing Mechanisms in German.
An Electrophysiological Investigation with School-Aged Children and Adults

62 Axel Christian Kühn

Bestimmung der Lateralisierung von Sprachprozessen unter besondere Berücksichtigung des temporalen Cortex, gemessen mit fMRT

63 Ann Pannekamp

Prosodische Informationsverarbeitung bei normalsprachlichem und deviantem Satzmaterial: Untersuchungen mit ereigniskorrelierten Hirnpotentialen

64 Jan Derrfuß

Functional specialization in the lateral frontal cortex: The role of the inferior frontal junction in cognitive control

65 Andrea Mona Philipp

The cognitive representation of tasks
Exploring the role of response modalities using the task-switching paradigm

66 Ulrike Toepel

Contrastive Topic and Focus Information in Discourse – Prosodic Realisation and Electrophysiological Brain Correlates

67 Karsten Müller

Die Anwendung von Spektral- und Waveletanalyse zur Untersuchung der Dynamik von BOLD-Zeitreihen verschiedener Hirnareale

68 Sonja A.Kotz

The role of the basal ganglia in auditory language processing: Evidence from ERP lesion studies and functional neuroimaging

69 Sonja Rossi

The role of proficiency in syntactic second language processing: Evidence from event-related brain potentials in German and Italian

70 Birte U. Forstmann

Behavioral and neural correlates of endogenous control processes in task switching

71 Silke Paulmann

Electrophysiological Evidence on the Processing of Emotional Prosody: Insights from Healthy and Patient Populations

72 Matthias L. Schroeter

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