

Muralikrishnan, R.: An Electrophysiological Investigation of Tamil
Dative-Subject Constructions.
Leipzig: Max Planck Institute for Human Cognitive and Brain Sciences,
2011 (MPI Series in Human Cognitive and Brain Sciences; 132)



Impressum

Max Planck Institute for Human Cognitive and Brain Sciences, 2011



Diese Arbeit ist unter folgender Creative Commons-Lizenz lizenziert:
<http://creativecommons.org/licenses/by-nc/3.0>

Titelfoto: A silhouette of the Mahabalipuram Shore Temple at sunrise.
A UNESCO World Heritage Site at Mahabalipuram, built between 700--728 AD, India.

Druck: Sächsisches Druck- und Verlagshaus Direct World, Dresden

ISBN 978-3-941504-16-5

An Electrophysiological Investigation Of
Tamil Dative-Subject Constructions

INAUGURAL-DISSERTATION

zur

Erlangung der Doktorwürde

des

Fachbereichs Germanistik
und Kunstwissenschaften
der Philipps-Universität Marburg

vorgelegt von

R. Muralikrishnan

aus Madras, Indien

Marburg
2011

Vom Fachbereich Germanistik und Kunstwissenschaften der
Philipps-Universität Marburg als Dissertation angenommen am: 27.07.2011

Tag der Disputation : 22.08.2011

Erstgutachter : Prof. Dr. Ina Bornkessel-Schlesewsky
Zweitgutachter : Dr. Petra B. Schumacher

Abstract

The present dissertation concerns the online processing of transitive constructions involving dative nominals in Tamil. We exploited the ERP technique in order to investigate the processing of Tamil dative nouns in constructions involving a class of verbs that serve to express states of affairs rather than active events, which are variously called experiencer-subject or dative-subject constructions. These so-called dative-stative verbs require that their subject-like argument be in the dative case. Whereas active verbs agree with their nominative subjects, stative verbs simply show a third-person, singular, neuter agreement, henceforth called default-agreement, regardless of the person, number, gender features of their dative-subjects. This dissertation thus attempts to investigate specifically the question of whether and in what manner dative nominals that are subjects are processed differently from other nominals, such as nominative subjects and dative nominals that are not subjects. It further strives to examine whether dative-stative verbs are processed differently compared to verbs that require a nominative subject.

The results of the three auditory ERP Experiments reported here suggest processing differences at the sentence-initial position between dative-subjects and nominative subjects as well as dative indirect objects. They further suggest that dative-stative verbs are processed differently from non-stative verbs, possibly due to default-agreement. In addition, the context in which a stimulus sentence occurs, as well as the experimental task requirements appear to have a significant impact on the ERP effects obtained. In sum, these results appear to suggest that neurocognitive models of language comprehension need to take both linguistic and extra-linguistic factors into account in order for their predictions to have a broader scope.

Acknowledgements

Generous is the word that comes to my mind when I think of all those who directly or indirectly contributed to the fact that this dissertation exists. I should like to thank them here.

I thank Prof. Dr. Ina Bornkessel-Schlesewsky for having offered me the wonderful opportunity to be one of her doctoral students, first at the Max-Planck Institute for Human Cognitive and Brain Sciences, and then at the University of Marburg. Ina has been a great inspiration all along. She somehow seemed to always know the right moment to lend me a word of encouragement or a helping hand in proceeding further with my work. Her detailed and insightful comments on the previous draft of this dissertation have significantly contributed to its improvement. I am also grateful to her for generously funding my experiments.

I thank Dr. Petra B. Schumacher for providing detailed comments on the draft version of this dissertation, which helped a lot in improving it. Petra has been exceptionally kind to me from the beginning when I came to know her after moving to Mainz. She seems to master the art of making everyone around her feel special, and therefore I cherished every little conversation that I had with her, technical and non-technical. I am very thankful to her in this respect.

My sincere thanks go to Prof. Matthias Schlewsky for providing me unfettered access to the EEG lab in Mainz, which has been vital for my work. One has to learn from Matthias to look at experimental data from various points of view so as to present it optimally. His comments during a discussion of results from Experiment 3 were thought-provoking. I thank Franziska Kretschmar for spending precious time to share her knowledge about the P300 component with me. By asking insightful questions about the design of Experiment 3, she helped me shape and streamline my line of argumentation in a significant manner.

ACKNOWLEDGEMENTS

I should thank Isabel Plauth for lending her support in the EEG lab in Berlin during data collection for Experiment 1. Isabel's kindness and warmth are almost contagious. Hung Yu-Chen deserves a very special mention in this regard, for she went out of her way to help me set up the EEG cap for my first participant in Experiment 2, and thereby taught me to use the caps and software used in the lab in Mainz. My thanks should also go to Maiko Koyanagi, Jane Han and Wang Luming for their support in setting up the EEG cap during the first several sessions of Experiment 2. Thanks to Sun Linlin for her kind support during some sessions of Experiment 3. Thanks also to Markus Philipp for his quick and basic introduction to the Presentation software. I am grateful to all the participants of my experiments, for their efforts were an important pre-requisite for my work.

Over the past years, I have been fortunate to receive the warmth and exceptional kindness of those around me. My heartfelt thanks in this regard go to Sabine Frenzel. What a lovely office mate Sabine has been! She deserves a whole sack of thanks just for lending a sympathetic ear to my never-ending list of complaints that I seemed to invent and reinvent every time I only had a chance to. And Luming has to be mentioned again here, for she has been a great friend and philosopher all along the past years. She doesn't perhaps know how much it helped me talking to her. Yu-Chen and Linlin deserve a second thanks here, too. I thank Kamal Kumar Choudhary for the moral support he provided. I can't possibly begin to thank Kamal for the innumerable delicious dinners he provided me during our time in Leipzig.

My thanks also go to Laura Maffongelli and Alexander Dröge for their warmth and kindness during my time in Marburg. Laura and Alex's presence contributed significantly to the nice atmosphere in our office. Thanks to Jona Sassenhagen, Phillip M. Alday and Sarah Tune in Marburg, Torsten Schenk, He Yifei, Bao Meiyi, Hanna Weiland and Stefanie Röhrig in Mainz for the short but sweet conversations that we had once in a while. During my time at the MPI and afterwards, many people have extended their support, amongst whom I especially thank Anja Lange (Library), Margrund Greiner (Secretary), Stephan Moeller (IT support).

I would like to thank the State Bank of India for extending a loan for partly financing my studies. Mr. Inian, Mr. Arun and Mrs. Indira need a mention in this regard. My thanks also go to Prof. V.Seshadri, Dr. P.Venugopal, Mrs. Vathsala Vijayakumar, Mr. P.Seralathan and Mrs. Swarnalatha Subramanian for their support at the outset. I thank my friends Karthik Prabhu, Riyas Hussain, Karthik Paithankar, Ravi Anand,

Ravichandran, Kavitha Ravichandran, Syed Ather Ahmed, Bhanumathy, Pratima, Kirubakar, Isaac Mathew and Arvind for their kindness. Karthik and Riyas's kindness and moral support during the past years have been exceptional. My special thanks go to Olga Zaharieva. Thank you Olga for the confidence that you have in me and all your words of reassurance at various points in time—you cannot imagine how important they are for me and how much they have helped me over the years.

If this work at all exists, it is thanks to the unconditional support of my Parents E.A.Kalyani and K.Ramasamy. My thanks also to my brother R.Gopilakshmanan in this regard. I thank my Parents from the bottom of my heart for having supported me in everything with boundless love and selfless generosity. It would have been much easier for them if I had continued working at home, but they rather chose to encourage me to go ahead with my doctoral studies. I know they sacrificed a lot in order for their son to go for higher studies abroad. I owe a lot to my Parents. Thank you Amma and Appa.

— * —

‘...But the intelligent man is he who can convert
every work into one that suits his taste.’

- Swami Vivekananda



To my Parents.

உ

ஐசுவரீ ஸஹயஃ

ॐ गम गणपतये नमः। ॐ सरस्वत्यै नमः।

பாலும் தெளி தேனும் பாகும் பருப்பும் இவை
நாலும் கலந்துனக்கு நான் தருவேன் கோலம் செய்
துங்கக் கரிமுகத்துத் தூமணியே நீயெனக்குச்
சங்கத் தமிழ் மூன்றும் தா!

தாரமர் கொன்றையும் சண்பக மாலையும் சாத்தும் தில்லை
ஊரார்தம் பாகத்து உமை மைந்தனே உலகேழும் பெற்ற
சீர் அபிராமி அந்தாதி எப்போதும் என் சிந்தையுள்ளே
காரமர் மேனிக் கணபதியே நிற்கக் கட்டுரையே!

உதிக்கின்ற செங்கதிர் உச்சித் திலகம் உணர்வுடையோர்
மதிக்கின்ற மாணிக்கம் மாதுளம்போது மலர்க்கமலை
துதிக்கின்ற மின் கொடி மென்கடிக் குங்குமத் தோயமென்ன
விதிக்கின்ற மேனி அபிராமி என் தன் விழுத்துணையே!

வல்லபமொன்றியேன் சிறியேன் நின் மலரடிச்செம்
பல்லவமல்லது பற்றொன்றிலேன் பசும்பொற் பொருப்பு
வில்லவர் தம்முடன் வீற்றிருப்பாய் வினையேன்றொடுத்த
சொல்லவமாயினும் நின் திரு நாமங்கள் தோத்திரமே!

தனம் தரும் கல்வி தரும் ஒரு நாளும் தளர்வறியா
மனம் தரும் தெய்வ வடிவும் தரும் நெஞ்சில் வஞ்சமில்லா
இனம் தரும் நல்லனவெல்லாம் தரும் அன்பரென்பவர்க்கே
கனம் தரும் பூங்குழலாள் அபிராமி கடைக்கண்களே!

Contents

Overview	1
1 Introduction	3
1.1 Sentence Processing	3
1.2 Incrementality	3
1.3 Grammatical Relations and Semantic Roles	5
1.4 Factors Influencing Sentence Processing	8
1.4.1 Word-Order	10
1.4.2 Animacy	11
1.4.3 Case	12
1.5 Studying Online Processing	17
1.6 The Present Dissertation	19
2 Electrophysiology of Language	21
2.1 Introduction	21
2.2 Strengths and Limitations	22
2.3 ERP Components	22
2.3.1 Types and Nomenclature	23
2.3.2 Language-related Components	23
2.3.3 Interim Summary	39
2.4 Interplay of word-order, case and animacy	39
2.5 Summary	45

CONTENTS

3 Neurocognitive Models	47
3.1 Introduction	47
3.2 Friederici's Neurocognitive Model	48
3.2.1 Architecture of the Neurocognitive Model	48
3.2.2 Phase 1	49
3.2.3 Phase 2	49
3.2.4 Phase 3	50
3.3 The Declarative/Procedural Model	50
3.4 The MUC Framework	51
3.4.1 The Memory Component	51
3.4.2 The Unification Component	52
3.4.3 The Control Component	52
3.5 The eADM	53
3.5.1 Architecture of the eADM	53
3.5.2 Phase 1	53
3.5.3 Phase 2	54
3.5.4 Phase 3	55
3.5.5 Neurophysiological Correlates of the eADM	56
3.6 Summary	57
4 Tamil	59
4.1 Language Profile	59
4.2 Syntax	60
4.2.1 The Tamil Nominative Case	61
4.2.2 The Tamil Accusative Case	62
4.2.3 The Tamil Dative Case	65
4.3 Why Tamil?	72
4.4 The Present Set of Studies	74
4.5 A Note on Stimulus Presentation	75

5	Experiment 1	77
5.1	Overview	77
5.2	Participants	78
5.3	Materials	79
5.3.1	Critical Conditions	79
5.3.2	Fillers	81
5.3.3	Items Distribution	81
5.3.4	Comprehension Questions	82
5.3.5	Auditory Stimuli	82
5.4	Acoustic Analysis	83
5.4.1	Duration	83
5.4.2	Intensity	85
5.4.3	Fundamental Frequency	86
5.5	Methods	89
5.5.1	Experimental Trial Structure	89
5.5.2	The Practice Phase	90
5.5.3	The Experiment Phase	90
5.5.4	EEG Data	91
5.6	Results	91
5.6.1	Behavioural Data	91
5.6.2	ERP Data	93
5.6.3	Summary of Results	107
5.7	Discussion	108
6	Experiment 2	111
6.1	Overview	111
6.2	Participants	112
6.3	Materials	113
6.3.1	Critical Conditions	113

CONTENTS

6.3.2	Context Questions	114
6.3.3	Fillers	116
6.3.4	Items Distribution	116
6.3.5	Comprehension Questions	116
6.3.6	Auditory Stimuli	117
6.4	Acoustic Analysis	117
6.4.1	Duration	117
6.4.2	Intensity	118
6.4.3	Fundamental Frequency	119
6.5	Methods	120
6.5.1	Experimental Trial Structure	121
6.5.2	The Practice Phase	121
6.5.3	The Experiment Phase	122
6.5.4	EEG Data	122
6.6	Results	122
6.6.1	Behavioural Data	122
6.6.2	ERP Data	124
6.6.3	Summary of Results	141
6.7	Discussion	142
6.7.1	Effects at NP1 and NP2	142
6.7.2	Effects at the Verb	144
6.7.3	Summary	147
7	Experiment 3	149
7.1	Overview	149
7.2	Participants	152
7.3	Materials	152
7.3.1	Critical Conditions	152
7.3.2	Context Questions	154

7.3.3	Fillers	155
7.3.4	Items Distribution	155
7.3.5	Comprehension Questions	156
7.3.6	Auditory Stimuli	156
7.4	Methods	157
7.4.1	Experimental Trial Structure	157
7.4.2	The Practice Phase	158
7.4.3	The Experiment Phase	158
7.4.4	EEG Data	158
7.5	Results	158
7.5.1	Behavioural Data	158
7.5.2	ERP Data	162
7.5.3	Summary of Results	186
7.6	Discussion	186
7.6.1	Categorisation-based Account	189
7.6.2	Match-Mismatch Account	192
7.6.3	Summary	205
8	General Discussion	209
8.1	General Discussion	209
8.1.1	Processing of Dative Nominals	209
8.1.2	Processing of Stative Verbs	213
8.1.3	Influence of Experimental Design and Task	215
8.2	Consequences of our Results	220
9	Outlook	225
9.1	Future Directions	225
9.1.1	Designs focussing on Dative Nominals	226
9.1.2	Designs focussing on the Verb	228
9.2	Concluding Remarks	230

CONTENTS

Appendices	233
A ERP Curves	235
B Glossing Conventions	237
C Stative Versus Literal Meanings	241
D Statistical Tables	245
E Experiment 1 : Supplement	247
E.1 Condition Codes	247
E.2 Items Distribution Scheme	247
E.3 Experimental Stimuli	248
E.4 Duration of Bare NPs and Pauses	258
F Experiment 2 : Supplement	261
F.1 Condition Codes	261
F.2 Items Distribution Scheme	261
F.3 Experimental Stimuli	262
F.4 Duration of Bare NPs and Pauses	270
F.5 Supplementary ERP Plots	270
F.5.1 ERPs at NP1	270
F.5.2 ERPs at NP2	273
F.5.3 ERPs at the Verb	276
G Experiment 3 : Supplement	279
G.1 Items Distribution Scheme	279
G.2 Supplementary ERP Plots	281
G.2.1 ERPs at NP1	281
G.2.2 ERPs at NP2	282
G.2.3 ERPs at the Verb	283

Bibliography	291
List of Tables	309
List of Figures	312

Overview

Language is certainly one of the defining characteristics of humans, which sets us apart from other forms of life. An extensive and diverse system of communication, the diversity of human languages is quite astounding (Evans & Levinson, 2009). With so many profound ways in which the 6,000 to 8,000 languages of the world differ, language is surely one of the most complex systems to study and understand. Whilst it is true that natural language is indeed an effective and well-organised tool for communication, it is also often highly complex and ambiguous (Crocker, 1999). It is the medium to narrate about events that are under way, those that happened or will happen, and even those that will never ever happen. It is equally capable of expressing the most abstract and most profound of thoughts. Therefore, it might not be an exaggeration to say comprehending language in real time amounts to solving puzzles after complex puzzles on end.

However, the human brain solves this puzzle online, and solves it does with presumably equal ease and poise in any given language. That is to say, it efficiently processes a string of sounds or signs to arrive at a coherent meaningful utterance in real time, which appears almost as if it is a miracle. Even as you are reading this, your brain is making this miracle happen—so consistently and continuously—without your ever being consciously aware of it. Language processing is so pervasive and quite intriguing in that, in the absence of cognitive impairments, a native speaker of a certain language would not normally be able to consciously avoid comprehending an utterance in that language.

One of the ways in which to study the mechanisms in the brain that enable online language processing is to observe the ongoing electrical activity of the brain that is recordable on the scalp, so as to later deduce interpretations from the thus resulting Event-Related Brain Potentials, or ERPs in short. A non-invasive technique, this allows for a temporal

resolution in the range of a millisecond, typically suitable for studying language comprehension as it happens in real time.

The present dissertation concerns the online processing of transitive constructions involving dative nominals in Tamil, a verb-final language spoken mainly in the state of Tamil Nadu in southern India. Specifically, we exploited the ERP technique in order to study the processing of Tamil dative nouns in sentences involving a class of verbs that express states of affairs rather than events. These dative-stative verbs require their subject-like argument to be in the dative case. Unlike active verbs that agree with their nominative subjects for their person, number and gender features, the dative-stative verbs show a third-person, singular, neuter agreement, henceforth called default-agreement, regardless of the person, number and gender features of their dative-subjects. We report here, three auditory ERP experiments conducted in this regard.

This dissertation is organised as follows: -

- ❖ [Chapter 1](#) introduces online sentence processing in general, presents an overview of relevant linguistic concepts, and briefly discusses the factors influencing sentence processing.
- ❖ An introduction to ERPs is provided in [Chapter 2](#), in which we also introduce several language-related ERP components, especially those that are relevant to the present set of studies.
- ❖ We move on to present briefly in [Chapter 3](#), several neurocognitive models of sentence processing that we reckon most relevant here.
- ❖ In [Chapter 4](#), we provide a brief introduction to the Tamil language with relevant examples and motivate the choice of Tamil before introducing the present set of studies.
- ❖ [Chapter 5](#) presents Experiment 1, in which we gained a first insight into the processing of Tamil dative-subjects.
- ❖ [Chapter 6](#) presents Experiment 2, in which we introduced a simple but effective context design to observe the effects of processing dative-subjects versus dative indirect-objects, which in turn enabled observing the difference between processing dative-stative and ditransitive verbs.
- ❖ [Chapter 7](#) presents Experiment 3, in which we extended the context design further so as to be able to reveal a better picture of the processing of dative-stative verbs.
- ❖ We provide a general discussion and present the consequences of our results in [Chapter 8](#).
- ❖ [Chapter 9](#) presents an outlook discussing possible future work and concludes the dissertation.

— * —

Introduction

1.1 Sentence Processing

The processing of an auditory linguistic input online roughly involves, amongst other things, discriminating individual bits of sound from the auditory stream so as to compose meaningful chunks of information from them to start with. These must then be related to each other in a systematic manner according to the rules of a given language to arrive at a well-formed interpretation of the utterance in real time. Although it is highly debatable as to how and in what order, if any, the various processes take place in the human brain in order to accomplish this, it must be fairly uncontroversial to say that the interpretation of an utterance or a sentence as a whole requires the interpretation of the roles that the individual meaningful chunks or sentential constituents represent, and their possible relationship(s).

1.2 Incrementality

Several parameters, such as the order in which the constituents of the sentence are realised, morphological case-marking and so on decide the role that a nominal argument plays in the action or state being described in a sentence. Nevertheless, the number of (mandatory) arguments is totally dependent upon the verb. For example, a verb such as ‘*laugh*’ requires one argument that performs the action of laughing—intransitive verbs. A verb such as ‘*love*’ usually requires two arguments, the one who loves and the one who is loved—transitive verbs. Further, a verb such

as ‘give’ requires three arguments in many languages, namely the giver, the receiver and what is being given—ditransitive verbs. Implicitly, this also means that there cannot be more (mandatory) argument roles in a sentence than are required by the verb. Thus, it is the verb that assigns roles to the arguments in a sentence, which are expressed by various mechanisms, such as word-order, case-marking and so on.

These relationships between the verb describing the action or the event or the state of affairs concerned, and its nominal argument(s) play a central role in language comprehension. However, this does not mean that the processing system is solely driven by verb-related information. If this were to be true, it would entail that consistently verb-final languages such as Japanese or Turkish, in which the verb of a sentence is almost always realised in the sentence-final position, could not possibly be comprehended at all, which is of course not the case. Furthermore, the memory and processing load would be much higher in such a case, which would render the processing inefficient. The more efficient manner in which to build an interpretation for the ongoing utterance would be to process the incoming material as and when it is encountered rather than waiting for the verb. That is, processing the sentence *incrementally*.

Indeed, language comprehension proceeds in an incremental manner. It is so incremental that, [Marslen-Wilson \(1973\)](#) found that participants could repeat the words in an unfolding passage as and when they hear¹ them, with less than 300 ms delay. This amounted to repeating at the rate of syllables rather than words. This and the errors made by the shadowers clearly showed that linguistic processing is incremental right from the first stage in which speech is perceived.

Therefore, it is no wonder that almost all the proposed psycholinguistic models of sentence comprehension, despite their differences in approach and their assumptions, are strictly incremental ([Crocker, 2005](#)). For a detailed review of the various approaches, discussion about several models and an extensive list of references, see [Mitchell \(1994\)](#); [Crocker \(1999\)](#); [Townsend & Bever \(2001\)](#) and [Crocker \(2005\)](#).

If language processing indeed proceeds incrementally, it is thanks to the mechanisms that languages employ so as to indicate the relationship(s) between arguments and their relationship to the verb. These relationships could be described based on a grammatical basis or a semantic basis, brief details of which are discussed in the following section.

1. Such a task is called speech shadowing, in which the participant (shadower) is presented with speech that they have to repeat as the words unfold, in other words shadow the speech that they hear. Thus the name speech shadowing.

1.3 Grammatical Relations and Semantic Roles

Languages of the world exploit various mechanisms to denote the roles of arguments of a verb, such as word-order, case-marking and so on. The relationships holding between the verb and its arguments are crucial to the interpretation of an utterance, because they provide the mappings between the arguments and the role they play in a given sentence. These relations are usually termed based on the syntactic role that the argument plays in a sentence—the so-called grammatical relations², namely subject, direct object or indirect object. However, a quick comparison of the simple sentences ‘*The man ran.*’ and ‘*The man fell down.*’ is sufficient to reveal that there is more to the relationships between arguments and verbs than meets the eye syntactically. Thus, whilst the noun-phrase (NP) ‘*The man*’ is the syntactic subject in both these sentences, it is however clear that the action in the former is presumably voluntary, whereas the event described in the latter is most probably accidental, causing an adverse effect on the syntactic subject. That is, the notion of subject represents varied semantic roles (B. J. Blake, 2001). Similarly, in the sentences ‘*The woman drives the car.*’ and ‘*The woman likes the car.*’, the NP ‘*the car*’ has the same grammatical relation (direct object); however, in the former sentence there is a change of location involved, whereas there is none in the latter.

Therefore, whilst grammatical relations are convenient notions by which to differentiate the syntactic roles that the various arguments play in a sentence, such generalisations nevertheless do not capture the varied semantic relationships that an argument, say a syntactic subject, could possibly have with the verb in a sentence. In other words, there is not always a one-to-one mapping between the grammatical relation and the actual semantic role expressed by an argument in a structurally similar set of sentences. A separate set of relations that are based on meaning rather than structure thus becomes necessary. See Van Valin Jr. (2004a, chap. 2) for a detailed review of grammatical relations and how and why they are different from semantic roles.

The concept of syntax-independent semantic relations holding between the verb and its nominal arguments could be traced back to Pāṇini’s Kāraka theory (B. J. Blake, 2009; Dowty, 1991) as part of his grammar of Sanskrit extant since two millennia. In recent literature, this kind of meaning-based relationships expressed by nominal arguments have

2. See Van Valin Jr. & LaPolla (1997, chap. 6) for a detailed overview and discussion of grammatical relations.

been variously called case relationships (F. R. Blake, 1930, cited here from Dowty, 1991), thematic relations (Gruber, 1965), cases³ (Fillmore, 1968), thematic roles (Dowty, 1989) etc., for which the framework-neutral term seems to be semantic roles (Haspelmath, 2009).

Initial proposals included a well-defined, disjoint list of semantic roles such as the hundred or so that F. R. Blake (1930, as cited by Dowty, 1991) proposed, or Gruber's Agent, Experiencer, Theme etc. Similarly, Fillmore (1968, p. 24) proposed a finite number of semantic roles in his seminal paper, which he argued would 'comprise a set of universal, presumably innate, concepts which identify certain types of judgments which human beings are capable of making on the events that are going on around them'.

However, it has been argued that the more atomic and fine-grained the definitions of semantic roles are, the more problematic (Dowty, 1991) and less useful (Butt, 2009) they become, especially when it comes to addressing the question of semantic relationships that tend to be at the intersection of multiple roles (B. J. Blake, 2001) rather than fully falling under a single atomic role.

In order to address this issue, there have been two kinds of proposals. One proposal is to assign less generic verb-dependent roles, termed as individual thematic roles (Dowty, 1989), such as 'hitter role, builder role' etc., rather than using more generic roles such as Agent, Patient etc. However, this approach is not without its problems, since one cannot say anything generic about semantic relationships across verbs anymore, as Dowty (1991) points out.

The other kind of proposal has been, for instance, to view semantic roles as generic clusters encapsulating the so-called entailments⁴ such as volition, sentience etc. (Dowty, 1991), or generalisations subsuming multiple traditional thematic relations such as agent, experiencer etc. (Van Valin Jr., 1999). Such generic roles are termed Generalised Semantic Roles (GSRs).

Dowty (1991, p. 571) argues that the traditional semantic roles 'are simply not discrete categories at all, but rather are cluster concepts', in which

3. Note however, that Fillmore (1968) uses the term 'case' to denote the sort of meaning-based relationships being discussed here rather than the usual notion of inflectional case, and attributes this usage to F. R. Blake (1930). He uses the term 'case form' to refer to the usual notion.

4. Verbs, by virtue of their lexical meaning, entail their arguments to have certain properties. For instance, a verb such as 'hit' requires its subject argument to be capable of acting volitionally, whereas a verb such as 'skid' does not. Every noun that fulfils a verb's entailment(s) can theoretically function as its argument.

‘arguments may have different *degrees of membership*’. This led him to propose two ‘prototypical, fuzzy’ categories, namely Proto-Agent and Proto-Patient. These semantic proto-roles are entailments stemming from the verb, based on its arguments’ properties, such as volition, sentience etc. The difference in the number of Proto-Agent and Proto-Patient entailments of an argument would then determine its potential status as a subject or a direct object.

The lists of contributing properties for the Proto-Agent and Proto-Patient entailments is to a small degree comparable to the Subjects Properties List that Keenan (1976) provides whilst arguing for a multi-factor concept of ‘subject’. The correlations that one could derive between proto-roles and grammatical relations notwithstanding, Dowty (1991, p. 582) argues that ‘proto-roles and grammatical relations are distinct’.

Van Valin Jr. (1977) proposed that, in addition to the traditional thematic relations, two generic semantic relationships holding between the arguments and the verb could be identified, namely Actor and Undergoer. These semantic macroroles are fundamental to the Role and Reference Grammar (RRG) framework, in that they play a crucial role in the linking rules that operate at the syntax-semantics interface (Van Valin Jr., 2004b). The current version of RRG (Van Valin Jr. & LaPolla, 1997; Van Valin Jr., 2005) solely recognises GSRs, which are discrete categories that arguments can bear, unlike Dowty’s proto-roles. That is to say, there is no theoretical status for the traditional semantic roles in the current version of RRG, since RRG’s lexical representation is not based on them (Van Valin Jr., 1999).

According to this idea, verbs are represented as logical structures, which are decomposed hierarchical semantic representations of the verb’s arguments, derived directly from the lexical meaning of the verb. Depending upon the verb, these are basically one-place or two-place structures (see Van Valin Jr., 2005; Van Valin Jr. & LaPolla, 1997, for details). The argument positions in the logical structure constitute a five-point continuum of the traditional semantic roles, which then translates to the Actor-Undergoer hierarchy, one end of which represents prototypical Actors and the other end prototypical Undergoers. All other roles fall somewhere in between, either closer to the Actor end or the Undergoer end depending upon whether they are more Actor-like or Undergoer-like respectively, nevertheless less prototypically so. For instance, the roles such as Experiencer, Perceiver etc., fall at the mid-point of the continuum, thus relatively closer to the Actor end than their counterparts such as Sensation, Stimulus etc., which are closer to the Undergoer end

of the hierarchy. For details about the five-point continuum of semantic roles and the Actor-Undergoer hierarchy, see [Van Valin Jr. \(2005, chap. 2\)](#).

In addition to [Dowty's](#) two proto-roles, [Primus \(1999\)](#) proposed a third one, namely Proto-recipient, which is said to subsume the recipient, addressee and benefactive roles, primarily to account for three-place predicates involving a subject, direct object and an indirect object. However, [Van Valin Jr. \(2005, p. 66\)](#) argues that positing such a third one is not justified, because 'it would not be universal, it would not receive consistent morphosyntactic treatment, and it would be relatively unimportant for the syntax'. For the treatment of three-place predicates in the absence of a third macrorole (in the RRG framework), see ([Van Valin Jr., 2007](#)).

As to whether generalised semantic roles are relevant to language processing from a psycholinguistic perspective, it has been argued that they indeed are relevant to both production and comprehension (see [Van Valin Jr., 2006](#), for instance).

To summarise the discussion on semantic roles, there have been generalisations on three levels as [Van Valin Jr. \(1999, 2004b\)](#) point out. The least generic are the verb-specific individual thematic roles such as 'hitter, builder' etc, with the next level of generalisation being the traditional roles such as Agent, Experiencer, Patient etc. [Van Valin Jr.'s](#) semantic macroroles Actor and Undergoer that are an integral part of the RRG framework, and [Dowty's](#) proto-roles Proto-agent and Proto-patient are the most generic of semantic roles.

1.4 Factors Influencing Sentence Processing

There are many factors involved in processing an unfolding sentence incrementally, including sentence-internal factors such as linear order, morphological case-marking, animacy of arguments and so on, as well as discourse-level factors. Several psycholinguistic models of language comprehension have been proposed in recent decades (see [Mitchell, 1994](#), for an overview). Most of these models are mainly based upon data from studies of a particular phenomenon of interest in a certain language, usually English. However, given the overwhelming diversity of human language at every level ([Evans & Levinson, 2009](#)), it is only inevitable for any model claiming a broad scope to be cross-linguistic at the outset.

One of the first psycholinguistic models of sentence comprehension that is explicitly cross-linguistic in its approach, the Competition Model

(Bates, McNew, MacWhinney, Devescovi, & Smith, 1982; MacWhinney & Bates, 1989) was proposed based on offline behavioural decision studies on several languages. As per this model, a number of factors are said to compete with each other to provide the form-to-function mapping, thereby accomplishing sentence comprehension. These factors could be syntactic (word-order, case-marking), semantic (animacy), functional (topic, agent) or even phonological (prosody, word stress) in nature. Nevertheless such a functional distinction between the various factors is not made in the model, because the factors interact regardless of their linguistic domain, and it is the language-specific relative weightage of the factors that actually matters most. That is, the model assumes parallel processing based on ‘rapid and simultaneous interactions’ (Bates et al., 1982, p. 259) of competing factors or cues⁵ of different strengths and probabilities rather than serial processing. Cue strength or cue validity is defined as the ‘information value of a given phonological, lexical, morphological, or syntactic form within a particular language’ (Bates, McNew, Devescovi, & Wulfeck, 2001, p. 371). In other words, the strength of a cue is determined by its availability when it is needed and its reliability, that is how unambiguous it is.

This model provides predictions based on whether the various factors converge, compete or conspire. Owing to the fact that the model is based on behavioural data, the predictions pertain to behavioural measures. *Convergence* happens, when the various factors all converge towards a certain interpretation to the sentence being processed. *Competition* is the situation in which two factors with different cue strengths compete such that the processing system is driven towards that interpretation, which corresponds to the one based on the stronger cue that ‘wins’ in the competition. *Conspiracies* can occur when more than two factors operate at the same time with varying cue strengths, but without a sole outright ‘winner’. In such situations, the Competition Model predicts that the final interpretation of the sentence concerned would depend upon whether the less stronger cues form a ‘coalition’ such that the relatively stronger cue loses out. Thus for instance, Bates & MacWhinney (1989) provide a table listing the order of importance of the various cues based on results from their experiments in 12 languages. A few of these cues or information-types that are relevant for the present purposes are briefly discussed in the following sections.

5. For an intuitive notion of what a cue is, see MacWhinney (1989).

1.4.1 Word-Order

The order in which constituents are realised in a sentence is one of the primary factors influencing the comprehension of sentences. It is said to represent the ‘order in which the speaker wishes the hearer to attend to’ what is being said, and permutations in linear order of arguments ‘are mechanisms for managing Attention Flow’, which represents the natural ‘flow of attention involved in actually witnessing the event’ being reported (DeLancey, 1981, p. 632). The most frequent word-order amongst the world’s languages is Subject-Object-Verb, with the word-order Subject-Verb-Object being the second most frequent. (Dryer, 2008).

In a language such as English, in which the basic word-order is Subject-Verb-Object, the position of constituents alone can provide information about the role of the nominal argument(s) in the event being described. As an example, consider the sentences ‘*The author praised the publisher.*’ and ‘*The publisher praised the author.*’. Although only the order in which the constituents are realised (and not the constituents themselves) has changed, they mean different things. This is because, in English, the linear position of a constituent in the sentence decides its syntactic and semantic roles.

Now consider the German sentences in (1.1) and (1.2). Here again, only the order has changed and not the constituents, but still both the sentences have essentially one and the same sense. This is because of the morphological case-marking on the noun-phrases of the sentences. The nominative case assigns the subject function to an NP, whereas the accusative case marks an NP as the object of a sentence in German.

(1.1) Der Autor lobte den Herausgeber.
[The author]_{NOM} praised [the publisher]_{ACC}.
‘The author praised the publisher’.

(1.2) Den Herausgeber lobte der Autor.
[The publisher]_{ACC} praised [the author]_{NOM}.
‘The author praised the publisher’.

This illustrates that languages that use some kind of morphological marking to denote grammatical relations tend to allow relatively more flexible word-orders⁶ for the constituents, because the case-marker could

6. Although it is true that morphological case-marking enables free word-order, most languages tend to have a basic canonical word-order preference for the verb and its

indicate the role of the constituent in the action being described, independent of the word-order. There are counter-examples though, such as Icelandic, in which the word-order is relatively rigid in spite of the rich case morphology, as well as Chinese or Bulgarian, in which the word-order is free despite the absence of rich case morphology.

Thus, in languages like English, in which the linear order of arguments is the primary marker of roles of the arguments, the processing system could rely on this factor to determine the roles of arguments and process them accordingly, whereas in languages with richer morphology, other factors such as case, animacy etc., have to be taken into account additionally. Therefore, depending upon the language concerned, word-order may play a very significant part in comprehension.

1.4.2 Animacy

Among other factors that influence the comprehension of a sentence, the animacy of the nominal arguments in question is an important property. This is because animacy indicates whether a noun is capable of being an Agent (by virtue of the fact that it is a sentient being capable of self-initiated action and volition) or not. This in turn determines if the grammar of the given language treats the noun as a natural or unmarked Agent, or it is marked in some way, say morphologically, so as to indicate that it is not an ideal fit for a certain role, in this case, Agent.

Differences in the animacy of nominal arguments is a crucial element of the 'hierarchy of person and number features' that Silverstein (1976, p. 175) proposed, which Dixon (1979, p. 85) calls the 'potentiality of agency' scale. Originally posited to account for the split-ergative case systems in Australian languages, this has been found to have a much broader scope beyond explaining split-ergativity as Dixon (1979) notes, and has come to be known variously as the nominal or animacy hierarchy, because it specifies that personal pronouns outrank human nouns in being unmarked Agents, which in turn outrank animates, with the inanimate nouns being the lowest on the scale.

The animacy hierarchy of the NPs interacts with other parameters such as definiteness (Comrie, 1989), so as to influence the morphological case-marking of: subjects of intransitive sentences, subjects and objects of

arguments. That is, not all languages that have many cases show free word-order (Butt, 2009). Thus, in the aforementioned German examples, note that in both cases the verb is in the second position, since German main-clauses must have the verb in the second position for them to be grammatical.

transitive sentences. This in turn influences the interpretation of the NPs in the sentence. Thus, Comrie (1989, chap. 6) discusses about natural flow of information—along the lines of DeLancey’s Attention Flow—in transitive sentences involving the NPs with the more agent-like (A) and the more patient-like (P) generalised roles⁷, and notes that

...in actual discourse, there is a strong tendency for the information flow from A to P to correlate with an information flow from more to less animate and from more to less definite. In other words, the most natural kind of transitive construction is one where the A is high in animacy and definiteness, and the P is lower in animacy and definiteness; and any deviation from this pattern leads to a more marked construction (Comrie, 1989, p. 128).

Although this does not directly translate to a processing issue, this has a lot of relevance here because of the fact that a sentence to be processed is essentially the flow of that information, which a speaker wants to convey. Comrie further defines an animacy hierarchy that is general, namely human > animal > inanimate, with some languages making a less fine or finer level of distinction in this hierarchy. For an exhaustive cross-linguistic discussion of the functional role of case-marking and the phenomena controlled by animacy, the interested reader is referred to Comrie (1989).

1.4.3 Case

Case is the concept of marking nominal arguments morphologically in order to denote their relationships to the predicate and to differentiate them from each other. B. J. Blake (2001, p. 1) defines it thus:

Case is a system of marking dependent nouns for the type of relationship they bear to their heads. Traditionally the term refers to inflectional marking, and, typically, case marks the relationship of a noun to a verb at the clause level or of a noun to a preposition, postposition or another noun at the phrase level.

Further, cases are language-specific categories, and can be abstract, denoting the core grammatical relations such as subject, object etc.,

7. The single argument of intransitive verbs is denoted as S, whereas the more Agent-like argument and the more Patient-like argument of transitive verbs are denoted as A and P respectively. Notice that the A and P are generalised roles rather than agent and patient per se.

or more concrete⁸, expressing spatial and non-spatial semantic roles. Case-markers could be adpositions or affixes.

Whilst languages with a rigid word-order can denote the roles that arguments play using their linear position in a sentence, those with a flexible word-order tend to use some sort of morphological marking in order to achieve the same. Thus, a basic function of case or case-markers is to identify the grammatical relations of the arguments. Discussing the discriminatory function of case-marking in the languages of the world, Comrie (1989, chap. 6) posits that this function ‘shows itself most clearly in transitive constructions’.

However, this function is almost always only one of many others, and in actuality, languages put to use case-markers for various other purposes (Butt, 2009). For instance, cases are also the means of expressing semantic relations between the arguments and the verb (B. J. Blake, 2009). Jespersen (1924, p. 179) puts it thus: ‘However far back we go, we nowhere find a case with only one well-defined function: in every language every case served different purposes, and the boundaries between these are far from being clear-cut’. Therefore, as a property that has so many functions, overt morphological case is obviously one of the very important factors that influence sentence comprehension.

If cases serve many functions, they do so in broad terms. That is to say, the inventory is usually small, with a single case being used to express multiple relationships. Further, they are economical, in that only one argument is usually case-marked, with the other remaining unmarked in a simple transitive clause (B. J. Blake, 2001).

Depending upon the treatment of the S, A and P arguments mentioned earlier, that is whether some, all or none of these arguments are similarly or differently case-marked, three kinds of case-alignments have been identified in the languages of the world. These are the *accusative alignment*, in which S and A are treated alike as opposed to a marked P, the *neutral alignment*, in which S, A and P are treated alike, and the *ergative alignment*, in which A is marked differently from S and P, which are on the other hand treated alike (see Haspelmath (2005) for a detailed review of the various case alignments).

However, pure accusative or ergative systems are rare (B. J. Blake, 2001), in that most languages show some kind of deviation or ‘split’ in their case-

8. For the terms that different authors use to make this distinction, and for an overview of notions and terminology related to case in general, see Haspelmath (2009). The abstract cases and concrete cases will be henceforth referred to as syntactic and semantic cases respectively.

systems, whereby arguments that would be usually marked are treated differently (that is, left unmarked) based on, say, their specificity / definiteness, animacy etc. This kind of differential treatment of P arguments is referred to as Differential Object Marking (see Comrie, 1989, chap. 6), a typical example of which is Turkish. When the P argument is unmarked in Turkish, as in (1.3) from Comrie (1989), it renders a non-specific reading, whereas marking it accusative renders a specific reading, as in (1.4).

(1.3) Hasan öküz aldı.
 [Hasan]_{NOM} [ox]_{NOM} bought.
 ‘Hasan bought an ox / oxen’.

(1.4) Hasan öküzü aldı.
 [Hasan]_{NOM} [ox]_{ACC} bought.
 ‘Hasan bought the ox’.

Similarly, there are also languages in which the case alignment is different based on, say, the verbal aspect. This is the case in Hindi, an Indo-Aryan language spoken in northern India. As shown in (1.5) adapted from Choudhary (2011), when the verb is imperfective, the case-alignment in Hindi is nominative-accusative, whereas the actor argument is marked ergative in the perfective aspect. See Dryer (2008) for an overview of other kinds of asymmetrical case-marking.

(1.5) *Hindi example: Case-alignment based on verbal aspect* □

कुमार	आम	खाता	है ।
Kuma:r	a:m	kha:-th-a:	hai
[Kumar] _{NOM}	[Mango] _{NOM}	[eat] _{Imperfective}	[exist] _{Auxiliary}

‘Kumar eats a mango’.

कुमार ने	आम	खाया	है ।
Kuma:r ne:	a:m	kha:-y-a:	hai
[Kumar] _{ERG}	[Mango] _{NOM}	[eat] _{Perfective}	[exist] _{Auxiliary}

‘Kumar has eaten a mango’.

An influential proposal in the pursuit of accounting for split case systems based on NP type is Silverstein (1976)’s nominal hierarchy, mentioned earlier. This hierarchy of NP types defined based on their person, number and animacy features—that is their inherent lexical content (Silverstein, 1976, 1981, 1993)—is said to explain, at least in part, the differences in case systems. According to this idea, the ‘hierarchical relationship of the feature values of the NPs serving as Agent—Patient in a two-argument structure’ is said to determine the case-marking pattern (Silverstein,

1993, p. 477). For instance, an Agent NP would be case-marked if it is lower than the Patient NP on the hierarchy, or, by corollary, a Patient NP higher on the hierarchy than the Agent NP would be case-marked.

Another approach is to assign case-marking in terms of the macroroles that the arguments take. Depending upon whether the language shows accusative alignment or ergative alignment, case assignment rules based on the Actor-Undergoer hierarchy operate in conjunction with the so-called Privileged Syntactic Argument selection hierarchy (Van Valin Jr., 2005, p. 100, 108), which is defined in terms of the argument positions in the logical structure (see the section on semantic roles above), in order to determine the case-marking of arguments.

Since further review of this is beyond the remit of the current discussion, the interested reader is referred to Haspelmath (2009), B. J. Blake (2001) and Malchukov & Spencer (2009) for detailed reviews of case in general, and the individual cases found in languages. However, the cases most relevant for the present purposes—namely the nominative, accusative and dative cases—will be briefly introduced in the following sections.

1.4.3.1 Nominative Case

The nominative case is a core syntactic case in that encodes the S and A arguments in nominative-accusative languages, and the S and O arguments in ergative-absolutive languages. In languages that show accusative case alignment (see discussion above), the unmarked citation form of a noun used as the S argument in intransitive clauses or the A argument in transitive clauses is its nominative form. The nominative argument is mostly the highest ranking macrorole argument (Actor) in these languages. Languages that show ergative alignment, whilst marking their A arguments, use the citation form of nouns for the S and P arguments, in which case they are called absolutive rather than nominative (Haspelmath, 2009).

1.4.3.2 Accusative Case

The accusative case is a core syntactic case that mainly encodes the affected participant of transitive clauses (Kittilä & Malchukov, 2009), that is it typically denotes the *direct object*. It further encodes a variety of semantic roles of entities that are directly affected (B. J. Blake, 2001). It is the marked form of a noun used as the P argument in transitive clauses. The accusative marked argument is the lower ranking macrorole argu-

ment (Undergoer) in languages showing the accusative case alignment. As mentioned earlier, accusative marking is sensitive to specificity / definiteness as well as animacy in many languages, such that not all P arguments are marked. Furthermore, when an argument that is not a typical patient is marked accusative, it is said to express ‘an added sense of affectedness’ (B. J. Blake, 2001, p. 133).

1.4.3.3 Dative Case

The dative case is a syntactic case (but, see below) that is typically used for marking recipients in ditransitive clauses. Of the three main kinds of ditransitive constructions that have been identified in the languages of the world (Haspelmath, 2008, see), the indirect-object construction is the most frequent, which suggests that the most common grammatical relation that the dative case expresses is that of the *indirect object* for a verb such as ‘give’. The dative case further encodes a variety of other roles such as experiencers, benefactives, malefactors, goals and purposes (Næss, 2009) in the languages of the world. In spite of its many functions, B. J. Blake (2001, p. 144) suggests that the central function of the dative case ‘is to encode entities that are the target of an activity or emotion’ and terms it a peripheral grammatical case. In terms of macroroles, the dative argument does not receive a macrorole and is said to be a non-macrorole core argument (Van Valin Jr., 2005, p. 110, following Silverstein, 1981), for which the dative case is assigned by default.

Næss (2009, p. 573) observes that the dative case ‘appears to straddle the structural-semantic divide’ in that, whilst recipients in ditransitive clauses could be explained on syntactic terms, other roles such as experiencers need a semantic explanation. That is, the dative case is said to encompass both syntactic and semantic functions. This is said to be attributable to the fact that the core meaning of the dative case seems to be of a ‘sentient affected entity’ (Næss, 2009, p. 574, 576), because the roles that are typically expressed by the dative, whether they are recipients in ditransitive clauses, or indirectly affected objects of verbs that are relatively less transitive such as ‘help’, or atypical subjects such as experiencers, or benefactives, all require sentient animate nouns to be maximally felicitous.

1.5 Studying Online Processing

The question of how language comprehension actually ensues can be studied using various methods. Offline methods, such as asking participants to judge the grammaticality of sentences in a questionnaire are relatively simple, but do not provide a real time response as and when the processing is proceeding. Online methods such as measuring the eye-movements as the participants process a sentence and / or measuring the electrical activity of the brain, on the other hand, crucially provide real-time measurements (Crocker, 1992). In fact, these are the very few methods available to study spoken language comprehension as it happens in real-time.

The eye-tracking methodology strives to glean important clues about the kind of relationship or mediation between processing the linguistic input that unfolds over time, and the visual context in which it unfolds. One of the widely used paradigms in eye-tracking studies, the *Visual World Paradigm* capitalises on the fact that language comprehension in day-to-day natural contexts mostly happens in the presence of a concurrent visual context, in which the speaker and the listener look at the object under discussion or the object of interest. It involves presenting participants with auditory sentences in the context of a visual scene, during which their eye-movements are recorded, which are then compared between an experimental condition and a control condition to study the differences between the two conditions, which could then be used to gain insights into the underlying language processing mechanism(s).

Eye-tracking studies using the *Visual World Paradigm* have been used for instance to gain insights on how the visual and linguistic information are integrated (Tanenhaus, Spivey-Knowlton, Eberhard, & Sedivy, 1995), to study if the comprehension system could predict what comes next based on the selectional restrictions of the verb Altmann & Kamide (1999), to investigate how syntactic and semantic information are integrated and used to predict the unfolding linguistic input Kamide, Scheepers, & Altmann (2003), and to study the influence of such a visual context on the incremental thematic role assignments / grammatical functions to case-ambiguous (and thus role-ambiguous) arguments Knoeferle, Crocker, Scheepers, & Pickering (2005). This paradigm has also been used to provide evidence for the fact that the human sentence processor could indeed predict what is going to be referred to next (in the utterance) on the basis of the syntactic case-marking and lexical-semantic information, even in the absence of the verb, as is the case in verb-final languages

such as Japanese Kamide, Altmann, & Haywood (2003). It is important to note here that although (anticipatory) eye-movements provide valuable information and insights into the processing of an unfolding utterance, they are not just restricted to linguistic input (Altmann & Kamide, 2007).

Another online method of importance that provides crucial insight into the mechanisms involved in processing language is the technique that directly records the ongoing electrical activity of the brain in real-time. Since the current set of studies all involve this online method, Chapter 2 provides a detailed introduction to that methodology with a discussion of several studies. Of late, several studies have combined these methodologies in order to investigate the relationship between eye-movements and the electrical activity recorded at the scalp (Serenó, Rayner, & Posner, 1998; Knoeferle, Habets, Crocker, & Münte, 2008; Kretzschmar, Bornkessel-Schlesewsky, & Schlewsky, 2009). For an extensive review and discussion of such a concurrent method of measurement, see Kretzschmar (2010).

Our discussion until now has shown that language comprehension proceeds incrementally as utterances unfold in time. Further, different languages use different mechanisms to indicate the grammatical and semantic roles that the arguments play in a given sentence in that language. These factors interact in complex ways. For instance, whilst an imperative for a relatively flexible word-order is the availability of case-marking, having many cases is not a guarantee for free word-order (Butt, 2009). A much more complex interaction would be between case and animacy. Not all nouns may be marked in the same way, and even amongst animates, pronouns may show an idiosyncratic behaviour in many respects (Kittilä & Malchukov, 2009). And there are further factors such as agreement, which may be determined by grammatical relations, governed by a particular case, position of the noun on the nominal hierarchy etc. (see B. J. Blake, 2001, chap. 5). As discussed earlier, the Competition Model derives the hierarchy of these factors or information types in a certain language from offline studies on that language. However, a question that this might give rise to is, whether and in what manner these information types influence the processing of language in real time. Cross-linguistic evidence that has emerged in recent years from studies on *online* language comprehension indicate that such a common list of cues with language-specific weightings indeed influence language comprehension in a number of ways.

For instance, based upon online studies on various languages, Bornkessel-Schlesewsky & Schlewsky (2009b) have argued that cross-linguistic

information types such as case-marking, linear order of words, animacy, definiteness / specificity and person, which they collectively term *Prominence Scales*, are indeed important factors that influence online language comprehension. Furthermore, they propose the Interface Hypothesis of incremental argument interpretation (Bornkessel-Schlesewsky & Schlewsky, 2009b, p. 28), whereby the processing system accomplishes argument interpretation using these Prominence Scales according to their language-specific weightings. They approach the issue of form-to-meaning mapping by focussing on what they call Role Identification and Role Prototypicality, both of which are influenced by Prominence Scales. Role Identification concerns the question of how the processing system identifies the Actor and Undergoer roles in a transitive event, whereas Role Prototypicality addresses the question of whether and to what extent does a non-prototypical role distribution in such an event affect the online processing of the event.

Given these insights, we discuss previous findings from several online studies of sentence processing that show how the various information types interact to influence online sentence comprehension in [Chapter 2, Section 2.4](#), after providing a general introduction to the methodology used in our studies.

1.6 The Present Dissertation

The studies in this dissertation concern the online processing of dative nominals in the subject position in constructions that serve to report a state of affairs rather than an active event, which are variously called experiencer-subject or dative-subject constructions. We use the term dative-subject or dative-stative constructions so as to specifically refer to the Tamil stative constructions⁹ that are of interest to our present purposes. This is also in view of the fact that ‘not all experiencer subjects are dative, nor all dative subjects experiencers’ (Verma & Mohanan, 1990, p. 3). This dissertation thus attempts to investigate the question of whether and in what manner dative nominals that are subjects are processed differently from nominative subjects and dative nominals that are not subjects. It further strives to examine whether verbs that require a dative nominal as their subject are processed differently compared to verbs that require a nominative subject.

— * —

9. See [Chapter 4](#) for details about Tamil dative-subject stative constructions and the motivations for choosing them for the purposes of our study.

Electrophysiology of Language

2.1 Introduction

The Electroencephalogram (EEG) is the electrical activity of the human brain that can be recorded using electrodes fixed at the scalp. It includes the rhythmic variations in voltage that are elicited due to the various functions of the brain and the variations in voltage that directly reflect the response of the brain to various stimuli, including linguistic stimuli. These miniscule changes in the amplitude of the electrical activity of the brain in response to an internal or external event or stimulus are called Event-Related Brain Potentials, or ERPs in short.

As the name suggests, ERPs are time-locked to internal or external events or stimuli such as reading or hearing a word, looking at a picture, listening to a tone and so on. These event-related changes in voltage related to linguistic stimuli are typically less than $10 \mu\text{V}$ at the scalp as opposed to the spontaneous (background) electrical activity of the brain (EEG), which is upwards of $10 \mu\text{V}$ and up to $100 \mu\text{V}$.

This means that there is a low signal-to-noise ratio, which in turn means that for a reliable average ERP, a high number of trials in each experimental condition of interest is necessary. This is also the reason why the number of participants must also be approximately 20. As is conventional¹⁰ in plotting the EEG, ERP curves are mostly plotted with negative voltages above the zero-line and positive voltages below it.

10. See [Appendix A](#)

2.2 Strengths and Limitations

The important advantage of using ERPs is their temporal resolution, which is in the order of a few milliseconds. Thus, it is possible to study cognitive processes as they unfold in real-time. The processing of a stimulus can be observed even if there is no specific task to perform and thus no behavioural response. When studying language-comprehension using ERPs, the processing of any word in the middle of the utterance or visual input can be easily studied. This is because the processing is being continuously recorded, so any word can be time-locked and the response to the stimulus measured at all stages of processing.

ERPs are multi-dimensional. That is, they vary in polarity, amplitude, scalp distribution and latency from stimulus onset, depending upon the underlying processes that they reflect. Thus, in contrast to uni-dimensional behavioural methods such as reading times, ERPs can be used to distinguish qualitatively different effects (or *components*) that might be elicited during the processing of a certain stimulus.

However, ERPs do not exhibit fine spatial resolution: it is very difficult, if not almost impossible, to localise the source of a signal recorded at a certain electrode at the scalp. This is because of several reasons, such as volume conduction or the distortion of electrode activity by the skull and so on. Furthermore, a certain signal is the product of various neuro-anatomical processes taking place at a point in time at a number of locations in the brain. In other words, one cannot draw unique conclusions on the underlying sources based upon the EEG recorded at the scalp - the so-called *Inverse Problem*. What directly follows from this is that, an ERP component cannot be conclusively mapped to a certain underlying process. As mentioned earlier, due to the low signal-to-noise ratio, typically 30 to 50 trials are necessary in each experimental condition for a reliable result. For further discussion, see Luck (2005) and Otten & Rugg (2005).

2.3 ERP Components

Kutas, Van Petten, & Kluender (2006) discuss what should be considered a 'component', thereby identifying two sets of factors crucial to identify 'some portion of the ERP as a unitary component'. The first set of factors, namely the polarity, the latency from stimulus onset and the scalp distribution of the amplitude, is said to be related to the anatomy of the

‘underlying neural generators’. The second set of factors consists of the comparisons between the curves from several experimental conditions, and comparison with a control condition in particular, to determine the influence of the manipulations on a particular ‘temporal region of the waveform’.

2.3.1 Types and Nomenclature

ERP components are of two types, namely *exogenous* and *endogenous* (Luck, 2005; Kutas et al., 2006). The *exogenous* components are the early sensory responses that depend upon the external factors as the name suggests, that is the physical parameters of the evoking stimulus. The *endogenous* components occurring beyond 100 ms after stimulus onset are elicited by perceptual and cognitive operations. These are the more informative ‘late’ components, which depend upon the internal factors such as the processing of the stimulus, the task being performed and the response to the stimulus rather than the physical properties of the stimulus. In other words, different *endogenous* components may be elicited by one and the same stimulus depending upon the task, for example, whilst the *exogenous* components won’t change unless one or more of the physical properties of the stimulus change(s). The components that are usually used for studying psycholinguistic research questions are the *endogenous* components.

The ERP components are typically named according to the polarity of the peak or trough under consideration, P indicating a positive and N a negative deflection, followed by the latency (in milliseconds) of the deflection after the stimulus onset. A component such as N100 indicates a negativity peaking approximately 100 ms after the stimulus onset and P600 indicates a positivity peaking about 600 ms after the onset of the stimulus. However, there are other conventions, where just the ordinal position of the peak or the trough in the waveform is indicated instead of the latency, or a functional description is used, such as MMN indicating MisMatchNegativity, or a label indicating the scalp location is used, such as ELAN indicating Early Left Anterior Negativity.

2.3.2 Language-related Components

ERP components that are specific to language-related processes as well as those that are elicited due to task influences when processing language are briefly discussed here. Difficulties or problems at various

stages of language processing elicit certain ERP components that are believed to reflect the resulting increased processing effort of that part of the processing system that is particularly taxed by the stimulus at hand. These components are traditionally seen to reflect problems arising in a certain domain of language processing such as syntax, semantics and so on. This conventional view notwithstanding, of late many studies have found results that defy such a hard and fast mapping of components to the several domains of linguistic processing. See [Kutas et al. \(2006\)](#) for a review of these so-called ‘unexpected’ effects. Such a one-to-one mapping between components and various domains of language processing has become more and more untenable (see [Bornkessel-Schlesewsky & Schlewsky, 2008](#), for example).

2.3.2.1 N400

[Kutas & Hillyard \(1980\)](#) showed in their seminal work that semantically incongruous words (visual) at the end of a sentence elicited what they called an N400. In sentences such as ‘*He spread the warm bread with socks.*’, they observed a negative deflection peaking at around 400 ms after the word ‘socks’ appeared, which is not semantically appropriate in that position in the sentence, although syntactically there is no problem. They compared this with two other conditions, namely sentences in which the last word is both syntactically and semantically appropriate, such as¹¹ ‘*It was his first day at WORK.*’, and sentences in which the last word, although syntactically and semantically appropriate, appeared a little larger in size (typeface size) than the preceding words, such as ‘*She put on her high heeled SHOES.*’. Although the sentences of the latter type (the physically deviant ones) elicited a positivity, neither of the semantically well-formed conditions elicited such a negativity as seen in sentences of the ‘socks’ type. Thus they argued that ‘semantic deviations activate a different constellation of brain activity than do physical deviations’ ([Kutas & Hillyard, 1980](#), p. 204). They further argued that the N400 in fact seems to be engendered by the difficulty in processing of a semantically incongruent or inappropriate constituent: they called this a ‘reprocessing’ or ‘second look’ that becomes necessary to extract meaning from senseless sentences.

The semantic relatedness of the input to be processed and the word that is most-expected apparently modulates the amplitude of the N400 component. For example, [Federmeier & Kutas \(1999\)](#) used stimuli such

11. Word(s) in small-capitals in this and other examples of stimuli indicate(s) the point(s) of interest for ERP observation.

2.3. ERP COMPONENTS

as ‘They wanted to make the hotel look more like a tropical resort, so along the driveway they planted rows of palms/pines/tulips.’, where one of the words *palms/pines/tulips* completed the sentence. They reported that the violations that used semantically closer words (that is, sentences of the *pin* type) elicited an N400 that was slightly smaller in amplitude than the violations with words that are semantically relatively more distant (that is, sentences of the *tulip* type). For a review of other factors influencing or modulating the N400 component, the interested reader is referred to Federmeier & Kutas (1999) and Kutas & Federmeier (2000).

Furthermore, the N400 component is not just restricted to anomalous words (that is, the linguistic domain), but also to anomalous line-drawings (in the position of an anomalous word in a sentence). Nigam, Hoffman, & Simons (1992) used stimuli such as ‘I can never find a matching pair of socks’ and ‘I ate an apple and a WHISTLE’, where the words SOCKS and WHISTLE were presented as line-drawings depicting the objects rather than words. In the sentences of the WHISTLE type, they observed an N400 at the position of the line-drawing, whereas this was not the case with the sentences of the SOCKS type. These findings suggested that whenever there is some difficulty or problem in semantically integrating new information (not necessarily linguistic) to the already constructed cognitive interpretation, this is reflected in the ERPs elicited.

Although the studies discussed above used clear semantic violations or anomalies, the N400 component is not just restricted to violations. This component is elicited in varying degrees of amplitude also in cases where there is no semantic violation per se but rather just a deviation from the expected completion of a sentence¹².

Kutas & Hillyard (1984), for example, used meaningful sentences and reported N400 components of amplitudes that varied in an inverse relation to the expected completion of sentences. That is, the more the participants expected a word to complete a sentence (i.e., the higher the cloze probability¹³), the lower the amplitude of the N400 that it elicited, and vice versa. The levels of constraints, namely high (*The bill was due at the end of the HOUR.*), medium (*The dog chased our cat up the LADDER.*) and low (*He was soothed by the gentle WIND.*), posed by a sentence context for its completion (just before the last word) did not appear to modulate the amplitude of the N400 significantly. Furthermore, the more the last

12. Note that all the studies discussed here were concerned with the last words of sentences, which seems to give an impression that only the last words engender such effects. However, words in any position may elicit the various ERP effects.

13. The cloze probability of a word is the proportion of people who continue a sentence fragment with that target word.

word was semantically related to the most expected word, the smaller the amplitude of the N400, and vice versa. Thus, they concluded that ‘semantic incongruity is not a necessary condition for N400 elicitation’.

These are just a few of the situations in which an N400 is elicited. The N400, however, is not restricted to the purely semantic domain of language processing. As the studies below show, grammatical function reanalyses also elicit N400s. Hopf, Bayer, Bader, & Meng (1998) used case-ambiguous nouns as German sentential onsets and clause-final verbs that assign to their objects either accusative case as in (2.1) or dative case as in (2.2). They found that the dative verbs with case-ambiguous sentence-initial objects elicited an N400, which wasn’t the case with the accusative verbs with case-ambiguous objects or the dative verbs with unambiguously case-marked objects.

(2.1) Dirigenten, die ein schwieriges werk einstudiert
 [Conductors]_{AMB} who a difficult opus rehearsed
 haben, kann ein Kritiker ruhig UMJUBELN.
 have, can [a critic]_{NOM} safely [celebrate]_{ACC}
 ‘A Critic can safely celebrate the conductors, who have rehearsed a difficult opus’.

(2.2) Dirigenten, die ein schwieriges werk einstudiert
 [Conductors]_{AMB} who a difficult opus rehearsed
 haben, kann ein Kritiker ruhig APPLAUDIEREN.
 have, can [a critic]_{NOM} safely [celebrate]_{DAT}
 ‘A Critic can safely applaud the conductors, who have rehearsed a difficult opus’.

Exploring the reanalysis of case ambiguities further, Bornkessel, McElree, Schlesewsky, & Friederici (2004) showed that syntactic reanalysis can take place along several dimensions. In one of their ERP experiments, they visually presented German sentences that contained case ambiguous subject and object NPs that had to be reanalysed as either nominative and accusative (or vice versa) or nominative and dative (or vice versa) depending upon the clause-final verb and verb-type, which disambiguate for the case as well as subjecthood and objecthood of the NPs. The accusative-initial (as opposed to nominative-initial) structures elicited a P600 at the verb, whilst the dative-initial structures elicited an N400. In spite of the fact that both are reanalyses of object-initial structures, the different effects for dative-initial and accusative-initial reanalyses suggested that different reanalysis mechanisms were involved.

However, subsequent studies (Haupt, Schlesewsky, Roehm, Friederici, & Bornkessel-Schlesewsky, 2008) have found results suggesting that the dative pattern is more pervasive.

In a further experiment, Bornkessel et al. (2004) used the dative active (e.g. *folgen* - *follow*) verbs from their previous experiment and replaced the accusative verbs with dative object-experiencer¹⁴ (*gefallen* - *please*) verbs. Whilst both type of verbs elicited an N400 in the object-initial order, the N400 in case of object-experiencer verbs was less pronounced, which was attributed to the lower processing costs owing to the ease of processing a dative-initial order in case of object-experiencer verbs. These verbs, in addition, elicited a LAN in the subject-initial order. Bornkessel et al. (2004) attributed this to the mismatch between the thematic and case hierarchies. Further, they concluded that the reanalysis of case-marking elicits a 'reanalysis N400' rather than a P600, which is elicited by phrase-structure reanalyses, thus dividing reanalyses along several dimensions.

Negativities of the N400 type have also been reported in the comprehension of metaphors (Pynte, Besson, Robichon, & Poli, 1996; Coulson & Van Petten, 2002; Sotillo et al., 2005), jokes (Coulson & Kutas, 2001) and figurative language such as proverbs (Ferretti, Schwint, & Katz, 2007).

Whilst *expected completions* of idiomatic collocations in an entailing sentence context have been shown to elicit a frontally distributed N400 (Molinaro & Carreiras, 2010), a recent study (Lotze, Tune, Schlesewsky, & Bornkessel-Schlesewsky, Submitted) has found that *unexpected words* that otherwise elicit a larger negativity may elicit an N400 smaller in amplitude, provided there was some bottom-up information (such as an orthographic deviation in their study) suggesting that the word, albeit unexpected, was going to be highly informative.

To summarise, an N400 is elicited not only when processing semantically anomalous sentences, but also when reanalysing grammatical functions based on, say, ambiguous case information, and in the case of processing non-literal language.

Given these results and those from studies such as Hopf et al. (1998) and Bornkessel et al. (2004), it is clear that an ERP component ought not to be tied down to one particular macroscopic domain of linguistic processing.

14. The dative object experiencer verbs (unlike the dative active ones) provide explicit lexical information for a dative-initial word-order.

2.3.2.2 P600

Osterhout & Holcomb (1992) studied syntactic anomalies using acceptable reduced relative-clause English sentences that lead to the unintended—and thus ungrammatical—interpretation¹⁵. The verbs in the main-clause of sentences with a clausal complement were either transitive or intransitive. Transitive sentences used in the study (such as “*The man hired to tend the store.”) forced a passive reading of the main-clause and an incomplete reduced relative-clause reading of the clausal complement (as in “*The man who was hired to tend the store -incomplete-”) - thus ungrammatical. However, the intransitive sentences were grammatical (such as “The man intended to help the poor.”). They observed a positive deflection, the mid-point of which was at around 600 ms after the appearance of the word ‘to’ in the transitive verb condition, which they called the P600¹⁶.

In a further experiment as part of the study, the sentences were extended by adding a clause such as ‘...WAS fired for theft’. In such extended sentences with an intransitive verb in the clausal complement, such as ‘?The man intended to help the store WAS fired for theft’, Osterhout & Holcomb observed the same effect (positivity) also after the auxiliary verb ‘was’. This, they suggested, showed that the P600 component is elicited not just due to verbal argument violations, but also in cases where a certain input contradicts with the constraints posed by the phrase-structure inventory of the language under study. Thus, they suggested that the P600 might be, in effect, ‘a marker of the syntactic garden-path effect’ and claimed that the P600 component ‘co-occurs with syntactic anomaly’.

Harris, Wexler, & Holcomb (2000) used the syntactic constraints posed by binding of anaphors with antecedents in English and found P600 components at the position of the anaphor in sentences such as “*The sailors’ captain trusted THEMSELVES in the worst seas.’, as opposed to their grammatical counterparts such as ‘The sailors’ captain trusted HIMSELF in the worst seas.’. They argued that this is due to the syntactic violation at the point of the anaphor in sentences of the former type, where the anaphor does not agree in number to its only possible antecedent, which is a syntactic constraint violation in English.

Frisch, Schlesewsky, Saddy, & Alpermann (2002) argued that the P600 component also reflects the recognition of a syntactic ambiguity by the

15. For a discussion of the so-called garden-path sentences and why they constitute a syntactic anomaly in their unintended interpretation, see Altmann (1998).

16. Whilst some research groups use the terms P600 and late-positivity mostly interchangeably in the literature, others differentiate these terms functionally.

processing system. They used sentence constituents in German that were either ambiguously marked for their syntactic function (subject or object) or unambiguous. Ambiguously marked sentences such as (2.3), in which NP1 is a subject, and (2.4), in which NP1 is an object, elicited a late positivity (P600 component) at NP1. This was as opposed to the unambiguously marked control sentences, such as (2.5) and (2.6). They also found a P600 component at NP2, when it disambiguated the initial ambiguity to a dispreferred object-initial reading of the sentence.

- (2.3) Die Detektivin hatte den Kommissar gesehen und...
 [The detective]_{AMB} had [the policeman]_{ACC} saw and...
 ‘The female detective had seen the policeman and...’
- (2.4) Die Detektivin hatte der Kommissar gesehen und...
 [The detective]_{AMB} had [the policeman]_{NOM} saw and...
 ‘The policeman had seen the female detective and...’
- (2.5) Der Detektiv hatte die Kommissarin gesehen und...
 [The detective]_{NOM} had [the policewoman]_{AMB} saw and...
 ‘The detective had seen the policewoman and...’
- (2.6) Den Detektiv hatte die Kommissarin gesehen und...
 [The detective]_{ACC} had [the policewoman]_{AMB} saw and...
 ‘The policewoman had seen the detective and...’

Thus, Frisch et al. argued that the processing system, having recognised the ambiguity at NP1, had to make ‘structural predictions’ and that, the P600 component elicited was thus due to the syntactic ambiguity alone. When NP2 disambiguated the sentence and led to a dispreferred reading, this syntactic revision involved a processing cost, which then engendered the P600 component. Based on these results, they suggested that the ‘P600 component must be taken as an indicator of syntactic processing cost in general’.

The P600 component is not restricted to reanalysis processes, as shown by Frisch et al. (2002). Kaan, Harris, Gibson, & Holcomb (2000), for example, proposed that the P600 reflects difficulty with syntactic

- (2.7) (a) Emily wondered *who* the performer in the concert had imitated for the audience’s amusement.
 (b) Emily wondered *whether* the performer in the concert had imitated a pop star for the audience’s amusement.
 (c) Emily wondered *which* pop star the performer in the concert had imitated for the audience’s amusement.

integration processes in general. In this study, they used non garden-path sentences such as those in (2.7). They argued that the late positivities elicited at the embedded participle verb for ‘*whether*’ and ‘*who*’ conditions relative to the ‘*which*’ condition reflected that the harder the syntactic integration the larger the P600. Thus they concluded that the P600 is ‘an index of syntactic integration difficulty in general’.

Further, Kim & Osterhout (2005) reported a P600 in the processing of sentences such as ‘*The hearty meal was DEVOURING...*’, which they argued indicated a reanalysis (of ‘*devouring*’ as ‘*devoured*’) of a ‘perceived syntactic anomaly’, rather than considering it as a possible reflection of the direct semantic anomaly in such sentences.

Even though this is just a small subset of studies that reported a P600, these and other studies appear to suggest a close association between the P600 and syntactic processing difficulties. Such a view notwithstanding, the following studies rather suggest that both syntactic and semantic processes (and perhaps a syntax-semantics interface) are involved in engendering a P600.

In a study using Dutch sentences, van Herten, Kolk, & Chwilla (2005) used unacceptable but syntactically correct and unambiguous semantic reversal sentences such as (2.8) and (2.9), and compared the response to the verb in these sentences to that in the acceptable versions, where the poacher(s) hunted the fox and not the other way around. So as to rule out the possibility that the responses are interpreted as ‘a mismatch between an observed inflection’ of the verb and the expected one, they used both the singular and plural versions of the object in separate conditions. They found P600s in all the semantically reversed and thus unacceptable conditions and not N400s, although the sentences are syntactically correct and only semantically implausible. They concluded that the P600 in this study indeed ‘must have been elicited by a semantic anomaly as such’.

(2.8) ?De vos die op de stropers JOEG sloop door het bos.
?‘The fox that hunted the poachers stalked through the woods’.

(2.9) ?De vos die op de stroper JOEG sloop door het bos.
‘The fox that hunted the poacher stalked through the woods’.

Some of the other studies that reported these so-called ‘semantic P600’ effects employing stimuli that contained semantic reversal anomalies include Kolk, Chwilla, van Herten, & Oor (2003), Kuperberg, Sitnikova, Caplan, & Holcomb (2003) and Hoeks, Stowe, & Doedens (2004). For a de-

tailed discussion of such effects and an alternative perspective about P600 effects related to semantic reversal anomalies, see Bornkessel-Schlesewsky & Schlesewsky (2008). See Bornkessel-Schlesewsky et al. (2011) for a parsimonious account of these effects based upon empirical ERP evidence from German, Mandarin Chinese, Turkish and Icelandic.

The P600 is, however, not restricted to one or the other linguistic domain, such as syntax or semantics. Both syntactic and semantic factors and their interaction, can engender a P600. Gunter, Stowe, & Mulder (1997) studied the syntax-semantics interface in one of their experiments. The verbs in their Dutch stimulus sentences were either semantically correct or incorrect and syntactically correct or incorrect (fully crossed 2x2 design). Semantically incongruent verbs elicited a large N400 component. Sentences with incorrect verb conjugation elicited a late positivity (P600) regardless of semantic congruency. Based on the interaction of N400 and P600 in some electrodes, they argued that syntactic and semantic processes are not totally independent. In a further experiment, they also showed that the probability of occurrence of a syntactic violation influenced the P600 but not the negativity (LAN), occurring at an early syntactic processing stage. They thus concluded that the P600 'may reflect a more general language-related reanalysis process in which the outcome of both the early syntactic and semantic analyses are jointly (re-)evaluated' (Gunter et al., 1997, p. 673).

Using German sentences with high (*Sie bereist DAS LAND... - She travels the land*) and low (*Sie befährt DAS LAND... - She drives the land*) cloze probability object nouns, Gunter, Friederici, & Schriefers (2000) found an interaction of semantic expectancy and grammatical gender in their experiment. The ERPs were measured on the object noun which was either in agreement or disagreement with its article. Gender violations elicited a LAN in all cases regardless of the semantic cloze probability. The syntactic gender mismatch did not influence the N400 elicited by the low-cloze (larger N400) and high-cloze nouns. The P600 elicited by the high-cloze nouns alone, however, was influenced by both the semantic cloze-probability and syntactic gender violation. These results, they claimed, indicated that the syntactic and semantic processes at the early processing stage are autonomous, whilst they interact during a later stage.

As shown by Coulson, King, & Kutas (1998), the P600 also varies as a function of purely non-linguistic information such as the proportion of grammatical to ungrammatical sentences in an experimental block. The visual scene can be an influencing factor as well (Knoeferle et al., 2008).

Beyond the sentence level, increased discourse complexity arising due to the processing of information that needs to be inferred from the discourse context has been found to engender late positivities (Burkhardt, 2006). Similarly, when the discourse structure needs to be updated with information inferred from the discourse context, a late positivity ensues (Burkhardt, 2007). Furthermore, the late positivity has been recently shown to reflect enriched composition processes. Schumacher (2011) presented participants with mini-discourses involving a context sentence and a corresponding stimulus sentence visually. The context sentence introduced two individuals representing a typical situation, whereby the one asked the other a question of the form ‘*who did x?*’, as in (2.10). The target sentence that followed was an answer that specified either the individual (2.11) who did the action or a salient property of the individual, as in (2.12), which then necessitated a reference transfer.

(2.10) Der Arzt fragt seine Helferin erneut, wer so früh
 [The doctor]_{NOM} asks [his assistant]_{ACC} again, who so early
 angerufen hat.
 called has

‘The doctor asks his assistant again who had called that early’.

(2.11) Die Helferin antwortet, dass DIE THERAPEUTIN so früh
 [The assistant]_{NOM} responds, that [the therapist]_{NOM} so early
 angerufen hat.
 called has

‘The assistant responds that the therapist had called that early’.

(2.12) Die Helferin antwortet, dass DIE HEPATITIS so früh
 [The assistant]_{NOM} responds, that [the hepatitis]_{NOM} so early
 angerufen hat.
 called has

‘The assistant responds that the hepatitis had called that early’.

The reference transfer condition elicited a late positivity when compared to the control condition, but crucially, there was no N400 elicited in either condition, in spite of the fact that the NP involved in the reference transfer condition was not capable of doing the action described. Thus Schumacher argued that the initial integration was equally easy in both conditions, whereas the late positivity reflected the extra processing cost due to the enriched composition taking place in the reference transfer condition. Given these evidences that the P600 reflects the integration of a variety of information types, the conventional view that the P600 indexes difficulties in syntactic processing alone is clearly not borne out.

2.3.2.3 Anterior Negativities

There are two kinds of anterior negativities reported in the literature, namely the so-called Early Left Anterior Negativity (ELAN) that is elicited in the 100-300 ms after the onset of the critical word, and the Left Anterior Negativity (LAN) that is elicited in the 300-500 ms range (Kutas et al., 2006). Both these anterior negativities are elicited due to morpho-syntactic rather than semantic reasons. The ELAN is elicited whenever there are word-category violations that are, broadly speaking, phrase-structure violations in general.

In an experiment designed to study various kinds of violations, Neville, Nicol, Barss, Forster, & Garrett (1991) also used sentences with phrase-structure violations, such as “*The man admired Don’s of sketch the landscape.’ and “*The editor published Harry’s ABOUT report drugs.’. Comparing with sentences such as ‘The man admired a sketch of the landscape’ and ‘The editor published a report ABOUT drugs.’, they found larger negativities peaking at around 125 ms (after the words ‘of’ and ‘about’ in the ungrammatical sentences) that were confined to the anterior part of the left hemisphere. A late positivity followed this early negativity.

Hahne & Friederici (2002) auditorily presented stimulus sentences in German, which contained phrase-structure violations, such as (2.13). They compared these with the correct control sentences such as 2.14, which showed that the phrase-structure violations elicited an early anterior negativity (ELAN) peaking in the time-range of 100-250 ms after the onset of the violating word. There was also a P600 component that followed. Another critical condition in this experiment contained both a syntactic (phrase-structure) and a semantic violation, as in (2.15). The semantic violation, however, did not have any effect on the ELAN.

(2.13) *Das Eis wurde im GEGESSEN.
 [The ice cream]_{NOM} was in-the eaten
 *‘The ice cream was in the eaten’.

(2.14) Das Eis wurde GEGESSEN.
 [The ice cream]_{NOM} was eaten
 ‘The ice cream was in the eaten’.

(2.15) Der Vulkan wurde im GEGESSEN.
 [The volcano]_{NOM} was in-the eaten
 *‘The volcano was in the eaten’.

The LAN, on the other hand, is elicited when violations occur in the person, number and gender agreement. Osterhout & Mobley (1995) used stimuli such as ‘*The elected officials HOPES to succeed.’ and ‘The elected officials HOPE to succeed.’, and found focal left anterior negativities in the 300-500 ms range at the agreement-violating verb. Gunter et al. (2000) found focal LANs for gender violations in German regardless of the semantic cloze probability of the object nouns concerned (see above for discussion).

A sustained LAN is elicited in cases of long-distance dependency constructions that are fully grammatical, as Kluender & Kutas (1993) reported. Münte, Schiltz, & Kutas (1998) showed that sentences such as ‘BEFORE the scientist submitted the paper, the journal changed its policy.’ elicited a sustained LAN as opposed to sentences such as ‘AFTER the scientist submitted the paper, the journal changed its policy.’. Although the sentences differed only in the first word, this had a sustained effect (LAN) on the whole sentence, starting from 300 ms after the onset of the first word. They attributed such an effect to the increased load¹⁷ on the working-memory processes that ensues due to the long-distance dependency in the ‘Before...’ sentences. They argued that this showed, for the first time, that ‘high level, real-world knowledge has immediate and sustained consequences on neural processing during sentence comprehension’.

For a further detailed discussion of the functional significance of the various ERP components, the interactions among them and an extensive list of references for each component, the interested reader is referred to Kutas et al. (2006).

2.3.2.4 P300

The P300 is a positive deflection peaking at approximately 300 ms after stimulus onset. It was first described by Sutton, Braren, Zubin, & John (1965), and it has ever since been studied quite extensively. Rather than a unitary component, the P300 is considered to be a family of domain-general components that are engendered by rare, improbable, task-relevant or informative stimuli (Picton, 1992; Bornkessel-Schlesewsky & Schlewsky, 2009a). Although it can be generally said that rare events elicit a P300, it is the *perception of the relative frequency* of events, that is the

17. The ‘Before...’ sentences present events in reverse chronological order. That is, the event reported by the ‘Before...’ subordinate clause has to be retained in working memory in order to process the event reported in the subsequent main clause and come up with the correct chronological order of events, whereas this is not the case in the ‘After...’ sentences.

‘subjective probability or expectancy’, that is suggested to be the crucial variable and not the relative frequency itself (Donchin, 1981). Simply put, regardless of the actual relative frequency of a certain event, if this event is *perceived* to be more or less frequent, this then modulates the amplitude of the P300. The context in which a stimulus occurs is said to play an important role in the scalp distribution and latency of the P300 (Katayama & Polich, 1998). In addition to such stimulus constraints, the P300 also varies as a function of the experimental task. Furthermore, it has also been suggested that the strategies that participants use to perform well in the task play a crucial role in modulating the P300 (Roehm, Bornkessel-Schlesewsky, Rösler, & Schlewsky, 2007). For an extensive review of and discussion about the P300 component, especially in relation to language, see Kretzschmar (2010).

There seems to be a general consensus in the literature that the P300 could be said to comprise of at least two sub-components, commonly termed as P3a and P3b, differentiated first by Squires, Squires, & Hillyard (1975). Such a distinction is based mainly upon the scalp distribution of the component and the type of event that engenders it. Whilst a P300 with highest amplitudes in the central to parietal regions is consistently termed as target P300 or P3b, positivities that are predominantly frontally or centrally distributed have been variously termed as P3a, novelty P3, no-go P3 and so on, which are considered to be ‘variants of the same ERP that varies in scalp topography as a function of attentional and task demands’ (Polich, 2007, p. 2134).

2.3.2.4.1 Oddball Paradigm

A paradigm that has been extensively used to study the P300 ERP component, the so-called oddball paradigm presents participants with an infrequent *target* stimulus that they are required to distinguish from a train of other stimuli, either mentally or physically (say, by pressing a button). At least three variants of the oddball paradigm (Polich, 2007) have been used in studies investigating the P300: i. a single-stimulus version, in which a *target* stimulus is presented with random intervening intervals of usually blank screen or silence; ii. a typical oddball version, in which a predetermined *target* stimulus is presented randomly amongst frequently occurring *standard* stimuli; and iii. a three-stimulus variant of the paradigm, in which an infrequently occurring *non-target* distractor that is either easy or difficult to distinguish from the *target* stimulus is presented amongst the frequently occurring *standard* stimuli.

2.3.2.4.2 P3a

As mentioned earlier, almost all early positive deflections with a predominantly anterior distribution seem to be considered as variants of or related to the P3a (Polich, 2007). This is sometimes called the ‘novelty’ P3 since it was first reported to be elicited by ‘novel’ *non-target* stimuli in the visual modality using the three-stimulus oddball paradigm (Courchesne, Hillyard, & Galambos, 1975). Such a component has also been reported in other modalities subsequently (see Katayama & Polich, 1998, for a complete list of references). The distinctiveness of the stimulus is said to play a crucial role in the P3a amplitude (Comerchero & Polich, 1998).

However, it has been shown in several studies using the oddball paradigm that ‘novelty’ is not a strict pre-requisite for a P3a to ensue. In a study using tone stimuli in the three-stimulus oddball paradigm, Katayama & Polich (1998) found a frontally distributed early positivity for the *non-target* stimulus in the condition in which the *non-target* stimulus (970 Hz) deviated considerably from the *standard* stimulus (1940 Hz) from which, in turn, the *target* stimulus (2000 Hz) was difficult to distinguish. Arguing that such a stimulus context entailed that the *non-target* attracted focal attention similar to an entirely novel stimulus, they concluded that this positivity was a P3a and claimed that ‘it may be possible to produce an anterior P300 potential without using novel stimuli per se’ (Katayama & Polich, 1998, p. 31).

In a similar study that Comerchero & Polich (1999) reported, they manipulated the discriminability between the *target* and *standard* stimuli, in both the auditory and visual modalities using tones differing in their pitch and shapes differing in their area respectively. Thus none of the stimuli was ‘novel’ within a certain modality. In the condition in which the discriminability was difficult, *non-target* stimuli elicited a larger early positivity in the fronto-central regions as opposed to *target* stimuli, thereby confirming the earlier claim that ‘an anterior P3a component can be produced without using ‘novel’ stimuli’ (Comerchero & Polich, 1999, p. 29). Wronka, Kaiser, & Coenen (2008) have shown that this claim is true even if participants were doing an unrelated visual task and were only listening to the three different tones passively without any task to do with regard to the tones. Furthermore, the P3a effect is not exclusive to detecting novel stimuli, deviant tones and other non-speech stimuli. For instance, words in a three-stimulus oddball paradigm with an infrequent *non-target* phoneme deviating from the standard in the stimulus train have been shown to elicit a P3a effect (Winkler, Kujala, Alku, & Näätänen, 2003).

2.3.2.4.3 P3b

A much studied component than its anterior counterpart(s), the P3b is a parietally distributed P300. It ensues when *target* stimuli are recognised as such in the oddball paradigms (Polich & Criado, 2006) in both auditory and visual modalities (Katayama & Polich, 1999). The rarer the occurrence of the *target*, the larger the amplitude of the P3b. In all the studies cited in the discussion on P3a, a P3b was observed when the target was recognised. That is to say, task-relevant stimuli elicit a P3b, which means that it is elicited only in cases where there is some sort of explicit recognition, classification or judgement of the stimuli is involved.

Roehm et al. (2007) reported an instance of the P3b in the linguistic domain in their study involving antonyms, in which a P3b ensued for expected completions of sentences describing an antonymy (such as, ‘The opposite of *black* is *white*.’), which participants had to judge for their sensicality. This was also the case when the participants judged whether a word-pair constituted an antonymy. However, when the task was to judge whether one of the words in the word-pair was a word or pseudo-word (lexical decision), they did not observe a positivity. This clearly demonstrates that the P3b is task-relevant.

Further, Kretzschmar (2010) has argued based on results from concurrent EEG and eye-tracking studies that unless all the information necessary to categorise stimuli as matching the expectations became available all at once, there is no P300 engendered. For instance, she found P300s for antonyms in sentence contexts such as ‘x is the opposite of y’ in the auditory modality and in the rapid serial visual presentation method (i.e., word-by-word presentation), but there was no P300 elicited in a natural reading setting, although the stimuli were identical in all cases. She argued, this was due to the fact that neither the word form (i.e., orthographic) information about the expected word available para-foveally nor its semantic information that became available on fixating the word were, independent of each other, reliable indicators of a match so as to accomplish categorisation. The para-foveal preview is a crucial difference in the natural reading setting from the auditory and word-by-word visual presentations, in which these information types become available concurrently.

Whilst antonymies present an ideal paradigm in which to observe target P300s, these positivities are not restricted to these paradigms alone. Such positivities have been reported for expected completions of colloc-

ations in figurative expressions (Molinaro & Carreiras, 2010) and idioms (Vespignani, Canal, Molinaro, Fonda, & Cacciari, 2010).

2.3.2.4.4 P3a versus P3b

To summarise, the distinction Näätänen (1990) made between the P3a and P3b sub-components of the P300 family seems to be by far the simplest and most clear one. The following quote is from Katayama & Polich (1998, p. 24).

... Näätänen (1990) distinguished P3a and P3b such that P3a is considered to be the reflection of the attentional switch produced from the *mismatch* between a stimulus presented and passively formed neuronal trace, whereas P3b reflects the *match* between the stimulus and voluntarily maintained attentional trace.

Polich (2007, p. 2128) makes the distinction as follows:

... P3a originates from stimulus-driven frontal attention mechanisms during task processing, whereas P3b originates from temporal-parietal activity associated with attention and appears related to subsequent memory processing.

2.3.2.4.5 Is the P6 a P3?

There is a debate in the literature as to whether or not the P600 is actually a P300. Whilst some researchers have claimed / supported the view that the P600 is indeed a member of the P300 family (Gunter et al., 1997; Coulson et al., 1998; Hahne & Friederici, 1999), others have claimed the opposite (Osterhout & Hagoort, 1999). For instance, Frisch, Kotz, von Cramon, & Friederici (2003) presented aphasic patients with either temporo-parietal lesions or lesions including the basal ganglia with an oddball task and verb inflection violations in two auditory experiments respectively. A P300 effect ensued in the oddball experiment in both patient groups, but the verb violation experiment elicited a P600 in the patient group with temporo-parietal lesions patient group only. They thus attributed a crucial role for the basal ganglia with respect to a P600 modulation, but not a P300, which led them to conclude that these are two different components. On the other hand, a recent dissertation (Kretzschmar, 2010) studied the P300 in various experimental contexts using ERPs as well as concurrent ERPs and eye-tracking, and remained

ambivalent in concluding that although it is true that there are quite some similarities between the early and late positive components, in view of the fact that there are also differences between the two, extensive research is necessary to say anything conclusive about the question.

2.3.3 Interim Summary

The brief discussion of the various ERP components that are elicited during language comprehension has shown that the conventional view held about components and their mappings to linguistic domains is untenable. Further, effects elicited during language comprehension need not necessarily be directly related to language-specific processes: the experimental task requirements also have an influence on the effects elicited, as the antonym studies cited have shown. Moreover, the final outcome of effects in a certain experimental manipulation is the result of language-specific information types interacting with task requirements. In the following section, we discuss how various information types interact during online language comprehension with relevant examples.

2.4 Interplay of word-order, case and animacy

Cross-linguistic information types such as case-marking, linear order of words, animacy, definiteness / specificity and person, which Bornkessel-Schlesewsky & Schlewsky (2009b) collectively call *Prominence Scales*, are important factors influencing language comprehension. However, their influence is language-specific in that a certain factor that is highly reliable in a certain language may not be as informative in another (Bates et al., 1982; MacWhinney & Bates, 1989). For instance, a rigid word order in languages such as English means that the processing system can reliably interpret the roles of the arguments based on their linear order in a sentence. Languages with morphological case-marking, on the other hand, tend to be flexible in their word-order, thereby providing an ideal testing ground to observe how the processing system deals with word-order phenomena to accomplish the form-to-meaning mapping. A small sample of studies that exploited morphological richness, flexible word-order in a given language, as well as some that manipulated animacy are reviewed here.

In German, ditransitive verbs (such as *give*) typically assign accusative case to the direct object and dative case to the indirect object. Rösler, Pechmann, Streb, Röder, & Hennighausen (1998) used such verbs with

unambiguous case-marking (on the articles) of the arguments. They used all the six possible clause-medial word-orders for the three arguments following the conjugated (auxiliary) verb at the second position. An example of a critical sentence in the canonical word-order used in their study is shown in (2.16). One of its non-canonical counterparts is shown in (2.17). Such clause-medial word-order permutations within a clause are conventionally known as *Scrambling*, following Ross (1967)¹⁸. Note that these non-canonical scrambled word-orders are fully grammatical sentences in German, which can be uttered in constraining contexts. They found negativities at the case-marked article of the first NP in cases when this indicated a non-canonical word-order (that is, not Subject - Indirect object_{DAT} - Direct object_{ACC}). A similar negativity was elicited at the article of the second NP when it was the direct object following a subject and not the indirect object. They assumed this negativity to be a LAN and attributed it to working-memory related phenomenon, although further studies (see below) rendered this interpretation questionable.

(2.16) Dann hat der Vater dem Sohn den Schnuller gegeben.
 Then has [the father]_{NOM} [the son]_{DAT} [the pacifier]_{ACC} gave
 ‘Then the father gave the pacifier to the son’.

(2.17) Dann hat dem Sohn der Vater den Schnuller gegeben.
 Then has [the son]_{DAT} [the father]_{NOM} [the pacifier]_{ACC} gave
 ‘Then the father gave the pacifier to the son’.

Since this negativity is attributed to the difficulty arising due to the processing of non-canonical (scrambled) word-orders, it has come to be known as *Scrambling Negativity* (Bornkessel, Schlewsky, & Friederici, 2002; Schlewsky, Bornkessel, & Frisch, 2003). The distribution of the Scrambling Negativity is ‘intermediary’ between that of the LAN and N400. Bornkessel et al. (2002) tested if such a negativity ensuing due to word-order variations could be due to the relative infrequency of such non-canonical structures. Crucially, they presented the noun-phrases as a whole rather than splitting the article and the noun. They used subordinate ‘dass’ clauses with accusative(2.18) and dative(2.19) transitive verbs. This meant that a passive reading of the dative-initial sentences is possible, whereas the Rösler et al. (1998) study ruled out any passive reading due to the choice of the auxiliary verb. Bornkessel et al. (2002) argued that the dative-initial structures, owing to the fact that they could

18. We hereafter use the term *Scrambling* to refer to word-order permutations within a clause. Crucially, however, we don’t subscribe to the transformational idea behind the original definition by Ross (1967).

introduce a passive clause that is canonically dative-initial, would not pose such a difficulty to the processing system as an accusative-initial structure would. Indeed, only accusative-initial NPs elicited a scrambling negativity. Thus, they concluded that the scrambling negativity in case of clause-medial word-order variations is in fact due to ‘the application of fine-grained linguistic distinctions’ rather than the infrequency¹⁹ of the structures concerned.

(2.18) ...dass der Jäger dem Gärtner hilft.
 ...that [the hunter]_{NOM} [the gardener]_{DAT} helps
 ‘...that the hunter helps the gardener’.

(2.19) ...dass der Jäger den Gärtner besucht.
 ...that [the hunter]_{NOM} [the gardener]_{ACC} visits
 ‘...that the hunter visits the gardener’.

In an attempt to show that the effects reported by Rösler et al. (1998) were not due to working-memory processes but rather due to syntactic processes, Schlesewsky et al. (2003) adopted three of the six conditions from that study, which replicated the results of Rösler et al. (1998). Crucially, they constructed three more conditions replacing the first NP in the adopted conditions with a pronoun.

(2.20) Gestern hat DEN Schnuller der Vater dem
 Yesterday has [the pacifier]_{ACC} [the father]_{NOM} [the
 Sohn gegeben.
 son]_{DAT} gave
 ‘Yesterday the father gave the pacifier to the son’.

(2.21) Gestern hat IHN der Vater dem Sohn
 Yesterday has [him]_{ACC} [the father]_{NOM} [the son]_{DAT}
 gegeben.
 gave
 ‘Yesterday the father gave it to the son’.

An example of a sentence in the adopted condition with a non-canonical word-order is shown in (2.20). A crucial point to note here is that a structure with a pronoun at the edge of the German middlefield as in (2.21) (that is, following the verb at the second position) is unmarked

19. Both ‘dass [...]’_{ACC} and ‘dass [...]’_{DAT} are equally infrequent in German.

(Grewe et al., 2005). The pronouns, unlike the articles, did not elicit a negativity, which bore out their hypothesis²⁰.

In the study discussed earlier in the section on P600, Frisch et al. (2002) used declarative German main-clause sentences with sentence-initial arguments ambiguous for case (nominative or accusative) and thus for the subject or object in the sentence. They found a P600 effect on the sentence-initial ambiguous argument as opposed to the unambiguous ones. They also reported a P600 when the second argument disambiguated the sentence to an OVS reading.

Matzke, Mai, Nager, Rüsseler, & Münte (2002) investigated the processing of canonical and non-canonical sentences in German and found sustained negativities in the non-canonical OVS word-order as opposed to the canonical SVO word-order, when the sentence-initial argument was masculine, and thus unambiguous. They attributed this to the demands of OVS sentences on working-memory.

Thus, it is borne out that variations in word-order in languages with a flexible word-order for the arguments tax the processing system, and this is reflected in the ERPs elicited during the processing of such non-canonical structures. However, this is not without exceptions. For instance, Wolff, Schlesewsky, Hirotsu, & Bornkessel-Schlesewsky (2008) have shown that such a disadvantage does not ensue in object initial structures in Japanese in view of the availability of subject drop, unless there is a specific cue in the sentence suggesting that the subject is expected.

Another information type that has been studied cross-linguistically is the influence of the animacy of the arguments involved in an utterance. Weckerly & Kutas (1999) studied the effects of animacy of the nouns in the processing of English object relative-clauses. Using the same syntactic structure for their two experimental conditions, they reversed the animacy of the main-clause subject²¹ and that of the relative-clause subject. For instance, in a sentence such as (2.22), called the A(I) condition, the main-clause subject is animate (*novelist*) and the relative-clause subject is inanimate (*movie*). When the animacy of these constituents is reversed, as in (2.23), called the I(A) condition, the subject of the main-clause is inanimate (*movie*) and the subject of the relative-clause is an-

20. By contrast, a working-memory based hypothesis would predict that the object pronouns are as costly as full (object) NPs, because both have to be held in memory until they could be integrated later when the subject becomes available.

21. Note that in both cases, the subject of the main-clause is the object of the relative-clause, thus the name object relative-clause.

imate (*novelist*). At the position of the main-clause subject (the second word in the stimulus sentences), an N400 effect was elicited when the noun was inanimate; that is, in the I(A) condition as opposed to the A(I) condition.

(2.22) The NOVELIST that the movie inspired praised the director for staying true to the complicated ending.

(2.23) The MOVIE that the novelist praised inspired the director for staying true to the complicated ending.

In a study on German, Frisch & Schlesewsky (2001) used subordinate clauses with two nouns in the nominative case, which is a syntactic violation in German. They argued that two nominative arguments in a clause is problematic not just syntactically but also for thematic interpretation. Ungrammatical sentences such as (2.24) and (2.26), in which both the NPs in the subordinate clause are clearly marked nominative and thus destined to play the actor role (in a sentence with two arguments) rendering them ungrammatical, were compared to grammatical ones such as (2.25) and (2.27), in which the first argument ‘*welchen Angler*’ is marked accusative and thus is the object of the sentence. The second nominative NP in the ungrammatical sentences elicited an N400 followed by a P600.

(2.24) *Peter fragt sich, welcher Angler
 [Peter]_{NOM} asks himself, [which angler]_{NOM}
 DER JÄGER gelobt hat.
 [the hunter]_{NOM} praised has
 *‘Peter asks himself, -uninterpretable-’.

(2.25) Peter fragt sich, welchen Angler
 [Peter]_{NOM} asks himself, [which angler]_{ACC}
 DER JÄGER gelobt hat.
 [the hunter]_{NOM} praised has
 ‘Peter asks himself, which angler did the hunter praise’.

(2.26) *Peter fragt sich, welcher Förster
 [Peter]_{NOM} asks himself, [which forester]_{NOM}
 DER ZWEIG gestreift hat.
 [the branch]_{NOM} touched has
 *‘Peter asks himself, -uninterpretable-’.

- (2.27) Peter fragt sich, welchen Förster
 [Peter]_{NOM} asks himself, [which forester]_{ACC}
 DER ZWEIG gestreift hat.
 [the branch]_{NOM} touched has
 ‘Peter asks himself, which forester did the twig touch’.

However, this effect changed when the second nouns in the ungrammatical sentences were inanimate, as in (2.26). The N400 effect was absent and only the P600 effect was elicited by the second nominative noun that was inanimate, as opposed to their grammatical counterparts such as (2.27). Thus, they argued that the N400 reflects not just semantic anomalies but also problems that arise when thematic competition occurs due to problems in hierarchising the arguments.

This study showed clearly that the processing system uses animacy as a cue to resolve problems with thematic hierarchies online. Based on the fact that an N400 was elicited at the second noun in German subordinate clauses only in the case where both the nominative nouns were animate and not when one of the arguments was inanimate, they argued that the ‘brain makes use of the knowledge that inanimate arguments are potentially less agentive than animate ones’ (Frisch & Schlesewsky, 2001, p. 3394), which helps to resolve the thematic competition (for the higher thematic role, i.e., subjecthood) between two nominative arguments.

Roehm, Schlesewsky, Bornkessel, Frisch, & Haider (2004) used the ERP data from the study by Frisch & Schlesewsky (2001) and analysed the frequency characteristics of that data. Crucially, they also compared the conditions that had an accusative undergoer followed by a nominative actor which was either animate or inanimate. This revealed that the inanimate actor NPs following animate undergoer NPs in sentences such as (2.27) elicited an N400 effect as opposed to sentences such as (2.25) with animate actors.

Philipp, Bornkessel-Schlesewsky, Bisang, & Schlesewsky (2008) studied the role of animacy in the auditory processing of Madarin Chinese using the same sort of manipulation as that of Frisch & Schlesewsky (2001). They used sentences with the coverbs²² *bǎ* and *bèi*, which render an active-like and passive-like reading to the sentences of the structure ‘Argument1 *bǎ/bèi* Argument2 Verb’ respectively. That is to say, the *bǎ* construction is one in which the first argument is the actor and the second one the undergoer, whereas in the adversative passive *bèi* construction,

22. Coverbs are grammaticalised lexical items used as adpositions that indicate a syntactic function rather than the original verbal meaning.

the first argument is the adversative undergoer of the action performed by the second argument, the actor. Notice that both these constructions lead to an unmarked word-order that this is not anymore the Chinese basic SVO word-order. All possible animacy combinations were used for the two arguments, that is inanimate-inanimate, inanimate-animate, animate-inanimate and animate-animate. In addition to construction-specific effects due to the particular properties of the *bèi* construction, they replicated the N400 elicited by inanimate actor arguments following animate undergoer arguments in Chinese, which Frisch & Schlesewsky (2001) reported in their German study.

Similarly, in an auditory study in Tamil, Muralikrishnan (2007) showed that inanimate actor arguments following animate undergoer arguments elicited a negativity. Since it was a fully crossed design involving animate and inanimate actors and undergoers in simple transitive sentences, it added further evidence to the argument that a non-prototypical actor engenders more processing effort compared to a prototypical one, regardless of the type of language involved. The results of the studies on Chinese and Tamil taken together suggests that it cannot simply be a lexical effect. Converging evidence for this stems from a frequency-based analysis (Roehm, Muralikrishnan, Philipp, & Bornkessel-Schlesewsky, 2008) performed on the Tamil and Chinese data from Muralikrishnan (2007) and Philipp et al. (2008) respectively.

2.5 Summary

Given the fine-grained temporal resolution of the EEG methodology, and the extensive literature available on the various language-related ERP components from cross-linguistic studies on sentence comprehension, it is reasonable to assume that this methodology is promising for studies on the real-time processing of languages that have not been examined to date.

— * —

Neurocognitive Models

3.1 Introduction

Models of language comprehension, as the name suggests, strive to model the various processes involved in comprehending language. The various approaches proposed in the past decades have been based upon psycholinguistic studies, mostly in English, that predominantly used behavioural methods. These models are usually classified based on whether they assume a serial or parallel processing regime, whether they consist of independent modules that process the various aspects of language independently of each other (modular models) or, alternatively, processes that fully interact with each other very early on (interactive models), whether they are complexity-based, working-memory based, frequency-based, lexicalist constraint-based and so on. In view of the fact that most of the psycholinguistic models were developed based on studies on a certain language (usually English), the cross-linguistic applicability of these models leaves much to be desired. The interested reader is referred to [Mitchell \(1994\)](#) for an overview of the various approaches to modelling language comprehension.

Instead, given that the studies reported in this thesis all use the ERP methodology, we provide a chronologically ordered brief overview of some of the models proposed in the past decade, which were inspired by the neural basis of comprehending language. These are the so-called neurocognitive models that have been proposed based upon results from studies of online language comprehension. In such studies, the activity of the brain is observed in response to the linguistic stimuli participants read or listen to, that is, they employ neurophysiological

measures and/or neuroanatomical imaging techniques. We review each model in more or less detail depending upon its relevance to our purposes, that is, whether it provides predictions from a cross-linguistic perspective for the processing of transitive sentences, which constitute the bulk of the stimuli used in our studies, and whether it has a particular focus on the neurophysiological correlates of language processing.

3.2 Friederici's Neurocognitive Model

Based on the then prevailing neurophysiological data, [Friederici \(1995\)](#) proposed a model of language comprehension that consists of three phases. [Friederici \(1999, 2002\)](#) further specified this basic idea of a three phase model of sentence comprehension in time and space, and proposed the Neurocognitive Model of Sentence Comprehension, with an emphasis on auditory comprehension.

3.2.1 Architecture of the Neurocognitive Model

The Neurocognitive Model of auditory sentence processing consists of three sequentially organised phases. The first phase of the model is primarily syntactic in nature, the second phase processes both syntactic and semantic information parallelly but independently of each other, and the third phase is when the integration of all the available information takes place. According to the model, structure building is independent from, and precedes, semantic processing. These different kinds of information interact with each other only in the third phase of processing. Thus, the model is compatible with other syntax-first models as well as those interactive models that assume late integration. In addition to specifying the time-course of the different processes involved, the proposed architecture tries to explicitly model the functional neuroanatomy of auditory language processing, and therefore specifies, whenever possible, the neuroanatomical structures involved in the different processes necessary to comprehend language, but only after successful speech perception has taken place in a preliminary phase as proposed by [Hickok & Poeppel \(2000\)](#). In other words, all three phases of the Neurocognitive Model focus on sentence level processes. In addition, due to the focus on auditory language comprehension, prosodic processes are considered, the exact details of which have been described in later research elsewhere ([Friederici & Alter, 2004](#)). As far as the neuroanatomical regions subserving prosodic processes are concerned, they are said to be

primarily in the right hemisphere. Specifically, the right temporal region is said to support the identification of prosodic parameters, whereas the right frontal cortex is said to be subserving the processing of sentence melody. It has been further suggested that the corpus callosum is involved in the interplay between the brain hemispheres during prosodic processing, corroborated by subsequent studies (Friederici, von Cramon, & Kotz, 2007).

3.2.2 Phase 1

In the first phase of processing, an initial phrase structure is said to be assigned to the input based on its word-category information. This phase takes place in a time-window of approximately 100–300 ms after the onset of the auditory input. Problems in this phase are typically due to word-category violations, which typically elicit the ELAN effect because the structure built based on previous input cannot be upheld due to the conflicting word-category. The anatomical structure that is said to primarily subserve this phase of processing is the anterior portion of the Superior Temporal Gyrus (STG). The superior-anterior and inferior portions of Brodmann Area (BA) 44 are recruited in the process of retrieving the related syntactic structures in this phase.

3.2.3 Phase 2

Full lexical access is accomplished in the second phase of the model, whereby the selectional restrictions and subcategorisation information related to the item being processed become fully available. This then enables thematic role assignment to ensue based on the syntactic and semantic information about the item. This phase is specified to be in the time-range of 300 - 500 ms relative to the onset of the input. In this phase, processing issues could arise either due to agreement features or other morphosyntactic properties of the verb that are in conflict with what is actually required based on the subcategorisation information, or due to the lexical-semantic properties of the item being processed. Issues related to the verb-agreement elicit a LAN in this phase, the subserving anatomical region being the left frontal cortex. When an item cannot be semantically integrated into the structure due to its lexical-semantics, an N400 ensues, the subserving region being the middle temporal lobe. BA 45 and BA 47 are thought to support the process of retrieving the semantic features from memory, whereas BA 44 and BA 45 are said to be the regions that are involved in the processing of morpho-syntax.

3.2.4 Phase 3

In the third phase of processing, the syntactic structure built initially is mapped onto the lexical-semantic information and the information about the argument structure of the verb concerned. That is to say, the integration of syntactic and semantic information is accomplished in this phase of processing, which spans from 500 - 1000 ms. Further, any kind of reanalysis or repair that is required also takes place during this phase. In case of a conflict between the syntactic structure built in the previous phase(s) and lexical-semantic information or verb argument information, a structural reanalysis becomes necessary in this phase for a successful mapping of the syntactic and semantic information. Late positivities (P600) are said to correlate with such a reanalysis in this phase. Similarly, outright syntactic violations also elicit a P600 effect during this phase. Fronto-central and centro-parietal regions are said to subserve processing in this phase, as well as the Left Inferior Frontal Gyrus (BA 45 and BA 47).

3.3 The Declarative/Procedural Model

Ullman (2001, 2004) proposed the Declarative / Procedural (DP) Model, focussing mainly on the processing of grammar and morphology. According to the DP model, the 'mental lexicon' and 'mental grammar' depend upon the declarative and procedural memory systems respectively, in that they use the respective neuroanatomical structures that subserve these two memory systems. Thus it is a 'dual-system' model, whereby it is assumed that the learning, representation and processing of lexicon and that of grammar are subserved by two different cognitive systems. Nevertheless, these two memory systems are not the only neural structures assumed to be involved.

Specifically, the DP model is mainly based on evidence available on the production and / or processing of regular (e.g., *walk - walked*) versus irregular (*sing - sang*) English past tense forms. It is argued that the irregular forms, owing to the fact that they are arbitrary, are part of the declarative system, and thus stored in declarative memory, because this is the system that learns associations between arbitrary items (and therefore the name, 'associative' memory). This system is said to be subserved by regions of the medial temporal lobe and the hippocampus in particular. Regular forms, on the other hand, are said to be part of the procedural system, because this is the system that can be recruited for procedural

tasks, an instance of which in language would be manipulating a symbol using a grammatical rule for example (that is, adding the ‘-ed’ suffix to a regular English verb to get its past tense form). The procedural system is said to be subserved by, amongst other regions, the basal ganglia and regions of the frontal cortex.

The predictions of the DP model appear to be very general. Language and non-language functions that depend on the same brain systems are predicted to pattern in a similar manner. Problems in lexical processing are said to elicit N400s, whereas morphosyntactic and morphophonological violations are said to result in LAN effects. Further, difficulties arising in syntactic processing are predicted to elicit P600s.

3.4 The MUC Framework

Hagoort (2003, 2005) proposed the Memory, Unification and Control (MUC) framework, arguing that a design perspective is needed rather than an experimental task perspective in order to account for the available neuroimaging data on language. The MUC framework, which is said to apply both to language production and to language comprehension, assumes that there is no precedence for syntax temporally, and that the various syntactic, semantic and phonological processes are to some extent interactive, and operate concurrently.

3.4.1 The Memory Component

The Memory component, subserved by the left temporal cortex, refers to aspects of language that are stored in and retrieved from long-term memory. The MUC framework assumes that words are stored in memory with a corresponding structural frame that contains three layers of information about every word that is stored. The first layer, called as the *root node*, of such a frame is assumed to be a single phrasal node (say, NP). The second layer contains one or more nodes connected to the root-node, indicating the syntactic functions (such as subject, direct object etc.), the so-called *functional nodes*. Phrasal nodes (say, N, NP, V etc.), to which lexical items or other structural frames can then be attached, constitute the third layer of the structural frame, the *foot node*.

Due to the fact that syntactic nodes with their corresponding functions labelled on the structural frame are directly retrieved from memory, no further extra nodes are introduced during the parsing process. That is

to say, prefabricated chunks of syntactic structure are retrieved from memory rather than constructed on the fly, only to be *unified* together.

3.4.2 The Unification Component

Syntactic Unification in this framework refers to the operation of building multi-word utterances from the structural chunks retrieved for each input word. This takes place in what is called the *unification workspace*, wherein the structural frames enter in the order of the input sequentially (Vosse & Kempen, 2000). The frames are linked such that the root node of the new frame being linked is identical to the foot node of the existing frame. The strength of these dynamic unification links is said to vary over time until a stable state is reached. A selection mechanism called lateral inhibition ensures that, at the end of the unification process, only one final unification link is chosen to remain amongst alternatives. The Unification process is also applicable to the phonological and semantic levels. Semantic unification is the process by which the meaning of words is integrated into the preceding context, whereas phonological unification is at work when lexical items are integrated into intonational phrases to form a complete intonational contour.

The neuroanatomical region subserving unification operations, and thus serving as the unification space is, according to the MUC framework, the left inferior frontal cortex that includes BA 44, BA 45, BA 47 and the ventral part of BA 6. Specifically, BA 47 and BA 45 are said to be involved in semantic processing, whereas BA 45 and BA 44 are considered to be supporting syntactic processing. BA 44 and parts of BA 6 apparently play a role in phonological processing. Furthermore, the LIFG is said to support the unification of linguistic and non-linguistic information such as co-speech gestures.

3.4.3 The Control Component

The Control component serves the purpose of relating language to action in a given context. Examples include speaking in the context of seeing objects that are relevant or irrelevant to the conversation, or waiting for the interlocutor to finish speaking to take one's turn in the conversation, or selecting the correct target language in a bilingual setting. The dorsolateral prefrontal cortex (BA 46 and BA 9) as well as the anterior cingulate cortex are said to subserve the Control component.

3.5 The eADM

The uniquely human cognitive ability of language has been studied in detail until recently based on very few languages, at least with regard to online language comprehension. However, in order to account for the comprehension of diverse languages of the world, it seems essential that theories of language comprehension are based upon studies on varied languages. Taking this as a point of departure, Bornkessel & Schlesewsky (2006) proposed a neurocognitive model of language comprehension, which is the cross-linguistically oriented and motivated extended Argument Dependency Model (eADM). The present architecture of the eADM is concerned with the processing of core-constituents, that is the verb and the arguments that it subcategorises for, rather than any other optional constituent(s).

3.5.1 Architecture of the eADM

The architecture of the eADM (Bornkessel-Schlesewsky & Schlesewsky, 2008) consists of three hierarchically organised cascaded phases in its latest version. The processing in one phase reaching a certain threshold is the pre-requisite for the initiation of the next phase, that is, there is some overlap between the phases due to the cascaded hierarchy. Each phase is again hierarchical within itself, comprising various processes within a phase. Should one of the processes within a phase fail, this does not entail that the other processes within the same phase shall not be initiated. The eADM posits a least-effort principle that is said to apply in all the phases of the architecture. This principle, called MINIMALITY, is as follows: -

In the absence of explicit information to the contrary, the human language comprehension system assigns minimal structures. This entails that only required dependencies and relations are created (Bornkessel & Schlesewsky, 2006, p. 790).

3.5.2 Phase 1

In Phase 1 (TEMPLATE ACTIVATION/SELECTION) of processing, templates of phrase-structures are activated and selected based exclusively upon the word-category information. Thus, the output of this phase is an activated syntactic phrase-structure template based on the word-category of the input. Crucially, no relational information is invoked, which means

that it does not lead to argument interpretation as to their roles and relations yet, that is, case-marking, agreement and thematic roles don't come into picture at this stage of processing. Such a structure building phase stripped of the relational aspects, the authors of the model argue, is crucial and necessary in order for the model to account for a variety of languages of the world with different kinds of mapping between their syntactic structures and the relational properties and grammatical functions of their constituents.

3.5.3 Phase 2

This phase, consisting of two subphases 2a and 2b, is said to be the heart of the model, because the relations between the argument(s) being processed and those that have already been processed and the verb, if already encountered, are built at this stage of the processing. Thus the mapping from form to meaning also happens here. Based on the category of the input item, namely nominal or verbal, either of the two different processing paths is chosen, motivated by the fact that the two categories differ in more than one way as to the information sources that they encode and the resulting interpretive consequences.

3.5.3.1 Phase 2a

Prominence hierarchies are activated for the non-predicating categories (nominals) in this subphase, deriving information from the case-marking and position of the input constituent in the phrase. The eADM uses the term *prominence* in the sense of 'information used to construct an interpretive (actor - undergoer)²³ hierarchy between the arguments even in the absence of explicit verb-based information'. This is crucial for the model, because this accounts for the many verb-final languages found in the world, where the information from the verb comes only at the end of the clause. Cross-linguistic information types such as case-marking, argument order, animacy, definiteness / specificity and person, which constitute the various *Prominence Scales*, play an important role at this stage. According to the *Interface Hypothesis* of incremental argument interpretation (Bornkessel-Schlesewsky & Schlewsky, 2009b, p. 28) the processing system accomplishes argument interpretation using these *Prominence Scales* according to their language-specific weightings. For

23. The eADM assumes the Generalised semantic Roles (GRs) 'actor' and 'undergoer' that correspond to agent and patient prototypes respectively.

predicating categories (verbals), information about the voice, agreement and the logical structure (LS²⁴) are extracted for use in the next subphase.

3.5.3.2 Phase 2b

In Phase 2b, for the non-predicating categories, based on the input from the previous subphase and based on other cross-linguistically motivated information sources such as animacy and definiteness, prominence is assigned (COMPUTE PROMINENCE), that is the GRs actor and undergoer. This enables to establish the relation between the argument currently being processed and the argument, if any, that was processed earlier. It has to be noted here, however, that the weightage of the various information sources used for the GR assignment depends upon the language being processed. Based on the prominence information, the agreement of the argument (with the verb) is assigned (ASSIGN AGREEMENT).

In case of the predicating categories, the linking of the LS of the verb with any other already processed arguments (COMPUTE LINKING) takes place. This enables phase 2 to derive and establish relations between the arguments and the verb. This step serves to generate predictions derived from the LS in case if no argument has been processed yet. Establishing agreement (ESTABLISH AGREEMENT) between one of the arguments in the LS and the verb is a pre-requisite to compute the linking. Additionally, based on the lexical specification of the verb and the nouns concerned, the most plausible combination of arguments for the verb is determined (*'plausibility processing'*) in this phase.

3.5.4 Phase 3

The eADM assumes that factors such as pitch accents, stress patterns, plausibility or world-knowledge, frequency of occurrence and lexical-semantic association 'do not modulate the processing of core relations in phase 2' (Bornkessel & Schlesewsky, 2006, p. 802). By core relations, the authors of the model mean the relation between the obligatory arguments of a verb and that between the arguments and the verb. In Phase 3, factors such as world-knowledge as well as the aforementioned factors are mapped (GENERALISED MAPPING) onto each other. Furthermore, the well-formedness (on an acceptability gradient scale) of the constituents

24. The logical structure of a verb is a decomposed hierarchical semantic representation of its arguments derived directly from the lexical meaning of the verb. The eADM follows RRG assumptions about LS. See Van Valin Jr. (2005, chap. 2) for an introduction to logical structures.

processed until the present step is checked and any repair or reanalysis (of dispreferred structures, for instance) needed is performed at this stage.

3.5.5 Neurophysiological Correlates of the eADM

At each phase of the eADM, problems encountered in processing are said to elicit certain ERP components, which are indicative also of the time-course of the processing steps. In Phase 1, when word-category violations occur, an ELAN (Early Left-Anterior Negativity) is elicited between 150 and 200 ms after the onset of the input string. This, the authors of the model argue, reflects a template selection failure due to the fact that ‘the template inventory of the language being processed does not contain a template that is compatible with the current input string’. Crucially however, a template switch does not elicit an ELAN.

The ERP components elicited in Phase 2 reflect the difficulties at the various steps in processing the arguments and verbs. For the arguments, when a mismatch occurs in the compute prominence step with the previous prominence information, an N400 is elicited. For example, at the position of an inanimate actor following an animate undergoer an N400 is elicited, which the authors of the model propose, is due to ‘the increased processing cost associated with having to assign an actor role to an inanimate argument’ (Bornkessel & Schlesewsky, 2006, p. 796).

When a clause-initial argument with accusative case-marking is encountered, prominence information suggests that this must be assigned an undergoer role. It also signals that an argument with the actor role must follow, if the language concerned does not allow subjects to be dropped. This leads to a mismatch between the prominence information that necessitates a two-argument template and the (one-argument) template that would have been selected in phase 1 in accordance with the Minimality principle. Such a conflict in computing the prominence due to processing of non-canonical word-orders elicits a Scrambling Negativity (see the discussion on Effects of Word-order in Chapter 2).

Conflicts in assigning the agreement when processing arguments result in a LAN. The same effect is elicited in establishing the agreement in case of verbs, that is when there is an agreement mismatch between the verb and its argument that it is supposed to agree with. During the processing of a verb, a GR mismatch in the compute linking step elicits an early positivity (P345), whereas a LAN is elicited in case of a hierarchy mismatch in this step. Increased linking costs due to grammatical func-

tion ambiguities arising when the expected agreement relation is not borne out give rise to an N400.

In Phase 3, difficulties in the Generalised Mapping step, well-formedness violations and repair processes give rise to a Late Positivity. For further review of the architecture of the eADM with a discussion in detail of the motivation for the different hierarchical information types used for computing prominence, the interested reader is referred to [Bornkessel & Schlesewsky \(2006\)](#); [Bornkessel-Schlesewsky & Schlesewsky \(2008, 2009b\)](#). They provide examples from various languages illustrating the crucial aspects of the model as well as a discussion on the neurophysiological and neuroanatomical correlates.

3.6 Summary

Whilst some of the neurocognitive models reviewed here focus on a certain aspect of language processing, others such as [Friederici's](#) Neurocognitive model of auditory processing and [Bornkessel & Schlesewsky's](#) eADM provide relatively more specific claims with regard to the types of manipulations involved in our current set of studies. Thus these two models are particularly relevant here. We presume that both of these models will be equally good to interpret data like ours. However, in view of the fact that the eADM allows for an even broader scope for predictions based on factors such as animacy, word-order, availability of case-marking etc. for languages that have not been neurophysiologically studied until now, we shall use that as the reference model with which to interpret our data whenever possible.

— * —

Tamil

4.1 Language Profile

Tamil is a Dravidian language belonging to the southern Tamil-Malayalam branch of the family, with at least 74 million speakers around the world, of which at least 66 million use it as their first language (Gordon Jr., 2005). Around 61 million of these native speakers live in India in the southern state of Tamil Nadu, and some in its neighbouring states, with many living in Sri Lanka, Singapore, Malaysia (Peninsular), Fiji, South Africa, Canada, the Gulf states, the USA and the UK. It is one of the official languages of India, Sri Lanka and Singapore.

Tamil exhibits one of the most typical examples of Diglossia, which Ferguson (1959, p. 336) defined in his seminal work as follows: -

DIGLOSSIA is a relatively stable language situation in which, in addition to the primary dialects of the language (which may include a standard or regional standards), there is a very divergent, highly codified (often grammatically more complex) superposed variety, the vehicle of a large and respected body of written literature, either of an earlier period or in another speech community, which is learned largely by formal education and is used for most written and formal spoken purposes but is not used by any sector of the community for ordinary conversation.

Thus there is a distinct literary variety of Tamil and a distinct spoken variety. The literary variety is used in formal written communication, speeches, newspapers and the news broadcast on radio and TV. The spoken variety, called standard spoken Tamil, is the vernacular used in

everyday conversation, conversational parts of prose literature, films, radio and TV plays. The standard spoken Tamil and the other regional dialects and caste-based sociolects are all mutually intelligible. The exception to this is the case of Sri Lankan Tamil, which is still intelligible, but has clear differences in vocabulary, especially verbs, and pronunciation. Due to these reasons, the formal variety of Tamil is used for the purpose of this study to avoid anything stereotypical of a particular place or community.

4.2 Syntax

Tamil is an agglutinative head-final language, typically SOV, with free word-order for the arguments of the verb. That is, scrambling of the argument word-order is possible, thus generating, say, an OSV structure. As a stylistic variant, an argument can also occur after the verbal predicate in a finite clause. There are no articles. Nouns are classified into rational and non-rational rather than animate and inanimate nouns (Lehmann, 1993). Deities, humans and demons are rational, whilst most other things, animate and inanimate, are non-rational²⁵. There are no prepositions in Tamil. Rather, there are postpositions or bound forms that contribute to various semantic functions. Adjectives and adverbs precede the head. Person-number-gender (PNG), tense, aspect and so on are marked on the verb. There are verbal paradigms in the past, present and future tenses with various possible aspects. Rational nouns are gender-marked for their natural gender, whilst non-rational nouns take the neuter gender. Argument-drop is possible in all cases where the syntactic subject of the sentence is clear from the context or from the PNG-marking on the verb. Verbless-clauses, which are equational and generally express the existence of something or someone, are possible, with a nominative or even a dative nominal predicate NP.

The Tamil nominal case system is generally defined to have eight grammatical cases realised by case suffixes with no syncretism. These are the nominative, accusative, instrumental, dative, ablative, genitive, locative and vocative cases (Arden, 1942, p. 75). In addition, several semantic functions of noun-phrases are realised by free and bound postpositions. Note, however, that Schiffman (1999) argues that such a delimitation ‘does not function very well’, because the postpositions are functionally

25. For the sake of clarity, whenever the discussion is specific to Tamil, we hereafter use the term *inanimate* to mean *inanimate non-rational* nouns alone, because none of our experimental items were animate non-rational. For example, a dog is non-rational, although it is a living being and thus animate.

not very different from the traditional cases based on suffixes. Lehmann (1993) suggests that a large number of cases could be distinguished if the various semantic functions of the postpositions are taken into account. Nouns in a grammatical case other than the nominative are almost always case-marked, although see Section 4.2.2 for exception(s).

4.2.1 The Tamil Nominative Case

The nominative form of a noun stem is nothing but its dictionary form, which is the morphologically unmarked case in Tamil. It is syntactically unmarked as well, since a nominative noun may function as a subject, predicate, subject-complement, object-complement or object. This is illustrated by the sentences²⁶ in (4.1), adapted from Lehmann (1993, chap. 1). In all these sentences, the first NP is always interpreted as the syntactic subject. Consider the sentences with two animate nominative nouns. If the linear order of the NPs in these sentences with only two nominative nouns were to be changed, they would become strange or

(4.1) Possible syntactic functions of the nominative case

குமார்	மாணவன்.
Kuma:r	ma:n.av-an
[Kumar] ^S _{NOM-An.M}	[Student] ^P _{NOM-An.M}
'Kumar is a student'.	

குமார்	தலைவன்	ஆனான்.
Kuma:r	thalaiv-an	a:-n-a:n
[Kumar] ^S _{NOM-An.M}	[Leader] ^{SC} _{NOM-An.M}	[become] _{Past-3singular.Masculine}
'Kumar became a leader'.		

கமலா	குமாரைத்	தலைவன்	ஆக்கினாள்.
Kamala:	Kuma:r-ai~th	thalaiv-an	a:kk-in-a:l.
[Kamala] ^S _{NOM-An.F}	[Kumar] ^O _{ACC-An.M}	[Leader] ^{OC} _{NOM-An.M}	[make] _{Past-3singular.Feminine}
'Kamala made Kumar a leader'.			

குமார்	பால்	குடித்தான்.
Kuma:r	pa:l	kudi-thth-a:n
[Kumar] ^S _{NOM-An.M}	[Milk] ^O _{NOM-In}	[drink] _{Past-3singular.Masculine}
'Kumar drank milk'.		

26. See Appendix B for the phonetic and morphological conventions used in glossing the Tamil examples in this dissertation.

ungrammatical²⁷. Notice the inanimate noun in the object position in the last sentence, not marked for the accusative case. The sentence is indeed grammatical in spite of this, owing to the phenomenon called Differential Object Marking (DOM), discussed briefly in the forthcoming section on the accusative case.

The nominative case is semantically unmarked too, because it does not express a particular semantic role, unlike other cases in Tamil. Thus, a nominative NP with subject function may express semantic roles such as agent, instrument, patient and so on, depending upon the verb. A nominative NP, regardless of its semantic role, usually necessitates agreement. That is, the verb must show agreement with the nominative NP in person, number and gender²⁸, unless it happens to be a morphologically defective²⁹ one.

4.2.2 The Tamil Accusative Case

The accusative case of a noun is formed by adding the suffix *-ai* to the noun stem in Tamil, the stem being either the plain noun stem in its dictionary form if no oblique form thereof exists, or the oblique stem³⁰ in case of nouns where such an oblique stem exists. In case of plural nouns and those that are derived by agglutinative morphology, the accusative case-marker, like other Tamil case-markers, appears as the final suffix.

In a transitive or a ditransitive event, the argument undergoing the action being described, that is the direct object or the Undergoer, will be usually marked by the accusative case. However, there is a strong interdependence between the definiteness³¹ and the rationality of the noun, and the accusative case-marking. As a consequence, case-marking of object arguments is differential in Tamil, which is discussed briefly later in this section. As illustrated in (4.2), non-rational objects are intended to be

27. The verbless-sentence, however, could be marginally acceptable in some cases, provided the predicate in the original sentence indicated, say, a profession such as Doctor or Lawyer, which could then be interpreted as an attributive adjective or so.
28. No gender agreement for 1st & 2nd personal pronouns—they're gender non-specific.
29. A morphologically defective verb in Tamil is one that can only show the default agreement, which is the 3rd person singular neuter pronominal suffix regardless of the person, number and gender features of the syntactic subject. Some of the dative-stative verbs, discussed later in this chapter, are primarily of this type.
30. Some nouns in Tamil have what is called an oblique stem, which basically serves the following purpose: if available, it is this form of a noun that is used to add case suffixes, postpositions and other such compound morphological forms in which the noun under consideration is the first morphological element.
31. (In)Definiteness is marked by noun-modifiers, specifiers or quantifiers, henceforth called as determiners (superscribed as D in examples), albeit not articles proper.

4.2. SYNTAX

interpreted as indefinite or unspecific in the absence of accusative case-marking. On the other hand, in order to interpret a non-rational noun as indefinite in the absence of a determiner, the accusative case-marking has to be obligatorily dropped. In the presence of an indefinite determiner though, it is optional to drop the case-marking, as (4.3) shows. Thus, whenever the noun is marked with the accusative case-suffix in the absence of a determiner, this usually indicates that the noun is definite or specific. Note, however, that it is not true that definite or specific nouns alone are marked with the accusative case-suffix.

(4.2) Non-rational nouns without determiners

குமார்	பால்	குடித்தான்.
Kuma:r	pa:l	kudi-thth-a:n
[Kumar] ^S _{NOM-An.M}	[Milk] ^O _{NOM-In}	[drink] _{Past-3singular.Masculine}

'Kumar drank milk'.

குமார்	பாலைக்	குடித்தான்.
Kuma:r	pa:l-ai~k	kudi-thth-a:n
[Kumar] ^S _{NOM-An.M}	[Milk] ^O _{ACC-In}	[drink] _{Past-3singular.Masculine}

'Kumar drank the milk'.

(4.3) Non-rational nouns with a determiner: Optional case-marking

உமா	ஒரு	பெட்டி(யை)	வாங்கினாள்.
Uma:	oru'	petti(~y-ai)	va:ng-in-a:l.
[Uma] ^S _{NOM-An.F}	[one] ^D	[Box] ^O _{NOM(ACC)-In}	[buy] _{Past-3singular.Feminine}

'Uma bought a box'.

(4.4) Rational nouns: Obligatory accusative case-marking

குமார்	கமலாவைப்	பார்த்தான்.
Kuma:r	Kamala:~v-ai~p	pa:r-thth-a:n
[Kumar] ^S _{NOM-An.M}	[Kamala] ^O _{ACC-An.F}	[see] _{Past-3singular.Masculine}

'Kumar saw Kamala'.

குமார்	பையனைப்	பார்த்தான்.
Kuma:r	paiyan-ai~p	pa:r-thth-a:n
[Kumar] ^S _{NOM-An.M}	[Boy] ^O _{ACC-An.M}	[see] _{Past-3singular.Masculine}

'Kumar saw a/the boy'.

குமார்	ஒரு	பையனைப்	பார்த்தான்.
Kuma:r	oru'	paiyan-ai~p	pa:r-thth-a:n
[Kumar] ^S _{NOM-An.M}	[one] ^D	[Boy] ^O _{ACC-An.M}	[see] _{Past-3singular.Masculine}

'Kumar saw a boy'.

Rational nouns, for example, are always obligatorily case-marked, regardless of whether they are definite or not. This is the case even if the rational noun is marked with an indefinite determiner, as shown in (4.4). Lehmann (1993, chap. 1) indicates one known rare exception to this rule, shown here in (4.5). Certain lexical items such as ‘son-in-law’/‘bridegroom’ and ‘bride’, can be used with optional case-marking, with certain verbs such as ‘look for’, ‘search’ and ‘see’ (in the sense of ‘look for’). In such sentences, they are preferably interpreted as indefinite / non-specific, with the indefinite specifier being optional.

(4.5) *Rational nouns: Exception* □

ரவி	(ஒரு)	மாப்பிள்ளை(யைத்)	தேடுகிறான்.
Ravi	(oru)	ma:ppil.l.ai(~y-ai~th)	the:du-gir-a:n
[Ravi] ^S _{NOM-An.M}	([one] ^D)	[Son-in-law] ^O _{NOM(ACC)-An.M}	[search] _{Present-3singular.Masculine}

‘Ravi is looking for a son-in-law’. (i.e., a bridegroom for, say, his daughter)

4.2.2.1 Differential Object Marking

Differential Object Marking is the phenomenon, whereby inanimate (non-rational) nouns in the direct-object position in transitive or ditransitive sentences are case-marked differently in different contexts, depending upon a range of factors. The specificity / definiteness of the object in question is one of the main factors that determines whether or not the object will be marked accusative in the given sentence. Other factors include, for instance, the effect of the action (i.e., the verb) on the Undergoer, the animacy of the Actor argument and the word-order. In other words, if the action causes adverse effects on the Undergoer, or if both arguments involved in the event being described are inanimate, or if the subject follows the object, the inanimate object argument will then be accusative case-marked, regardless of whether or not it is definite / specific. Not marking the object in such sentences usually renders them either very strange or, in most cases, uninterpretable or ungrammatical. For instance, scrambling of the subject and object in the examples in (4.2) is possible only in the case where the non-rational NP is case-marked. If a non-rational NP1 that is not case-marked is followed by another NP2, unless NP2 is marked (with some case-suffix), the sentence becomes ungrammatical in most cases, or at least non-standard. The scrambled versions of (4.2) illustrate this in (4.6). By contrast, scrambling of rational nouns is never a problem, since they are almost always case-marked. In a discourse, scrambling could be usually used in certain contexts when a part of the information is known or understood by the listener, say the

(4.6) Scrambled word-order

*பால் ரவி குடித்தான்.
 Pa:l Ravi kudi-thth-a:n
 [Milk]^{O/S}_{NOM-In} [Ravi]^S_{NOM-An.M} [drink]_{Past-3singular.Masculine}
 *'Ravi drank milk'. (Intended meaning)

பாலை ரவி குடித்தான்.
 Pa:l-ai Ravi kudi-thth-a:n
 [Milk]^O_{ACC-In} [Ravi]^S_{NOM-An.M} [drink]_{Past-3singular.Masculine}
 'Ravi drank the milk'.

(4.7) Intransitive and pro-dropped transitive sentences

பால் கொதித்தது.
 Pa:l kodhi-thth-adhu'
 [Milk]^S_{NOM-In} [boil]_{Past-3singular.Neuter}
 '(The) Milk boiled'.

பால் குடித்தேன்.
 Pa:l kudi-thth-e:n
 [Milk]^O_{NOM-In} [drink]_{Past-1singular}
 '(I) drank milk'.

object of the action being described by the speaker, but not the subject. In such cases, the listener might want to raise a question in the scrambled order. Or, highlighting a certain argument, not necessarily the subject, could be done by way of a prosodic highlight or by scrambling or by both.

Finally, a non-rational noun unmarked for accusative case that occurs as the first noun-phrase (sentence-initially or otherwise) in a sentence could be initially interpreted either as the subject of an intransitive verb or an unspecific object of a pro-dropped transitive sentence, as in (4.7).

4.2.3 The Tamil Dative Case

The dative case of a noun is formed by adding the suffix $-(u')(k)ku'$ to the noun stem in Tamil, the stem being either the plain noun stem for nouns that do not have an oblique stem, or the oblique stem for those nouns that have it. The dative case has a wide range of functions in Tamil. Lehmann (1993, sec. 1.16), citing Paramasivam (1983), discusses nine functions of the Tamil dative case in detail with examples, amongst which the following two are the most relevant ones for our present pur-

poses: the use of the dative case marker to indicate i. the indirect object in ditransitive constructions and ii. the recipient of experience in dative subject constructions, which are the result of a closed class of stative verbs that require their subject in the dative case and the only other argument either in the accusative case or the nominative case depending upon the verb semantics (See the section on Dative Subjects for details).

4.2.3.1 Dative Indirect Objects

Ditransitive verbs such as ‘give’, ‘show’, etc. in Tamil take three arguments, namely the subject NP in the nominative case, the direct object NP in the accusative case or nominative case (owing to DOM) and the indirect object NP in the dative case. As in any other finite clause in Tamil, the order of these pre-verbal arguments is usually completely free, and therefore the order in which the three arguments are realised in a ditransitive sentence mostly depends upon discourse or stylistic factors. In a given discourse context, one or more arguments could be, and usually are, dropped.

(4.8) Dative Indirect Objects: Inanimate direct objects

காவேரி	குமாருக்கு	பேனாவைக்	கொடுத்தாள்.
Ka:ve:ri	Kuma:r~u'-kku'	pe:na:~v-ai~k	kodu'-thth-a:l.
[Kaveri] ^S _{NOM-An.F}	[Kumar] ^{IO} _{DAT-An.M}	[pen] ^O _{ACC-In}	[give] _{Past-3singular.Feminine}

‘Kaveri gave the pen to Kumar’.

ரவி	உமாவுக்கு	(ஒரு)	கடிதம்	எழுதினான்.
Ravi	Uma:~v~u'-kku'	(oru')	kadidham	ezhu'dh-in-a:n
[Ravi] ^S _{NOM-An.M}	[Uma] ^{IO} _{DAT-An.F}	[(one) ^D]	[letter] ^O _{NOM-In}	[write] _{Past-3singular.Masculine}

‘Ravi wrote a letter to Uma’.

The sentences in (4.8) show typical ditransitive constructions. As in the case of any active sentence, the verb in a ditransitive sentence agrees in person, number and gender with the nominative NP that is causing the action or, in other words, the Actor, which is the syntactic subject in such sentences. Again, depending upon the specificity / definiteness of an inanimate direct object, it may or may not be marked accusative, as illustrated by the two sentences in this example. By virtue of the fact that ditransitive verbs mostly indicate some kind of transaction, most of these verbs require an inanimate direct object. There are thus very few of them that can take (or, in some cases, require) an animate direct object though. The sentences in (4.9) show three such verbs. Notice that the

4.2. SYNTAX

second and third sentences in this example are structurally the same, with the only difference being that in the former, the subject pronoun has been explicitly realised (less common; used perhaps in a contrastive context to highlight the subject), whilst in the latter, the pronoun has been dropped (more common). In both cases, the person and number marking on the verb is the same, which clearly suggests that the subject is the first person singular pronoun.

(4.9) Dative Indirect Objects: Animate direct objects

கமலா	குமாருக்கு	மாலாவைக்	காட்டினாள்.
Kamala:	Kuma:r~u'-kku'	Ma:la:~v-ai~k	ka:tt-in-a:l.
[Kamala] ^S _{NOM-An.F}	[Kumar] ^{IO} _{DAT-An.M}	[Mala] ^O _{ACC-An.F}	[show] _{Past-3singular.Feminine}

'Kamala showed Mala to Kumar'. (as in indicating who she is...)

குமாருக்கு	மாலாவை	நான்	அறிமுகப்படுத்தினேன்.
Kuma:r~u'-kku'	Ma:la:~v-ai	na:n	arimugappaduthth-in-e:n
[Kumar] ^{IO} _{DAT-An.M}	[Mala] ^O _{ACC-An.F}	[I] ^S _{NOM-An}	[introduce] _{Past-1singular}

'I introduced Mala to Kumar'.

குமாருக்கு	மாலாவை	ஞாபகப்படுத்தினேன்.
Kuma:r~u'-kku'	Ma:la:~v-ai	nya:bagappaduthth-in-e:n
[Kumar] ^{IO} _{DAT-An.M}	[Mala] ^O _{ACC-An.F}	[remind] _{Past-1singular}

'(I) reminded Kumar about Mala'.

4.2.3.2 Dative Subjects

A closed class of stative verbs in Tamil require their subject in the dative case. These so-called dative-stative verbs, as the name suggests, declare the state of affairs rather than describe an active event. The peculiarity of these verbs is that they are not bound to agree with their subject in person, number and gender. Rather, they mostly only show the default-agreement (but see Section 4.2.3.2.2), which is the 3rd person singular neuter pronominal suffix, regardless of the person, number and gender features of the syntactic subject³². This could not be entirely due to the fact that many of these are morphologically defective, because at least some of these verbs have an alternative literal non-stative meaning, to express which the sentence must be rendered in the usual nominative-accusative pattern with the verb agreeing with the person, number and gender features of the nominative subject. See Appendix C for a brief

32. See Section 4.2.3.2.3 for a discussion of why the dative arguments indeed constitute subjects

discussion on the stative versus literal meanings of the dative stative-verbs used in the studies presented in this dissertation.

The dative noun in these constructions usually has the semantic role of experiencer of some sort, the experience being physical (e.g., ‘feel cold’, ‘feel pain’), mental (‘know’, ‘understand’), biological (‘be hungry’, ‘be thirsty’) or emotional (‘like’). Further, verbs expressing existence (‘exist’, ‘be not’), possession (‘get’), need or obligation (‘want’, ‘need’, ‘be enough’) and some others that are very specific to the various senses (e.g. ‘be able to see, hear, speak’) etc. require their subjects to be marked dative.

(4.10) *Dative Subjects: Intransitive* ┌

கமலாவுக்கு	குளிக்கிறது.
Kamala:-v~u'-kku'	kul.ir-gir-adhu'
[Kamala] ^S _{DAT-An.F}	[be cold] _{Present-3singular.Neuter}
‘Kamala is (feeling) cold’.	

(4.11) *Dative Subjects: Pro-dropped* ┌

பசிக்கிறது.
Pasi-kkir-adhu'
[be hungry]_{Present-3singular.Neuter}
‘(I am) hungry’. (Default interpretation)

(4.12) *Verbless clause with a Dative Subject* ┌

குமாருக்கு	தலைவலி.
Kuma:r~u'-kku'	thalaivali
[Kumar] ^S _{DAT-An.M}	[headache] ^P _{NOM-In}
‘Kumar has a headache’.	

(4.13) *Verbless clause with a Dative Predicate* ┌

இது	குமாருக்கு.
Idhu'	Kuma:r~u'-kku'
[This] ^S _{NOM-In}	[Kumar] ^P _{DAT-An.M}
‘This is (meant) for Kumar’.	

Dative-stative constructions can be intransitive, transitive, or even verbless clauses. An example of such an intransitive stative verb taking a dative NP as its subject is shown in (4.10). Notice the default marking on the verb in this example. As in the case of nominative subjects, the dative subject NP in such stative sentences can be dropped, as illustrated in (4.11), in which case the default interpretation would be to take the

speaker as the intended subject who experiences hunger, although it could be theoretically anyone else. Stative constructions in the form of verbless clauses, an example of which is illustrated in (4.12), nevertheless require the subject-like NP to be in the dative case. However, if the order of a verbless clause happens to be nominative-dative as shown in (4.13), then the dative NP is usually interpreted as the predicate.

4.2.3.2.1 Dative-Accusative Pattern

Stative constructions with verbs expressing mental or emotional experience are usually rendered in the dative-accusative pattern, whereby the argument other than the dative one needs to be marked accusative for the resulting sentence to be acceptable. There are no nominative NPs in this pattern of sentences, as shown in (4.14). Thus, the dative NP in this pattern is the only subject-like argument, and there is no competition for the subject role from the other (accusative) argument. As mentioned already, in order to express the stative meaning, verbs of this type simply show the default agreement, regardless of the PNG features of the dative experiencer NP.

(4.14) *Dative Subjects: Other argument - Animate accusative*

குமாருக்கு	மாலாவைத்	தெரியும்.
Kuma:r~u'-kku'	Ma:la:~v-ai~th	theri~y-um
[Kumar] ^S _{DAT-An.M}	[Mala] ^O _{ACC-An.F}	[know] _{Future-3singular.Neuter}
'Kumar knows Mala'.		

காவேரிக்கு	குமாரைப்	பிடிக்கும்.
Ka:ve:ri-kku'	Kuma:r-ai~p	pidi-kk-um
[Kaveri] ^S _{DAT-An.F}	[Kumar] ^O _{ACC-An.M}	[like] _{Future-3singular.Neuter}
'Kaveri likes Kumar'.		

4.2.3.2.2 Dative-Nominative Pattern

Stative constructions involving certain verbs expressing existence, need, obligation or possession result in the dative-nominative pattern. Thus, the non-dative argument in these sentences is in the nominative case as illustrated by the examples in (4.15). This is interesting due to the fact that nominative arguments necessitate verb agreement in Tamil. Whilst some verbs in this class are indeed defective such that they cannot show agreement with the nominative NP, others (such as 'get', for instance) are

not morphologically defective, and therefore can show agreement. This is in fact the case in the first sentence in (4.15), although it may not be apparent because the nominative NP there happens to be inanimate. As to why the non-dative argument is in the nominative form, one could argue that this is just because of the fact that the non-dative argument mostly happens to be inanimate, and thus not marked for the accusative case (due to DOM). This is not true though, because there are instances where the non-dative argument happens to be animate, but nevertheless left in the nominative form, as shown in (4.16). Therefore, there are two subject-like NPs (or, as we would like to call them, Quasi-Subjects³³), rather than one in this pattern of sentences, which would then translate to competition amongst the two arguments for subjecthood.

(4.15) Dative Subjects: Other argument - Inanimate Nominative

குமாருக்கு	பணம்	கிடைத்தது.
Kuma:r~u'-kku'	pan.am	kidai-thth-adhu'
[Kumar] ^{QS} _{DAT-An.M}	[money] ^{QS} _{NOM-In}	[get] _{Past-3singular.Neuter}

'Kumar got money'. (say, on the street or after having looked for it, or the like)

காவேரிக்கு	ஒரு	வீடு	வேண்டும்.
Ka:ve:ri-kku'	oru'	vi:du'	ve:n.d-um
[Kaveri] ^{QS} _{DAT-An.M}	[one] ^D	[house] ^{QS} _{NOM-In}	[want] _{Future-3singular.Neuter}

'Kaveri wants (needs) a house'.

(4.16) Dative Subjects: Other argument - Animate Nominative

மாலாவுக்கு	ஒரு	பையன்	இருக்கிறான்.
Ma:la:~v~u'-kku'	oru'	paiyan	iru-kkir-a:n
[Mala] ^{QS} _{DAT-An.F}	[one] ^D	[Boy] ^{QS} _{NOM-An.M}	[exist] _{Present-3singular.Masculine}

'Mala has one boy(child)'.

குமாருக்கு	நல்ல	வேலைக்காரன்	கிடைத்தான்.
Kuma:r~u'-kku'	nalla	ve:laikka:r-an	kidai-thth-a:n
[Kumar] ^{QS} _{DAT-An.M}	[good] ^{ADJ}	[Servant] ^{QS} _{NOM-An.M}	[get] _{Past-3singular.Masculine}

'Kumar got (found) a good servant'.

4.2.3.2.3 Dative, yes, but subject ?

The analysis as to whether the dative NP in the stative constructions is indeed the subject seems to very much depend upon whether one

33. Abbreviated in the morphological gloss as QS

considers the two patterns to be distinct or not. Thus, some authors in the literature consider the two patterns described above as two distinct cases, whilst others simply see this difference ensuing from the animacy of the non-dative argument, that is, they see DOM at work, as a result of which animate NPs seem to be marked accusative and inanimate NPs seem to be left in their nominative form. These different opinions notwithstanding, there is considerable consensus in the literature so as to come to the same conclusion that the dative NP is the subject or at least the more subject-like argument after all.

For instance, whilst Schiffman (1999, sec. 3.14.3) directly suggests that ‘it is easier ... to consider the dative’ NP to be the subject in all dative-stative constructions, Lehmann (1993, sec. 1.16) approaches the issue distinguishing the two aforementioned patterns as distinct. Indeed, a closer look at the data suggests that a simplistic animacy-based view does not account for the dative subject structures in (4.16) above, simply due to the fact that the nominative NPs in these sentences are as such (that is, not marked accusative), in spite of the fact that they are animate. If DOM were at work in these sentences, then these should have been marked accusative. In fact, marking the non-dative argument in the sentences in (4.16) accusative renders them clearly ungrammatical, whereas it is exactly the opposite in the dative-accusative pattern.

Therefore the right approach seems to be to consider these patterns as distinct after all. Taking this approach, Lehmann (1993, sec. 1.16) then analyses the subjecthood of the dative NP based on the properties characteristically associated with the subject in Tamil, namely whether:

- (a) the argument under consideration (here, the dative NP) occurs as the antecedent of the reflexive pronoun in reflexive constructions;
- (b) it occurs as the controller of the deleted nominative subject NP in a complex construction; and
- (c) the verb agrees with the PNG features of the NP;

and concludes as follows. In the dative-accusative pattern, the dative NP satisfies conditions (a) and (b), and there is no other NP in the sentence that satisfies condition (c). That is, there is no competition for subjecthood. Therefore the dative NP is the subject in this pattern, albeit less subject-like than a prototypical nominative subject NP that would satisfy all three conditions. This is in line with the notion of subject as defined by Keenan: ‘the subjecthood of an NP (in a sentence) is a matter of degree’ (Keenan, 1976, p. 307). As for the dative-nominative pattern, the

dative NP satisfies conditions (a) and (b), whilst the nominative NP, at least in some instances where the verb is not defective, necessitates the verb to agree, and thus satisfies condition (c). Therefore, he concludes that the dative-nominative pattern neither has a single subject nor no subject at all, but ‘two subject-like NPs’, where the dative NP is more subject-like than the nominative NP. Since further review of this is beyond the remit of the present discussion, the interested reader is referred to Lehmann (1993) and Schiffman (1999) for a detailed review of these issues with relevant Tamil examples.

To summarise, there are two patterns of transitive stative constructions, both involving a dative NP in the subject position, with the main difference being the case marking of the other argument. There is no competition for subjecthood in the dative-accusative pattern, whereas the status of subject is in a sense shared by two subject-like arguments in the dative-nominative pattern. Both the arguments in the latter pattern fulfil subject properties only in part, and thus there is a competition for subjecthood in this pattern. This is a crucial observation for our present purposes, because the dative-stative stimuli in our present set of studies to investigate the processing of Tamil dative subjects all involved only the dative-accusative pattern due to this very reason, that is, the subjecthood of the dative NP in this pattern is relatively unambiguous, and thus ideal for our present purposes.

4.3 Why Tamil?

Constructions in which nominals in a case other than the nominative case serve as the subject-like argument are common in many languages of the world (Bhaskararao & Subbarao, 2004, see). Nevertheless, there seems to be a considerable debate³⁴ in the literature as to whether the non-nominative nominals in these constructions *indeed* constitute subjects in the strict sense of the word. Remaining neutral about this debate, we presume that depending upon the notion of subject that one presupposes—namely that subjecthood is a matter of degree, following Keenan (1976), versus discrete grammatical relations as per Johnson (1977)—dative and other non-nominative nominals in at least certain constructions in Icelandic, German, Russian and many other languages

34. See for instance, Moore & Perlmutter (2000); Sigurðsson (2002, 2004); Barðal & Eythórsson (2003), and references therein for discussion and debate about the status of subject-like non-nominative nominals in Icelandic, Russian and German.

could be taken to represent examples of more or less prototypical instances of dative-subjects.

Thus, the processing of dative nominals serving a subject-like role could have been theoretically studied in any of these languages. However, the Tamil dative-stative constructions seem to be unique in a number of respects when compared to the languages mentioned above.

A first consideration in this regard is that, the assignment of a non-nominative case for a subject-like nominal in the languages mentioned above is mostly lexical, thus ‘quirky’ in nature, whereas the Tamil dative-stative constructions have a more semantic basis. This is clear from the fact that dative-stative constructions are consistently employed in Tamil to report a state of affairs, in which the subject is less agentive and represents the semantic role of an experiencer of some sort. In other words, states of affairs are always reported using dative-stative constructions. Thus the dative case serves in these constructions in Tamil to mark the subject as a less prototypical Actor.

Secondly, the availability of the dative-accusative pattern of sentences in dative-stative constructions in Tamil is crucial. As mentioned earlier, the presence of a nominative nominal in this pattern of dative-stative sentences renders them clearly ungrammatical, which is in clear contrast with similar constructions in Russian, in which the non-dative argument is usually nominative. By marking the non-dative argument accusative, and thus as an Undergoer, this pattern rules out the possibility of analysing it as a formal subject or the like, thus in turn rendering a substantial, albeit less prototypical, subject status to the dative nominal. Thus, the debate about the subjecthood of non-nominative nominals in languages such as German or Russian is essentially of no import to this pattern of dative-stative sentences in Tamil.

Thirdly, recall that Tamil stative verbs do not agree with their dative-subjects, only showing default-agreement instead, and that at least some of these verbs have an alternative literal non-stative meaning, to express which they need a nominative subject with which they must show normal person-number-gender agreement like other active verbs in order for the sentence to be grammatical (see [Appendix C](#)). This means that the choice of Tamil for our studies also enables observing the online processing of default-agreement.

Furthermore, the relevance of studying the processing of the so-called experiencer-subject constructions or dative-subject constructions in a South Asian language such as Tamil becomes apparent when the fol-

lowing facts are considered. Dative-subject constructions are a common feature of South Asian languages. By virtue of the fact that they are used with a variety of predicates in a range of contexts, they are amongst the most frequently used constructions in these languages (Sridhar, 1979). A ‘high development of this feature’ is said to be characteristic of India so much so that it is ‘present in all the major languages to a degree that seems to be unparalleled elsewhere’, and particularly so in the Dravidian languages³⁵ (Masica, 1976, p. 164, cited here from Sridhar, 1979, p. 100).

4.4 The Present Set of Studies

The three studies presented in this dissertation are a first attempt to investigate the online processing of Tamil Dative nouns using electrophysiological measures (ERPs). Specifically, we were interested in the question of whether and in what manner dative-subjects are processed differently from nominative subjects on the one hand, and morphologically identical dative indirect objects on the other in simple Tamil sentences. In addition, the dative-stative verbs enabled studying the processing of default-agreement.

In this pursuit, we started out in [Experiment 1](#) by studying the processing of dative-subjects as compared to animate and inanimate nominative subjects. Such a design enabled gaining a first insight into the processing of Tamil dative-subjects, paving the way for further studies.

We augmented this design in [Experiment 2](#) by introducing ditransitive sentence conditions with a dropped subject, such that they resembled the dative-subject sentences prior to the verb, thereby rendering the nouns much more comparable. Additionally, we introduced context questions that preceded each stimulus sentence, such that they either indicated the exact structure and the verb of the forthcoming stimulus, thereby correctly signalling the type of the sentence, namely dative-stative or ditransitive, or remained neutral. Such a context manipulation was necessary so as to observe the effects at the argument positions, for one wouldn’t know otherwise whether the sentence being played is a dative-subject sentence or a ditransitive sentence prior to the verb. The

35. See Sridhar (1979) for a discussion of dative-subject constructions in Kannada, and Nizar (2010) for a detailed review of such constructions in Malayalam and a comparison to those in Tamil, its closest South-Dravidian neighbour. For approaches that do not analyse the dative-nominal in these constructions as the subject in these and other Dravidian languages, see Amritavalli (2004) and Jayaseelan (2004). For a general overview and detailed reviews of dative-subject constructions in South Asian languages, see Verma & Mohanan (1990).

correct context question thus disambiguated the two structures prior to the stimulus onset, such that the participant clearly expected one or the other structure. This design also enabled for the first time in our experiments to observe the effects of processing default-agreement at the position of the verb.

We extended the context design further in [Experiment 3](#), such that stimuli were presented in one of four possible contexts. These included the correct and neutral context questions mentioned above, with the other two context questions being modelled on the correct context, but with the difference that the verb in these did not match that of the stimulus in qualitatively two different ways. Such an extensive design enabled observing the effects at the verb in a much more straightforward and elegant manner, thus revealing a better picture of the processing of dative-stative verbs.

4.5 A Note on Stimulus Presentation

In all the experiments reported in this dissertation, stimulus sentences and context questions, if any, were presented auditorily in order to avoid any possible confound due to the fact that the participants lived in a different language environment in which reading Tamil regularly is not necessary; on the other hand, they spoke Tamil on a daily basis with family and friends. Another point to consider in this regard is that, due to constraints that the experimental conditions posed, some of the items happened to be English words widely used in everyday Tamil, such as doctor or nurse or auto(-rickshaw) or tractor. The phonetically imprecise transliteration of these words, which is the standard and only possible way to write them in Tamil orthography, could be a cause for concern in presenting the stimuli visually. The auditory medium effectively avoids any such potential confounds.

— * —

Experiment 1

5.1 Overview

The primary goal of Experiment 1 was to define a point of departure for studying the processing of dative subject arguments in Tamil. This is in view of the fact that there are no published studies to date on the online processing of dative case in this language. To this end, we used simple dative-stative sentences that contained an animate dative-subject and an animate accusative object argument in both possible argument orders. The dative-subjects in these sentences, in spite of being animate, are non-prototypical Actors by virtue of the dative case-marking. So as to have a reasonable reference to compare with, transitive sentences with another kind of non-prototypical Actor arguments were inevitable. Stimuli from [Muralikrishnan \(2007\)](#), containing either an animate or inanimate nominative subject and an object were an ideal choice for this purpose. Such a design would then enable observing the similarities and differences in processing two kinds of non-prototypical Actor arguments, namely animate dative and inanimate nominative subjects, which deviate from prototypicality in different dimensions, whilst also allowing to study the possible differences in processing nominative and dative subjects that are both animate.

Whilst this might seem counter-intuitive at first, the reasoning behind this was as follows. Both inanimate nominative subject nominals and dative nominals in the subject position are non-prototypical Actor arguments: the former, because they are lower on the Animacy hierarchy and thus the Actor-Undergoer hierarchy; the latter, due to their being marked dative, which typically indicates a non-macrorole argument in

the Actor-Undergoer hierarchy. Moreover, given that a previous electrophysiological study that addressed the question of the processing of animacy in simple transitive sentences in Tamil (Muralikrishnan, 2007) found differences based on the animacy of the nominative subject and its linear position in the sentence, any similarity between the pattern of effects elicited by dative-subjects and those by the animate nominative subjects, or alternatively those by the inanimate nominative subjects, would be helpful in the following manner. If the dative-subjects and animate nominative subjects behaved similarly, this could suggest that the case-marking did not make a huge difference, and all that mattered was the subject relation of the argument, that is the higher ranking semantic role, based also on the animacy of the argument. On the other hand, if the dative-subjects and inanimate nominative subjects show a similar pattern, such a result could speak for an account based on the prototypicality of the Actor argument. That is to say, the results might help differentiate between a competition for subjecthood (dative versus nominative independent of animacy) from a competition for actorhood (dative and inanimate nominative subjects versus animate nominative subjects). Alternatively, given the variety of roles that a dative argument could theoretically indicate, such a simple and straightforward correlation may not ensue after all, instead end up yielding a complex picture.

5.2 Participants

Twenty-seven persons, mostly students, residing in Berlin, Dresden, Magdeburg and Potsdam participated in the experiment after giving informed consent (6 female; mean age 29.25 years; age range 22–42 years). Three further participants had to be excluded from the final data analyses on the basis of EEG artefacts and/or too many errors in the behavioural control task. All participants were right-handed Tamil speakers hailing from different parts of Tamil Nadu, India, with normal or corrected-to-normal vision and normal hearing. All of them were fluent in an additional language (English) and at least half of them spoke one or two more languages. All the participants reported having learnt Tamil formally for at least ten years during their schooling in different parts of Tamil Nadu, India.

5.3 Materials

5.3.1 Critical Conditions

Experiment 1 consisted of six critical conditions that differed based on whether the word-order was subject-initial or object-initial; and whether the subject was animate dative, inanimate nominative or animate nominative. Table 5.1 provides an overview of the factors and their levels, with the condition codes relevant to each level. The dative-subject conditions DAS and ADS, henceforth referred to as the D-conditions, all consisted of animate dative subjects, whereas the other conditions, collectively called as the N-conditions, contained either an animate or inanimate nominative subject. The object argument was animate accusative in all the conditions. As illustrated by the examples pertaining to each condition in (5.1), all the critical sentences were three words long, so they were all comparable in their duration.

Table 5.1: Experiment 1: Factors and Levels

Factor	Level	Conditions
WO : Word-Order	SO : Subject initial	DAS, NIA, NAA
	OS : Object initial	ADS, SAI, SAA
ST : Subject-Type	DS : Dative Animate	DAS, ADS
	NI : Nominative Inanimate	NIA, SAI
	NA : Nominative Animate	NAA, SAA

Seventy-two sets of transitive sentences (N-conditions) with animate or inanimate nominative subjects and animate objects were adapted with minor lexical changes from Muralikrishnan (2007). Thus, there were seventy-two unique animate and inanimate nouns each. Of these, all but eight³⁶ animate nouns were proper nouns (Indian first names); all but six³⁷ inanimate nouns were non-abstract. The animate nouns were then used to construct the D-conditions³⁸. This resulted in seventy-two sentence sets in each of the six critical conditions, thus 432 critical sentences in all. An example set of conditions is shown in (5.1). See Appendix E.1 for an explanation of the condition codes.

36. These items were: doctor, nurse, boy, little boy, little girl and farmer.

37. These items were: prudence, intellect, anger, charity, darkness and brightness.

38. Thus all the animate nouns occurred in all possible positions.

(5.1) Experiment 1: Critical Conditions

DAS	ஷங்கருக்கு Shankar~u'-kku' [Shankar] _{DAT-An.M}	குருவைத் Guru~v-ai~th [Guru] _{ACC-An.M}	தெரியும். theri~y-um [know] _{Future-3singular.Neuter}
	‘Shankar knows Guru’.		
ADS	குருவை Guru~v-ai [Guru] _{ACC-An.M}	ஷங்கருக்குத் Shankar~u'-kku'~th [Shankar] _{DAT-An.M}	தெரியும். theri~y-um [know] _{Future-3singular.Neuter}
	‘Shankar knows Guru’.		
NIA	வெளிச்சம் Vel.ichcham [Brightness] _{NOM-In}	குருவை Guru~v-ai [Guru] _{ACC-An.M}	எழுப்பியது. ezhupp-i~y-adhu' [wake-up] _{Past-3singular.Neuter}
	‘Brightness woke Guru up’.		
NAA	ஷங்கர் Shankar [Shankar] _{NOM-An.M}	குருவை Guru~v-ai [Guru] _{ACC-An.M}	வணங்கினான். van.ang-in-a:n [greet] _{Past-3singular.Masculine}
	‘Shankar greeted Guru’.		
SAI	குருவை Guru~v-ai [Guru] _{ACC-An.M}	வெளிச்சம் vel.ichcham [Brightness] _{NOM-In}	எழுப்பியது. ezhupp-i~y-adhu' [wake-up] _{Past-3singular.Neuter}
	‘Brightness woke Guru up’.		
SAA	குருவை Guru~v-ai [Guru] _{ACC-An.M}	ஷங்கர் Shankar [Shankar] _{NOM-An.M}	வணங்கினான். van.ang-in-a:n [greet] _{Past-3singular.Masculine}
	‘Shankar greeted Guru’.		

The verbs used in the N-conditions had been originally chosen in such a way that the subject and object assignments in a certain combination of animacy of NP1 and animacy of NP2 were always acceptable. This resulted in several verbs being causative. Due to the agglutinative nature of the language, these were long to very long words. Furthermore, different verbs were used in different conditions, as the conditions necessitated this due to the animacy and subject-object combinations. This shall mean that any effect during the processing of the verb in these conditions may not be further analysed or interpreted. All the verbs in these conditions were used in the simple past tense.

On the other hand, the sentences in the D-conditions were constructed using one of the two dative-stative verbs ‘to know’ and ‘to like’, which require their subject to be marked dative and their object to be marked accusative. Half the stimuli in the D-conditions were affirmative and the other half negative³⁹, so that there was a bit of variation in the sentences. Due to the stative nature of these verbs, they showed default agreement, and thus in a sense tense non-specific.

5.3.2 Fillers

Fillers of various types were constructed to ensure that participants would not be able to predict what the sentence structure was going to be, after listening to the first word. Seventy-two of these were dative-initial ditransitive sentences, stative transitive sentences involving inanimate objects and other such sentences, which at the sentence onset sound like the critical sentences starting with a dative noun. There were 288 fillers of the noun-modifying type, which at the sentence onset sound like the sentences in the N-conditions. Some of the fillers contained lexical items not found in the critical sentences.

5.3.3 Items Distribution

The 432 critical sentences were divided into two unique lists X and Y consisting of 216 sentences each, as follows. Two sentences from the N-conditions and one from the D-conditions from each of the 72 sentence-sets were included in the X-list and the remaining three sentences in each set were included in the Y-list (see [Appendix E.2](#)). All 72 dative-initial fillers and half of the 288 noun-modifying fillers were included in each list. This resulted in the lists X and Y containing 432 sentences (216 critical sentences and 216 fillers) each. These lists were each further conditionally randomised twice to obtain four sets X1 & X2 and Y1 & Y2 respectively, one of which was used for every participant. The presentation of the randomised lists was counterbalanced across participants. (See [Appendix E.3](#) for the list of experimental stimuli).

39. The negative marker appears as part of verb, but only after the full verb stem in Tamil. So the verb’s lexical meaning is unambiguously available prior to processing the negative marker.

5.3.4 Comprehension Questions

In order to ensure that participants listened to the stimuli attentively, comprehension questions were constructed, which were in reality main clause declarative sentences. Nevertheless, they will henceforth continue to be called comprehension questions for reasons of clarity and convenience. These visually presented ‘questions’ were in the same word-order as that of the critical stimulus sentence. In case of fillers, depending upon the type of the filler sentence, the corresponding comprehension question was either intransitive, transitive or ditransitive. These questions were constructed in such a way that equal number of them required ‘Yes’ or ‘No’ as answers. Those that required a ‘Yes’ represented the identical meaning (for critical sentences) or part of the meaning (for fillers) as that of the auditory stimulus that preceded. Those that required a ‘No’ conveyed a different meaning. There were equal number of such ‘No’ questions, in which either the subject or the object or the action described did not match with that of the stimulus, or the roles of the arguments were reversed, as the case may be.

5.3.5 Auditory Stimuli

The stimulus sentences were presented auditorily, for which two unconditionally randomised sets of critical stimuli plus fillers were recorded in a lossless format by a native-speaker using a professional recording equipment (16-bit 44.1 kHz Wav format). The two sets were recorded in a silent room on different days, one set per day. All the sentences were recorded in a neutral prosody that didn’t give any cue to the listener about the type of sentence as it unfolds over time, while at the same time preserving the naturalness of the sentence. This was possible since the sentences were constructed in the literary variety of Tamil and not in the spoken variety, in which case it would have been very difficult, if not impossible, to get this effect. This made the sentences sound like news or formal announcements on TV or Radio, where the prosody is usually neutral, unless the context necessitates some sort of emphasis.

Individual sentences were extracted from the bigger recording chunks using a speech-analysis program to create one audio file per stimulus sentence. Almost all the audio files chosen for use in the experiment were from one and the same recording set, except for a few, either due to some external disturbance or due to poor voice quality or intonation. A silence of 50 ms was added to the beginning and the end of the individual audio files. The intensities of these audio files were averaged to arrive at

a mean value that was in turn used for normalising the intensity of the individual files, so as to avoid any effects of naturally slightly different intensities of individual sentences. Crucially, the duration and the pitch of the recordings were not changed or manipulated, thus retaining the naturalness of the stimuli as to their length and prosody.

5.4 Acoustic Analysis

The duration, intensity and fundamental frequency (F_0) of each of the constituents in the sound files were measured for the critical conditions using a speech-analysis program (Praat). These were then statistically analysed across conditions using repeated-measures analyses of variance (ANOVA) measures in order to examine possible acoustic differences between conditions. The statistical analysis was carried out in a hierarchical manner, that is to say, only interactions that are at least marginally significant were resolved. To avoid excessive type 1 errors due to violations of sphericity, the correction of Huynh and Feldt (1970) was applied when the analysis involved factors with more than one degree of freedom in the numerator. Factors with more than two levels, which resulted in a significant effect, were further resolved by comparing their individual levels pairwise. An effect resulting from such an individual pairwise comparison would be reported as significant only if it was still significant after applying the modified Bonferroni correction (Keppel, 1991).

5.4.1 Duration

Duration analyses were performed for the constituents and intervening pauses in the critical sentences. Since the duration of NP1 and NP2 varied depending upon whether they are case-marked or not, two analyses were performed, namely one for the full NPs and another for the bare ones⁴⁰, that is, NPs with their case-marking suffix, if any, stripped off. Table 5.2 shows the mean duration of the full NPs and the verbs in the critical conditions.

ANOVAs were computed for the critical conditions in order to observe the effects of the within-participants factors word-order and subject-type on the durations of NP1, NP2, the verb and the intervening pauses between

40. The analyses for the bare NPs are reported in Appendix E.4. The durations of the intervening pauses are likewise shown in Appendix E.4.

these arguments. Table 5.3 shows an overview of all the effects⁴¹ on the durations of NP1, NP2 and the verb in the critical conditions. The effects on the durations of the intervening pauses are shown in Appendix E.4.

Whilst the duration of the nouns in the accusative case is longer⁴² than those in the nominative case, nouns marked dative are the longest. This is because the dative case-suffix ‘-kku’ with the gemmated consonant is considerably longer than the accusative case-suffix ‘-ai’ in Tamil. All sentence-initial NPs are slightly longer than their corresponding counterparts in the second position, irrespective of their case-marking.

Table 5.2: Mean Duration

Condition	NP1 ms	SD	NP2 ms	SD	Verb ms	SD
DAS	954.70	97.31	733.89	80.74	739.15	92.47
ADS	779.36	79.22	857.69	102.93	735.95	100.73
NIA	662.43	89.15	740.31	79.62	1021.64	187.26
NAA	658.15	85.01	736.82	95.85	841.12	124.64
SAI	762.46	92.82	619.88	96.78	1027.82	189.76
SAA	786.57	82.93	641.60	79.38	847.87	118.48

At NP1, there was a main effect of subject-type, which was resolved by comparing its individual levels pairwise. The comparisons NA + DS and NI + DS showed a simple effect of subject-type. The interaction word-order x subject-type was significant. Resolving this for the two levels of word-order revealed an effect of subject-type in both word-orders. This was resolved in the individual word-orders by comparing the subject-types pairwise. This showed a simple effect of subject-type for comparisons NA + DS and NI + DS in the subject-initial conditions, whereas this effect was significant for the comparison NI + NA in the object-initial conditions.

At NP2, there were main effects of both word-order and subject-type. The effect of subject-type was resolved by pairwise comparisons of its levels, which showed a simple effect of subject-type for the comparisons NI + DS and NA + DS. The interaction word-order x subject-type also reached significance, which when resolved for the two levels of word-order revealed a significant effect of subject-type for the object-initial conditions

41. Statistical tables in this dissertation follow conventions described in Appendix D.

42. It is interesting to note here that it is exactly opposite in case of bare NPs, due to the fact that removing the case-suffix from the auditory material also removes the coarticulation, thus rendering the bare noun shorter than the original noun.

5.4. ACOUSTIC ANALYSIS

only. This was further pairwise resolved for the levels of subject-type, which revealed a simple effect of subject-type for the comparisons NA + DS and NI + DS.

At the position of the verb, there was a main-effect of subject-type, which was resolved by comparing its individual levels pairwise. This revealed a simple effect of subject-type for all the three comparisons.

Table 5.3: ANOVA: Duration

Factor	DF	NP1		NP2		Verb	
◆ W0	1,71			6.29	*		
◆ ST	2,142	263.21	***	138.73	***	86.03	***
↳ _{ST} = NA+DS ◆ ST	1,71	469.40	***	204.96	***	31.40	***
↳ _{ST} = NI+DS ◆ ST	1,71	338.53	***	187.40	***	159.57	***
↳ _{ST} = NI+NA ◆ ST	1,71					55.23	***
◆ W0 x ST	2,142	224.10	***	148.71	***		
↳ _{W0} = SO ◆ ST	2,142	353.63	***				
↳ _{ST} = NA+DS ◆ ST	1,71	712.62	***				
↳ _{ST} = NI+DS ◆ ST	1,71	467.92	***				
↳ _{W0} = OS ◆ ST	2,142	4.02	*	188.07	***		
↳ _{ST} = NA+DS ◆ ST	1,71			304.97	***		
↳ _{ST} = NI+DS ◆ ST	1,71			234.82	***		
↳ _{ST} = NI+NA ◆ ST	1,71	7.28	**				

5.4.2 Intensity

ANOVAs were computed for the critical conditions in order to observe the effects of the within-participants factors word-order and subject-type on the intensities of NP1, NP2 and the verb. An overview of effects on the intensities of NP1, NP2 and the verb are shown in Table 5.4. Both word-order and sentence-type had an influence of the intensity.

At NP1, there were main effects of word-order and subject-type. This effect of subject-type was resolved by comparing its individual levels pairwise, which showed a simple effect of subject-type for the comparisons NA + DS and NI + DS. The interaction word-order x subject-type also reached significance. When this was resolved for the individual levels of word-order, the effect of subject-type was significant in both word-orders. Resolving this further by pairwise comparing the levels of

subject-type in each word-order, there was a simple effect of subject-type for the comparisons NA + DS and NI + DS in the subject-initial conditions, whereas this effect was significant for the comparisons NA + DS and NI + NA in the object-initial conditions.

At NP2, there were main effects of word-order and subject-type. Resolving the effect of subject-type by comparing its individual levels pairwise, there was a simple effect of subject-type for the comparisons NA + DS and NI + DS. The interaction word-order x subject-type was also significant, which when resolved for the individual levels of word-order revealed an effect of subject-type in the subject-initial word-order only. This was further pairwise resolved, which showed a simple effect of subject-type for the comparisons NA + DS and NI + DS.

At the position of the verb, there were main effects of word-order and subject-type. The effect of subject-type was resolved by comparing its individual levels pairwise, which showed a simple effect of subject-type for the comparison NI + DS.

Table 5.4: ANOVA: Intensity

Factor	DF	NP1	NP2	Verb
◆ WO	1,71	54.39 ***	19.25 ***	3.82 *
◆ ST	2,142	6.12 **	7.29 ***	3.60 *
└ _{ST} = NA+DS ◆ ST	1,71	6.40 *	10.05 **	
└ _{ST} = NI+DS ◆ ST	1,71	13.04 ***	10.15 **	8.70 **
◆ WO x ST	2,142	14.78 ***	11.89 ***	
└ _{WO} = SO ◆ ST	2,142	12.87 ***	20.41 ***	
└ _{ST} = NA+DS ◆ ST	1,71	29.41 ***	29.03 ***	
└ _{ST} = NI+DS ◆ ST	1,71	13.90 ***	25.63 ***	
└ _{WO} = OS ◆ ST	2,142	7.03 **		
└ _{ST} = NA+DS ◆ ST	1,71	9.01 **		
└ _{ST} = NI+NA ◆ ST	1,71	12.74 ***		

5.4.3 Fundamental Frequency

As the fundamental frequency (F_0) differences between the words give rise to the perception of intonation or prosody, the F_0 values at the onset and offset of each constituent as well as the maximum and minimum values of the F_0 between the onset and offset of each constitu-

5.4. ACOUSTIC ANALYSIS

ent were measured. These values and their respective timepoints were then analysed statistically across conditions using ANOVA measures. As Table 5.5 shows, none of the F_0 differences exceeded the perceivable threshold (see Rietveld & Gussenhoven, 1985; t'Hart, Collier, & Cohen, 1990), and therefore no effect from the ANOVAs for the F_0 values is reported here. Nevertheless, the ANOVAs for the timepoints of the

Table 5.5: Mean F_0

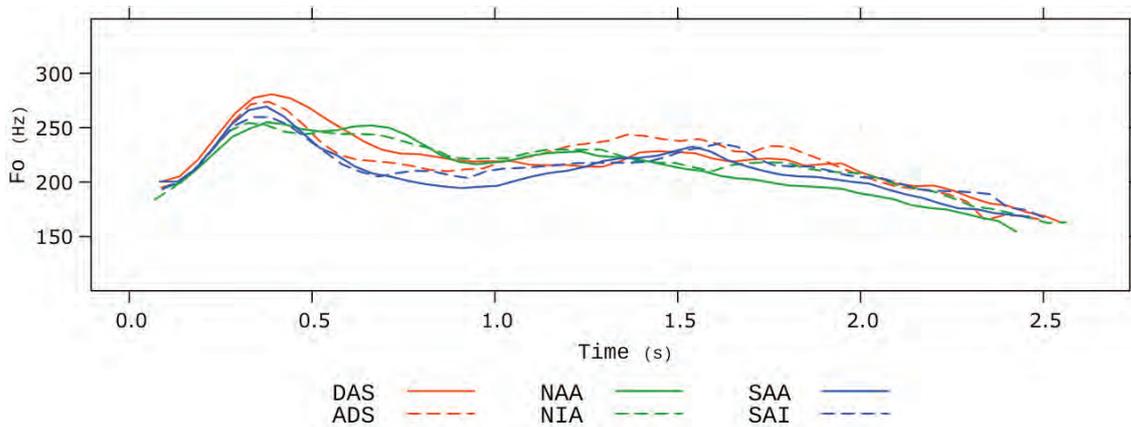
Condition	Onset	SD	Max.	SD	Min.	SD	Offset	SD	
NP1	DAS	204.58	22.51	324.77	36.02	166.25	30.40	228.58	57.62
	ADS	197.56	24.56	312.00	25.43	148.02	33.72	214.87	68.61
	NIA	202.20	37.34	321.06	37.05	158.81	35.75	239.63	72.37
	NAA	197.16	28.61	311.25	17.54	172.53	29.27	256.94	53.18
	SAI	200.51	23.61	301.30	21.14	143.04	35.96	211.34	63.29
	SAA	202.59	16.57	306.43	22.66	145.97	31.17	198.93	63.66
NP2	DAS	221.23	48.12	297.73	25.84	144.94	36.22	219.81	56.37
	ADS	215.33	50.27	305.47	35.07	166.95	30.98	237.34	57.01
	NIA	224.97	46.42	297.12	33.64	149.97	39.02	217.13	50.16
	NAA	220.11	37.20	303.32	38.14	140.97	37.95	207.16	57.68
	SAI	211.72	64.18	310.55	45.51	156.30	35.57	244.52	58.86
	SAA	193.86	41.49	295.72	25.38	153.43	35.93	233.13	63.32
Verb	DAS	211.91	51.39	263.88	74.88	131.47	35.65	161.77	48.17
	ADS	231.25	53.50	257.34	52.00	135.95	34.54	165.80	29.85
	NIA	220.40	46.73	264.51	64.99	130.58	32.33	163.18	51.02
	NAA	196.07	43.64	215.26	51.17	136.88	33.38	153.04	31.65
	SAI	215.90	52.12	262.04	69.80	132.83	38.35	165.94	36.10
	SAA	204.06	41.53	236.75	53.35	148.81	27.29	168.13	39.18

occurrence of maximum and minimum pitch values are shown in Table 5.6. At the position of NP1, there was a marginal effect of word-order on the timepoint of maximum F_0 , whilst this effect was significant on the timepoint of minimum F_0 . The main effect of subject-type was significant on the timepoint of maximum F_0 , which when resolved pairwise showed a simple effect of subject-type for the comparisons NA + DS and NI + NA. The effect of the interaction word-order x subject-type was significant on the timepoint of minimum F_0 alone, which did not resolve further. At NP2, there was a main effect of word-order on the timepoint

Table 5.6: ANOVA: Timepoint of Maximum and Minimum F_0

Factor		DF	Maximum		Minimum	
NP1	◆ W0	1,71	3.73	*	24.75	***
	◆ ST	2,142	3.32	*		
	└ST = NA+DS ◆ ST	1,71	5.78	*		
	└ST = NI+NA ◆ ST	1,71	4.96	*		
	◆ W0 x ST	2,142			3.01	*
NP2	◆ W0	1,71			10.95	***

Figure 5.1: Experiment 1: Pitch Contour Plot.



of minimum F_0 . There were no effects at the position of the verb. In order to better visualise the average pitch contour, F_0 values were also measured at 24 equally spaced positions (adjusted to the duration of the constituent) between the onset and offset of each constituent in each critical sentence. These were then averaged per constituent per condition so as to obtain the pitch contour plot shown in Figure 5.1.

5.5 Methods

The experiment was performed in the EEG laboratory of the Max Planck Institute for Human Cognitive and Brain Sciences in Berlin. Typically, participants filled an Edinburgh-Handedness questionnaire in Tamil when they arrived at the lab. Dominant right-handers alone were accepted as participants. They were given printed instructions about the experiment and the task that they had to perform, with a few examples. Crucially, these were self-illustratory and no explanation was given as to why a certain example required ‘Yes’ or ‘No’ as the answer.

Stimuli were presented using the ERTS software (BeriSoft, Frankfurt) that also recorded, amongst other things, the participant number, trial number, reaction time and the key or button used to register answers. The brightness and contrast settings of the monitor as well as the loudness of the loudspeakers were maintained the same for all the participants.

After setting up the electrode cap, the participant moved to a sound-proof chamber, where they were seated on a comfortable chair and were requested to avoid abrupt and drastic movements, especially of the head. Then the so-called ‘resting EEG’ was recorded for possible frequency-based EEG analyses later, where the participant had to sit still for two minutes with no specific task to perform. Two more minutes of resting EEG was recorded, but now the participant had to close their eyes. After a short pause, the experimental session commenced, which consisted of a short practice followed by the actual experiment.

5.5.1 Experimental Trial Structure

Figure 5.2 illustrates the structure of a trial in Experiment 1. The flat-screen LCD monitor was clear before the trial commenced. A fixation asterisk appeared in the centre of the screen 500 ms before the onset of the auditory stimulus and remained until 500 ms after the sentence had ended. Whilst listening to the auditory stimulus, participants were

Figure 5.2: Experiment 1: Schematic experimental trial.



asked to fixate on this asterisk. Further, since the EEG signals recorded on the scalp are sensitive to the electrical activity (in the range of mV) of the eye movements during blinking, participants were asked not to blink whilst they listened to the stimulus.

No sooner had the fixation asterisk disappeared from the screen than appeared the 'question' for the comprehension task, which the participants were required to answer with a 'Yes' or 'No' button press within 4000 ms. Participants had to compare the comprehension question with the sentence they heard to see if they both represented one and the same meaning. If so, they were required to answer 'Yes' by pressing the appropriate button in the button box that they were provided with, 'No' otherwise. When no button was pressed within 4000 ms, a time-out was registered as the answer. After an answer was registered or a time-out occurred, as the case may be, the next trial started. There was an inter-stimulus interval of 1000 ms, that is to say, there was a 1000 ms pause between the end of a trial and the beginning of the next one.

5.5.2 The Practice Phase

Before the actual experiment commenced, there was a short practice consisting of twelve trials, which helped participants to get used to the task and to feel comfortable about the pace of the trials and the blinking regime. For a given participant, none of the experimental stimuli occurred in their practice phase. The task was exactly the same as that of the experiment phase. The EEG of the participants was not recorded in this phase.

5.5.3 The Experiment Phase

In the main phase of the experiment, either of the four sets of materials as mentioned in Section 5.3.3 was chosen to be presented in 12 blocks of 36 trials each. There were equal number of comprehension questions that required 'Yes' or 'No' as answers in each block. Half the number of participants had the 'Yes' button on the right side and the other half had it on the left side so as to counterbalance for any right-dominance effects. The 'Yes' button being on the right or left was also counterbalanced across the stimuli sets. There was a short pause between blocks. Resting EEG was again recorded at the end of the experimental session. After the experiment, participants filled in a language knowledge questionnaire and a feedback about the experiment.

5.5.4 EEG Data

The EEG was recorded by means of 25 AgAgCl-electrodes fixed at the scalp by means of an elastic cap (Electro Cap International, Eaton, OH). AFZ served as the ground electrode. Recordings were referenced to the left mastoid, but re-referenced to linked mastoids offline. The electro-oculogram (EOG) was monitored by means of electrodes placed at the outer canthus of each eye for the horizontal EOG and above and below the participant's right eye for the vertical EOG. Electrode impedances were kept below 7 k Ω . All EEG and EOG channels were amplified using a Twente Medical Systems DC amplifier (Enschede, The Netherlands) and recorded with a digitisation rate of 250 Hz. The EEG data thus collected was pre-processed for further analysis using a bandpass filter that passed signals in the frequency range 0.3 Hz to 20 Hz. An 8.5 Hz low-pass filter was further applied on the data for achieving smoother ERP plots.

5.6 Results

5.6.1 Behavioural Data

The answering accuracy and mean reaction time for the critical conditions were calculated using the behavioural data collected during the experiment. [Table 5.7](#) shows the answering accuracy and mean reaction time for the critical conditions across participants. The answering accuracy was the highest for the conditions with inanimate nominative subjects, perhaps due to the fact that the two arguments are relatively more distinct in these conditions due to the animacy difference than in the other conditions, in which both arguments were animate. Accuracy was relatively low for the dative-subject conditions. Nevertheless, it must be noted that the accuracy was never less than 95 %. The reaction time data presented here pertain only to those trials in which participants performed the comprehension task correctly. However, these data must be interpreted with caution due to the fact that these are not time-locked with the stimulus sentences. The statistical analysis of the behavioural data was done by means of repeated-measures ANOVAs involving the within-subjects factors word-order and subject-type, and the random factors participants (F1) and items (F2).

Table 5.7: Answering Accuracy and Mean Reaction Time

Condition	AC %	SD	RT _s	SD
DAS	95.67	4.10	1.87	0.36
ADS	95.06	4.83	1.92	0.39
NIA	98.45	2.59	1.87	0.38
NAA	96.81	2.95	1.86	0.42
SAI	98.04	3.15	1.83	0.38
SAA	96.29	3.44	1.88	0.41

5.6.1.1 Answering Accuracy

An overview of significant effects on the answering accuracy is shown in Table 5.8. There was a main effect of subject-type both in the analysis by participants and by items, which when pairwise resolved for the levels of subject-type revealed the following. In the analysis by participants, the comparison NA + DS showed a marginal simple effect of subject-type, whereas this effect was significant in the other two comparisons. In the analysis by items, there was a simple effect of subject-type for the comparison NI + DS only. As Table 5.7 shows, the accuracy was relatively the highest for the N-conditions involving an inanimate Actor and an animate Undergoer, whereas it was relatively the lowest for the D-conditions. The answering accuracy for the N-conditions involving both animate arguments fared slightly better than the D-conditions.

Table 5.8: ANOVA: Answering Accuracy

Factor	DF	F1:Participants	DF	F2:Items
◆ ST	2,52	14.30 ***	2,142	3.72 *
└ _{ST} = NA+DS ◆ ST	1,26	4.57 *		
└ _{ST} = NI+DS ◆ ST	1,26	26.06 ***	1,71	8.20 **
└ _{ST} = NI+NA ◆ ST	1,26	11.31 **		

5.6.1.2 Reaction Time

Significant effects on the reaction time are shown in Table 5.9. In the analysis by participants, there were no main effects, but the interaction word-order x subject-type reached significance, which when resolved for the individual levels of word-order revealed a significant effect of subject-type in the object-initial conditions only. This was further pairwise resolved for the levels of subject-type, which revealed a simple effect of subject-type for the comparisons NI + DS and NI + NA. None of the effects reached significance in the analysis by items.

Table 5.9: ANOVA: Reaction Time

Factor		DF	F1:Participants	DF	F2:Items
◆	WO x ST	2,52	3.59	*	
└	WO = OS ◆ ST	2,52	7.03	**	
└	└ ST = NI+DS ◆ ST	1,26	10.24	**	
└	└ ST = NI+NA ◆ ST	1,26	5.82	*	

5.6.2 ERP Data

ERPs were calculated for each participant from 200 ms before the onset of NP1 until 1200 ms after onset (so -200 ms to 1200 ms) and similarly for NP2 and the Verb. These were averaged across items per condition per participant before computing the grand-average ERPs across participants per condition. Repeated-measures ANOVAs were computed for the statistical analysis of the ERP data, involving the within-participants factors word-order, animacy of NP1 and animacy of NP2 for mean amplitude values per time-window per condition in four lateral Regions of Interest (ROIs) (Table 5.10) and six midline ROIs (Table 5.11). Time windows were chosen based on visual inspection of the data.

The statistical analysis was carried out in a hierarchical manner, that is to say, only interactions that are at least marginally significant were resolved. To avoid excessive type 1 errors due to violations of sphericity, the correction of Huynh and Feldt (1970) was applied when the analysis involved factors with more than one degree of freedom in the numerator. Factors with more than two levels, which resulted in a significant effect, were further resolved by comparing their individual levels pairwise. An effect resulting from such an individual pairwise comparison would be

reported as significant only if it was still significant after applying the modified Bonferroni correction (Keppel, 1991). Further, given a resolvable effect was significant both *with* and *without* a ROI interaction in a certain analysis, only the interaction involving ROI was resolved further.

Table 5.10: Lateral Regions of Interest

Region Of Interest	Lateral Electrodes			
LA : Left-Anterior	F7	F3	FC5	FC1
LP : Left-Posterior	P7	P3	CP5	CP1
RA : Right-Anterior	F8	F4	FC6	FC2
RP : Right-Posterior	P8	P4	CP6	CP2

Table 5.11: Midline Regions of Interest

Region Of Interest	Midline Electrode
FZ : Frontal	FZ
FCZ : Fronto-Central	FCZ
CZ : Central	CZ
CPZ : Centro-Parietal	CPZ
PZ : Parietal	PZ
POZ : Parieto-Occipital	POZ

5.6.2.1 NP1

The ERPs at NP1 are shown in [Figure 5.3](#) for the subject-initial conditions and in [Figure 5.4](#) for the object-initial conditions. The statistical analysis was performed on the pre-processed data in two time-windows, which were selected based on visual inspection of the data.

5.6.2.1.1 NP1: Time Window 350–550 ms

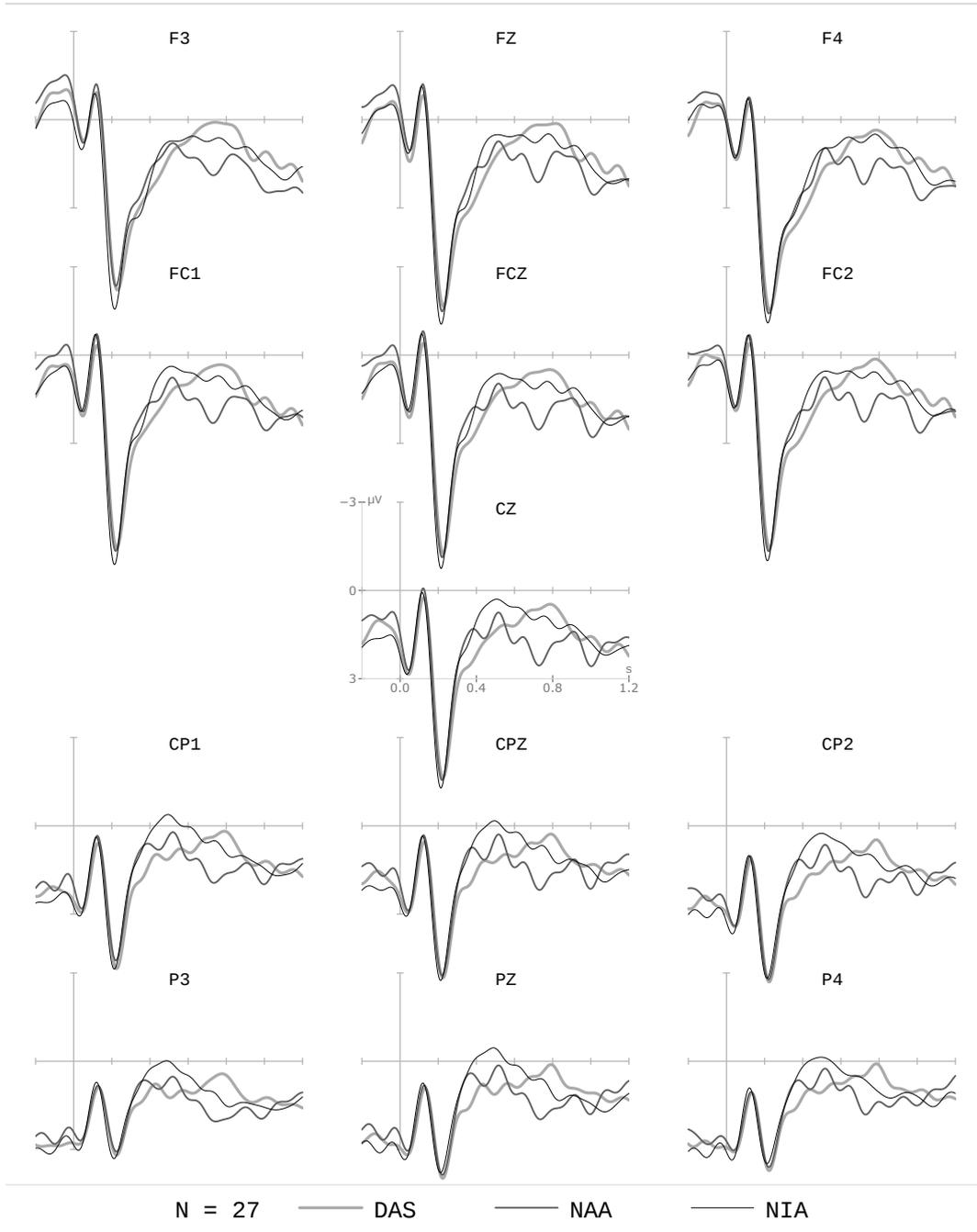
There seems to be a general difference between the inanimate nominative subjects and the other two subject-types in this time-window. The difference between the inanimate nominative subjects and the dative subjects especially turn out to be significant in all the midline regions, in which the ERPs for the inanimate nominatives are more negative. A slight difference between the animate nominatives and the dative subjects in the centro-parietal midline regions as well as a difference between the inanimate and animate nominatives in the posterior regions are also evident in the statistics.

A summary of all the effects that reached at least marginal significance at the position of NP1 in the 350–550 ms time-window is shown in [Table 5.12](#). There was a main effect of word-order in the lateral regions alone. The main effect of subject-type was marginal in the midline regions alone, which was further resolved by comparing the subject-types pairwise, which revealed a marginal simple effect of subject-type for the comparison NI + DS alone. The interaction ROI x word-order was marginally significant in the midline regions alone, whereas the interaction word-order x subject-type was significant in both the lateral and midline regions. The three-way interaction ROI x word-order x subject-type was significant in the midline regions alone.

Resolving the interaction ROI x word-order for the individual levels of ROI in the midline regions showed an effect of word-order in the frontal and central midline regions. Since the three-way interaction ROI x word-order x subject-type was not significant in the lateral regions, the interaction word-order x subject-type was resolved for word-order in the lateral regions, which showed a significant effect of subject-type in the subject-initial word-order in these regions. This effect of subject-type was further resolved by comparing the subject-types pairwise. The comparison NA + DS showed a marginally significant simple effect of subject-type, whilst this effect was significant for the comparison NI + DS.

The interaction ROI x word-order x subject-type was resolved for the individual levels of ROI in the midline regions, which revealed a significant interaction of word-order x subject-type in all the midline regions. This interaction was further resolved for word-order in each ROI concerned, which showed an effect of subject-type in all the midline regions for the subject-initial word-order alone. The comparison NA + DS showed a marginal simple effect of subject-type in the frontal midline region, whilst this effect was significant in the central, centro-parietal and

Figure 5.3: ERPs at NP1: Conditions in SO word-order.



5.6. RESULTS

Figure 5.4: ERPs at NP1: Conditions in OS word-order.

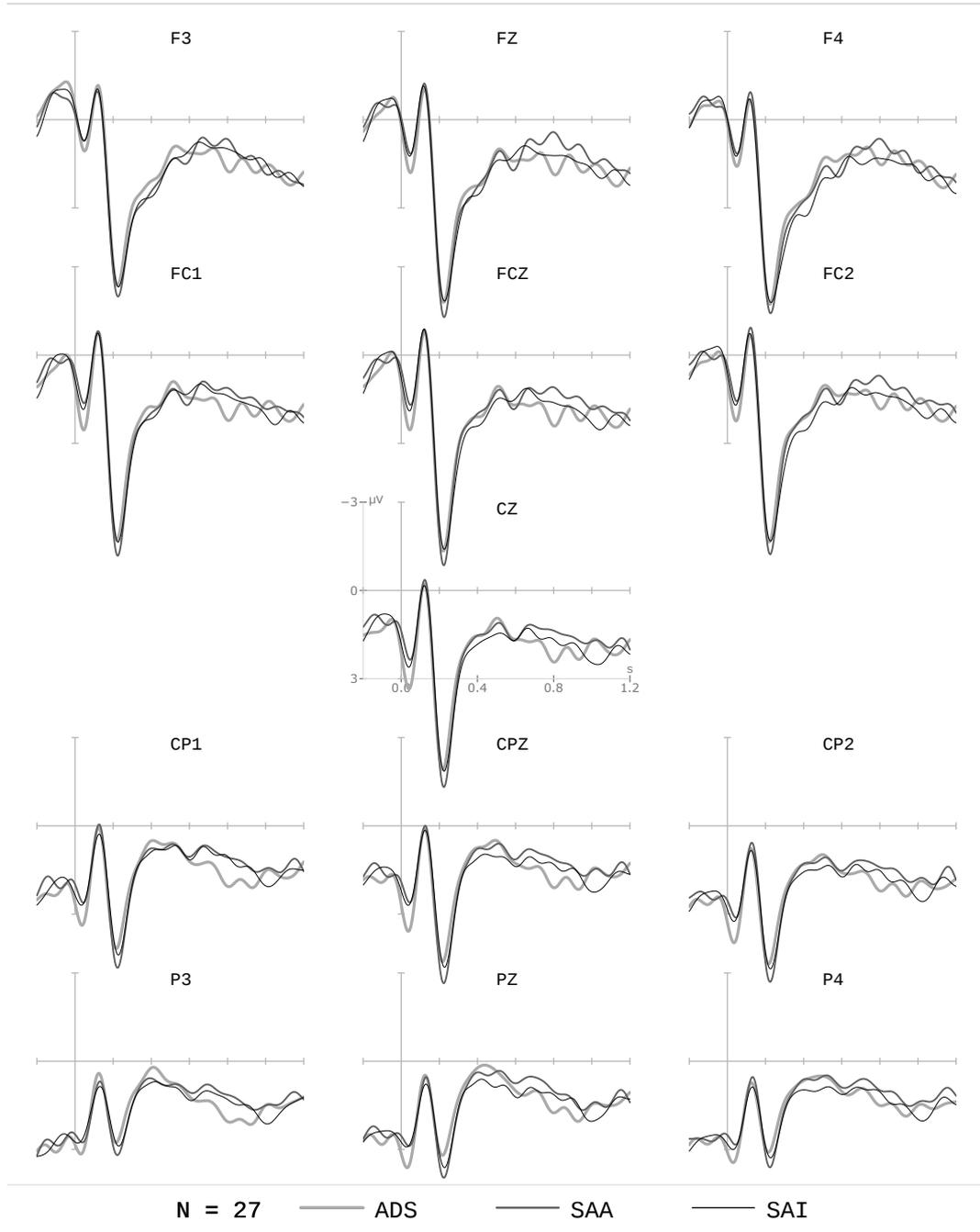


Table 5.12: ANOVA: ERPs at NP1 : 350–550 ms

Factor			DF	Lateral Regions		DF	Midline Regions	
◆	WO		1,26	6.40	*			
◆	ROI x WO					5,130	2.63	*
↳	ROI = FZ	◆ WO				1,26	7.19	**
↳	ROI = CZ	◆ WO				1,26	4.18	*
◆	ST					2,52	2.96	*
↳	ST = NI+DS	◆ ST				1,26	4.38	*
◆	WO x ST		2,52	8.51	***	2,52	9.20	***
↳	WO = SO	◆ ST	2,52	7.02	**			
		↳ ST = NA+DS	◆ ST	1,26	4.38	*		
		↳ ST = NI+DS	◆ ST	1,26	15.33	***		
◆	ROI x WO x ST					10,260	2.30	*
↳	ROI = FZ	◆ WO x ST				2,52	4.80	*
		↳ WO = SO	◆ ST			2,52	5.08	**
			↳ ST = NA+DS	◆ ST		1,26	4.14	*
			↳ ST = NI+DS	◆ ST		1,26	11.90	**
↳	ROI = FCZ	◆ WO x ST				2,52	4.76	*
		↳ WO = SO	◆ ST			2,52	4.40	*
			↳ ST = NI+DS	◆ ST		1,26	9.91	**
↳	ROI = CZ	◆ WO x ST				2,52	8.71	***
		↳ WO = SO	◆ ST			2,52	9.88	***
			↳ ST = NA+DS	◆ ST		1,26	5.12	*
			↳ ST = NI+DS	◆ ST		1,26	20.11	***
			↳ ST = NI+NA	◆ ST		1,26	4.64	*
↳	ROI = CPZ	◆ WO x ST				2,52	10.42	***
		↳ WO = SO	◆ ST			2,52	13.21	***
			↳ ST = NA+DS	◆ ST		1,26	7.95	*
			↳ ST = NI+DS	◆ ST		1,26	25.98	***
			↳ ST = NI+NA	◆ ST		1,26	5.46	*
↳	ROI = PZ	◆ WO x ST				2,52	12.24	***
		↳ WO = SO	◆ ST			2,52	16.91	***
			↳ ST = NA+DS	◆ ST		1,26	6.82	*
			↳ ST = NI+DS	◆ ST		1,26	34.81	***

Continued on next page ...

5.6. RESULTS

... Table 5.12 continued

Factor		DF	Lateral Regions	DF	Midline Regions
L _{ROI} =			L _{ST} = NI+NA ♦ ST	1,26	10.19 **
	POZ ♦ WO x ST			2,52	8.22 **
			L _{WO} = SO ♦ ST	2,52	12.66 ***
			L _{ST} = NI+DS ♦ ST	1,26	17.99 ***
			L _{ST} = NI+NA ♦ ST	1,26	17.71 ***

parietal midline regions. The comparison NI + DS was significant in all the midline regions. Comparing NI + NA, the simple effect of subject-type was marginal in the central midline region, whereas this effect was significant in the centro-parietal, parietal and parieto-occipital midline regions.

5.6.2.1.2 NP1: Time Window 600–900 ms

In this time-window, the predominant effect appears to be the more positive-going ERPs for the animate nominative subjects as opposed to the others in the subject-initial word-order conditions. Whilst there is considerable difference between the inanimate and animate nominative subjects, the difference between the two non-prototypical Actor arguments, namely the inanimate nominative subjects and the dative-subjects, is, if anything, very minimal as evidenced by the statistics. Comparing the object-initial conditions, that is, the three conditions all with an initial animate accusative noun, there is a slight difference between the accusative noun in the dative-subject condition and that in the animate nominative subject condition, whereby the former is slightly more positive-going in a few electrode sites.

Table 5.13 shows a summary of all the effects that reached at least marginal significance at the position of NP1 in the 600–900 ms time-window. There was a marginal main effect of word-order in the midline regions alone. The main effect of subject-type reached significance in the lateral regions alone, which was further resolved by comparing the subject-types pairwise, which revealed a simple effect of subject-type for the comparison NA + DS alone. The interaction word-order x subject-type was significant in both the lateral and midline regions, whereas the

Table 5.13: ANOVA: ERPs at NP1 : 600–900 ms

Factor		DF	Lateral Regions		DF	Midline Regions				
◆	WO				1,26	3.55	*			
◆	ST	2,52	3.18	*						
↳	ST = NA+DS	◆ ST	1,26	5.52	*					
◆	WO X ST	2,52	13.56	***	2,52	19.51	***			
↳	WO = SO	◆ ST	2,52	12.89	***					
		↳	ST = NA+DS	◆ ST	1,26	24.61	***			
			↳	ST = NI+NA	◆ ST	1,26	12.32	**		
↳	WO = OS	◆ ST	2,52	5.66	**					
		↳	ST = NA+DS	◆ ST	1,26	10.34	**			
◆	ROI x WO X ST	6,156	3.23	**						
↳	ROI = LA	◆	WO x ST	2,52	10.84	***				
		↳	WO = SO	◆	ST	2,52	10.01	***		
				↳	ST = NA+DS	◆	ST	1,26	15.51	***
				↳	ST = NI+DS	◆	ST	1,26	4.89	*
				↳	ST = NI+NA	◆	ST	1,26	6.78	*
↳	ROI = LP	◆	WO x ST	2,52	13.07	***				
		↳	WO = SO	◆	ST	2,52	8.04	**		
				↳	ST = NA+DS	◆	ST	1,26	10.94	**
				↳	ST = NI+NA	◆	ST	1,26	14.08	**
↳	ROI = RA	◆	WO x ST	2,52	9.74	***				
		↳	WO = SO	◆	ST	2,52	11.12	***		
				↳	ST = NA+DS	◆	ST	1,26	12.50	**
				↳	ST = NI+NA	◆	ST	1,26	19.51	***
↳	ROI = RP	◆	WO x ST	2,52	8.43	***				
		↳	WO = SO	◆	ST	2,52	7.45	**		
				↳	ST = NA+DS	◆	ST	1,26	14.16	**
				↳	ST = NI+NA	◆	ST	1,26	7.49	*

three-way interaction ROI x word-order x subject-type was significant in the lateral regions alone.

Since the three-way interaction ROI x word-order x subject-type was not significant in the midline regions, the interaction word-order x subject-

type was resolved for word-order in the midline regions, which showed a significant effect of subject-type in both word-orders in these regions. This effect of subject-type was further resolved by comparing the subject-types pairwise. The comparison NA + DS showed a simple effect of subject-type in both word-orders. The comparison NI + NA was significant in the subject-initial word-order alone.

The interaction ROI x word-order x subject-type significant in the lateral regions was resolved for the individual levels of ROI, which revealed an interaction of word-order x subject-type that was significant in all the lateral regions. This interaction was further resolved for word-order in each ROI concerned, which showed an effect of subject-type in all the lateral regions for the subject-initial word-order alone. This effect of subject-type was further resolved by comparing the subject-types pairwise in the subject-initial word-order. The comparisons NA + DS and NI + NA showed a simple effect of subject-type in all the lateral regions, whereas the comparison NI + DS was marginally significant in the left-anterior region alone.

5.6.2.2 NP2

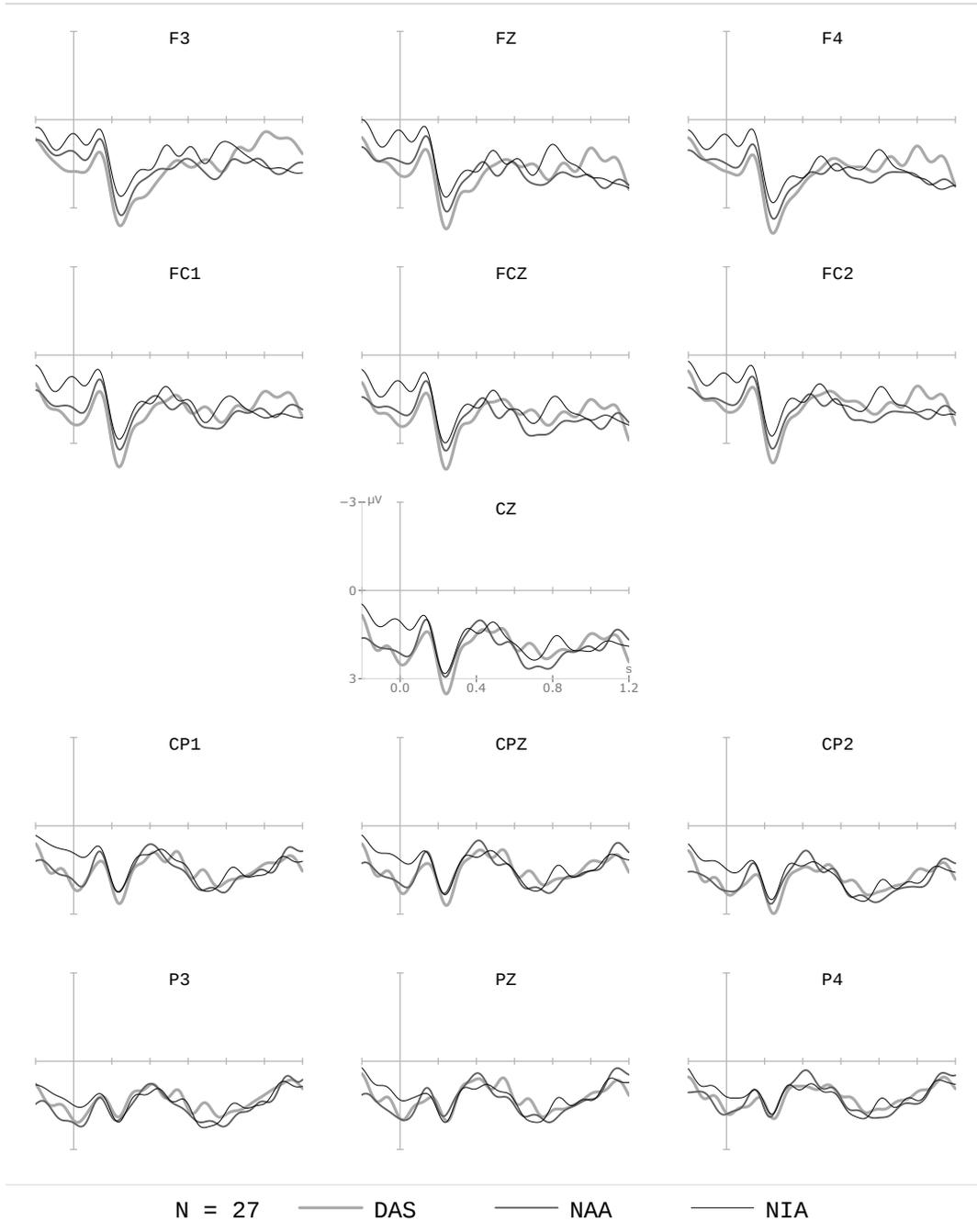
The ERPs at NP2 are shown in [Figure 5.5](#) for the subject-initial conditions and in [Figure 5.6](#) for the object-initial conditions. The statistical analysis was performed on the pre-processed data in two time-windows.

5.6.2.2.1 NP2: Time Window 350–550 ms

A negativity for the object-initial conditions with an inanimate nominative NP2 compared to the other subject-types apparent on visual inspection is significant in this time-window. That is, an inanimate Actor argument following an animate Undergoer argument elicits a negativity in this time-window. Any apparent difference between the animate nominative subjects and the dative-subjects does not turn out to be significant statistically.

A summary of all the effects that reached at least marginal significance at the position of NP2 in the 350–550 ms time-window is shown in [Table 5.14](#). There was a main effect of word-order in both the lateral and midline regions. The three-way interaction ROI x word-order x subject-type was significant in the midline regions alone. This was resolved for the individual levels of ROI in the midline regions, which revealed a significant interaction of word-order x subject-type in the parietal and

Figure 5.5: ERPs at NP2: Conditions in SO word-order.



5.6. RESULTS

Figure 5.6: ERPs at NP2: Conditions in OS word-order.

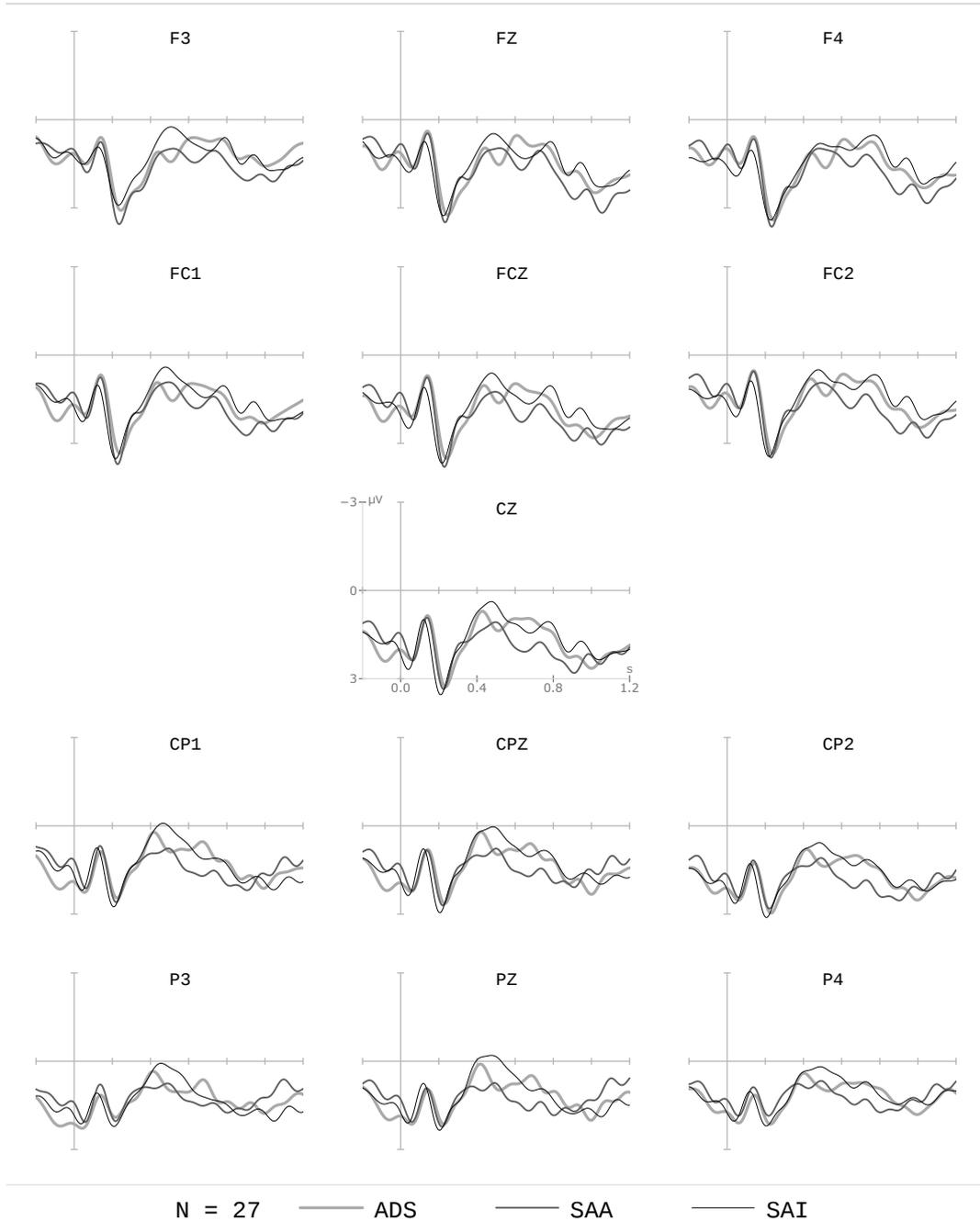


Table 5.14: ANOVA: ERPs at NP2 : 350–550 ms

Factor		DF	Lateral Regions	DF	Midline Regions
◆	WO	1,26	19.03 ***	1,26	8.96 **
◆	ROI x WO x ST			10,260	2.59 *
└	ROI = PZ			2,52	4.32 *
	◆ WO x ST				
	└ WO = OS			2,52	6.89 **
			◆ ST		
			└ ST = NI+DS	1,26	7.42 *
			└ ST = NI+NA	1,26	13.43 **
			◆ ST		
└	ROI = POZ			2,52	6.62 **
	◆ WO x ST				
	└ WO = OS			2,52	7.00 **
			◆ ST		
			└ ST = NI+DS	1,26	5.26 *
			└ ST = NI+NA	1,26	12.60 **
			◆ ST		

parieto-occipital midline regions. This interaction was further resolved for word-order in each ROI concerned, which showed an effect of subject-type in all the midline regions for the object-initial word-order alone. In both the regions concerned, the comparisons NI + DS and NI + NA reached significance, whilst the comparison NA + DS did not.

5.6.2.2.2 NP2: Time Window 600–900 ms

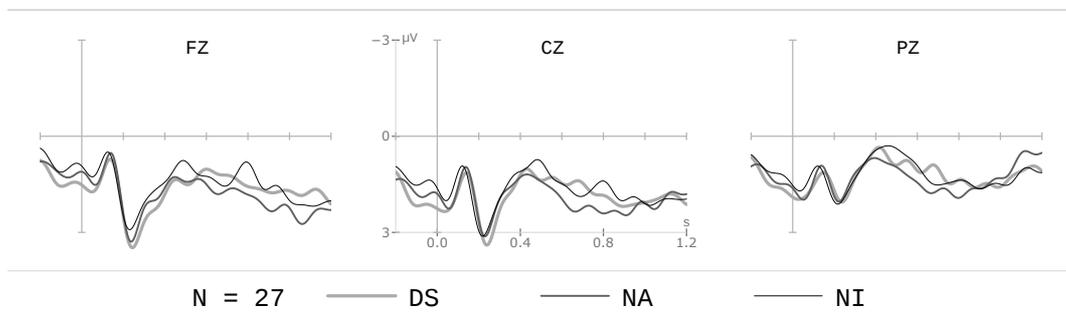
As Figure 5.7 illustrates, there seems to be a general difference in this time-window between sentences with animate nominative subjects on the one hand and those with inanimate nominative subjects or dative-subjects on the other, regardless of the word-order. Comparing the sentences within a certain word-order, it is apparent that the ERPs for the sentences with an animate nominative subject and an animate object are relatively more positive-going in all the regions in the respective word-orders. That is, when the sentence is a usual transitive sentence with a nominative subject, if both the subject and object arguments happen to be animate, a relatively more positive deflection in the ERPs is evoked. The negativity for inanimate nominative subjects as opposed to animate nominative subjects is a replication of the previous result from Muralikrishnan (2007) for the same comparison.

5.6. RESULTS

Table 5.15 shows a summary of all the effects that reached at least marginal significance at the position of NP2 in the 600–900 ms time-window. There were main effects of word-order and subject-type in the lateral as well as the midline regions. The interaction ROI x word-order was marginally significant in both the lateral and midline regions, whilst the interaction ROI x subject-type was significant.

Resolving the interaction ROI x word-order for the individual levels of ROI showed a significant effect of word-order in all the lateral and midline regions, except in the left-anterior region, in which the effect was marginal. The interaction ROI x subject-type, which when resolved for the levels of ROI, showed a significant effect of subject-type in all the lateral and midline regions, except the left-posterior region, in which it was marginal, and the parieto-occipital midline region, in which it was not significant. This was resolved further in each relevant ROI by comparing the subject-types pairwise. The comparison NA + DS showed a simple effect of subject-type in all the relevant lateral and midline regions except in the left-posterior region and the centro-parietal midline region, in which the effect was marginal. The comparison NI + NA was significant in all the lateral and midline regions concerned except the left-posterior region and the parietal midline region.

Figure 5.7: ERPs at NP2 collapsed over ST: All Conditions.



CHAPTER 5. EXPERIMENT 1

Table 5.15: ANOVA: ERPs at NP2 : 600–900 ms

Factor	DF	Lateral Regions			DF	Midline Regions		
◆ WO	1,26	18.22	***		1,26	17.78	***	
◆ ROI X WO	3,78	2.67	*		5,130	2.52	*	
└ROI = LA FZ ◆ WO	1,26	3.55	*		1,26	8.16	**	
└ROI = LP FCZ ◆ WO	1,26	14.31	***		1,26	10.44	**	
└ROI = RA CZ ◆ WO	1,26	16.24	***		1,26	21.76	***	
└ROI = RP CPZ ◆ WO	1,26	29.86	***		1,26	23.06	***	
└ROI = PZ ◆ WO					1,26	17.04	***	
└ROI = POZ ◆ WO					1,26	14.86	***	
◆ ST	2,52	6.22	**		2,52	5.47	**	
◆ ROI X ST	6,156	2.73	*		10,260	2.75	*	
└ROI = LA FZ ◆ ST	2,52	3.65	*		2,52	5.35	**	
└└ST = NA+DS ◆ ST	1,26	5.14	*		1,26	6.02	*	
└└ST = NI+NA ◆ ST	1,26	5.63	*		1,26	9.84	**	
└ROI = LP FCZ ◆ ST	2,52	3.22	*		2,52	7.45	***	
└└ST = NA+DS ◆ ST	1,26	4.56	*		1,26	8.23	*	
└└ST = NI+NA ◆ ST	1,26				1,26	13.46	**	
└ROI = RA CZ ◆ ST	2,52	9.06	***		2,52	7.96	***	
└└ST = NA+DS ◆ ST	1,26	8.56	*		1,26	9.58	**	
└└ST = NI+NA ◆ ST	1,26	19.09	***		1,26	13.71	**	
└ROI = RP CPZ ◆ ST	2,52	4.61	*		2,52	3.67	*	
└└ST = NA+DS ◆ ST	1,26	6.48	*		1,26	4.39	*	
└└ST = NI+NA ◆ ST	1,26	5.78	*		1,26	6.02	*	
└ROI = PZ ◆ ST					2,52	3.32	*	
└└ST = NA+DS ◆ ST					1,26	5.42	*	

5.6.3 Summary of Results

We compared the processing of dative-subjects with that of animate and inanimate nominative subjects in both possible argument orders in this experiment. As the verbs were very different between the conditions, we analysed effects observed at the argument positions alone.

At NP1, inanimate nominative subjects elicited a negativity as opposed to the other two subject-types, and especially the dative-subjects in a time-window between 350-550 ms. A slight difference between the animate nominative subjects and the dative-subjects was also apparent in a few of the posterior electrode sites in the same time-window. The animate nominative subjects elicited a positivity in the time-window 600-900 ms, whereas the other two subject-types, which were non-prototypical Actors, behaved similarly. As for the object-initial conditions, in which the sentence-initial noun was an animate accusative noun in all three conditions, there was no difference between conditions in the early time-window, whereas there was a slight difference between the object noun in the dative-subject condition as opposed to that in the animate nominative subject condition in the late time-window.

At NP2, the subject-initial conditions all behaved similarly in the time-window 350-550 ms. The fact that NP2 was an animate accusative noun in all these conditions perhaps explains this. The object-initial conditions on the other hand were more interesting in this time-window, whereby the inanimate nominative subjects elicited a negativity as opposed to the animate nominative subjects. This is a replication of results from [Muralikrishnan \(2007\)](#). In the time-window 600-900 ms, a general pattern seemed to be that sentences with nominative subjects in which both the subject and object arguments were animate elicited a relatively more positive-going ERP compared with other conditions, regardless of whether the argument in question at NP2 was the subject or the object of the sentence concerned.

To summarise the pattern for dative-subjects in particular, they broadly behave not very differently from the other type of non-prototypical Actor, namely the inanimate nominative subjects in the sentence-initial position, in that both of them show a negativity as opposed to animate nominative subjects. At NP2, the negativity that is elicited by inanimate nominative subjects as opposed to animate nominative subjects seems to be specific to inanimate nominative subjects. In other words, a difference between the dative-subjects and (animate) nominative subjects can be clearly observed in the sentence-initial position only.

5.7 Discussion

Experiment 1 was a first attempt to study the processing of dative-subject nominals in the dative-accusative pattern of stative sentences in Tamil. Accordingly, the hypotheses were basic. An initial hypothesis was that the dative-subject nominals, by virtue of their case-marking, must show processing differences as opposed to nominative nominals. Specifically, we expected that the kind of difference ensuing between animate dative and nominative nominals should be an important indicator as to the status of dative nominals in general, and those that are subjects in particular. In order to predict this though, an impediment was that there were no similar electrophysiological studies in Tamil or related languages. To address this, one possible solution seemed to be to compare animate dative nominals with inanimate nominative nominals.

The results at NP1 in the early time-window (350–550 ms) show that the dative-subjects broadly behave very similarly to the animate nominative subjects⁴³ in contrast to the inanimate nominative subjects that elicit a negativity. This is true also at the position of NP2 in the same time-window, which suggests that perhaps the dative-subjects are less atypical than one might think at first glance in terms of role assignments. On the other hand, results from the later time-window (600–900 ms) at both positions suggest that the dative-subjects are processed more similarly to the inanimate nominative subjects as opposed to the animate nominative subjects that elicit a more positive-going ERP than the other two subject-types. Thus in brief, the effects in the early and late time-windows differ based upon the availability of the dative case-marker (see elaborate discussion further below).

As for the accusative nouns, a slight difference between the accusative nouns at the position of NP1 in the object-initial conditions is apparent in the later time-window. However, given that this was the sentence-initial position and that the accusative nouns in all three conditions were identical sets of items, the most plausible interpretation for this difference would appear to be to attribute it to acoustic differences⁴⁴ in the stimuli rather than anything functional at this stage. The fact that no such difference between the accusative nouns at the position of NP2 in the subject-initial sentences was observable supports such an interpretation. This is because, any major difference in the effects between the

43. See Frenzel, Schleewsky, Primus, & Bornkessel-Schleewsky (2011) for a similar result in a functional imaging study on German.

44. As discussed in Section 5.4, there were significant differences in the acoustic parameters of the accusative nouns at NP1. See Table 5.4 for instance.

accusative nouns at NP2 would have meant that the accusative nouns were functionally different between the sentence types.

The pattern of effects on the dative-subject nouns could thus be summarised as follows. Prior to the availability of the dative case-marker, the sentence-initial animate dative-subjects and nominative subjects are processed similarly. When the dative case-marker is encountered, this signifies that the noun is not anymore an ideal Actor argument, because its ideal Actorhood property of being maximally agentive is compromised by virtue of its being marked dative. Thus, at this later stage of processing, an animate dative noun is similar to another type of non-prototypical Actor argument, namely inanimate nominative nouns. The fact that the ERPs of the dative and inanimate nominative nouns show no difference in the later time-window seems suggestive of this point. Furthermore, this effect cannot be simply due to lexical differences between the nouns, given the asymmetry in effects between the argument positions.

This is a first indication of the processing of Tamil dative-subjects in stative constructions, but an interesting question that such an interpretation raises—but does not answer—is about the special status, if any, of dative nouns that are in the subject position. That is to say, the present results indeed provide some evidence for the processing of dative-subjects being different from inanimate nominative subjects at a relatively early stage of processing only to become similar at a later stage, in which they begin to differ from animate nominative subjects instead. However, it is not clear if this pattern of processing difference is suggestive of some kind of special subjecthood properties of a dative-subject or whether it is owing to the ambiguity involved in determining whether a dative nominal is the subject or indirect object.

Results from Experiment 1 thus need further examination as to the status of dative-subjects. A comparison between dative nominals that are subjects and dative nominals that are not subjects will be worthwhile in this regard. One way to accomplish this would be to introduce into the experimental design, sentences involving dative nominals that are indirect objects. Since Tamil dative nominals are morphologically identical for a given item regardless of the role that they play in a sentence, and thus are ambiguous for their role prior to the verb, the new design must include a mechanism to disambiguate the role of the dative nominal at the outset. We address these issues in the design of Experiment 2.

— * —

Experiment 2

6.1 Overview

The focus of Experiment 2 was to address the question of studying the difference in processing a dative-subject as opposed to a dative nominal that is not a subject. We examined the processing of dative nouns in dative-stative constructions as a first step in Experiment 1. But a limitation of that design was that the dative-subject nouns could only be compared with either nominative or accusative nouns, which are morphologically different from dative nouns in Tamil. However, in order to be able to derive concrete interpretations about the processing of dative-subjects, it would be rather elegant to compare them with nouns that morphologically differed minimally. Dative indirect objects in ditransitive constructions in Tamil are an ideal option in this regard, because they are morphologically identical to the dative-subjects, notwithstanding their different role in the sentence. Given that there is a choice to drop the subject argument in Tamil, ditransitive sentences with a dropped (nominative) subject resemble dative-subject constructions in their surface structure prior to the verb. Nevertheless, as the ditransitive verbs agree with their nominative subject in person, number and gender, subject-dropped ditransitive sentences still clearly indicate their subject noun. This is unlike the dative-stative verbs that only show a default-agreement (that is, ‘3rd person singular neuter’ agreement) regardless of the PNG-features of their dative-subject.

Thus, in addition to the dative-subject conditions from Experiment 1, we introduced pronoun-dropped ditransitive sentences in Experiment 2. Since the two structures are exactly identical on the surface, the clause-

final verb is the one that disambiguates for the roles of the arguments that preceded. That is, listening to a structure with a dative NP1 and an accusative NP2 (or vice versa), one would not know at the outset whether the sentence-final verb is going to be a dative-stative verb or a ditransitive verb—unless there is some sort of acoustic cue or an entailing context, that is. Therefore, in order to disambiguate for the stimulus structure at the outset, we introduced auditory context questions⁴⁵ in Experiment 2, which either provided a clear and specific indication of the structure of the forthcoming stimulus, or remained neutral. To be specific, each critical sentence was either presented in a correct⁴⁶ context that signalled the stimulus verb as part of the context question, which was a double *wh*-phrase question, or in a neutral context that did not give away any information about the forthcoming stimulus. Crucially, the critical sentence itself was acoustically identical in both contexts, that is, the same audio file was presented either after a correct context question or a neutral one. This ensured that there is no acoustic confound whatsoever when comparing a certain critical stimulus across the two contexts. The context question in combination with the stimulus sounded like a dialogue. Given that the material preceding the verb would be identical, such a design would further enable observing the effects of processing stative verbs in comparison to non-stative verbs.

The hypothesis would then be the following. If dative nouns are processed as subjects in the absence of information to the contrary, then a processing disadvantage for those that are not subjects must obtain. On the other hand, if dative nouns are analysed as non-subjects by default, then the processing system must show a processing disadvantage for dative-subjects. As for the effects at the verb, it remains to be seen if stative verbs are processed differently to non-stative verbs.

6.2 Participants

Thirty persons, many of them students, residing in Bonn, Darmstadt, Frankfurt, Kaiserslautern and Koblenz participated in the experiment after giving informed consent (mean age 26.20 years; age range 23–40

45. We use the term ‘context’ in this dissertation specifically to denote the following: the question-answer pairs represent mini-discourse environments, such that the question forms the discourse context within which the answer (i.e., the stimulus sentence) would be processed.

46. There were no incorrect context questions in Experiment 2: all non-neutral context questions were specific and correct. We nevertheless refer to the specific non-neutral context in Experiment 2 as the correct context, because a specific question need not always be the correct context, as will become clear later in Experiment 3.

years). Seven further participants had to be excluded from the final data analyses on the basis of EEG artefacts and/or too many errors in the behavioural control task. Other details about the participants are as described in [Chapter 5, Section 5.2](#).

6.3 Materials

6.3.1 Critical Conditions

Experiment 2 consisted of four critical conditions that differed based on whether the word-order was dative-accusative or accusative-dative; and whether the sentence-type was a dative-subject sentence or a pronoun-dropped ditransitive sentence. Additionally, since each critical sentence could be presented following either a correct context or a neutral one, context was also a factor for further analyses (except for acoustic analyses, since the stimuli from a certain condition were acoustically identical in either context; only the preceding context question varied). [Table 6.1](#) provides an overview of the factors and levels, with the condition codes relevant to each level. As illustrated by the examples pertaining to each condition in [\(6.1\)](#), all the critical sentences in a certain word-order shared the identical surface structure. See [Appendix F.1](#) for an explanation of the condition codes.

Table 6.1: Experiment 2: Factors and Levels

Factor	Level	Conditions
WO : Word-Order	DA : Dative Accusative	DAS, DAI
	AD : Accusative Dative	ADS, ADI
ST : Sentence-Type	DS : Dative Subject	DAS, ADS
	DI : Ditransitive	DAI, ADI
CT : Context	CQ : Correct: Verbs of context and stimulus are identical	All Conditions
	NQ : Neutral: No specific information about the stimulus	All Conditions

The seventy-two sets of dative-subject sentences from Experiment 1 were adopted as they are. The corresponding sets of ditransitive sentences were constructed simply by changing the dative-stative verb in the original stative sentences to a pronoun-dropped ditransitive verb. The ditransitive verbs used were ‘to introduce somebody to someone’, ‘to

show/indicate somebody to someone’, ‘to remind somebody about someone’ and ‘to marry somebody off to someone’. Of the three animate arguments that these verbs required, the nominative subject argument was dropped in our stimuli. The agreement on the verb nevertheless indicated the subject, which was always first person singular in our stimuli. This resulted in a total of seventy-two sets of sentences in four critical D-conditions, thus 288 critical sentences.

(6.1) Experiment 2: Critical Conditions

DAS	ஷங்கருக்கு Shankar~u'-kku' [Shankar] _{DAT-An.M}	குருவைத் Guru~v-ai~th [Guru] _{ACC-An.M}	தெரியும். theri~y-um [know] _{Future-3singular.Neuter}
	‘Shankar knows Guru’.		
DAI	ஷங்கருக்கு Shankar~u'-kku' [Shankar] _{DAT-An.M}	குருவை Guru~v-ai [Guru] _{ACC-An.M}	ஞாபகப்படுத்தினேன். nya:bagappaduthth-in-e:n [remind] _{Past-1singular}
	‘(I) reminded Shankar about Guru’.		
ADS	குருவை Guru~v-ai [Guru] _{ACC-An.M}	ஷங்கருக்குத் Shankar~u'-kku'~th [Shankar] _{DAT-An.M}	தெரியும். theri~y-um [know] _{Future-3singular.Neuter}
	‘Shankar knows Guru’.		
ADI	குருவை Guru~v-ai [Guru] _{ACC-An.M}	ஷங்கருக்கு Shankar~u'-kku' [Shankar] _{DAT-An.M}	அறிமுகப்படுத்தினேன். arimugappaduthth-in-e:n [introduce] _{Past-1singular}
	‘(I) introduced Guru to Shankar’.		

6.3.2 Context Questions

As mentioned in the overview above, context questions were used before presenting stimuli such that the structure (and the verb) of the forthcoming stimulus sentence is either primed or not. The specific or correct context question, henceforth referred to simply as CQ, primed the verb of the forthcoming stimulus sentence using a double question and the correct verb in the same word-order as that of the stimulus sentence. This meant that each stimulus sentence had its own variant of CQ based upon its verb, as illustrated by the example set of CQs in (6.2), which correspond to the critical stimuli shown in (6.1).

6.3. MATERIALS

However, it is crucial to note here that a CQ pertaining to a certain verb(form), say ‘to know’, was *identical* across the experiment for all the stimuli that required this as the CQ. Using the identical audio file for a certain CQ variant ensured that there is no acoustic confound between the CQs across different stimuli that contained a given verb(form).

(6.2) Experiment 2: Correct Context (CQ) for D-Conditions

CQDAS	யாருக்கு	யாரைத்	தெரியும்?
	Ya:r~u'-kku'	ya:r-ai~th	theri~y-um
	[Who] _{DAT-An}	[who] _{ACC-An}	[know] _{Future-3singular.Neuter}
	‘Who knows whom?’		
CQDAI	யாருக்கு	யாரை	ஞாபகப்படுத்தினாய்?
	Ya:r~u'-kku'	ya:r-ai	nya:bagappaduthth-in-a:y
	[Who] _{DAT-An}	[who] _{ACC-An}	[remind] _{Past-2singular}
	‘Whom did (you) remind to whom?’		
CQADS	யாரை	யாருக்குத்	தெரியும்?
	Ya:r-ai	ya:r~u'-kku'~th	theri~y-um
	[Who] _{ACC-An}	[who] _{DAT-An}	[know] _{Future-3singular.Neuter}
	‘Who knows whom?’		
CQADI	யாரை	யாருக்கு	அறிமுகப்படுத்தினாய்?
	Ya:r-ai	ya:r~u'-kku'	arimugappaduthth-in-a:y
	[Who] _{ACC-An}	[who] _{DAT-An}	[introduce] _{Past-2singular}
	‘Whom did (you) introduce to whom?’		

(6.3) Experiment 2: Neutral Context (NQ)

NQ	சொல்லவந்ததை	சுருக்கமாக	சொல்!
	Solla-vandh-adh-ai	surukkam-a:ga	sol
	[Say-come-that] _{ACC-In}	[briefly] _{ADV}	[tell] _{Imperative-2singular}
	‘Say what you wanted to briefly!’		

On the other hand, the neutral context question, henceforth simply referred to as NQ, must be very neutral and must fit to all kinds of stimuli that followed, including the fillers. A question such as ‘What happen-end?’ or ‘What about x?’ would not fit this bill owing to the fact that the critical stimuli were not active sentences but rather dative-statives that described a certain state of affairs. Stative variants of such questions that would be considered appropriate in languages such as English or German do not seem very acceptable in Tamil. This led us to choose

the NQ shown in (6.3), which would fit with just about anything the interlocutor might say (in the present case, the stimulus sentence). Thus, listening to it does not give any hint about the forthcoming stimulus.

6.3.3 Fillers

The N-conditions from Experiment 1 served as fillers in Experiment 2. In addition to these N-fillers, there were intransitive fillers with animate and inanimate nominative subjects and pronoun-dropped transitive fillers with animate and inanimate objects. In all, there were 576 fillers, which were also presented in the correct and neutral contexts. The CQs were again specific to a certain filler, containing the same verb as that of the filler sentence.

6.3.4 Items Distribution

The 288 critical sentences were divided into two unique lists A and B consisting of 144 sentences each, as follows. Two sentences from the D-conditions from each of the 72 sentence-sets were included in list A and the remaining two sentences in each set were included in list B (see [Appendix F.2](#)). The fillers were similarly distributed. This resulted in the lists A and B containing 432 sentences (144 critical sentences from D-conditions, 144 fillers from N-conditions and 144 fillers of other types) each. Each stimulus in these lists was presented once in the correct context and another time in the neutral context, thus doubling the number of trials to 864 per participant. This necessitated splitting these lists into A1, A2 and B1, B2 respectively. These lists were each further conditionally randomised to obtain four lists A1X, A2X, B1X and B2X. The order of items in these were then reversed to obtain four other lists A1Y, A2Y, B1Y and B2Y respectively. One of the four sets A1X & A2X, A1Y & A2Y, B1X & B2X or B1Y & B2Y was used for every participant. Thus every participant heard 864 context+stimulus combinations in two experimental sessions of 432 trials each. The presentation of the randomised lists was counterbalanced across participants. (See [Appendix F.3](#) for the list of experimental stimuli).

6.3.5 Comprehension Questions

In order to ensure that participants listened to the stimulus sentences attentively, comprehension questions were constructed, the details of

which are the same as described for Experiment 1 in Chapter 5, Section 5.3.4, with one minor difference: all questions that required a ‘Yes’ as the answer represented the identical meaning as that of the stimulus that preceded regardless of whether the stimulus was a critical one or a filler.

6.3.6 Auditory Stimuli

For the auditory presentation of context and stimuli, critical sentences and fillers were recorded by a female native-speaker and the context questions were recorded in a separate recording session by a male native-speaker using a professional recording equipment (16-bit 44.1 kHz Wav format). The individual stimulus sentences and context questions were then extracted from the bigger recording chunks to create one sound file per stimulus and per context question. The different context questions were dynamically combined during the experimental session for presenting according to the experimental manipulation, that is for presenting a certain context question before a certain stimulus with enough pause inbetween, such that participants perceived the question-answer pair as a dialogue. This method ensured that, for a given critical condition, the context question sounded exactly the same for all the critical items with a certain verb in that condition. The same is also true for the neutral context question, which was identical for all the stimuli. All other details are as described for the auditory stimuli in Experiment 1 (See Section 5.3.5).

6.4 Acoustic Analysis

The duration, intensity and fundamental frequency (F_0) of every constituent in the sound files were measured using a speech-analysis program (Praat) and they were statistically analysed across conditions using ANOVA measures in order to examine possible prosodic differences between conditions. The statistical analysis was carried out as described in the section on acoustic analysis in Chapter 5, Section 5.4.

6.4.1 Duration

Duration analyses for the full NPs are reported here and those for the bare NPs are reported in Appendix F.4. The durations of the intervening

pauses are likewise shown in [Appendix F.4](#). [Table 6.2](#) shows the mean duration of the full NPs and the verb in the critical conditions.

Table 6.2: Mean Duration

Condition	NP1 ms	SD	NP2 ms	SD	Verb ms	SD
DAS	1026.56	114.44	817.77	101.58	761.13	151.02
DAI	1024.41	117.49	829.60	97.19	1410.17	387.02
ADS	861.72	104.53	968.58	123.51	763.42	146.48
ADI	871.37	105.35	991.69	115.16	1436.29	376.43

ANOVAs were computed for the critical conditions in order to observe the effects of the within-participants factors word-order and sentence-type on the duration of NP1, NP2 and the intervening pause between these arguments. An overview of effects on the duration of NP1, NP2 and the verb in the critical conditions are shown in [Table 6.3](#). The effects on the duration of the intervening pauses are shown in [Appendix F.4](#).

The duration of the nouns in the dative case is longer than those in the accusative case, obviously due to the fact that the dative case-suffix ‘-kku’ with the gemmated consonant is considerably longer than the accusative case-suffix ‘-ai’ in Tamil. All sentence-initial NPs are slightly longer than their corresponding counterparts in the second position, irrespective of their case-marking. As for the duration of the verb, the ditransitive verbs are almost doubly longer than the dative subject verbs. This is due to the fact that the ditransitive verbs are inherently long because they are mostly noun-verb complexes, and in some cases causatives.

Table 6.3: ANOVA: Duration

Factor	DF	NP1		NP2		Verb	
♦ WO	1,71	73.21	***	71.24	***		
♦ ST	1,71			7.11	**	411.06	***

At NP1, there was a main effect of word-order, whereas at NP2, there were main effects of both word-order and sentence-type. At the position of the verb, there was a significant main effect of sentence-type.

6.4.2 Intensity

As far as the intensity is concerned, there were no effects.

6.4.3 Fundamental Frequency

As Table 6.4 shows, none of the F_0 differences exceeded the perceivable threshold (see Rietveld & Gussenhoven, 1985; t'Hart et al., 1990), and therefore no effect from the ANOVAs for the F_0 values is reported here. Nevertheless, the ANOVAs for the timepoints of the occurrence of maximum and minimum pitch values are shown in Table 6.5.

Table 6.4: Mean F_0

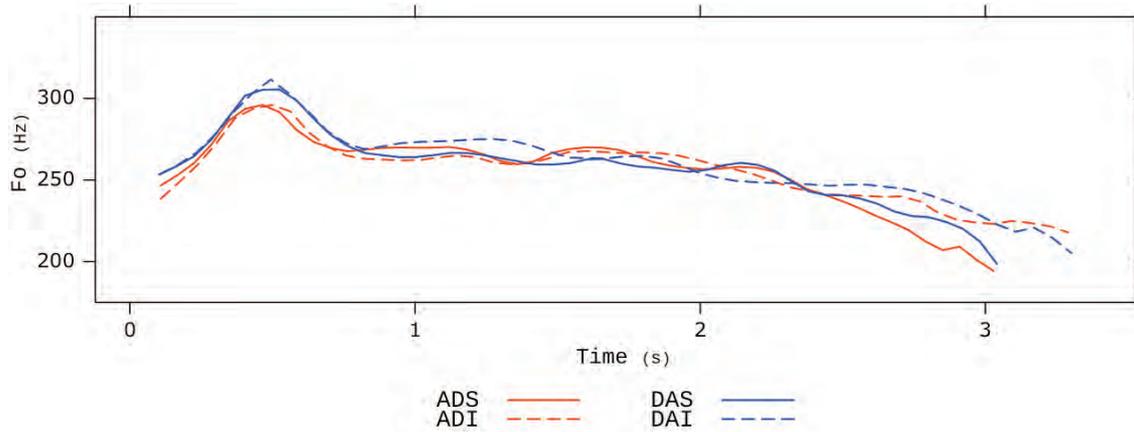
Condition	Onset	SD	Max.	SD	Min.	SD	Offset	SD	
NP1	DAS	274.36	51.63	358.87	53.93	215.72	30.41	264.43	46.89
	DAI	270.20	51.65	365.01	54.52	217.23	30.12	281.19	46.41
	ADS	269.37	45.47	346.72	39.54	211.97	30.64	276.77	43.57
	ADI	265.91	26.00	346.26	24.97	207.54	33.96	283.43	45.45
NP2	DAS	260.13	32.25	316.94	21.50	206.91	33.87	261.47	50.35
	DAI	272.70	48.67	326.20	49.20	205.02	37.07	255.45	43.04
	ADS	255.37	29.50	332.30	52.93	208.11	28.65	256.44	44.32
	ADI	260.72	37.56	340.51	57.87	208.22	30.15	263.54	43.77
Verb	DAS	240.38	44.07	285.90	83.43	160.72	50.67	198.23	86.38
	DAI	245.81	28.46	290.65	47.63	179.62	48.37	205.00	64.66
	ADS	233.31	59.30	274.29	102.88	155.44	53.58	188.69	87.44
	ADI	241.20	36.81	301.58	73.63	177.23	48.38	217.15	73.82

Table 6.5: ANOVA: Timepoint of Maximum and Minimum F_0

	Factor	DF	Maximum	Minimum
NP1	◆ WO	1,71	7.51	**
	◆ ST	1,71	5.61	*
NP2	◆ WO x ST	1,71	4.14	*
	└WO = AD ◆ ST	1,71	3.30	*
VP	◆ ST	1,71	27.78	*** 11.17 ***

In order to better visualise the average pitch contour in the critical conditions, F_0 values were also measured at 24 equally spaced positions (adjusted to the duration of the constituent) between the onset and offset of each constituent in each critical sentence. These were then averaged per

Figure 6.1: Experiment 2: Pitch Contour Plot.



constituent per condition so as to obtain the pitch contour plot. Figure 6.1 shows that there were no significant intonational differences between the sentences in the critical conditions prior to the verb.

6.5 Methods

The experiment was performed in the EEG laboratory of the Department of English and Linguistics at the Johannes Gutenberg University in Mainz. Typically, participants filled an Edinburgh-Handedness questionnaire in Tamil when they arrived at the lab. Dominant right-handers alone were accepted as participants. They were given printed instructions about the experiment and the task that they had to perform, with a few examples. Due to the fact that there were two experimental sessions, participants either chose to do the two sessions on the same day with a reasonable break in between the sessions, or they did the two sessions on two different days.

Stimuli were presented using the Presentation software (www.neurobs.com) that recorded, among other things, the trial number, reaction time and the key or button used to register answers. Otherwise the methods followed were as described in Chapter 5, Section 5.5.

6.5.1 Experimental Trial Structure

The structure of a trial in Experiment 2 consisted of the following phases: the presentation of the auditory context question, followed by that of the auditory stimulus sentence, which in turn was followed by the comprehension task, a schematic illustration of which is shown in Figure 6.2.

The flat-screen LCD monitor was clear before the trial commenced. A fixation asterisk appeared in the centre of the screen 500 ms before the onset of the auditory context question and continued to remain visible on screen until 500 ms after the auditory stimulus sentence had ended. There was a pause of 1000 ms between the end of the context question and the beginning of the auditory stimulus. Whilst listening to the auditory context, during the short pause that followed and when the auditory stimulus was being played, participants were asked to fixate on the asterisk all along without blinking.

As soon as the fixation asterisk disappeared from the screen, the ‘question’ for the comprehension task appeared, which the participants were required to answer with a ‘Yes’ or ‘No’ button press within 5000 ms. Participants had to compare the comprehension question with the sentence they heard to see if they both represented one and the same meaning. If so, they were required to answer ‘Yes’ by pressing the appropriate button in the button box that they were provided with, ‘No’ otherwise. When no button was pressed within 5000 ms, a time-out was registered as the answer. After an answer was registered or a time-out occurred, as the case may be, the next trial started. There was an inter-stimulus interval of 1500 ms, that is to say, there was a 1500 ms pause between the end of a trial and the beginning of the next one.

Figure 6.2: Experiment 2: Schematic experimental trial.



6.5.2 The Practice Phase

There was a practice before the first session of the experiment. Other details are as described for Experiment 1 in Chapter 5, Section 5.5.2.

6.5.3 The Experiment Phase

In the main phase of the experiment, either of the four sets of materials as mentioned in Section 6.3.4 was chosen to be presented. Each participant had to take part in two sessions to complete the experiment, each consisting of 12 blocks of 36 trials each. Other details are as described for Experiment 1 in Chapter 5, Section 5.5.3.

6.5.4 EEG Data

The EEG recording and pre-processing procedures for Experiment 2 were as described for Experiment 1 in Chapter 5, Section 5.5.4, except that the elastic cap (Easycap GmbH, Herrsching, Germany) was different, and the EEG and EOG channels were amplified using a BrainAmp DC amplifier (Brain Products GmbH, Gilching, Germany).

6.6 Results

6.6.1 Behavioural Data

The answering accuracy and mean reaction time across participants for the critical conditions, shown in Table 6.6, were calculated using the behavioural data collected during the experiment. The overall accuracy

Table 6.6: Accuracy (AC) and Mean Reaction Time (RT)

Condition		AC %	SD	RT _s	SD
CQ	DAS	97.96	3.00	2.44	0.48
	DAI	96.48	4.31	2.64	0.52
	ADS	97.03	3.71	2.51	0.51
	ADI	96.20	5.02	2.65	0.49
NQ	DAS	98.24	2.67	2.51	0.49
	DAI	95.92	3.84	2.69	0.53
	ADS	96.94	4.39	2.61	0.49
	ADI	96.75	3.79	2.74	0.49

was very high across conditions, with no significant differences between the two contexts. Accuracy for the DS conditions was slightly higher than that for the DI conditions. The reaction time data presented here

pertain only to those trials in which participants performed the comprehension task correctly. However, these data must be interpreted with caution because these are not time-locked with the stimulus sentences. The statistical analysis of the behavioural data was done by means of ANOVAs involving the within-subjects factors word-order, sentence-type and context, and the random factors participants (F1) and items (F2).

6.6.1.1 Answering Accuracy

An overview of significant effects on the answering accuracy is shown in Table 6.7. There was a main effect of sentence-type in the analysis by participants as well as the analysis by items. The interaction word-order x sentence-type reached significance only in the analysis by participants, which when resolved for the individual levels of word-order, revealed a simple effect of sentence-type only in the dative-accusative word-order. As Table 5.7 shows, within a certain context (CQ or NQ), the accuracy for the dative subject conditions were slightly higher than that for the ditransitive conditions.

Table 6.7: ANOVA: Answering Accuracy

Factor	DF	F1:Participants	DF	F2:Items
♦ ST	1,29	7.69 **	1,71	6.22 *
♦ WO x ST	1,29	3.88 *		
↳WO = DA ♦ ST	1,29	12.79 **		

6.6.1.2 Reaction Time

As Table 6.6 shows, the reaction times were slightly faster across conditions in the correct context as opposed to their counterparts in the neutral context. Further, within a certain context (CQ or NQ), the reaction times for the ditransitive conditions were slightly higher than those for the dative subject conditions. The effects on the reaction that reached statistical significance are shown in Table 6.8. There were main effects of word-order, sentence-type and context both in the analysis by participants and that by items. The interaction word-order x sentence-type reached significance only in the analysis by participants, which when resolved for the individual levels of word-order, revealed that there were simple effects of sentence-type in both the dative-accusative and accusative-dative word-orders.

Table 6.8: ANOVA: Reaction Time

Factor	DF	F1:Participants	DF	F2:Items
♦ WO	1,29	13.27 **	1,71	5.60 *
♦ ST	1,29	132.43 ***	1,71	55.10 ***
♦ CT	1,29	27.68 ***	1,71	26.66 ***
♦ WO x ST	1,29	7.18 *		
↳ _{WO} = DA ♦ ST	1,29	108.37 ***		
↳ _{WO} = AD ♦ ST	1,29	49.14 ***		

6.6.2 ERP Data

ERPs were calculated at NP1, NP2 and the verb as described in [Chapter 5, Section 5.6.2](#), with the difference that repeated-measures ANOVAs were computed for the statistical analysis of the ERP data, involving the within-participants factors word-order (WO), sentence-type (ST) and context (CT). Given that we were mainly interested in the processing of dative-subjects versus dative indirect-objects, dative nouns alone would be considered for the statistical analysis at NP1 and NP2. This will also ensure that we are comparing acoustically identical stimuli in a given sentence-type in all cases.

6.6.2.1 NP1

The statistical analysis was performed for dative-initial conditions alone at NP1. The ERPs comparing the effect of the contexts at NP1 are shown in [Figure 6.3](#) and [Figure 6.4](#) for the dative-initial stative conditions and ditransitive conditions respectively. Plots showing all dative nominals at NP1, and those for the accusative-initial conditions are shown in [Appendix F.5](#). The statistical analysis was performed on the pre-processed data in three time-windows, which were selected based on visual inspection of the data.

6.6.2.1.1 NP1: Time Window 170–270 ms

The ERPs for the dative NPs in this time-window appear to be significantly different based on the role of the dative NP in the sentence,

6.6. RESULTS

whereby the ditransitive sentences are more positive than their dative-subject counterparts. Figure 6.5 illustrates this difference for the dative-initial conditions (see Appendix F.5 for a similar plot for the accusative-initial conditions). Prosodic differences between the sentence-types appear to be reason for this effect.

A summary of all the effects that reached at least marginal significance at the position of NP1 in the dative-accusative word-order in the 170–270 ms time-window is shown in Table 6.9. There was a main effect of sentence-type in both the lateral and midline regions. The interaction ROI x sentence-type was significant only in the midline regions, which when resolved for the levels of ROI showed a simple effect of sentence-type in all but the parietal and parieto-occipital midline regions.

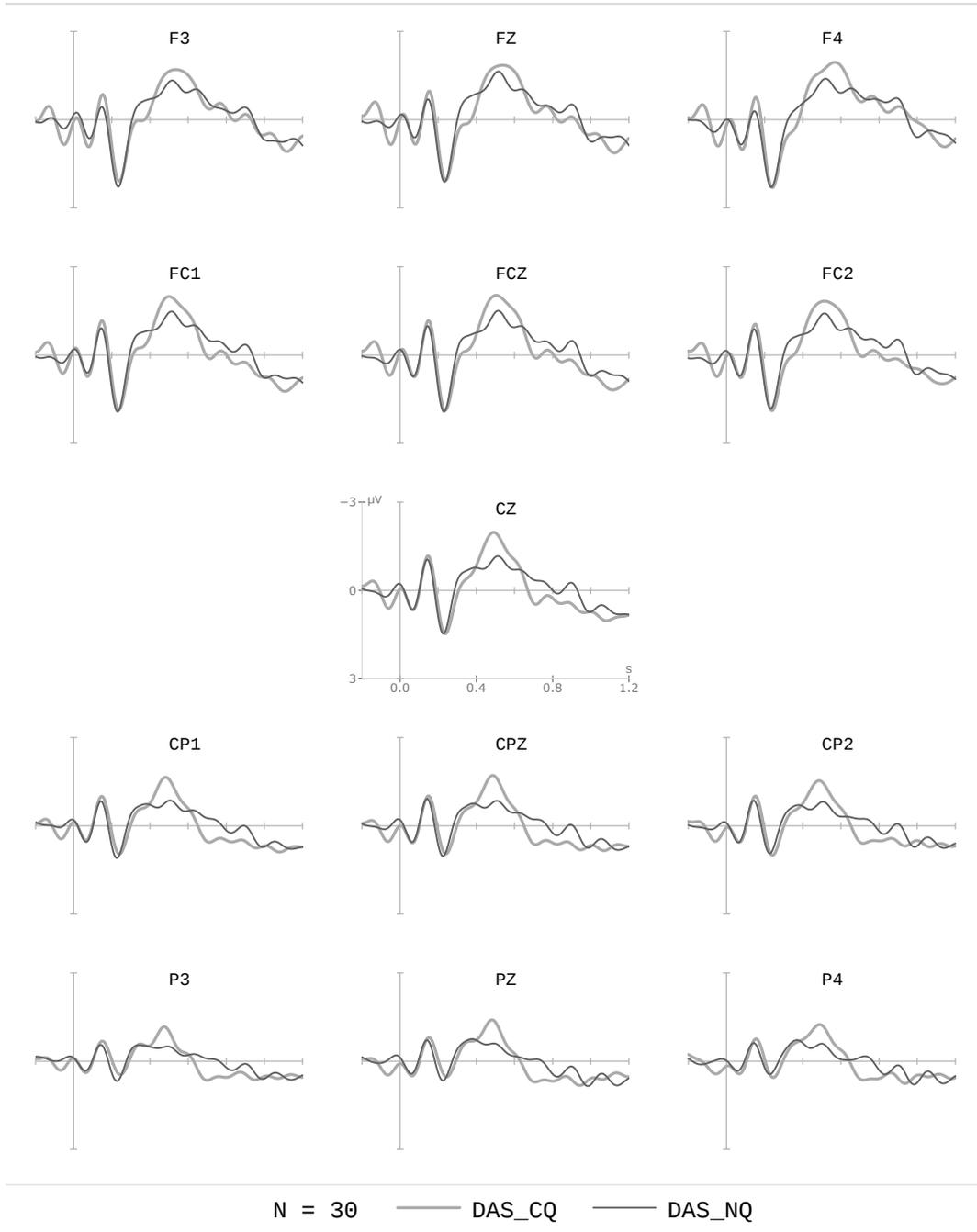
Table 6.9: ANOVA: ERPs at NP1 in DA conditions : 170–270 ms

Factor	DF	Lateral Regions	DF	Midline Regions	
◆ ST	1,29	6.24	*	1,29	8.34 **
◆ ROI X ST				5,145	8.12 **
└ROI = FZ ◆ ST				1,29	9.55 **
└ROI = FCZ ◆ ST				1,29	11.98 **
└ROI = CZ ◆ ST				1,29	11.61 **
└ROI = CPZ ◆ ST				1,29	8.08 **

6.6.2.1.2 NP1: Time Window 450–600 ms

The ERPs in this time-window for the dative-subject NP show a broadly-distributed negativity for the correct context condition as opposed to the neutral context condition. Table 6.10 shows a summary of all the effects that reached at least marginal significance at the position of NP1 in the dative-accusative word-order in the 450–600 ms time-window. There was a marginal main effect of context in the lateral regions. The interaction sentence-type x context was marginally significant in the lateral regions and significant in the midline regions. This was resolved for sentence-type, which showed a simple effect of context for the dative-subject sentences in both the lateral and midline regions.

Figure 6.3: ERPs at NP1: DAS Conditions.



6.6. RESULTS

Figure 6.4: ERPs at NP1: DAI Conditions.

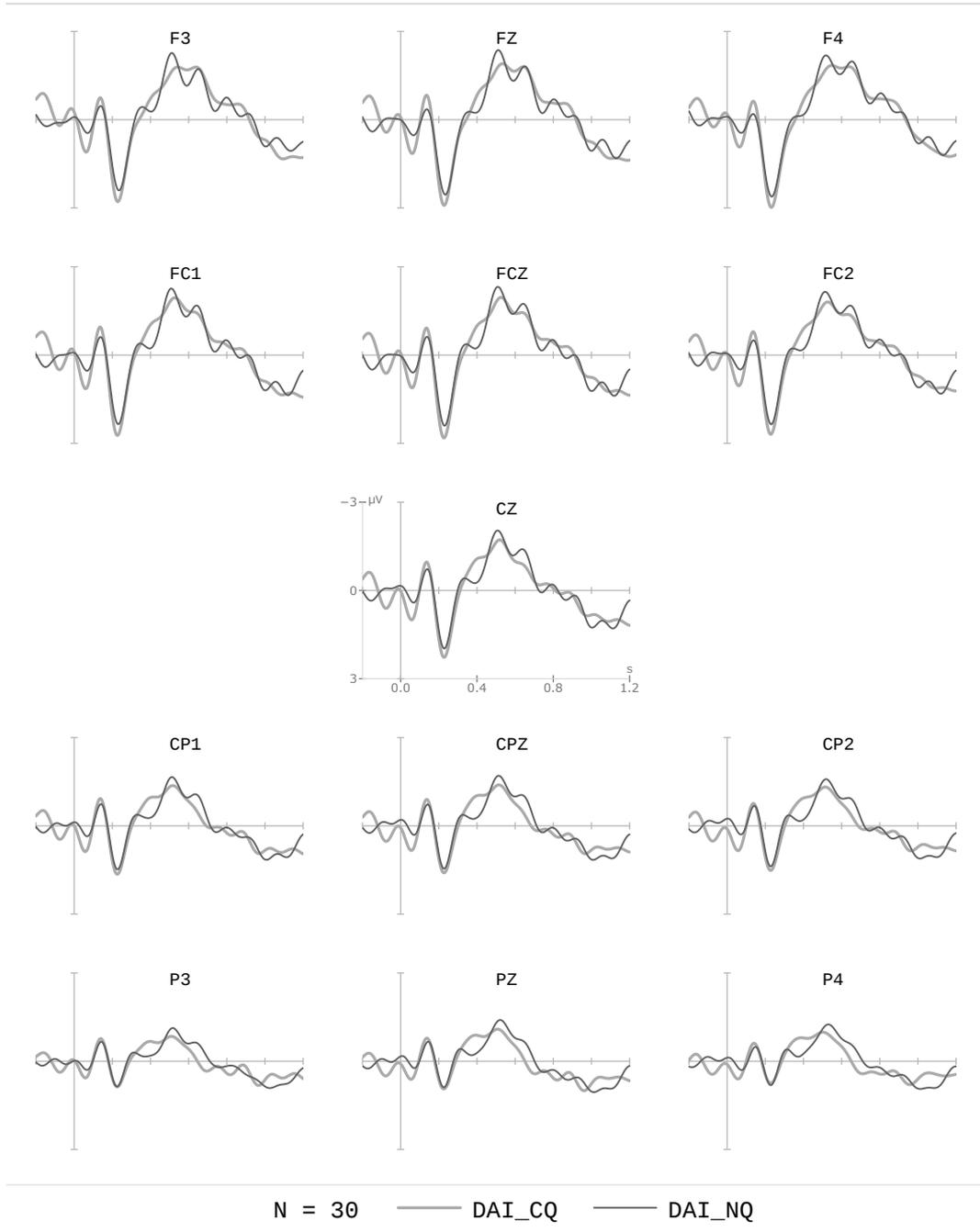


Figure 6.5: ERPs at NP1 - Collapsed over CT: DA Conditions.

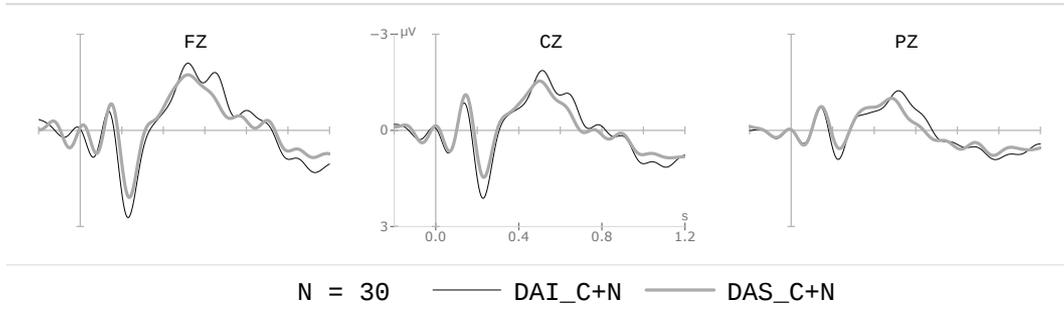


Table 6.10: ANOVA: ERPs at NP1 in DA conditions : 450–600 ms

Factor	DF	Lateral Regions		DF	Midline Regions	
♦ CT	1,29	3.88	*			
♦ ST x CT	1,29	3.27	*	1,29	4.59	*
↳ _{ST = DS} ♦ CT	1,29	7.43	**	1,29	3.46	**

6.6.2.1.3 NP1: Time Window 650–950 ms

The statistics in this time-window confirm the visually apparent positivity with a centro-parietal left-posterior distribution for the correct context conditions. The apparent difference between the sentence-types in the frontal midline region appear to stem from the more pronounced positivity for the dative-stative sentences.

A summary of all the effects that reached at least marginal significance at the position of NP1 in the dative-accusative word-order in the 650–950 ms time-window is shown in Table 6.11. There was a main effect of context in the midline regions. The interaction ROI x sentence-type was likewise significant in the midline regions alone, whereas the interaction ROI x context was significant in both the lateral as well as the midline regions. The interaction sentence-type x context was significant in the midline regions.

Resolving the interaction ROI x sentence-type for the levels of ROI showed a simple effect of sentence-type in the frontal midline region. Resolving the interaction ROI x context for the levels of ROI revealed a simple effect of context in the posterior lateral regions as well as the central,

6.6. RESULTS

centro-parietal, parietal and parieto-occipital midline regions. Resolving the interaction sentence-type x context for the levels of sentence-type showed a simple effect of context for the dative-stative sentences.

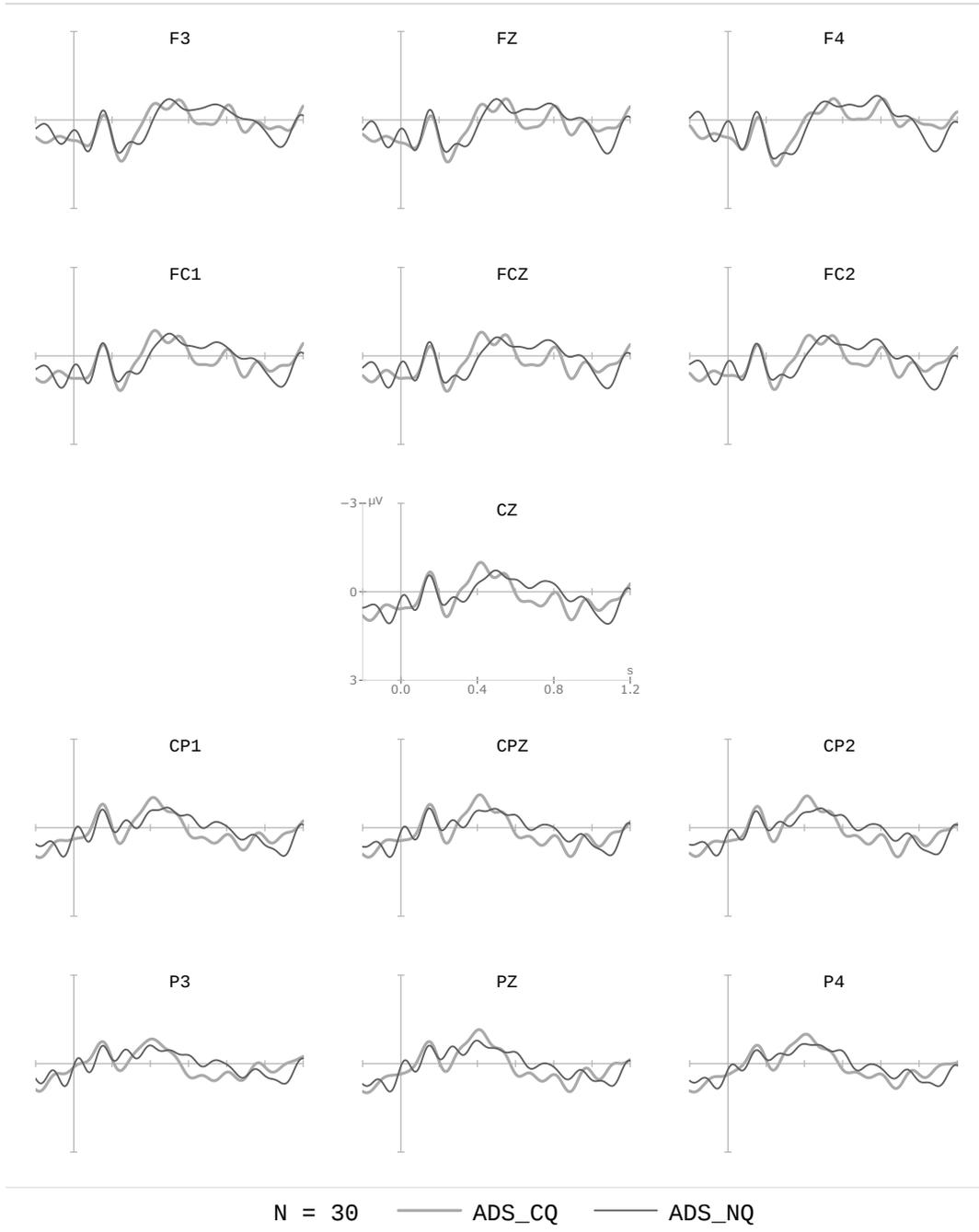
Table 6.11: ANOVA: ERPs at NP1 in DA conditions : 650–950 ms

F a c t o r	DF	Lateral Regions	DF	Midline Regions		
◆ ROI X ST			5,145	3.46	★★	
↳ ROI = FZ ◆ ST			1,29	3.60	*	
◆ CT			1,29	5.52	*	
◆ ROI X CT	3,87	4.44	★★	5,145	2.82	*
↳ ROI = LP ◆ CT	1,29	7.96	★★			
↳ ROI = CZ ◆ CT				1,29	6.03	*
↳ ROI = RP CPZ ◆ CT	1,29	7.60	★★	1,29	9.87	★★
↳ ROI = PZ ◆ CT				1,29	7.56	★★
↳ ROI = POZ ◆ CT				1,29	6.93	★★
◆ ST X CT				1,29	4.30	*
↳ ST = DS ◆ CT				1,29	9.10	★★

6.6.2.2 NP2

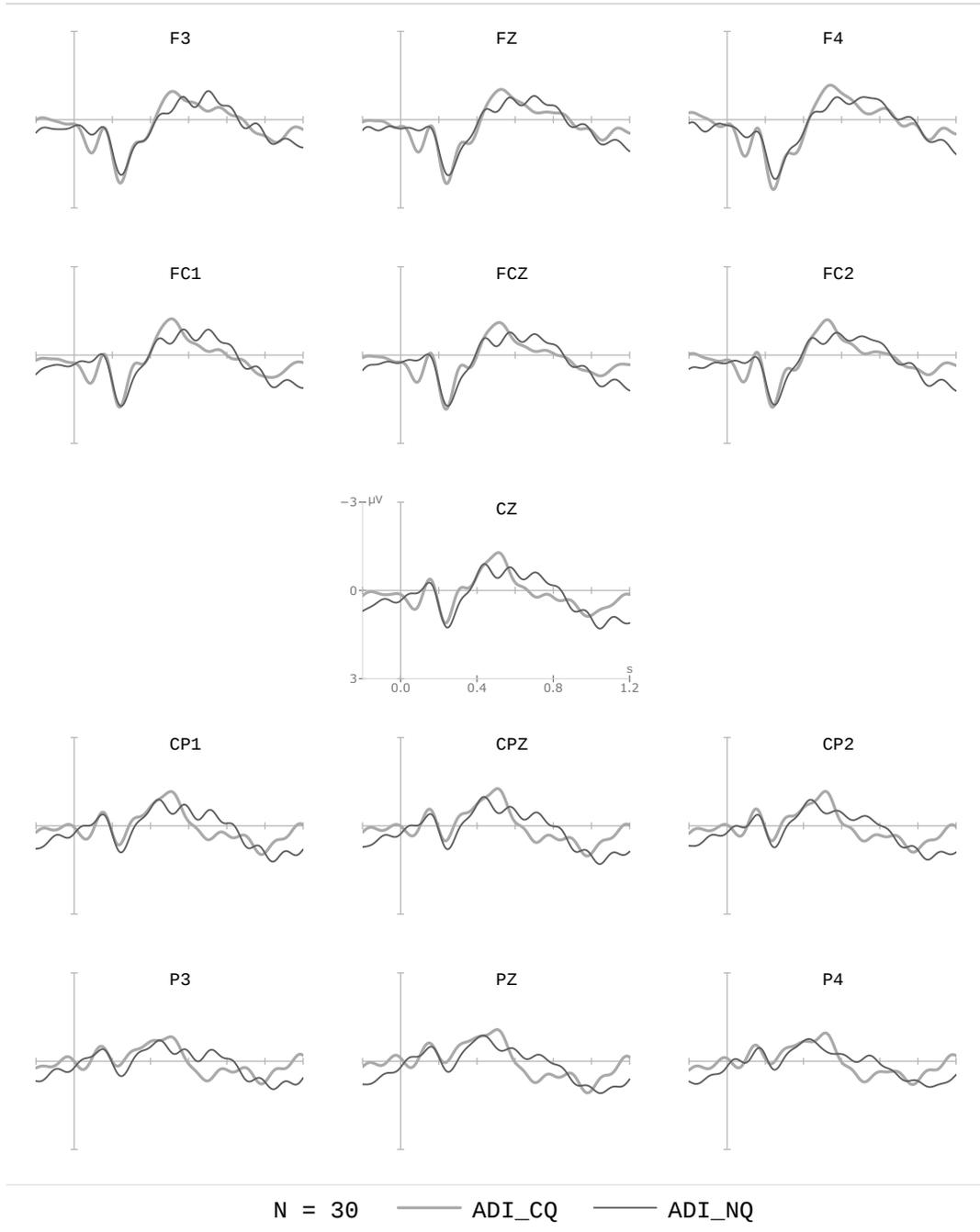
The statistical analysis was performed for accusative-initial conditions alone at NP2, thus in effect analysing the processing of dative-subjects and dative indirect-objects alone. The ERPs comparing the effect of the contexts at NP2 are shown in [Figure 6.6](#) and [Figure 6.7](#) for the accusative-initial stative conditions and ditransitive conditions respectively. Plots showing all dative nominals at NP2, and those for the dative-initial conditions are shown in [Appendix F.5](#). The statistical analysis was performed on the pre-processed data in three time-windows, which were selected based on visual inspection of the data.

Figure 6.6: ERPs at NP2: ADS Conditions.



6.6. RESULTS

Figure 6.7: ERPs at NP2: ADI Conditions.



6.6.2.2.1 NP2: Time Window 200–300 ms

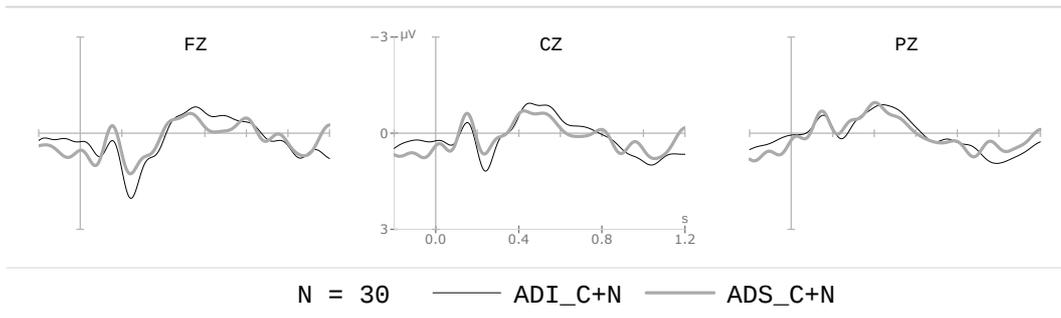
In this early time-window, similar to the one in NP1, the ERPs for the dative NPs in ditransitive sentences are more positive-going than those in the dative-subject sentences, regardless of the context. Figure 6.8 shows this difference for the accusative-initial conditions (see Appendix F.5 for a similar plot for the dative-initial conditions).

Table 6.12 shows a summary of all the effects that reached at least marginal significance at the position of NP2 in the accusative-dative word-order in the 200–300 ms time-window. There was a main effect of sentence-type in both the lateral and midline regions. The interaction ROI x sentence-type was likewise significant in all regions. When this was resolved for the levels of ROI, there was a simple effect of sentence-type in the left-anterior, left-posterior and right-anterior regions, as well as in the frontal, fronto-central and central midline regions.

Table 6.12: ANOVA: ERPs at NP2 in AD conditions : 200–300 ms

Factor	DF	Lateral Regions			DF	Midline Regions	
♦ ST	1,29	6.72	**	1,29	4.34	*	
♦ ROI X ST	3,87	4.08	*	5,145	7.25	**	
↳ ROI = LA FZ ♦ ST	1,29	7.39	**	1,29	8.66	**	
↳ ROI = LP FCZ ♦ ST	1,29	4.51	*	1,29	7.28	**	
↳ ROI = RA CZ ♦ ST	1,29	8.64	**	1,29	4.70	*	

Figure 6.8: ERPs at NP2 - Collapsed over CT: AD Conditions.



6.6.2.2.2 NP2: Time Window 450–550 ms

There is no sentence-type related effect in this time-window unlike the one observed in the comparable time-window at NP1. The correct context conditions elicit a negativity in this time-window. As Table 6.13 shows, there was only a marginal effect of context in the lateral regions at the position of NP2 in the accusative-dative word-order in the 450–550 ms time-window.

Table 6.13: ANOVA: ERPs at NP2 in AD conditions : 450–550 ms

Factor	DF	Lateral Regions	DF	Midline Regions
♦ CT	1,29	3.43	*	

6.6.2.2.3 NP2: Time Window 650–950 ms

In this time-window again, there is no sentence-type related effect unlike at NP1 in the same time-window. The correct context conditions elicit a positivity in this time-window. As Table 6.14 shows, there was a main effect of context in both the lateral and midline regions at the position of NP2 in the accusative-dative word-order in the 650–950 ms time-window.

Table 6.14: ANOVA: ERPs at NP2 in AD conditions : 650–950 ms

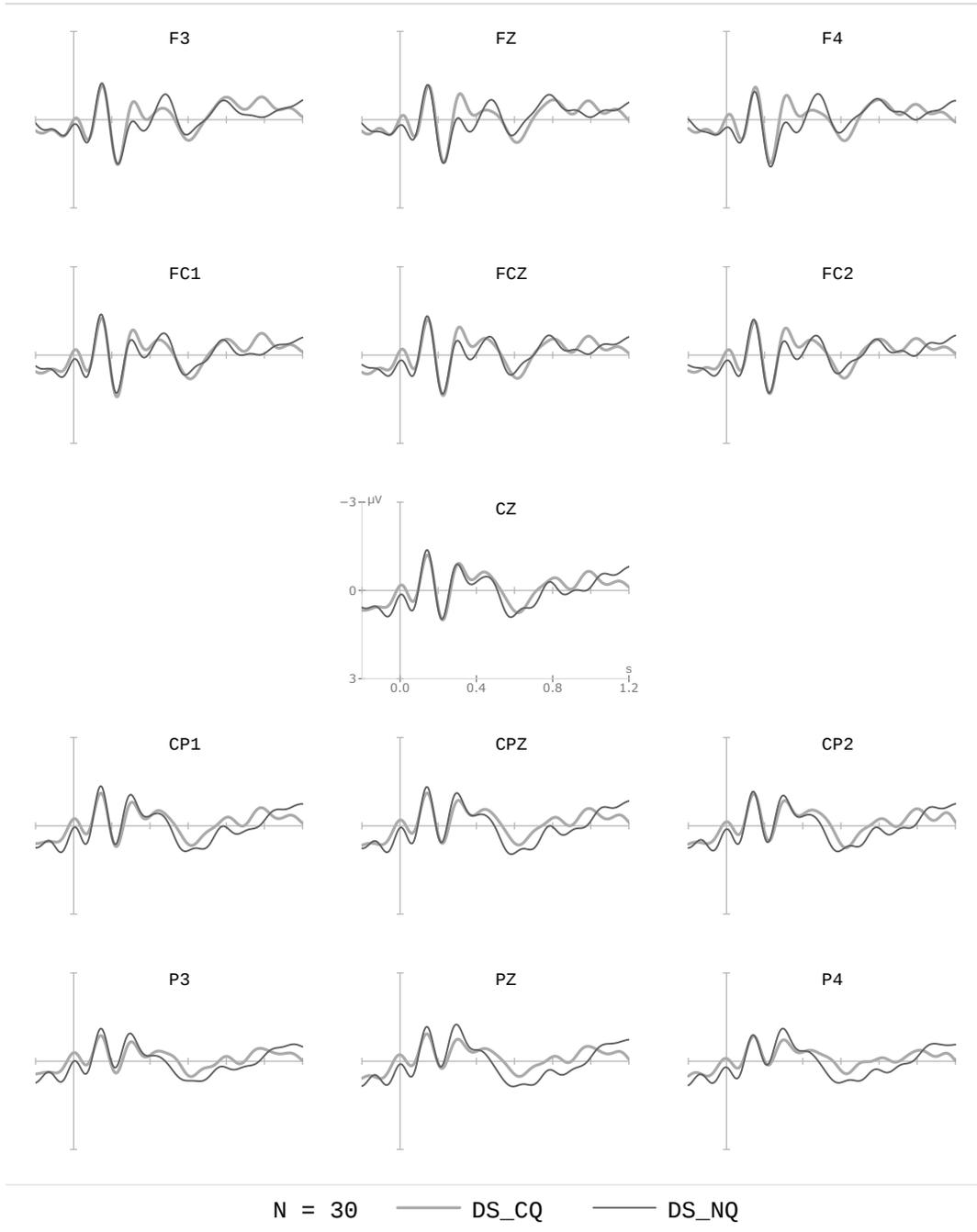
Factor	DF	Lateral Regions	DF	Midline Regions
♦ CT	1,29	6.44	*	1,29 8.20 **

6.6.2.3 Verb

At the position of the verb, the statistical analysis was performed for all the critical conditions⁴⁷. There were no significant main effects related to word-order, but there were interactions with word-order. The ERPs comparing the effect of the contexts at the position of the verb are

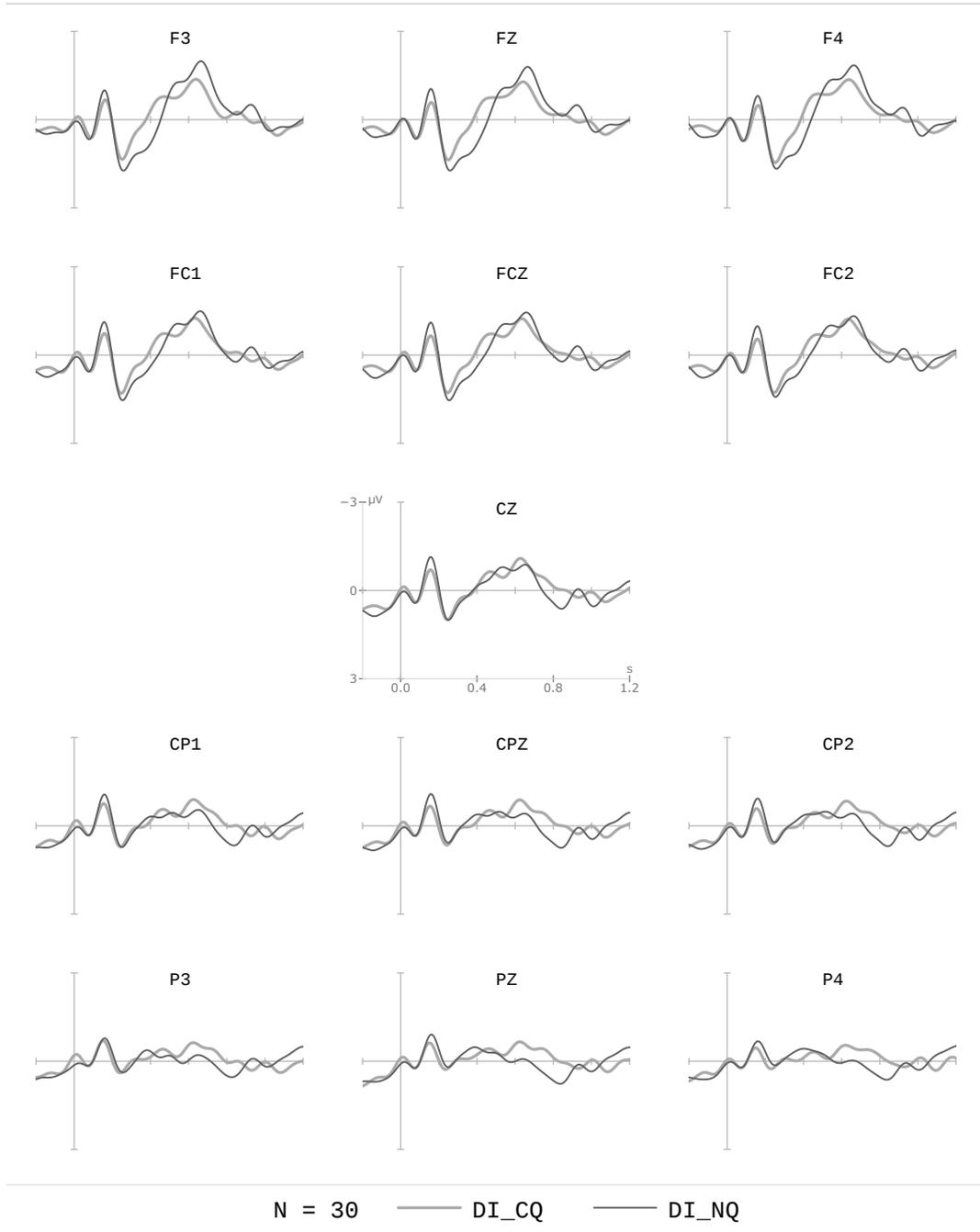
47. Whilst a direct comparison of the two verb-types would be clearly problematic, not just in view of their linguistic differences, but also due to the vast difference between the durations of the two verb-types, the hierarchical manner in which the ANOVAs were performed allowed to first separate the conditions by word-order and then in each word-order by sentence-type, to the effect that the two verb-types are never actually directly compared within a certain context. All interactions were resolved in a hierarchical manner.

Figure 6.9: ERPs at the Verb: DS Conditions.



6.6. RESULTS

Figure 6.10: ERPs at the Verb: DI Conditions.



shown after collapsing over word-order in Figure 6.9 and Figure 6.10 for the dative-stative conditions and ditransitive conditions respectively. See Appendix F.5 for plots showing the effects at the verb for the two word-orders separately. The statistical analysis was performed on the pre-processed data in three time-windows, which were selected based on visual inspection of the data.

6.6.2.3.1 Verb: Time Window 250–450 ms

There appears to be a predominantly frontally-distributed difference between the contexts in this time-window, whereby the ERPs for the neutral context conditions are slightly more positive-going in these regions than those for the correct context conditions regardless of the word-order.

Table 6.15 shows a summary of all the effects that reached at least marginal significance at the verb in the 250–450 ms time-window. There was a main effect of sentence-type in both the lateral and midline regions, whilst the effect of context was marginal in the lateral regions only. The interactions ROI x word-order, ROI x sentence-type, ROI x context and the three-way interaction ROI x word-order x context were likewise significant in the lateral and midline regions. Additionally in the lateral regions, the three-way interaction ROI x sentence-type x context was marginal, whilst the three-way interaction word-order x sentence-type x context was significant, but neither resolved further.

Resolving the interaction ROI x word-order for the individual levels of ROI showed a significant effect of word-order in the left-anterior region alone. The interaction ROI x sentence-type resolved for ROI revealed a significant effect of sentence-type in all the lateral and midline regions. Resolving the interaction ROI x context for the levels of ROI showed a significant effect of context in the anterior lateral regions as well as in the frontal, fronto-central and parieto-occipital midline regions.

The three-way interaction ROI x word-order x context was resolved for the levels of ROI, which revealed that the interaction word-order x context was marginally significant in the right-anterior region alone. Resolving this interaction further for word-order showed a simple effect of context for both the word-orders.

6.6. RESULTS

Table 6.15: ANOVA: ERPs at the Verb : 250–450 ms

Factor	DF Lateral Regions			DF Midline Regions		
◆ ROI x WO	3,87	5.13	**	5,145	5.77	**
└ROI = LA ◆ WO	1,29	11.17	**			
◆ ST	1,29	23.40	***	1,29	38.69	***
◆ ROI x ST	3,87	3.49	*	5,145	9.41	**
└ROI = LA FZ ◆ ST	1,29	11.62	**	1,29	29.33	***
└ROI = LP FCZ ◆ ST	1,29	17.82	***	1,29	38.13	***
└ROI = RA CZ ◆ ST	1,29	20.27	***	1,29	38.34	***
└ROI = RP CPZ ◆ ST	1,29	20.11	***	1,29	33.93	***
└ROI = PZ ◆ ST				1,29	16.78	***
└ROI = POZ ◆ ST				1,29	8.38	**
◆ CT	1,29	3.63	*			
◆ ROI x CT	3,87	36.37	***	5,145	46.41	***
└ROI = LA FZ ◆ CT	1,29	12.77	***	1,29	13.49	***
└ROI = FCZ ◆ CT				1,29	5.47	*
└ROI = RA ◆ CT	1,29	10.90	**			
└ROI = POZ ◆ CT				1,29	7.64	**
◆ ROI x WO x CT	3,87	5.71	**	5,145	8.03	**
└ROI = RA ◆ WO x CT	1,29	3.18	*			
└WO = DA ◆ CT	1,29	5.30	*			
└WO = AD ◆ CT	1,29	12.19	**			
◆ ROI x ST x CT	3,87	2.54	*			
◆ WO x ST x CT	3,87	5.80	**			

6.6.2.3.2 Verb: Time Window 450–550 ms

The prominent effect in this time-window seems to be the negativity for the neutral context conditions in the dative-subject sentences.

Table 6.16 shows a summary of all the effects that reached at least marginal significance at the verb in the 450–550 ms time-window. There was a marginal effect of sentence-type in the lateral regions, whereas this effect was significant in the midline regions. The interactions ROI x word-order, ROI x context, the three-way interaction ROI x sentence-type x context and the four-way interaction ROI x word-order x sentence-type x context were significant in the lateral and midline regions, whilst the interaction ROI x sentence-type and the three-way interaction word-order x sentence-type x context were significant in the lateral regions alone.

Resolving the interaction ROI x word-order for the individual levels of ROI showed a significant effect of word-order in the left-anterior region alone. The interaction ROI x sentence-type resolved for ROI revealed a significant effect of sentence-type in the anterior lateral regions. Resolving the interaction ROI x context for the levels of ROI showed a marginal effect of context in the parietal midline region, whereas this effect was significant in the parieto-occipital midline region.

The three-way interaction ROI x sentence-type x context was resolved for the levels of ROI, which revealed that the interaction sentence-type x context was significant in the right-posterior region and the parieto-occipital midline region. Resolving this interaction further for word-order showed a marginal effect of context in the right-posterior region for the dative-subject sentences, with this effect reaching significance in the parieto-occipital midline region.

Resolving the four-way interaction ROI x word-order x sentence-type x context for the individual levels of ROI revealed a significant interaction of word-order x sentence-type x context in the anterior lateral regions as well as the frontal midline regions, with this interaction being marginal in the fronto-central midline region. This was further resolved for word-order, revealing a significant interaction of sentence-type x context in the dative-accusative word-order in the anterior lateral regions and the frontal midline region only. Resolving this further for the levels of sentence-type in these three regions revealed a simple effect of context for the dative-subject sentences alone.

6.6. RESULTS

Table 6.16: ANOVA: ERPs at the Verb : 450–550 ms

Factor		DF	Lateral Regions			DF	Midline Regions		
◆ ROI x WO		3,87	3.42	*		5,145	4.42	*	
↳ ROI = LA	◆ WO	1,29	4.83	*					
◆ ST		1,29	3.38	*		1,29	5.18	*	
◆ ROI x ST		3,87	3.38	*					
↳ ROI = LA	◆ ST	1,29	4.04	*					
↳ ROI = RA	◆ ST	1,29	5.32	*					
◆ ROI x CT		3,87	10.62	***		5,145	4.69	*	
↳ ROI = PZ	◆ CT					1,29	3.75	*	
↳ ROI = POZ	◆ CT					1,29	6.48	*	
◆ ROI x ST x CT		3,87	4.10	*		5,145	5.29	*	
↳ ROI = RP	◆ ST x CT	1,29	6.17	*					
	↳ ST = DS	◆ CT	1,29	3.55	*				
↳ ROI = POZ	◆ ST x CT					1,29	6.00	*	
	↳ ST = DS	◆ CT				1,29	10.93	**	
◆ WO x ST x CT		1,29	5.61	*					
◆ ROI x WO x ST x CT		3,87	3.88	*		5,145	5.71	**	
↳ ROI = LA FZ	◆ WO x ST x CT	1,29	7.70	**		1,29	8.64	**	
	↳ WO = DA	◆ ST x CT	1,29	6.65	**	1,29	8.06	**	
		↳ ST = DS	◆ CT	1,29	12.68	***	1,29	8.68	**
↳ ROI = FCZ	◆ WO x ST x CT					1,29	3.18	*	
↳ ROI = RA	◆ WO x ST x CT	1,29	7.88	**					
	↳ WO = DA	◆ ST x CT	1,29	8.56	**				
		↳ ST = DS	◆ CT	1,29	13.14	***			

6.6.2.3.3 Verb: Time Window 500–700 ms

The ERP pattern in this time-window is clearly different for the two sentence-types. There appears to be a broad late positivity for the dative-subject conditions in both contexts (see [Appendix F.5](#) for more plots). However, the ERPs for the neutral context conditions are slightly more positive in the posterior regions. Further, the two word-orders show differences in the ERPs frontally.

A summary of all the effects that reached at least marginal significance at the verb in the 500–700 ms time-window is shown in [Table 6.17](#). There was a main effect of sentence-type in both the lateral and midline regions. The interactions ROI x word-order, ROI x sentence-type and ROI x context also reached significance in all the regions.

Table 6.17: ANOVA: ERPs at the Verb : 500–700 ms

Factor	DF	Lateral Regions			DF	Midline Regions		
◆ ROI x WO	3,87	4.07	**		5,145	4.77	*	
└ROI = LA FZ ◆ WO	1,29	3.96	*		1,29	4.46	*	
└ROI = RA ◆ WO	1,29	6.50	**					
◆ ST	1,29	88.22	***		1,29	88.18	***	
◆ ROI x ST	3,87	48.77	***		5,145	42.86	***	
└ROI = LA FZ ◆ ST	1,29	109.41	***		1,29	97.26	***	
└ROI = LP FCZ ◆ ST	1,29	45.53	***		1,29	92.65	***	
└ROI = RA CZ ◆ ST	1,29	86.05	***		1,29	95.76	***	
└ROI = RP CPZ ◆ ST	1,29	46.14	***		1,29	79.60	***	
└ROI = PZ ◆ ST					1,29	48.49	***	
└ROI = POZ ◆ ST					1,29	23.14	***	
◆ ROI x CT	3,87	38.98	***		5,145	31.21	***	
└ROI = LA FZ ◆ CT	1,29	12.36	***		1,29	4.06	*	
└ROI = LP ◆ CT	1,29	8.58	**					
└ROI = RA ◆ CT	1,29	8.83	**					
└ROI = RP CPZ ◆ CT	1,29	8.04	**		1,29	7.43	**	
└ROI = PZ ◆ CT					1,29	13.45	***	
└ROI = POZ ◆ CT					1,29	19.90	***	

Resolving the interaction ROI x word-order for the levels of ROI showed a marginal effect of word-order in the left-anterior region and a significant effect of the same in the right-anterior region and the frontal midline region. The interaction ROI x sentence-type resolved for ROI showed a simple effect of sentence type in all the lateral and midline regions. Resolving the interaction ROI x context for ROI revealed a simple effect of context in all the lateral regions, as well as in the frontal, centro-parietal, parietal and parieto-occipital midline regions.

6.6.3 Summary of Results

We compared the processing of dative-subjects and morphologically identical dative indirect-objects in a context in which the role of the dative nominal was clear as opposed to a neutral context in which the role was ambiguous. The context design also enabled observing the effects at the position of the verb.

At NP1, dative indirect-objects were slightly more positive in the very early time-window regardless of context. In the 450-600 ms time-window, whilst dative-subjects in the correct context condition elicited a negativity, there was only a minimal difference between contexts in case of dative indirect-objects. Both sentence-types in the correct context additionally elicited a positivity in the 650-850 ms time-window, with this effect slightly more pronounced for the dative-stative sentences.

At NP2, dative indirect-objects were slightly more positive in the very early time-window regardless of context, like at NP1. In the two later time-windows, there were effects of context, whereby the correct context conditions in both sentence-types elicited a slight negativity followed by a positivity as opposed to their counterparts in the neutral context.

At the position of the verb, the neutral context conditions elicited a frontally distributed positivity in the time-window 250-450 ms in both sentence-types. An anterior negativity ensued for the dative-subject sentences in the correct context in this time-window. A similar anterior negativity ensued for the dative-subject sentences in the neutral context in the 450-550 ms time-window. The two sentence-types differed significantly in the time-window 500-700 ms, whereby the dative-subject conditions elicited a positivity in both contexts.

6.7 Discussion

Experiment 2 addressed the question of the status of dative-subjects as against dative indirect objects. Due to the verb-final nature of the language, a context design involving either a correct context or a neutral context was used to invoke specific expectations about the role of the dative noun in the forthcoming stimulus sentence (see Section 6.1 for details). As noted in the discussion of results from Experiment 1, the hypothesis was that any significant difference between the contexts at the positions of the dative noun in each sentence-type would indicate a processing advantage or disadvantage, as the case may be, for dative-subjects versus dative indirect objects.

6.7.1 Effects at NP1 and NP2

The results for the dative nouns at the position of NP1 show that there is a difference between the sentence-types at a very early stage of processing (170–270 ms), whereby the dative indirect objects are slightly more positive in both contexts as opposed to the dative-subjects. Since a similar pattern obtains in a comparable time-window for the dative nouns at the position of NP2, we presume that this has something to do with the physical (acoustic) parameters⁴⁸ of the stimuli in the two sentence-types. A possible hint for such an interpretation stems from the acoustic analysis (see Section 6.4), whereby the timepoint of occurrence of the maximum F_0 at NP1 is significantly different between the sentence-types, although the maximum F_0 itself did not turn out to be significant. Similarly, there is an effect of sentence-type for the accusative-dative word-order on the timepoint of occurrence of the maximum F_0 at NP2.

Given that the correct context conditions in the respective sentence-types induced an expectation to process the dative noun in the stimulus sentence as either a dative-subject or an indirect object, and that these are very different as far as the thematic roles are concerned, it was hypothesised that there would be some difference between the two sentence-types at the argument positions accordingly. The results of Experiment 2 at the argument positions reveal the following. The dative nouns in the dative-stative sentences at the position of NP1 showed a difference between contexts, whereby the ERPs for the correct context condition was more negative-going as opposed to those for the neutral context condition. As for the statistics in this time-window, there was

48. See Philipp et al. (2008), Exp.1, for a similar effect in Chinese.

no general effect of sentence-type, but only a marginal effect of context and an effect of context specific to the dative-stative sentences. This implies that the effect that we see must be interpreted as a negativity for the dative-subjects in the correct context. The dative nominals at NP2 showed a similar marginal effect of context in a comparable time-window, reflecting the very small negativity in the correct context for both sentence-types. A possible interpretation for this negativity could be along the lines of the interpretation in [Hruska & Alter \(2004\)](#) for a similar finding. In their study, prosodically focused constituents that elicited a positivity when presented in isolation additionally elicited a frontal negativity when presented in a context that questioned for the focused constituent, and suggested that the negativity reflected the expectation that the context induced for the focused information. Whilst such an interpretation appears valid given the results at hand, it could only be a tentative one for obvious reasons.

Furthermore, regardless of the sentence-type and word-order, a slight parietally distributed positivity is observed in the late time-window 650–850 ms for the dative nominals in the correct context in both argument positions. Since identical audio files were used in both contexts for a given sentence-type and word-order, this effect cannot be attributed to differences in the acoustic parameters. Similarly, neither does an argument along the lines of a functional difference hold good. Indeed, as the statistics at both NP1 and NP2 in this time-window illustrate, the effect is clearly only context-dependent.

Posterior positivities of this kind have been reported earlier in studies that induced context-based expectations about forthcoming stimuli, both in the visual and auditory modalities. In a visual study using German sentences, [Bornkessel, Schlesewsky, & Friederici \(2003\)](#) used context sentences that either questioned for the subject or object argument in the stimulus that followed, or remained neutral. Thus the non-neutral contexts induced an expectation for the argument concerned, in turn rendering them focused. In the focused contexts as opposed to the neutral context, the authors found a parietal positivity in a time-window between 280 and 480 ms at the position of the argument concerned, which they termed Focus Positivity⁴⁹, which they suggested ensued due to the new lexical material. [Cowles, Kluender, Kutas, & Polinsky \(2007\)](#) found a similar positivity in an English study, in which they used wh-questions to induce a focused constituent in the answer that followed.

49. Discussing several studies that reported a focus positivity, [Bornkessel-Schlesewsky & Schlesewsky \(2009a, p. 259\)](#) suggest that it 'appears to reflect the integration of an expected new referent into the slot opened up within the context'.

Both studies considered the positivity to be a variant of the P3b component. Similar positivities have been reported for prosodically focused constituents in the auditory domain (Hruska & Alter, 2004; Toepel & Alter, 2004), which have been interpreted as the Closure Positive Shift, or CPS (Steinhauer, Alter, & Friederici, 1999).

Given these results, there is good reason to believe that the *wh*-phrases in the correct context could indeed have been the reason why a parietal positivity ensued. Thus, the positivity in the later time-window could plausibly be classified as Focus Positivity in our study. Any alternative interpretation for this effect would be problematic, because the effects were found for identical stimuli that only differed with respect to the context that preceded. Whilst this is quite plausible, it is not clear as to why the positivity in the present case is quite late when compared to the visual studies mentioned above, in all of which the positivity was parietally distributed in a relatively early P300 time-window, that is prior to 400 ms post-onset. If the Focus Positivity is indeed a variant of the P3b component, then a possible explanation for the latency-shift stems from the late availability of the case-marker in our study. A recent dissertation found that the P3b even completely vanishes if the necessary information for it to be elicited become available in a piecemeal manner rather than all at once (Kretzschmar, 2010). In the present case, the case-marker is crucial in determining whether the stimulus indeed answered the *wh*-phrase in the context questions⁵⁰. However, the case-suffix becomes available in the auditory stream only after around 527 ms or more after the onset of the noun (see Appendix F.4 for the mean duration of bare NPs). Indeed, if the ERPs are time-locked at the onset of the case-marker rather than at the onset of the noun, it becomes apparent that the effect is between 200 and 400 ms after the onset of the case-marker.

6.7.2 Effects at the Verb

At the position of the verb, the dative-stative verbs elicited a frontal negativity in both contexts. This negativity was in a slightly earlier time-window (250–450 ms) in the correct context, whereas it was observable in the neutral context in the time-window 450–550 ms. Recall that all our stimuli were grammatical well-formed sentences in Tamil. Given this, it is not clear at this point as to whether this negativity is indeed related to the processing of stative verbs in some way. Whilst the absence of a

50. Similar context-dependent positivities visually apparent in the late time-window for the accusative nominals at both argument positions further adds support to such an argument. See Appendix F.5.

comparable effect for the ditransitive verbs speaks for a sentence-type specific interpretation of this effect rather than as an artefact, it remains to be seen if this effect is reproducible for the stative verbs under other task conditions.

In the 500–700 ms time-window, a clear positivity could be observed for the stative verbs, whereas the ERPs for the ditransitive verbs were more negative-going, especially in the correct context. Based upon the fact that the dative-stative verbs show default agreement, which is rather an exception than the rule for an overwhelming majority of Tamil verbs, whereas the ditransitives show normal agreement, this effect could be interpreted as a positivity for the dative-stative verbs in general. However, such an interpretation will not be straightforward, given that the ditransitive verbs are doubly longer in duration than the stative verbs (see Section 6.4, Table 6.2). So it is not clear at this stage whether this difference is indeed due to the differences in processing default-agreement in case of stative verbs as opposed to processing normal agreement in case of ditransitive verbs, or alternatively, whether it is simply an artefact due to the different lengths of the verbs concerned.

The ERPs in the neutral context conditions were relatively more positive-going in this time-window⁵¹ compared to the correct context counterparts in both sentence-types. Recall that the sentences were identical in both contexts in a given word-order and sentence-type. Given that the neutral context conditions elicited comparably similar effects in both sentence-types, any interpretation of this effect must be context-dependent rather than based upon the verb-type.

This leads us to the question of the difference between the two types of context questions. In the neutral context, the stimulus sentence could be one from any of the critical conditions as well as fillers. Thus there is no clear prediction for a certain verb nor verb-type when a sentence of the dative-accusative or accusative-dative type is still unfolding, other than that there could be a ditransitive or a stative verb: any of the verbs in these verb-types would be good enough to render the sentence acceptable. Under these circumstances, encountering a verb of one of these types thus leads to a proper closure⁵² of the ongoing sentence.

51. In fact, this positivity has a wider latency, but the time-window 500–700 ms was chosen to account for the effects of both sentence-types in the same time-window.

52. Friedman, Simson, Ritter, & Rapin (1975, p. 260) coins the term syntactic closure to denote 'the word which ends the syntactic structure' that preceded it. We use the term closure to specifically refer to the word (typically the verb in our studies) that not only ends the preceding structure, but also renders it syntactically and semantically well-formed.

That is, the verb is informative about the closure of the sentence. By contrast, given the nature of the correct context questions, and given that all stimuli following a correct context question always contained the identical verb as that in the context in Experiment 2, there is good reason to believe that participants specifically expected a certain verb, and could detect the verb right after its first syllable became clear. This is because all the verbs used in both sentence-types were phonologically distinct at their onsets. Thus, the verb does not deliver any new information as to the closure of the sentence in the ongoing auditory stream. Rather, it *simply* confirms the foregone conclusion about the closure, and will *always* lead to a proper closure given the experimental design. That is to say, a sentence-closure as that observable in the neutral context conditions is not a necessity, at least not in the same magnitude, in the correct context conditions.

Such an interpretation of the late positivities in the neutral context conditions is in line with earlier findings. For instance, [Friedman et al. \(1975\)](#) presented participants with three sentences of the form 'The wheel is on the axle' a number of times, sometimes as such, and some other times with the first grapheme of the second word ('wh' in 'wheel') missing. In the condition with the missing grapheme, the sentence-final word was thus very informative about the proper closure of the sentence, whereas in the condition in which all words were presented fully, participants simply knew / expected in advance that the sentence closure is imminent and bound to be successful. The authors reported, amongst other results, a larger P300 in the condition in which the sentence-final words were informative about the proper closure of the sentence as opposed to the condition in which they were not. Similarly, [Van Petten & Kutas \(1991\)](#) presented participants with sentences of different lengths, some of which were syntactically and semantically well-formed, whilst others only syntactically correct but semantically nonsensical and yet others neither syntactically nor semantically well-formed. The varied sentence lengths ensured that participants could not know if a sentence were complete until they encountered a word with a full-stop following it. Amongst other results, a robust P300 effect ensued in their study for the final words of congruent sentences as opposed to the other kinds of sentences.

Thus it is plausible to argue that the late positivities observed in the neutral context conditions in our study also reflect the closure of the stimuli involved. However, the positivities in the studies cited above were observed in the typical P300 time-window, whereas those in the present case ensue well after 500 ms post-onset. A possible explanation

for such an apparent delay could be that, the studies cited above employed the visual modality, due to which information about the whole word became available all at once. By contrast, word information in the auditory modality becomes available in a piecemeal manner from the auditory stream unfolding over time. This is the case in our study, which then necessitates that the processing system must wait for the word-recognition point in order to be able to convincingly recognise it as a potential word that could render a proper closure to the stimulus sentence concerned.

6.7.3 Summary

Results at the argument positions appear to suggest that, as envisaged in the hypothesis at the end of the discussion of Experiment 1, dative nouns that are subjects are processed differently from those that are non-subjects. However, it is not clear at the moment, why such a difference depends upon the position of the argument, because the effect is apparent only at NP1 and not at NP2. Further, the similarity of the differences observed *between* contexts in each sentence-type indicates that the expectation for or the knowledge of a specific type of argument that would be encountered, say a dative noun, as opposed to a neutral expectation or lack of such knowledge has a lot of significance for processing these arguments in real-time. In other words, it does not seem to matter whether one is processing a dative-subject or a dative indirect object, whereas prior knowledge, if any, about the arguments involved does seem to matter a lot. However, as suggested earlier, this could only be a tentative conclusion, and needs further investigation using other subtler and indirect methods of inducing expectations for a dative-subject versus indirect object.

As for the position of the sentence-final verb, the story seems to be much more complex. The late positivity that was observed for both sentence-types in the neutral context as opposed to the correct context seems to be the one effect that could be interpreted conclusively as a context-dependent sentence-closure effect. Whilst considerable differences in the processing pattern of the two types of verbs involved are apparent, both visually and statistically, further study is necessary to tease apart sentence-type specific effects from context-specific effects in a fairly straightforward manner, and to conclude one way or the other about the exact interpretations of the differences observed, especially in view of the constraints in comparing the two verb-types directly. Such a study should be able to specifically address the question of whether the

anterior negativity and the sentence-type specific late positivity for the dative-stative verbs are indeed sentence-type specific effects.

If these results seem to suggest that, at least in the sentence-initial position, the dative nominals are indeed processed differently in the two sentence-types, the effects observed at the verb look equally promising. They appear to point to the fact that Tamil dative-stative verbs, too, are processed differently from ditransitive verbs, in spite of the material preceding the verb being identical. A more direct comparison of the verb-types would be desirable, although such a comparison is not straightforward, given the difference in their durations. Therefore, a more sophisticated design would be necessary to disentangle the effects specific to dative-stative verbs as opposed to ditransitive verbs.

One major restriction in the present design that hinders differentiating sentence-type specific effects from context-dependent effects at the position of the verb has been the following. By its very nature, the correct context did not allow for observing the processing of a dative-stative verb versus the processing of a ditransitive verb under *identical* expectations about the verb. In other words, seen from another perspective, it was not possible to observe the processing of a certain verb-type under differing context-induced expectations. That is to say, by virtue of the fact that the correct context induced an expectation for a certain verb, it was in turn specific about the verb-type, too. The present design meant that whenever there was a specific context question, the stimulus verb always matched with the expectation induced by the context, and the alternative was never the case. Simply put, this led to a situation in which it would not be clear whether an effect ensuing in the correct context in a certain sentence-type was due to the expectation being met or due to the processing of that sentence-type per se. We address this issue in Experiment 3.

— * —

Experiment 3

7.1 Overview

The concept of a preceding context was exploited and evolved further in Experiment 3. We felt that a design in which the stimulus verb may or may not match the context-induced expectation would be ideal to address the issue mentioned in the summary of Experiment 2. That is to say, we would compare identical stimuli of a certain verb-type with a preceding context that signalled the stimulus verb correctly (as in Experiment 2), or alternatively one that signalled the other verb-type, thus leading to differing expectations. Mismatching context questions would be inevitable if we need to observe the effect of processing a stative verb when the expectation was actually for a ditransitive verb (and vice-versa). Such a design with a focus on the position of the verb would ensure that the stimulus verb cannot any more be taken for granted, because there would always be a possibility that the stimulus verb turns out to be of the other type than one was led to believe by the context question. Thus the effect of processing a certain verb-type could be observed under differing expectations.

In such a design, if an effect ensues for a certain verb-type in the correct context alone, and not in a context that induced an expectation for the other verb-type, then this effect could be said to be more of a context-dependent effect rather than somehow specific to the verb-type concerned. On the other hand, if an identical effect ensues in both the matching and mismatching contexts for a certain verb-type, then such an effect could be classified as sentence-type specific.

However, care must be taken to ensure that all verbs and verb-types are equally probable, both in the context questions and in the stimuli. A mechanism to ensure that participants do not simply ignore the context questions would be necessary. Additionally, if the probabilities of the combinations of context+stimulus verb combinations are also controlled for, any potential minuscule auditory cues⁵³ from the stimuli prior to the verb about the sentence-type would become useless from a participant's point of view, because all verbs would be equally probable in all non-neutral contexts. So it would be equally probable that any guess about the verb-type could turn out to be correct or incorrect, which then would lead to a situation in which guessing based on auditory cues prior to the verb would be abandoned in favour of going purely by the expectation induced by the context question.

We attempted this approach in Experiment 3 by presenting stimuli in four rather than two contexts. That is, in addition to the correct and neutral contexts of Experiment 2, each stimulus was presented in two additional mismatch contexts—these were similar to the correct context structurally, but with a crucial difference: the verb in the mismatch contexts, as the term suggests, did not match the stimulus verb. In the first type of mismatch context, the verb was different from the stimulus verb, but crucially, it was from the same verb-class. That is, a different verb of the dative-stative type was presented in the context if the stimulus verb was of the dative-stative type. In the second type of mismatch context, the verb as well as the verb-class was different. So in effect, the former type of mismatch context would prime for the identical structure as that of the stimulus, albeit it with a different lexical entry from the same verb-class, whereas the mismatch context of the latter type would prime for a ditransitive structure in case of a dative-stative stimulus verb, and vice-versa.

Such a context manipulation, then, would enable comparing acoustically identical stimuli at the position of the verb, with any differences attributable to the differing expectations depending upon the preceding contexts alone in a relatively straightforward manner. The verb-class context would be useful in observing effects common to a verb-class, whilst the wrong-verb context is a reliable control within a certain sentence-type for the other sentence-type, thus in effect ruling out the necessity of

53. Although there are no reliable indicators that there were major differences in the measurable auditory parameters between the stimuli of the two sentence-types, we cannot simply rule out the possibility that it could have been possible to guess the sentence-type to some extent after all. The positivities in the very early time-windows at NP1 and NP2 in Experiment 2 appear to support this idea.

comparing stimuli across sentence-types, which then renders the question of comparing acoustically different stimuli irrelevant.

Another aspect of interest here is the processing of default-agreement at the position of the verb. The results at the position of the verb for the dative-subject sentences in Experiment 2 as opposed to the ditransitive sentences point to the fact that there is *indeed* something different about default agreement, although we could not pinpoint the exact details with the data that we have from Experiment 2. The design of Experiment 3, by achieving better comparability of the different structures at the position of the verb, would enable shedding light on the processing of default agreement in the dative-subject sentences. In a language that favours verb agreement with the PNG-features of the subject in an overwhelming majority of instances, default agreement might seem to be a sort of deviation from the norm. However, a closer look at the stative constructions in the dative-accusative pattern reveals that the stative verbs that show default agreement when expressing such a dative-stative meaning also have an alternative, albeit completely unrelated, literal meaning (see [Chapter 4, Section 4.2.3.2](#)). This is important for our purposes, because the agreement pattern for expressing this literal meaning, not surprisingly, follows the rule rather than the exception. That is, when stative verbs express a literal meaning, they require a nominative subject. Furthermore, they show normal agreement with the PNG-features of this nominative subject just like any other non-stative verb would.

To ensure that participants did not ignore the context questions altogether because they did not always match the stimulus, we introduced an acceptability judgement task in addition to the comprehension task, whereby participants had to rate whether the context+stimulus combination was acceptable.

The hypothesis would then be the following. If the frontal negativity and late positivity that we observed in Experiment 2 for the stative verbs are indeed elicited due to the processing of these verbs, then we must find these effects also in the context in which the expectation was induced for a ditransitive verb, whilst the stimulus verb actually happened to be a stative verb. Alternatively, if these effects were mere artefacts, they should not be found in the more extensive design under consideration. Notwithstanding the fact that the verbs in the stimuli are not always going to meet the context-induced expectations about them, the stimuli themselves do not constitute outright violations of any sort. Therefore, we do not predict an N400-like effect ensuing due to the mismatch context conditions. Further, given previous results from other studies that

employed a judgement task in conjunction with designs that induced strong expectations about the stimuli, we expect task-related early positivities in view of the acceptability judgement task.

7.2 Participants

Thirty-four persons residing in Aachen, Bonn, Darmstadt, Esslingen, Frankfurt, Giessen, Kaiserslautern and Saarbrücken participated in the experiment after giving informed consent (6 female; mean age 25.47 years; age range 21–35 years). Three further participants (1 female) had to be excluded from the final data analyses on the basis of EEG artefacts. Other details are as described in [Chapter 6, Section 6.2](#).

7.3 Materials

7.3.1 Critical Conditions

Experiment 3 consisted of the four critical conditions from Experiment 2, which differed based on whether the word-order was dative-accusative or accusative-dative; and whether the sentence-type was a dative-subject sentence or a pronoun-dropped ditransitive sentence. Thus, there were 288 critical sentences in Experiment 3, adapted from Experiment 2. As in Experiment 2, context was also a factor in Experiment 3. However, as mentioned earlier, each critical sentence in Experiment 3 was presented following four possible contexts rather than two. [Table 7.1](#) provides an overview of the factors and levels, with the corresponding condition codes relevant to each level. As illustrated by the examples pertaining to each condition in [\(7.1\)](#), all the critical sentences in a certain word-order shared the identical surface structure. See [Appendix F.1](#) for an explanation of the condition codes.

7.3. MATERIALS

Table 7.1: Experiment 3: Factors and Levels

Factor	Level	Conditions
WO : Word-Order	DA : Dative Accusative	DAS, DAI
	AD : Accusative Dative	ADS, ADI
ST : Sentence-Type	DS : Dative Subject	DAS, ADS
	DI : Ditransitive	DAI, ADI
CT : Context	CQ : Correct: Verbs of context and stimulus are identical	All Conditions
	NQ : Neutral: No specific information about the stimulus	All Conditions
	VQ : Verb-class: Verbs mismatch, but verb-classes match	All Conditions
	WQ : Wrong-verb: Verbs mismatch, and verb-classes mismatch	All Conditions

(7.1) Experiment 3: Critical Conditions

DAS	ஷங்கருக்கு Shankar~u'-kku' [Shankar] _{DAT-An.M}	குருவைத் Guru~v-ai~th [Guru] _{ACC-An.M}	தெரியும். theri~y-um [know] _{Future-3singular.Neuter}
DAI	ஷங்கருக்கு Shankar~u'-kku' [Shankar] _{DAT-An.M}	குருவை Guru~v-ai [Guru] _{ACC-An.M}	ஞாபகப்படுத்தினேன். nya:bagappaduthth-in-e:n [remind] _{Past-1singular}
ADS	குருவை Guru~v-ai [Guru] _{ACC-An.M}	ஷங்கருக்குத் Shankar~u'-kku'~th [Shankar] _{DAT-An.M}	தெரியும். theri~y-um [know] _{Future-3singular.Neuter}
ADI	குருவை Guru~v-ai [Guru] _{ACC-An.M}	ஷங்கருக்கு Shankar~u'-kku' [Shankar] _{DAT-An.M}	அறிமுகப்படுத்தினேன். arimugappaduthth-in-e:n [introduce] _{Past-1singular}

7.3.2 Context Questions

The four possible context questions corresponding to the DAS stimulus sentence in (7.1) are presented in (7.2), which illustrates clearly that each stimulus had its own variants of all other contexts except the neutral context, which was common for all stimuli including the fillers. The correct context question, henceforth referred to simply as CQ, primed the verb of the forthcoming stimulus sentence using a double question and the correct verb in the same word-order as that of the stimulus sentence. The neutral context, hereafter referred to as NQ, was neutral and did not give any information about the forthcoming stimulus sentence, the details of which are as explained in the section on context questions in Chapter 6. The verb-class context, henceforth referred to simply as VQ, was similar to CQ, except that the context verb was, albeit from the same verb-class as that of the stimulus, a different verb⁵⁴. The wrong-verb context, hereafter referred to as WQ, was a context question similar in structure to CQ, but with a verb from a different verb-class as that of the stimulus, in effect priming for a different structure than the stimulus.

The contexts VQ and WQ will be collectively termed mismatch contexts henceforth, unless there is a need to differentiate between them. It is important to note here that the mismatch ensued neither due to the context question nor the stimulus sentence per se, but rather due to the combination of a context question *and* a stimulus sentence.

A CQ pertaining to a certain verb(form), say ‘to know’, was identical across the experiment for all the stimuli that required this as the CQ. Furthermore, the VQ and WQ variants that contained the same verb(form) were identical copies of the audio file of this CQ. This is very crucial for our present purposes, because this ensured that there would be no cue whatsoever from listening to a certain non-neutral context question with a given verb(form) as to possibly predict which *kind* of a context question (i.e., CQ, VQ or WQ) it was bound to be. In other words, listening to a non-specific context question only confirms the word-order of the forthcoming stimulus, but not *the verb*. There is equal probability (33.33 %) for the verb to turn out to be identical to that in the context (CQ), or from the same verb-class of the context verb but a different lexical item (VQ), or even a totally different kind of verb (WQ).

54. For the dative-stative sentences, two verbs were used in the affirmative and negative to get four variants as mentioned in the section on critical conditions in Chapter 5, Section 5.3. However, for a sentence with a given stative verb, the verb-class context was always constructed using the other stative verb rather than the affirmative or negative variant of the same verb, as the case may be.

(7.2) Experiment 3: Context Questions for DAS Conditions

CQ ^{Fm} DAS	யாருக்கு யாரைத் தெரியும்?
	Ya:r~u'-kku' ya:r-ai~th theri~y-um
	[Who] _{DAT-An} [who] _{ACC-An} [know] _{Future-3singular.Neuter}
	'Who knows whom?'
NQ ⁰⁰ SVS	சொல்லவந்ததை சுருக்கமாக சொல்!
	Solla-vandh-adh-ai surukkam-a:ga sol
	[Say-come-that] _{ACC-In} [briefly] _{ADV} [tell] _{Imperative-2singular}
	'Say what you wanted to briefly!'
VQ ^{Fm} DAS	யாருக்கு யாரைப் பிடிக்கும்?
	Ya:r~u'-kku' ya:r-ai~p pidi-kk-um
	[Who] _{DAT-An} [who] _{ACC-An} [like] _{Future-3singular.Neuter}
	'Who likes whom?'
WQ ^{Ar} DAI	யாருக்கு யாரை அறிமுகப்படுத்தினாய்?
	Ya:r~u'-kku' ya:r-ai arimugappaduthth-in-a:y
	[Who] _{DAT-An} [who] _{ACC-An} [introduce] _{Past-2singular}
	'Whom did (you) introduce to whom?'

7.3.3 Fillers

Fillers of various kinds were constructed to ensure the variability of stimuli. Some of these were nominative-initial transitive sentences, with an inanimate actor and either an inanimate or animate undergoer. These were presented either in CQ or NQ. The other fillers were either intransitive sentences with inanimate actors and pronoun-dropped transitive sentences with animate undergoers, which were presented in NQ alone. There were 72 fillers of each type constituting a total of 288 fillers.

7.3.4 Items Distribution

The 288 critical sentences were presented as part of one of four sets of stimuli, which were created for presentation to participants, such that in each set there were 27 sentences per critical condition per context. Thus, all participants heard all the 288 critical sentences. These stimuli were distributed according to the scheme illustrated in Appendix G.1.

Due to the fact that there were only 72 unique sentences per condition, the distribution in a certain set was done in two steps. This ensured that, when all four sets of stimuli are considered together, each critical sentence was equiprobable in every context across the four sets. Initially, 18 sentences per condition were allocated for each context, thus exhausting all the 72 sentences. Then, 9 sentences were chosen again from amongst each list of 18 sentences already chosen to be presented in a certain context, but now to be presented in one of the other three contexts. Thus 36 sentences in a certain condition occurred in two different contexts in a certain presentation set, whilst the rest of the 36 sentences in that condition occurred only in one context in that set. This procedure was repeated such that sentences that were presented only in one context in a certain set were the ones that were presented in two contexts in another set and vice versa, nevertheless in different contexts in the different sets, thus arriving at four counterbalanced sets of stimuli. The fillers were distributed similarly, such that in each of the four sets, there were 27 nominative fillers per condition in the correct and neutral contexts, and 18 single-argument fillers per condition in the neutral context alone. Thus, each set contained a total of 576 items, amongst which 432 were critical. Each set was further conditionally randomised, and the presentation of these was counterbalanced across participants. (See [Appendix F.3](#) for the list of experimental stimuli).

7.3.5 Comprehension Questions

In order to ensure that participants listened to the stimulus sentences attentively, comprehension questions were constructed, the details of which are as described for Experiment 2 in [Chapter 6, Section 6.3.5](#).

7.3.6 Auditory Stimuli

The stimulus sentences were presented auditorily as in the previous experiments. The critical stimuli used in this experiment were identical audio files from Experiment 2. Thus the acoustic analysis of the critical stimuli in Experiment 2 as reported in [Chapter 6, Section 6.4](#) also holds as it is for the critical stimuli in Experiment 3.

7.4 Methods

The experiment was performed in the EEG laboratory of the Department of English and Linguistics at the Johannes Gutenberg University in Mainz. The methods followed in Experiment 3 were as described in [Chapter 6, Section 6.5](#), with the difference that there was only one experimental session per participant.

7.4.1 Experimental Trial Structure

The structure of each trial in Experiment 3 consisted of the following phases: the presentation of the auditory context question, followed by the presentation of the auditory stimulus sentence, which in turn was followed by the acceptability judgement task and the comprehension task [Figure 7.1](#) provides a schematic illustration of the same.

The flat-screen LCD monitor was clear before the trial commenced. A fixation asterisk appeared in the centre of the screen 500 ms before the onset of the auditory context question and continued to remain visible on screen until 500 ms after the auditory stimulus sentence had ended. There was a pause of 1000 ms between the end of the context question and the beginning of the auditory stimulus. Whilst listening to the auditory context, during the short pause that followed and when the auditory stimulus was being played, participants were asked to fixate on the asterisk all along without blinking.

As soon as the fixation asterisk disappeared from the screen, a pair of smileys appeared on the screen, which prompted the participant to perform the acceptability judgement task, whereby the participant had to rate with an appropriate button press within 2000 ms, whether the combination of the context question and the auditory stimulus that preceded was acceptable or not. Note again that all our stimuli including the fillers were well-formed grammatical sentences in Tamil. Thus, this task was just a mechanism to ensure that participant paid attention to both the

Figure 7.1: Experiment 3: Schematic experimental trial.



context and the stimulus, and not a grammaticality judgement task. As soon as a response was recorded or after a time-out, as the case may be, the screen was clear for 50 ms and then the 'question' for the comprehension task appeared, which the participants were required to answer with a 'Yes' or 'No' button press within 5000 ms. Participants had to compare the comprehension question with the sentence they heard to see if they both represented one and the same meaning. If so, they were required to answer 'Yes' by pressing the appropriate button in the button box that they were provided with, 'No' otherwise. When no button was pressed within 5000 ms, a time-out was registered as the answer. After an answer was registered or a time-out occurred, as the case may be, the next trial started. There was an inter-stimulus interval of 1500 ms, that is to say, there was a 1500 ms pause between the end of a trial and the beginning of the next one.

7.4.2 The Practice Phase

Details about the practice phase are as described for Experiment 1 in Chapter 5, Section 5.5.2.

7.4.3 The Experiment Phase

In the main phase of the experiment, either of the four sets of materials as mentioned in Section 7.3.4 was chosen to be presented in 16 blocks of 36 trials each. Other details are as described for Experiment 1 in Chapter 5, Section 5.5.3.

7.4.4 EEG Data

The EEG recording and pre-processing procedures for Experiment 3 were as described for Experiment 2 in Chapter 6, Section 6.5.4.

7.5 Results

7.5.1 Behavioural Data

The mean acceptability for the various context+stimulus combinations, as well as the answering accuracy and mean reaction time in each of

7.5. RESULTS

the contexts for the different conditions were calculated using the behavioural data collected during the experiment. Table 7.2 shows the acceptability of the context+stimulus combinations, accuracy and mean reaction time across participants for the critical conditions. Only those trials in which the acceptability judgement task was performed (i.e., not timed out) were considered for the analysis. Further, the acceptability and reaction time data presented here pertain only to those trials in which the participants performed the comprehension task correctly. Perhaps not surprisingly, the best context+stimulus combination ratings were obtained for CQ, whilst the ratings for NQ were slightly lower than those for CQ. On the other hand, the ratings for the mismatch contexts VQ and WQ were significantly lower. As for the answering accuracy, there is no considerable difference between the conditions in any of the contexts, nor between the contexts. However, these data must be interpreted with caution due to the fact that these are not time-locked with the stimuli. Statistical analysis of the data (excluding fillers) was done by means of repeated-measures ANOVAs involving the within-subjects

Table 7.2: Acceptability (JUDG), Accuracy (AC) & Mean Reaction Time (RT)

Condition	JUDG %	SD	AC %	SD	RT s	SD	
CQ	DAS	95.38	9.31	96.48	3.80	2.15	0.52
	DAI	95.66	7.50	94.53	5.10	2.34	0.53
	ADS	96.77	8.51	94.98	4.90	2.19	0.52
	ADI	95.46	10.49	94.65	5.48	2.38	0.57
NQ	DAS	80.84	29.91	95.74	4.75	2.17	0.55
	DAI	77.95	34.70	93.19	5.74	2.33	0.59
	ADS	80.75	31.38	93.98	4.65	2.18	0.53
	ADI	77.08	33.16	93.68	6.35	2.34	0.52
VQ	DAS	5.90	11.73	95.84	4.37	2.29	0.53
	DAI	9.98	14.14	94.76	5.00	2.47	0.56
	ADS	5.23	9.67	94.54	5.40	2.31	0.55
	ADI	11.60	14.33	92.53	6.30	2.44	0.56
WQ	DAS	6.75	10.81	95.07	4.27	2.28	0.55
	DAI	5.99	8.42	93.11	4.67	2.44	0.52
	ADS	5.42	9.55	93.98	5.84	2.35	0.57
	ADI	4.72	8.18	94.07	4.60	2.46	0.54

factors word-order, sentence-type and context, and the random factors participants (F1) and items (F2).

7.5.1.1 Acceptability of Context+Stimulus Combinations

Table 7.3 summarises the effects on the acceptability of context+stimulus combinations. There was a main effect of context in the analyses both by participants and by items, which was resolved further by comparing the contexts pairwise. This showed a simple effect of context for all the comparisons. The interaction sentence-type x context reached significance in the analysis by participants as well as in the analysis by items, which was resolved for sentence-type, which revealed an effect of context in both sentence-types.

Table 7.3: ANOVA: Acceptability of Context+Stimulus Combination

Factor		DF	F1:Participants	DF	F2:Items
◆	CT	3,99	246.79 ***	3,213	12477.00 ***
└	CT = CQ+NQ ◆ CT	1,33	10.60 **	1,71	716.45 ***
└	CT = CQ+VQ ◆ CT	1,33	1119.00 ***	1,71	20029.00 ***
└	CT = VQ+NQ ◆ CT	1,33	144.68 ***	1,71	12060.00 ***
└	CT = CQ+WQ ◆ CT	1,33	1575.50 ***	1,71	35136.00 ***
└	CT = WQ+NQ ◆ CT	1,33	160.83 ***	1,71	13128.00 ***
└	CT = VQ+WQ ◆ CT	1,33	6.71 *	1,71	15.27 ***
◆	ST x CT	3,99	7.85 ***	3,213	5.66 ***
└	ST = DS ◆ CT	3,99	275.74 ***	3,213	4069.50 ***
	└ CT = CQ+NQ ◆ CT	1,33	9.37 **	1,71	117.04 ***
	└ CT = CQ+VQ ◆ CT	1,33	1313.10 ***	1,71	16722.00 ***
	└ CT = VQ+NQ ◆ CT	1,33	177.98 ***	1,71	3905.40 ***
	└ CT = CQ+WQ ◆ CT	1,33	1360.10 ***	1,71	15540.00 ***
	└ CT = WQ+NQ ◆ CT	1,33	179.15 ***	1,71	2830.30 ***
└	ST = DI ◆ CT	3,99	204.26 ***	3,213	3232.60 ***
	└ CT = CQ+NQ ◆ CT	1,33	11.24 **	1,71	179.90 ***
	└ CT = CQ+VQ ◆ CT	1,33	778.71 ***	1,71	5366.70 ***
	└ CT = VQ+NQ ◆ CT	1,33	110.51 ***	1,71	3225.90 ***
	└ CT = CQ+WQ ◆ CT	1,33	1549.10 ***	1,71	17265.00 ***
	└ CT = WQ+NQ ◆ CT	1,33	136.62 ***	1,71	2793.40 ***
	└ CT = VQ+WQ ◆ CT	1,33	13.35 **	1,71	19.63 ***

This was further resolved by comparing the contexts pairwise in each sentence-type, which revealed a simple effect of context for all the comparisons in both sentence-types, except for the comparison VQ + WQ in the dative-subject sentences. Notice that the F-values for the pairwise comparisons were the highest for the comparisons CQ + VQ and CQ + WQ, whereas those for the comparisons CQ + NQ and VQ + WQ were the least. This perhaps gives a first indication that the correct and mismatch contexts were maximally different, whereas the difference between the mismatch contexts as well as the difference between the correct and neutral contexts were, although significant, minimal. The verb-class context was rated more acceptable than the wrong-verb context for ditransitive stimuli, whereas this was not the case for the dative-stative stimuli.

7.5.1.2 Answering Accuracy

An overview of significant effects on the answering accuracy is shown in Table 7.4. There was a main effect of word-order in the analysis by participants, whereas the main effect of sentence-type reached significance in the analyses both by participants and by items. The interaction word-order x sentence-type was marginally significant in the analysis by participants, which when resolved for the individual levels of word-order showed a simple effect of sentence-type in the dative-accusative word-order only. Crucially, there were no effects involving context on the accuracy of answers.

Table 7.4: Repeated Measures ANOVA: Answering Accuracy

Factor	DF	F1:Participants	DF	F2:Items
♦ WO	1,33	4.16	*	
♦ ST	1,33	24.36	***	1,71 6.13 *
♦ WO x ST	1,33	3.18	*	
└WO = DA ♦ ST	1,33	17.91	***	

7.5.1.3 Reaction Time

Table 7.5 shows a summary of effects on the reaction time for the different conditions. There was a main effect of word-order in the analysis by participants alone, whereas the main effects of sentence-type and con-

text were significant in the analyses both by participants and by items. The effect of context was further resolved by comparing the contexts pairwise, which showed a simple effect of context for all the comparisons, except the comparisons CQ + NQ and VQ + WQ.

Table 7.5: Repeated Measures ANOVA: Reaction Time

Factor	DF	F1:Participants	DF	F2:Items
♦ WO	1,33	9.06	**	
♦ ST	1,33	173.56	***	1,71 58.69 ***
♦ CT	3,99	23.76	***	3,213 19.94 ***
↳CT = CQ+VQ ♦ CT	1,33	26.15	***	1,71 20.27 ***
↳CT = VQ+NQ ♦ CT	1,33	21.00	***	1,71 49.88 ***
↳CT = CQ+WQ ♦ CT	1,33	39.15	***	1,71 16.47 ***
↳CT = WQ+NQ ♦ CT	1,33	35.11	***	1,71 42.71 ***

7.5.2 ERP Data

ERPs were calculated at the verb and the statistical analysis was carried out as described in Chapter 6, Section 6.6.2. As the main motivation for this experiment was to observe the effects at the Verb in varying preceding contexts in detail, the ERPs time-locked to the onsets of NP1 and NP2 will not be discussed here⁵⁵ further.

7.5.2.1 Verb

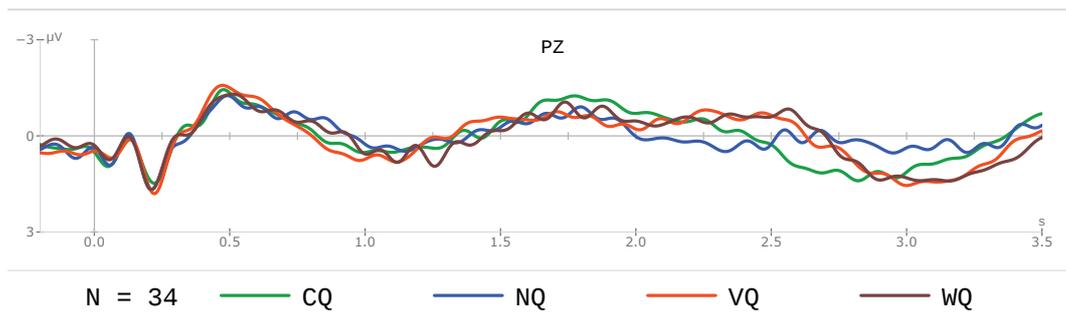
The analysis at the position of the verb was performed based on all the factors WO, ST and CT, and their levels. The statistical analysis was carried out on the ERP data after applying a baseline correction from -200 ms to 0 ms (verb onset), because there seemed to be a general difference⁵⁶ shortly prior to the onset of the verb between the ERPs in the NQ context and all other contexts, regardless of word-order and sentence-type. The ERPs time-locked to the sentence onset for all the critical conditions collapsed over these factors illustrates this clearly, as shown in Figure 7.2. Since there were no significant effects related to word-order, the ERPs comparing the effect of the four contexts at the position of the verb are shown after collapsing over word-order in

55. See Appendix G.2 for the ERPs at a few electrodes at NP1 and NP2.

56. For a brief discussion of potential reasons for this difference, see Section 7.6.

Figure 7.3 and Figure 7.4 for the dative-stative conditions and ditransitive conditions respectively. For reference purposes, the corresponding plots without baseline correction, as well as plots not collapsing over WO are shown in Appendix G.2.3. The statistical analysis was performed on the pre-processed data in four time-windows selected based on visual inspection of the ERP data at the position of the verb, namely 250–350 ms, 350–450 ms, 450–550 ms and 500–700 ms.

Figure 7.2: ERPs at Sentence Onset for all WO and ST: All Conditions.

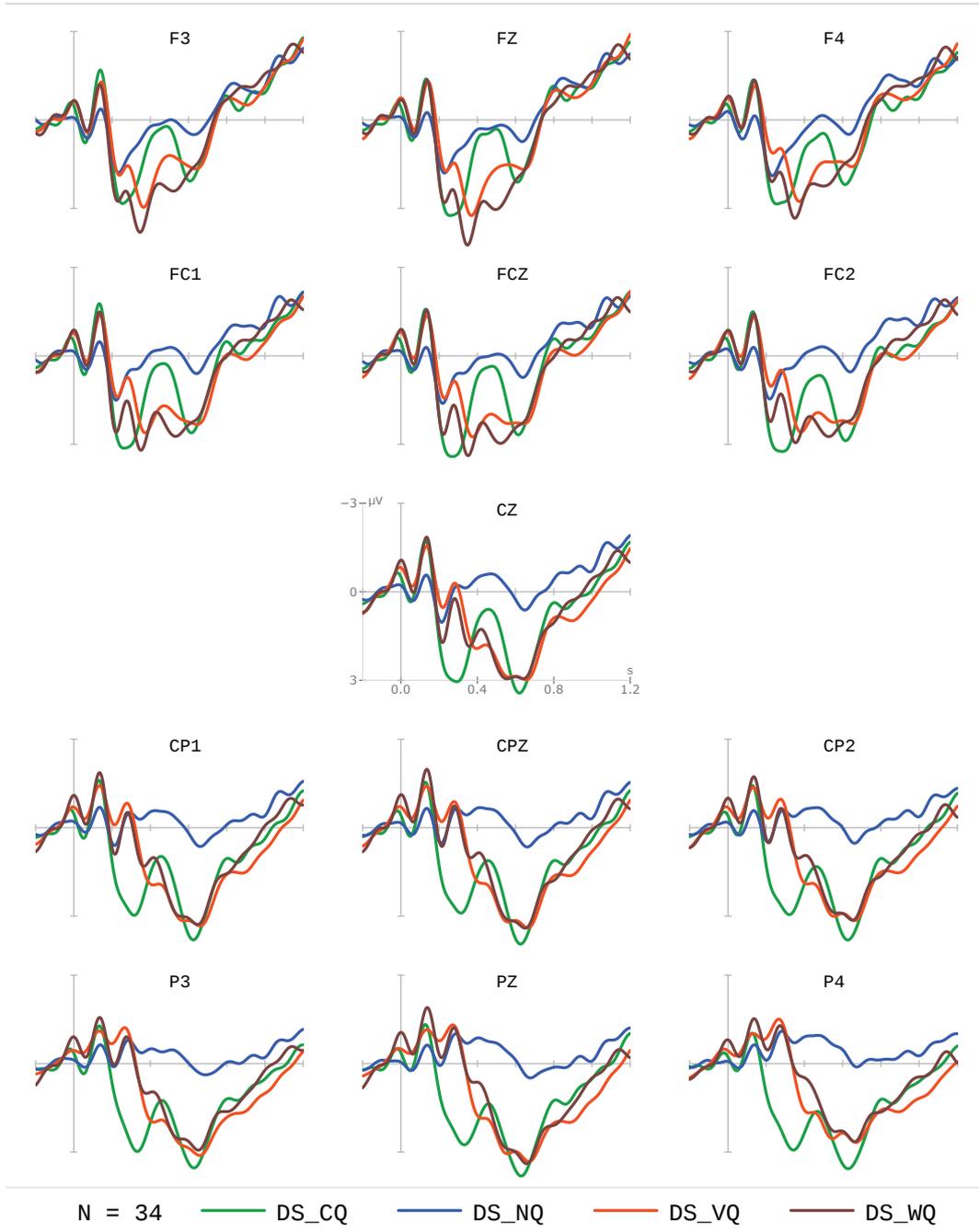


7.5.2.1.1 Verb: Time Window 250–350 ms

A general difference between the ERPs for the correct context on the one hand and all other contexts on the other that is apparent from visual inspection of the ERPs in this time-window turns out to be quite significant in the statistics in most regions. This confirms that the large positivity for the correct context conditions in both sentence-types is significant. Notwithstanding the slight differences between the two sentence-types as well as between the two word-orders, the general pattern of ERPs for all the conditions are overwhelmingly similar for a given context in this time-window, especially in the posterior regions. Additionally, in the anterior regions, differences between the ERPs for the mismatch contexts and between the wrong-verb and neutral contexts are also apparent.

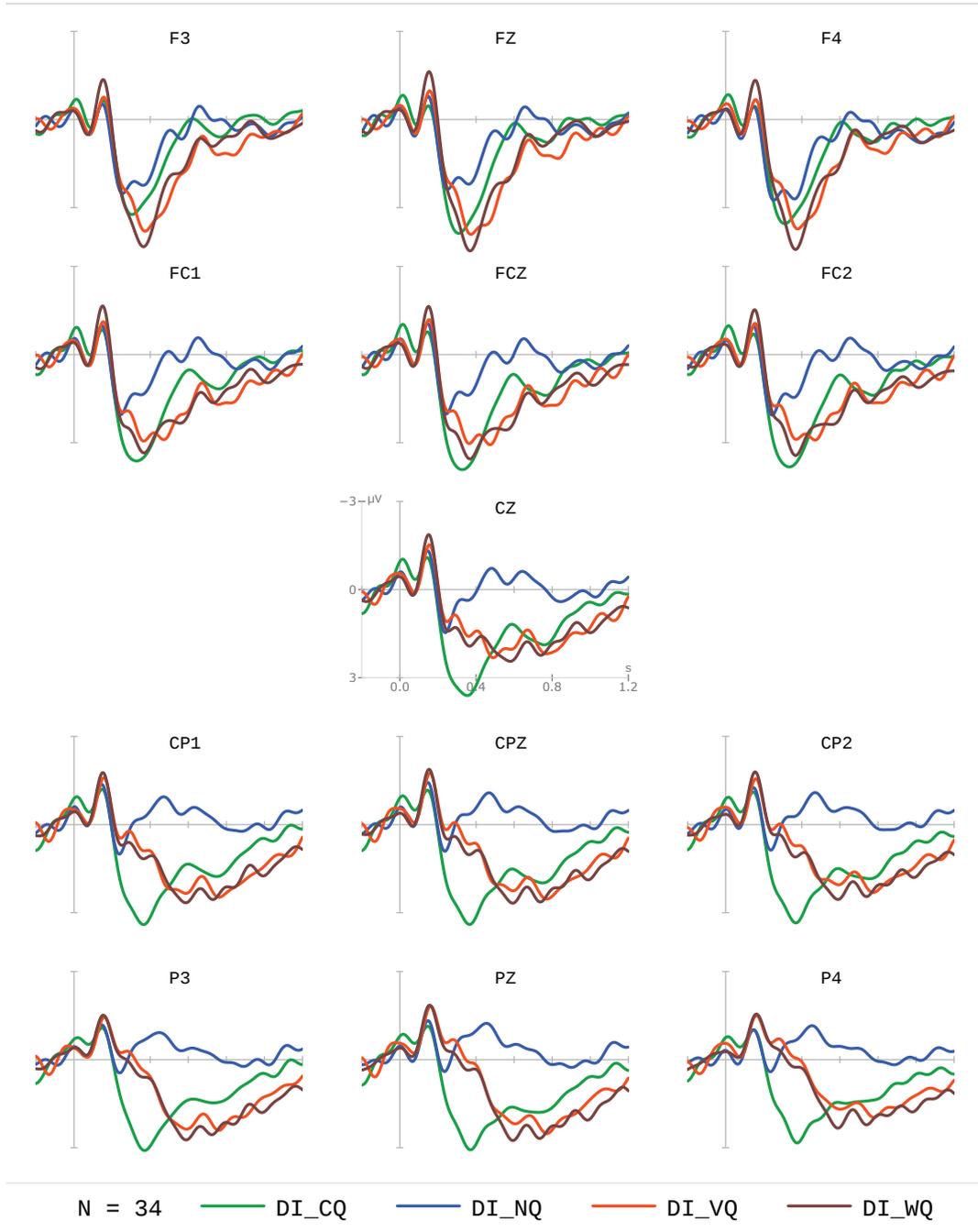
A summary of all the effects that reached at least marginal significance at the verb in the 250–350 ms time-window is shown in Table 7.6. Unless otherwise specified, all effects in the following description were significant in both the lateral and midline regions. There were main effects

Figure 7.3: Baseline Corrected ERPs at the Verb: DS Conditions.



7.5. RESULTS

Figure 7.4: Baseline Corrected ERPs at the Verb: DI Conditions.



of word-order, sentence-type and context in this time-window. The interactions ROI x word-order, ROI x sentence-type and ROI x context were also significant. The interaction word-order x context was marginally significant in the lateral regions and significant in the midline regions. The three-way interaction ROI x sentence-type x context that reached significance in the midline regions alone did not resolve further.

Resolving the interaction ROI x word-order for the individual levels of ROI showed a simple effect of word-order in all the lateral and midline regions. Resolving the interaction ROI x sentence-type, there was a simple effect of sentence-type in the left-anterior and right-anterior regions, whereas this effect was marginal in the left-posterior region. In the midline regions, this effect of sentence-type was significant in the frontal, fronto-central, central and centro-parietal midline electrodes.

The interaction ROI x context was resolved for the individual levels of ROI, which revealed a significant effect of context in all the lateral and midline regions. This was further resolved by comparing the contexts pairwise in the individual ROIs. The comparison CQ + NQ revealed a simple effect of context in all the lateral and midline regions, with the effect being marginal in the left-anterior region. This effect of context for the comparison CQ + VQ reached significance in the left-posterior, right-anterior and right posterior regions as well as in all the midline regions. The pairwise comparison CQ + WQ showed a significant effect of context in the left-posterior and right-posterior regions, and the central, centro-parietal, parietal and parieto-occipital midline electrodes. This effect of context for the comparison WQ + NQ reached significance in the left-anterior region and the fronto-central midline electrode. The comparison VQ + WQ revealed a simple effect of context in the left-anterior and right-anterior regions as well as frontal and fronto-central midline electrodes, with this effect being marginal in the central midline electrode.

The interaction word-order x context, which when resolved for the individual levels of word-order, showed an effect of context in both the dative-accusative and accusative-dative word-orders. [Figure 7.5](#) and [Figure 7.6](#) show the baseline corrected ERPs collapsed over sentence-type at the verb for the dative-accusative and accusative-dative word-orders respectively, clearly illustrating the effect of context.

This effect of context was further resolved by comparing the contexts pairwise in each word-order. In the dative-accusative word-order, this showed a simple effect of context for the comparisons CQ + NQ, CQ + VQ, CQ + WQ in the lateral as well as midline regions, whereas the

7.5. RESULTS

Table 7.6: ANOVA: ERPs at the Verb : 250–350 ms

Factor	DF	Lateral Regions	DF	Midline Regions
◆ WO	1,33	20.63 ***	1,33	25.71 ***
◆ ROI x WO	3,99	6.77 ***	5,165	13.28 ***
↳ROI = LA FZ ◆ WO	1,33	24.51 ***	1,33	26.88 ***
↳ROI = LP FCZ ◆ WO	1,33	8.76 **	1,33	34.61 ***
↳ROI = RA CZ ◆ WO	1,33	25.78 ***	1,33	31.61 ***
↳ROI = RP CPZ ◆ WO	1,33	12.19 ***	1,33	21.89 ***
↳ROI = PZ ◆ WO			1,33	9.05 **
↳ROI = POZ ◆ WO			1,33	5.91 *
◆ ST	1,33	8.64 **	1,33	6.54 **
◆ ROI x ST	3,99	6.86 ***	5,165	5.32 **
↳ROI = LA FZ ◆ ST	1,33	9.93 **	1,33	8.02 **
↳ROI = LP FCZ ◆ ST	1,33	3.14 *	1,33	7.89 **
↳ROI = RA CZ ◆ ST	1,33	13.17 ***	1,33	8.60 **
↳ROI = CPZ ◆ ST			1,33	5.26 *
◆ CT	3,99	16.61 ***	3,99	23.37 ***
◆ ROI x CT	9,297	37.34 ***	15,495	26.04 ***
↳ROI = LA FZ ◆ CT	3,99	6.70 ***	3,99	9.33 ***
↳CT = CQ+NQ ◆ CT	1,33	6.12 *	1,33	15.06 ***
↳CT = CQ+VQ ◆ CT			1,33	7.08 *
↳CT = WQ+NQ ◆ CT	1,33	15.33 ***	1,33	15.09 ***
↳CT = VQ+WQ ◆ CT	1,33	27.96 ***	1,33	27.79 ***
↳ROI = LP FCZ ◆ CT	3,99	32.04 ***	3,99	13.81 ***
↳CT = CQ+NQ ◆ CT	1,33	44.30 ***	1,33	25.16 ***
↳CT = CQ+VQ ◆ CT	1,33	62.50 ***	1,33	18.18 ***
↳CT = CQ+WQ ◆ CT	1,33	41.63 ***		
↳CT = WQ+NQ ◆ CT			1,33	13.38 ***
↳CT = VQ+WQ ◆ CT			1,33	17.17 ***
↳ROI = RA CZ ◆ CT	3,99	6.14 ***	3,99	22.34 ***
↳CT = CQ+NQ ◆ CT	1,33	9.47 *	1,33	35.73 ***
↳CT = CQ+VQ ◆ CT	1,33	14.39 ***	1,33	42.42 ***
↳CT = CQ+WQ ◆ CT			1,33	25.69 ***
↳CT = VQ+WQ ◆ CT	1,33	15.27 ***	1,33	6.66 *

Continued on next page ...

CHAPTER 7. EXPERIMENT 3

... Table 7.6 continued

Factor		DF	Lateral Regions			DF	Midline Regions		
↳ROI = RP CPZ	◆ CT	3,99	35.53	***		3,99	30.65	***	
	↳CT = CQ+NQ ◆ CT	1,33	47.13	***		1,33	43.23	***	
	↳CT = CQ+VQ ◆ CT	1,33	79.46	***		1,33	65.53	***	
	↳CT = CQ+WQ ◆ CT	1,33	52.25	***		1,33	44.80	***	
↳ROI = PZ	◆ CT					3,99	33.58	***	
	↳CT = CQ+NQ ◆ CT					1,33	44.14	***	
	↳CT = CQ+VQ ◆ CT					1,33	76.07	***	
	↳CT = CQ+WQ ◆ CT					1,33	52.60	***	
↳ROI = POZ	◆ CT					3,99	37.17	***	
	↳CT = CQ+NQ ◆ CT					1,33	46.26	***	
	↳CT = CQ+VQ ◆ CT					1,33	83.92	***	
	↳CT = CQ+WQ ◆ CT					1,33	63.04	***	
◆ WO x CT		3,99	2.37	*		3,99	2.85	*	
↳WO = DA	◆ CT	3,99	15.60	***		3,99	23.57	***	
	↳CT = CQ+NQ ◆ CT	1,33	23.17	***		1,33	37.49	***	
	↳CT = CQ+VQ ◆ CT	1,33	35.26	***		1,33	49.68	***	
	↳CT = CQ+WQ ◆ CT	1,33	15.74	***		1,33	27.01	***	
	↳CT = VQ+WQ ◆ CT	1,33	8.76	**					
↳WO = AD	◆ CT	3,99	9.55	***		3,99	12.09	***	
	↳CT = CQ+NQ ◆ CT	1,33	17.73	***		1,33	21.40	***	
	↳CT = CQ+VQ ◆ CT	1,33	13.74	***		1,33	17.70	***	
	↳CT = CQ+WQ ◆ CT					1,33	8.37	**	
	↳CT = WQ+NQ ◆ CT	1,33	8.41	**		1,33	7.75	*	
◆ ROI x ST x CT						15,495	2.48	*	

comparison VQ + WQ was significant only in the lateral regions. In the accusative-dative word-order, the comparisons CQ + NQ, CQ + VQ and WQ + NQ were significant in both the lateral and midline regions, and the comparison CQ + WQ showed a significant effect of context in the midline regions alone.

7.5.2.1.2 Verb: Time Window 350–450 ms

Similar to the previous time-window, the ERPs for the correct context conditions are different from the other contexts in this time-window as well. However, further fine-grained differences between the contexts start to emerge in this time-window. A sharp negative deflection in the ERPs for the dative-subject sentences in the correct context apparent in the frontal regions on visual inspection is confirmed by the statistics to be highly significant⁵⁷. More interestingly, the difference *between* the two mismatch contexts begin to become significant in the posterior regions for the dative-subject sentences alone, whilst the same difference is not to be seen in any of the regions for the ditransitive sentences. Further, the correct and verb-class contexts are not anymore significantly different in any of the posterior regions for the dative-subject sentences, whereas the difference between these contexts for the ditransitives is significant in all the posterior regions. That is, the ERPs in the mismatch contexts for the ditransitives, aligning together, lie between the more positive-going correct context and the negative-going neutral context. On the other hand, the ERPs for the dative-subject sentences start to show a graded difference, whereby the correct and verb-class contexts behave relatively similarly when compared to the other two contexts.

Notwithstanding the differences between the mismatch contexts in the two sentence-types, what is common amongst these in this time-window is the following: observing the ERPs in the midline electrodes starting from the anterior regions through to the posterior regions, the anterior positive deflections for the mismatch contexts that were significant in the previous time-window seem to recede to the baseline more and more to completely vanish in the central and centro-parietal regions.

Table 7.7 shows a summary of all the effects that reached at least marginal significance at the verb in the 350–450 ms time-window. Unless otherwise specified, all effects in the following description were significant in both the lateral and midline regions. There were main effects of word-order, sentence-type and context in this time-window. The interactions ROI x word-order, ROI x sentence-type, ROI x context, word-order x context and the three-way interaction ROI x sentence-type x context were also significant. The interaction sentence-type x context was marginal in the lateral regions and significant in the midline regions.

57. Notice the difference between CQ and NQ for the stative verbs in the statistics, which is totally absent in the frontal regions, becoming gradually significant as we proceed to the posterior regions.

Resolving the interaction ROI x word-order for the individual levels of ROI showed a simple effect of word-order in all the lateral and midline regions, except the parieto-occipital midline electrode. This effect was marginal in the parietal midline electrode. Resolving the interaction ROI x sentence-type, there was a simple effect of sentence-type in the left-anterior and right-anterior regions as well as the frontal, fronto-central, central and parietal-occipital midline electrodes.

The interaction ROI x context was resolved for the individual levels of ROI, which revealed a significant effect of context in all the lateral and midline regions. This was further resolved by comparing the contexts pairwise in the individual ROIs. The comparison CQ + NQ revealed a simple effect of context in the left-posterior, right-anterior and right-posterior regions as well as all the midline regions, with this effect being marginal in the frontal midline region. This effect of context for the comparison CQ + VQ was significant in the left-anterior and right-posterior regions, marginal in the left-posterior region, and significant in the frontal, centro-parietal, parietal and parieto-occipital midline regions. The comparison VQ + NQ was significant in all the lateral and midline regions. Comparing CQ + WQ, the effect of context reached significance in all the lateral regions and midline regions, except the fronto-central and central midline regions. The comparison WQ + NQ was significant in all the lateral and midline regions.

Resolving the interaction word-order x context for the individual levels of word-order showed an effect of context in both the dative-accusative and accusative-dative word-orders. This effect of context was further resolved by comparing the contexts pairwise in each word-order. In the dative-accusative word-order, this showed a simple effect of context for the comparisons CQ + NQ, VQ + NQ and WQ + NQ in the lateral as well as midline regions, whereas the comparisons CQ + VQ and CQ + WQ were significant only in the midline regions. In the accusative-dative word-order, the comparisons CQ + NQ, VQ + NQ and WQ + NQ were significant in both the lateral and midline regions.

The three-way interaction ROI x sentence-type x context was resolved for the individual levels of ROI, which showed that the interaction sentence-type x context was significant in the left-posterior and right-posterior regions, as well as all the midline regions except the frontal region. This was further resolved for the levels of sentence-type in the regions in which it was significant, which showed an effect of context for both sentence-types in all the aforementioned regions. The comparison CQ + NQ was significant for both sentence-types in the left-posterior and

7.5. RESULTS

right-posterior regions. It was also significant in all relevant midline regions for both sentence-types, except the fronto-central midline region in case of dative-subject sentences. Comparing CQ + VQ, the effect of context reached significance in all relevant regions except the fronto-central midline region for the ditransitive sentences. For the dative-subject sentences, on the other hand, it was significant in the fronto-central midline region only. The comparison VQ + NQ was significant in all relevant regions for both sentence-types. The simple effect of context when comparing CQ + WQ was significant for dative-subject sentences in the right-posterior region alone, whereas for the ditransitive sentences, it was significant in both the lateral posterior regions concerned as well as in the central, centro-parietal, parietal and parieto-occipital midline regions. The comparison WQ + NQ was significant for both sentence-types in all the regions concerned. Finally, the comparison VQ + WQ was significant for dative-subject sentences in the right-posterior region, and the parietal and parieto-central midline regions.

Figure 7.5: Baseline Corrected ERPs Collapsed over ST: DA word-order.

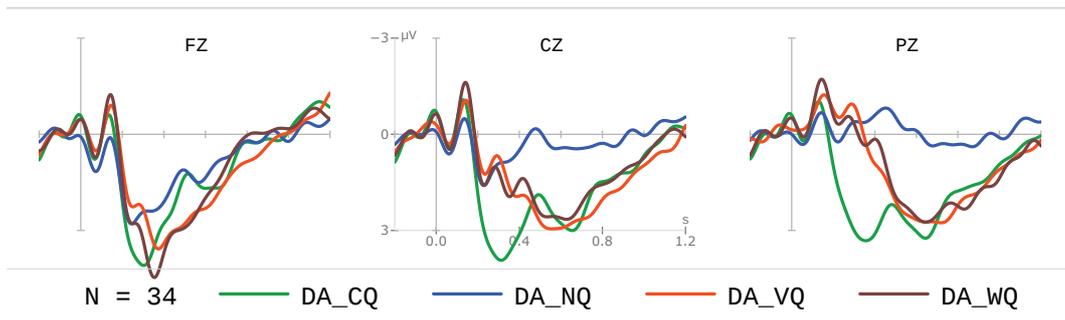
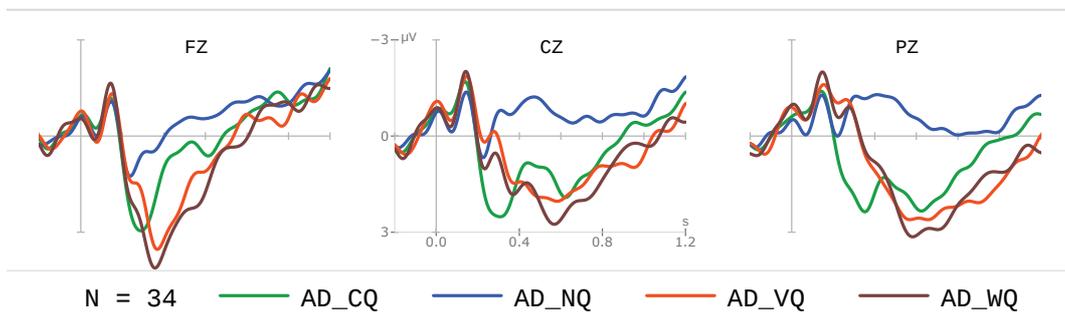


Figure 7.6: Baseline Corrected ERPs Collapsed over ST: AD word-order.



CHAPTER 7. EXPERIMENT 3

Table 7.7: ANOVA: ERPs at the Verb : 350–450 ms

Factor	DF	Lateral Regions			DF	Midline Regions		
◆ WO	1,33	17.58	***		1,33	19.98	***	
◆ ROI x WO	3,99	17.87	***		5,165	20.16	***	
↳ROI = LA FZ ◆ WO	1,33	29.88	***		1,33	30.22	***	
↳ROI = LP FCZ ◆ WO	1,33	5.58	*		1,33	37.21	***	
↳ROI = RA CZ ◆ WO	1,33	26.02	***		1,33	26.72	***	
↳ROI = RP CPZ ◆ WO	1,33	4.72	*		1,33	14.00	***	
↳ROI = PZ ◆ WO					1,33	3.61	*	
◆ ST	1,33	6.59	**		1,33	3.93	*	
◆ ROI x ST	3,99	43.93	***		5,165	60.92	***	
↳ROI = LA FZ ◆ ST	1,33	24.00	***		1,33	27.31	***	
↳ROI = FCZ ◆ ST					1,33	17.67	***	
↳ROI = RA CZ ◆ ST	1,33	24.75	***		1,33	7.08	**	
↳ROI = POZ ◆ ST					1,33	5.09	*	
◆ CT	3,99	15.16	***		3,99	14.63	***	
◆ ROI x CT	9,297	32.79	***		15,495	30.93	***	
↳ROI = LA FZ ◆ CT	3,99	15.01	***		3,99	13.25	***	
↳CT = CQ+NQ ◆ CT					1,33	4.78	*	
↳CT = CQ+VQ ◆ CT	1,33	8.18	**		1,33	5.88	*	
↳CT = VQ+NQ ◆ CT	1,33	19.84	***		1,33	18.68	***	
↳CT = CQ+WQ ◆ CT	1,33	17.55	***		1,33	11.34	**	
↳CT = WQ+NQ ◆ CT	1,33	29.24	***		1,33	27.33	***	
↳ROI = LP FCZ ◆ CT	3,99	25.07	***		3,99	10.83	***	
↳CT = CQ+NQ ◆ CT	1,33	63.30	***		1,33	13.32	***	
↳CT = CQ+VQ ◆ CT	1,33	6.10	*					
↳CT = VQ+NQ ◆ CT	1,33	27.33	***		1,33	17.94	***	
↳CT = CQ+WQ ◆ CT	1,33	9.90	**					
↳CT = WQ+NQ ◆ CT	1,33	28.33	***		1,33	24.28	***	
↳ROI = RA CZ ◆ CT	3,99	9.82	***		3,99	12.09	***	
↳CT = CQ+NQ ◆ CT	1,33	7.52	*		1,33	32.29	***	
↳CT = VQ+NQ ◆ CT	1,33	13.03	**		1,33	16.50	***	
↳CT = CQ+WQ ◆ CT	1,33	6.54	*					
↳CT = WQ+NQ ◆ CT	1,33	18.40	***		1,33	16.65	***	

Continued on next page . . .

7.5. RESULTS

... Table 7.7 continued

Factor		DF	Lateral Regions			DF	Midline Regions		
↳ROI = RP # CPZ	◆ CT	3,99	24.54	***	3,99	18.46	***		
	↳CT = CQ+NQ ◆ CT	1,33	60.22	***	1,33	55.09	***		
	↳CT = CQ+VQ ◆ CT	1,33	11.28	**	1,33	6.82	*		
	↳CT = VQ+NQ ◆ CT	1,33	20.62	***	1,33	16.79	***		
	↳CT = CQ+WQ ◆ CT	1,33	16.44	***	1,33	10.40	**		
	↳CT = WQ+NQ ◆ CT	1,33	20.16	***	1,33	14.23	***		
↳ROI = PZ	◆ CT				3,99	23.91	***		
	↳CT = CQ+NQ ◆ CT				1,33	62.84	***		
	↳CT = CQ+VQ ◆ CT				1,33	12.42	**		
	↳CT = VQ+NQ ◆ CT				1,33	17.45	***		
	↳CT = CQ+WQ ◆ CT				1,33	19.78	***		
	↳CT = WQ+NQ ◆ CT				1,33	15.22	***		
↳ROI = POZ	◆ CT				3,99	28.01	***		
	↳CT = CQ+NQ ◆ CT				1,33	61.43	***		
	↳CT = CQ+VQ ◆ CT				1,33	19.74	***		
	↳CT = VQ+NQ ◆ CT				1,33	15.99	***		
	↳CT = CQ+WQ ◆ CT				1,33	32.05	***		
	↳CT = WQ+NQ ◆ CT				1,33	14.74	***		
◆ WO x CT		3,99	5.64	***	3,99	6.93	***		
↳WO = DA	◆ CT	3,99	9.77	***	3,99	13.04	***		
	↳CT = CQ+NQ ◆ CT	1,33	28.99	***	1,33	40.39	***		
	↳CT = CQ+VQ ◆ CT				1,33	6.33	*		
	↳CT = VQ+NQ ◆ CT	1,33	12.90	**	1,33	10.58	**		
	↳CT = CQ+WQ ◆ CT				1,33	8.76	**		
	↳CT = WQ+NQ ◆ CT	1,33	13.90	***	1,33	9.05	**		
↳WO = AD	◆ CT	3,99	15.07	***	3,99	12.30	***		
	↳CT = CQ+NQ ◆ CT	1,33	20.52	***	1,33	21.50	***		
	↳CT = VQ+NQ ◆ CT	1,33	24.46	***	1,33	20.16	***		
	↳CT = WQ+NQ ◆ CT	1,33	28.64	***	1,33	25.43	***		
◆ ST x CT		3,99	2.45	*	3,99	4.83	**		
◆ ROI x ST x CT		9,297	2.90	**	15,495	2.73	*		
↳ROI = LP # FCZ	◆ ST x CT	3,99	5.03	**	3,99	4.39	**		
	↳ST = DS ◆ CT	3,99	14.68	***	3,99	9.10	***		

Continued on next page ...

CHAPTER 7. EXPERIMENT 3

... Table 7.7 continued

Factor			DF	Lateral Regions			DF	Midline Regions		
L _{ROI} =	CZ	◆ ST x CT	L _{CT} = CQ+NQ ◆ CT	1,33	32.23	***				
			L _{CT} = CQ+VQ ◆ CT				1,33	6.00	*	
			L _{CT} = VQ+NQ ◆ CT	1,33	25.67	***	1,33	14.74	***	
			L _{CT} = CQ+WQ ◆ CT				1,33	8.45	**	
			L _{CT} = WQ+NQ ◆ CT	1,33	16.03	***	1,33	15.52	***	
			L _{ST} = DI	◆ CT	3,99	21.59	***	3,99	8.32	***
			L _{CT} = CQ+NQ ◆ CT	1,33	47.60	***	1,33	19.17	***	
			L _{CT} = CQ+VQ ◆ CT	1,33	16.45	***				
			L _{CT} = VQ+NQ ◆ CT	1,33	18.95	***	1,33	14.06	***	
			L _{CT} = CQ+WQ ◆ CT	1,33	10.19	**				
			L _{CT} = WQ+NQ ◆ CT	1,33	23.01	***	1,33	20.01	***	
			L _{ST} = DS	◆ CT				3,99	5.98	***
								3,99	7.35	***
								1,33	11.20	**
L _{ROI} =	RP CPZ	◆ ST x CT	L _{CT} = VQ+NQ ◆ CT				1,33	15.71	***	
			L _{CT} = WQ+NQ ◆ CT				1,33	10.73	*	
			L _{ST} = DI	◆ CT			3,99	12.97	***	
			L _{CT} = CQ+NQ ◆ CT			1,33	31.58	***		
			L _{CT} = CQ+VQ ◆ CT			1,33	8.48	**		
			L _{CT} = VQ+NQ ◆ CT			1,33	10.78	**		
			L _{CT} = CQ+WQ ◆ CT			1,33	5.72	*		
			L _{CT} = WQ+NQ ◆ CT			1,33	13.51	***		
			L _{ST} = DS	◆ CT	3,99	3.91	**	3,99	5.63	**
					3,99	17.60	***	3,99	9.93	***
					1,33	36.13	***	1,33	27.58	***
					1,33	21.53	***	1,33	16.62	***
					1,33	13.75	***			
					1,33	12.15	**	1,33	8.37	**
		1,33	9.17	**						
L _{ST} = DI	◆ CT	3,99	18.03	***	3,99	18.37	***			
		1,33	43.69	***	1,33	42.39	***			
		1,33	17.07	***	1,33	17.18	***			
		1,33	8.85	**	1,33	9.98	**			

Continued on next page ...

7.5. RESULTS

... Table 7.7 continued

Factor			DF	Lateral Regions			DF	Midline Regions		
L _{ROI} =	PZ	◆ ST x CT	L _{CT} = CQ+WQ ◆ CT	1,33	10.40	**	1,33	11.66	**	
			L _{CT} = WQ+NQ ◆ CT	1,33	13.16	**	1,33	11.58	**	
		L _{ST} = DS	◆ CT				3,99	5.30	**	
			L _{CT} = CQ+NQ ◆ CT				3,99	14.61	***	
				L _{CT} = VQ+NQ ◆ CT			1,33	41.18	***	
				L _{CT} = VQ+NQ ◆ CT			1,33	19.30	***	
				L _{CT} = CQ+WQ ◆ CT			1,33	9.22	**	
				L _{CT} = WQ+NQ ◆ CT			1,33	8.88	**	
				L _{CT} = VQ+WQ ◆ CT			1,33	6.95	*	
		L _{ST} = DI	◆ CT				3,99	21.11	***	
			L _{CT} = CQ+NQ ◆ CT				1,33	44.34	***	
				L _{CT} = CQ+VQ ◆ CT			1,33	23.73	***	
				L _{CT} = VQ+NQ ◆ CT			1,33	8.42	**	
				L _{CT} = CQ+WQ ◆ CT			1,33	15.88	***	
		L _{CT} = WQ+NQ ◆ CT			1,33	11.69	**			
L _{ROI} =	POZ	◆ ST x CT	L _{CT} = CQ+WQ ◆ CT				3,99	3.72	*	
			L _{CT} = WQ+NQ ◆ CT				3,99	18.09	***	
		L _{ST} = DS	◆ CT				3,99	18.09	***	
			L _{CT} = CQ+NQ ◆ CT				1,33	46.18	***	
				L _{CT} = VQ+NQ ◆ CT			1,33	17.38	***	
				L _{CT} = CQ+WQ ◆ CT			1,33	23.92	***	
				L _{CT} = WQ+NQ ◆ CT			1,33	7.22	*	
				L _{CT} = VQ+WQ ◆ CT			1,33	7.56	*	
		L _{ST} = DI	◆ CT				3,99	21.20	***	
			L _{CT} = CQ+NQ ◆ CT				1,33	39.61	***	
				L _{CT} = CQ+VQ ◆ CT			1,33	26.60	***	
				L _{CT} = VQ+NQ ◆ CT			1,33	6.82	*	
				L _{CT} = CQ+WQ ◆ CT			1,33	16.84	***	
				L _{CT} = WQ+NQ ◆ CT			1,33	11.80	**	

7.5.2.1.3 Verb: Time Window 450–550 ms

The frontal regions are the main focus of this time-window. Two crucial points that apply only to the dative-subject sentences are apparent from the statistics. On the one-hand, there is no difference at all between the neutral and correct contexts in the left frontal electrode sites. On the other, the mismatch contexts are significantly different. Further, the morphology of the ERP curves in the correct context for the stative sentences can be viewed as a relatively strong indicator for a negativity. That is, the negativity for the dative-subject sentences in the correct context peaks such that there is no difference at all between the neutral and correct contexts, which is not the case for the ditransitives, in which case these two contexts still behave differently. That is, in the case of ditransitives, the mismatch contexts are the most positive-going and the neutral context the most negative, with the ERPs for the correct context beginning to lie in between.

Given these observations, it is reasonable to speculate that the slight negative peaks in the mismatch contexts in the frontal regions for the dative-subject sentences also constitute a negativity. This is crucial, because this suggests that this negativity is specific to the dative-stative sentences and it is modulated by the preceding context. That is, there is a significant graded negativity in the anterior regions for the dative-subject sentences, whereby the correct and neutral contexts, aligning together, are the most negative, whereas the verb-class context, whilst still slightly less negative than the correct context, however turns out to be significant at least in the left-anterior region, with the wrong-verb context being the least negative of all in this time-window.

A summary of all the effects that reached at least marginal significance at the verb in the 450–550 ms time-window is shown in [Table 7.8](#). Unless otherwise specified, all effects in the following description were significant in both the lateral and midline regions. There were main effects of word-order and context in this time-window, whereas the main effect of sentence-type was marginal in the lateral regions alone. The interactions ROI x word-order, ROI x sentence-type, ROI x context and the three-way interaction ROI x sentence-type x context were significant.

Resolving the interaction ROI x word-order for the individual levels of ROI showed a simple effect of word-order in all the left-anterior, left-posterior and right-anterior regions as well as the frontal, fronto-central, central and cento-parietal midline regions. The interaction ROI x sentence-type, which when resolved, showed a significant simple effect of sentence-

type in the anterior lateral regions as well as the frontal and fronto-central midline regions. This effect was marginal in the parietal and parieto-occipital midline regions.

The interaction ROI x context, which when resolved for the individual levels of ROI, showed a significant effect of context in all the lateral and midline regions. This was further resolved by comparing the contexts pairwise in the individual ROIs. The comparison CQ + NQ revealed a simple effect of context in all the regions except the left anterior region and the frontal midline region. This effect of context for the comparison CQ + VQ was significant in the anterior lateral regions as well as the frontal and fronto-central midline regions. It was marginal in the central midline region. The comparison VQ + NQ was significant in all the lateral and midline regions. Comparing CQ + WQ, the effect of context reached significance in the anterior lateral regions and the fronto-central midline region, and was marginal in the frontal midline region. The comparison WQ + NQ was significant in all the lateral and midline regions.

The three-way interaction ROI x sentence-type x context was resolved for the individual levels of ROI, which showed an effect of the interaction sentence-type x context in the left-anterior region as well as in the frontal, fronto-central and central midline regions, with this effect reaching marginal significance in the right-anterior and right-posterior regions as well as the centro-parietal midline region. This interaction was further resolved for the levels of sentence-type in the regions in which it was significant, which showed an effect of context in both sentence-types in all the aforementioned regions. The comparison CQ + NQ was significant for dative-subject sentences in the right-posterior region as well as the central and centro-parietal midline regions, whereas for the ditransitive sentences, this was significant in all the regions concerned. The simple effect of context when comparing CQ + VQ was significant for the dative-subject sentences in the anterior lateral regions and all the relevant midline regions. For the ditransitive sentences, this effect was significant in the left-anterior region and the frontal midline region, whereas it was marginally significant in the right-anterior region and the fronto-central midline region. Comparing VQ + NQ, the effect of context reached significance in all the relevant regions for both sentence-types. The comparison CQ + WQ revealed a significant simple effect of context for the dative-subject sentences in the anterior lateral regions as well as the frontal, fronto-central and central midline regions. For the ditransitive sentences, this effect was significant in the left-anterior region and marginal in the frontal midline region. The comparison WQ + NQ was significant for both sentence-types in all the regions concerned.

CHAPTER 7. EXPERIMENT 3

Table 7.8: ANOVA: ERPs at the Verb : 450–550 ms

Factor	DF	Lateral Regions			DF	Midline Regions		
◆ WO	1,33	13.55	***		1,33	12.12	***	
◆ ROI x WO	3,99	20.93	***		5,165	24.17	***	
↳ROI = LA FZ ◆ WO	1,33	25.03	***		1,33	21.87	***	
↳ROI = LP FCZ ◆ WO	1,33	5.74	*		1,33	21.43	***	
↳ROI = RA CZ ◆ WO	1,33	18.13	***		1,33	14.89	***	
↳ROI = CPZ ◆ WO					1,33	8.01	**	
◆ ST	1,33	3.39	*					
◆ ROI x ST	3,99	8.02	***		5,165	10.14	***	
↳ROI = LA FZ ◆ ST	1,33	7.39	**		1,33	7.01	**	
↳ROI = FCZ ◆ ST					1,33	4.50	*	
↳ROI = RA ◆ ST	1,33	9.10	**					
↳ROI = PZ ◆ ST					1,33	3.45	*	
↳ROI = POZ ◆ ST					1,33	3.21	*	
◆ CT	3,99	27.12	***		3,99	26.44	***	
◆ ROI x CT	9,297	11.42	***		15,495	14.92	***	
↳ROI = LA FZ ◆ CT	3,99	18.60	***		3,99	18.93	***	
↳CT = CQ+VQ ◆ CT	1,33	13.98	***		1,33	14.25	***	
↳CT = VQ+NQ ◆ CT	1,33	28.88	***		1,33	31.33	***	
↳CT = CQ+WQ ◆ CT	1,33	21.91	***		1,33	18.73	*	
↳CT = WQ+NQ ◆ CT	1,33	33.93	***		1,33	34.81	***	
↳ROI = LP FCZ ◆ CT	3,99	31.16	***		3,99	22.55	***	
↳CT = CQ+NQ ◆ CT	1,33	33.38	***		1,33	9.48	**	
↳CT = CQ+VQ ◆ CT					1,33	12.55	**	
↳CT = VQ+NQ ◆ CT	1,33	51.27	***		1,33	42.63	***	
↳CT = CQ+WQ ◆ CT					1,33	13.99	***	
↳CT = WQ+NQ ◆ CT	1,33	59.30	***		1,33	43.48	***	
↳ROI = RA CZ ◆ CT	3,99	18.04	***		3,99	26.17	***	
↳CT = CQ+NQ ◆ CT	1,33	8.26	**		1,33	27.50	***	
↳CT = CQ+VQ ◆ CT	1,33	13.99	***		1,33	4.81	*	
↳CT = VQ+NQ ◆ CT	1,33	30.69	***		1,33	50.40	***	
↳CT = CQ+WQ ◆ CT	1,33	11.60	**					
↳CT = WQ+NQ ◆ CT	1,33	27.81	***		1,33	47.65	***	

Continued on next page . . .

7.5. RESULTS

... Table 7.8 continued

Factor		DF	Lateral Regions			DF	Midline Regions		
L _{ROI} = RP CPZ	◆ CT	3,99	25.77	***	3,99	28.48	***		
	L _{CT} = CQ+NQ ◆ CT	1,33	33.47	***	1,33	41.47	***		
	L _{CT} = VQ+NQ ◆ CT	1,33	43.22	***	1,33	45.92	***		
	L _{CT} = WQ+NQ ◆ CT	1,33	54.90	***	1,33	50.77	***		
L _{ROI} = PZ	◆ CT				3,99	28.48	***		
	L _{CT} = CQ+NQ ◆ CT				1,33	46.14	***		
	L _{CT} = VQ+NQ ◆ CT				1,33	40.72	***		
	L _{CT} = WQ+NQ ◆ CT				1,33	53.58	***		
L _{ROI} = POZ	◆ CT				3,99	23.43	***		
	L _{CT} = CQ+NQ ◆ CT				1,33	41.82	***		
	L _{CT} = VQ+NQ ◆ CT				1,33	32.56	***		
	L _{CT} = WQ+NQ ◆ CT				1,33	45.90	***		
◆ ROI x ST x CT		9,297	5.38	***	15,495	5.57	***		
L _{ROI} = LA FZ	◆ ST x CT	3,99	3.86	**	3,99	4.09	**		
	L _{ST} = DS ◆ CT	3,99	12.30	***	3,99	14.91	***		
	L _{CT} = CQ+VQ ◆ CT	1,33	7.82	*	1,33	8.47	**		
	L _{CT} = VQ+NQ ◆ CT	1,33	11.33	**	1,33	11.59	**		
	L _{CT} = CQ+WQ ◆ CT	1,33	20.58	***	1,33	21.76	***		
	L _{CT} = WQ+NQ ◆ CT	1,33	24.14	***	1,33	31.12	***		
	L _{CT} = VQ+WQ ◆ CT	1,33	9.24	**	1,33	11.77	**		
	L _{ST} = DI ◆ CT	3,99	14.83	***	3,99	12.04	***		
	L _{CT} = CQ+NQ ◆ CT	1,33	6.00	*	1,33	5.17	*		
	L _{CT} = CQ+VQ ◆ CT	1,33	12.97	**	1,33	10.46	**		
	L _{CT} = VQ+NQ ◆ CT	1,33	29.97	***	1,33	30.93	***		
	L _{CT} = CQ+WQ ◆ CT	1,33	7.70	*	1,33	4.89	*		
	L _{CT} = WQ+NQ ◆ CT	1,33	20.02	***	1,33	17.57	***		
	L _{ROI} = FCZ	◆ ST x CT				3,99	2.67	*	
L _{ST} = DS ◆ CT					3,99	15.11	***		
L _{CT} = CQ+VQ ◆ CT					1,33	12.98	**		
L _{CT} = VQ+NQ ◆ CT					1,33	19.25	***		
L _{CT} = CQ+WQ ◆ CT					1,33	17.97	***		
L _{CT} = WQ+NQ ◆ CT					1,33	27.62	***		
L _{ST} = DI ◆ CT					3,99	16.84	***		

Continued on next page ...

... Table 7.8 continued

Factor		DF	Lateral Regions		DF	Midline Regions			
L _{ROI} = RA CZ	◆ ST x CT	L _{CT} = CQ+NQ ◆ CT	1,33	16.80	***				
		L _{CT} = CQ+VQ ◆ CT	1,33	4.93	*				
		L _{CT} = VQ+NQ ◆ CT	1,33	48.95	***				
		L _{CT} = WQ+NQ ◆ CT	1,33	36.78	***				
	L _{ST} = DS	◆ CT	3,99	2.31	*	3,99	2.95	*	
		◆ CT	3,99	14.24	***	3,99	18.17	***	
		L _{CT} = CQ+NQ ◆ CT				1,33	10.93	**	
		L _{CT} = CQ+VQ ◆ CT	1,33	11.62	**	1,33	11.03	**	
		L _{CT} = VQ+NQ ◆ CT	1,33	17.31	***	1,33	30.64	***	
		L _{CT} = CQ+WQ ◆ CT	1,33	17.88	***	1,33	9.53	**	
		L _{CT} = WQ+NQ ◆ CT	1,33	25.95	***	1,33	31.05	***	
		L _{ST} = DI	◆ CT	3,99	10.14	***	3,99	20.88	***
			L _{CT} = CQ+NQ ◆ CT	1,33	11.37	**	1,33	31.45	***
			L _{CT} = CQ+VQ ◆ CT	1,33	5.19	*			
L _{CT} = VQ+NQ ◆ CT	1,33		25.67	***	1,33	54.29	***		
L _{ROI} = RP CPZ	◆ ST x CT	L _{CT} = WQ+NQ ◆ CT	1,33	13.36	***	1,33	42.58	***	
		◆ CT	3,99	2.50	*	3,99	2.33	*	
		L _{ST} = DS	◆ CT	3,99	20.93	***	3,99	19.47	***
		L _{CT} = CQ+NQ ◆ CT	1,33	23.16	***	1,33	21.98	***	
	L _{ST} = DI	L _{CT} = CQ+VQ ◆ CT				1,33	5.52	*	
		L _{CT} = VQ+NQ ◆ CT	1,33	33.48	***	1,33	30.80	***	
		L _{CT} = WQ+NQ ◆ CT	1,33	36.93	***	1,33	32.11	***	
		◆ CT	3,99	17.59	***	3,99	23.01	***	
		L _{CT} = CQ+NQ ◆ CT	1,33	31.59	***	1,33	39.87	***	
		L _{CT} = VQ+NQ ◆ CT	1,33	34.89	***	1,33	46.37	***	
		L _{CT} = WQ+NQ ◆ CT	1,33	37.08	***	1,33	43.33	***	

Comparing VQ + WQ, the simple effect of context was significant in the left-anterior region and the frontal midline region for the dative-subject sentences alone.

7.5.2.1.4 Verb: Time Window 500–700 ms

This time-window mainly concerns the late positivities with a significant posterior distribution. The dative-stative sentences engender a two-way gradation in this effect, namely $VQ = WQ = CQ > NQ$. The ditransitive sentences, by contrast, engender a three-way gradation, namely $VQ = WQ > CQ > NQ$. The ERPs in the correct context for the ditransitives continue to recede towards the baseline, lying in between the ERPs of the neutral context and the two mismatch contexts that are still aligned with each other, receding from their late-positive peaks. The ERPs for the dative-subject sentences all show a clearly discernible late-positive peak. Additionally, there seems to be a slight difference between the word-orders according to the statistics, whereby the correct and wrong-verb contexts are different in the accusative-dative word-order alone. On closer inspection, this is quite plausibly due to the slightly more positive-going ERPs for the wrong-verb context as opposed to the correct context in case of ditransitive conditions in the accusative-dative word-order (see plots for the individual word-orders in [Appendix G.2.3](#)). However, this effect does not significantly affect the interaction of subject-type and context in the posterior regions. Moreover, since critical hypotheses all concerned effects pertaining to sentence-type, this effect is not relevant to the questions under consideration and therefore will not be discussed further.

[Table 7.9](#) shows a summary of all the effects that reached at least marginal significance at the verb in the 500–700 ms time-window. Unless otherwise specified, all effects in the following description were significant in both the lateral and midline regions. There were main effects of word-order, sentence-type and context in this time-window, and the interactions ROI x word-order and ROI x context also reached significance. The interactions ROI x sentence-type and word-order x context were significant in the midline regions alone, whereas the interaction sentence-type x context and the three-way interaction ROI x sentence-type x context were significant in the lateral regions alone. The three-way interaction ROI x word-order x sentence-type was marginal in the midline regions, which however did not resolve further.

Resolving the interaction ROI x word-order for the individual levels of ROI revealed a significant effect of word-order in all regions but the right-posterior region and the parietal and parieto-occipital midline regions. The interaction ROI x sentence-type, which when resolved for the individual levels of ROI, showed a significant effect of sentence-type in all the midline regions.

The interaction ROI x context was resolved for the individual levels of ROI, which revealed a significant effect of context in all the lateral and midline regions. This was further resolved by comparing the contexts pairwise in the individual ROIs. The comparison CQ + NQ revealed a simple effect of context in all regions but the left anterior region and the frontal midline region. This effect was marginal for the comparison CQ + VQ in the left-anterior region alone. Comparing VQ + NQ revealed a significant effect in all the regions. The comparison CQ + WQ was marginal in the left-anterior and left-posterior regions as well as the fronto-central midline region. The comparison WQ + NQ was significant in all the regions.

Resolving the interaction word-order x context revealed a significant effect of context in the midline regions for both word-orders, which was further resolved by comparing the contexts pairwise in each word-order (see [Figure 7.5](#) and [Figure 7.6](#)). The comparisons CQ + NQ, VQ + NQ and WQ + NQ showed a simple effect of context in both word-orders, whilst the comparison CQ + WQ was significant in the accusative-dative word-order alone.

The three-way interaction ROI x sentence-type x context was resolved for the levels of ROI, which revealed a significant interaction in the posterior lateral regions. Resolving this interaction further for the individual levels of sentence-type showed an effect of context for both sentence-types in the aforementioned regions. The comparisons CQ + NQ, VQ + NQ and WQ + NQ showed a simple effect of context for both sentence-types in both regions, whilst the comparisons CQ + VQ and CQ + WQ were significant for the ditransitive sentences in the left-posterior region alone.

7.5. RESULTS

Table 7.9: ANOVA: ERPs at the Verb : 500–700 ms

Factor	DF Lateral Regions			DF Midline Regions		
◆ WO	1,33	17.34	***	1,33	14.71	***
◆ ROI x WO	3,99	31.65	***	5,165	34.60	***
↳ROI = LA FZ ◆ WO	1,33	33.61	***	1,33	33.24	***
↳ROI = LP FCZ ◆ WO	1,33	6.74	**	1,33	29.85	***
↳ROI = RA CZ ◆ WO	1,33	27.36	***	1,33	20.03	***
↳ROI = CPZ ◆ WO				1,33	8.26	**
◆ ST	1,33	16.14	***	1,33	26.97	***
◆ ROI x ST				5,165	4.61	*
↳ROI = FZ ◆ ST				1,33	5.28	*
↳ROI = FCZ ◆ ST				1,33	7.07	**
↳ROI = CZ ◆ ST				1,33	25.15	***
↳ROI = CPZ ◆ ST				1,33	44.04	***
↳ROI = PZ ◆ ST				1,33	32.01	***
↳ROI = POZ ◆ ST				1,33	18.09	***
◆ ROI x WO x ST				5,165	3.08	*
◆ CT	3,99	21.59	***	3,99	24.37	***
◆ ROI x CT	9,297	13.13	***	15,495	11.86	***
↳ROI = LA FZ ◆ CT	3,99	9.12	***	3,99	7.96	***
↳CT = CQ+VQ ◆ CT	1,33	5.22	*			
↳CT = VQ+NQ ◆ CT	1,33	18.65	***	1,33	16.36	***
↳CT = CQ+WQ ◆ CT	1,33	5.39	*	1,33	4.85	*
↳CT = WQ+NQ ◆ CT	1,33	18.30	***	1,33	16.55	***
↳ROI = LP FCZ ◆ CT	3,99	33.21	***	3,99	14.10	***
↳CT = CQ+NQ ◆ CT	1,33	39.67	***	1,33	11.64	**
↳CT = VQ+NQ ◆ CT	1,33	52.35	***	1,33	29.62	***
↳CT = CQ+WQ ◆ CT	1,33	4.68	*			
↳CT = WQ+NQ ◆ CT	1,33	56.08	***	1,33	28.17	***
↳ROI = RA CZ ◆ CT	3,99	8.09	***	3,99	23.84	***
↳CT = CQ+NQ ◆ CT	1,33	7.48	*	1,33	31.55	***
↳CT = VQ+NQ ◆ CT	1,33	14.52	***	1,33	43.50	***
↳CT = WQ+NQ ◆ CT	1,33	14.46	***	1,33	43.42	***
↳ROI = RP CPZ ◆ CT	3,99	25.99	***	3,99	30.61	***

Continued on next page . . .

CHAPTER 7. EXPERIMENT 3

... Table 7.9 continued

		Factor	DF	Lateral Regions			DF	Midline Regions		
$\downarrow_{ROI} =$	PZ	$\downarrow_{CT} = CQ+NQ \quad \blacklozenge \quad CT$	1,33	32.72	***	1,33	48.46	***		
		$\downarrow_{CT} = VQ+NQ \quad \blacklozenge \quad CT$	1,33	38.31	***	1,33	47.82	***		
		$\downarrow_{CT} = WQ+NQ \quad \blacklozenge \quad CT$	1,33	44.25	***	1,33	52.54	***		
$\downarrow_{ROI} =$	POZ	$\blacklozenge \quad CT$				3,99	32.13	***		
		$\downarrow_{CT} = CQ+NQ \quad \blacklozenge \quad CT$				1,33	54.80	***		
		$\downarrow_{CT} = VQ+NQ \quad \blacklozenge \quad CT$				1,33	46.68	***		
$\blacklozenge \quad WO \times CT$	$\downarrow_{WO} = DA$	$\downarrow_{CT} = WQ+NQ \quad \blacklozenge \quad CT$				1,33	54.13	***		
		$\blacklozenge \quad CT$				3,99	27.54	***		
		$\downarrow_{CT} = CQ+NQ \quad \blacklozenge \quad CT$				1,33	49.82	***		
$\blacklozenge \quad WO \times CT$	$\downarrow_{WO} = AD$	$\downarrow_{CT} = VQ+NQ \quad \blacklozenge \quad CT$				1,33	39.85	***		
		$\downarrow_{CT} = WQ+NQ \quad \blacklozenge \quad CT$				1,33	43.63	***		
		$\blacklozenge \quad CT$				3,99	3.22	*		
$\blacklozenge \quad ST \times CT$	$\downarrow_{ST} = DS$	$\blacklozenge \quad CT$				3,99	16.73	***		
		$\downarrow_{CT} = CQ+NQ \quad \blacklozenge \quad CT$				1,33	25.55	***		
		$\downarrow_{CT} = VQ+NQ \quad \blacklozenge \quad CT$				1,33	30.94	***		
$\blacklozenge \quad ROI \times ST \times CT$	$\downarrow_{ROI} = LP$	$\downarrow_{CT} = WQ+NQ \quad \blacklozenge \quad CT$				1,33	28.07	***		
		$\blacklozenge \quad CT$				3,99	20.22	***		
		$\downarrow_{CT} = CQ+NQ \quad \blacklozenge \quad CT$				1,33	26.84	***		
$\blacklozenge \quad ST \times CT$	$\downarrow_{ST} = DI$	$\downarrow_{CT} = VQ+NQ \quad \blacklozenge \quad CT$				1,33	30.61	***		
		$\downarrow_{CT} = CQ+WQ \quad \blacklozenge \quad CT$				1,33	6.07	*		
		$\downarrow_{CT} = WQ+NQ \quad \blacklozenge \quad CT$				1,33	42.82	***		
$\blacklozenge \quad ROI \times ST \times CT$			3,99	3.08	*					
$\blacklozenge \quad ROI \times ST \times CT$			9,297	2.39	*					
$\blacklozenge \quad ST \times CT$	$\downarrow_{ST} = DS$	$\blacklozenge \quad ST \times CT$				3,99	5.14	**		
		$\blacklozenge \quad CT$				3,99	27.81	***		
		$\downarrow_{CT} = CQ+NQ \quad \blacklozenge \quad CT$				1,33	47.99	***		
$\blacklozenge \quad ST \times CT$	$\downarrow_{ST} = DI$	$\downarrow_{CT} = VQ+NQ \quad \blacklozenge \quad CT$				1,33	39.50	***		
		$\downarrow_{CT} = WQ+NQ \quad \blacklozenge \quad CT$				1,33	44.44	***		
		$\blacklozenge \quad CT$				3,99	25.38	***		
$\blacklozenge \quad ROI \times ST \times CT$	$\downarrow_{ROI} = LP$	$\downarrow_{CT} = CQ+NQ \quad \blacklozenge \quad CT$				1,33	17.12	***		
		$\downarrow_{CT} = CQ+VQ \quad \blacklozenge \quad CT$				1,33	10.23	**		
		$\downarrow_{CT} = VQ+NQ \quad \blacklozenge \quad CT$				1,33	51.43	***		
$\blacklozenge \quad ST \times CT$	$\downarrow_{ST} = DS$	$\downarrow_{CT} = CQ+WQ \quad \blacklozenge \quad CT$				1,33	11.23	**		

Continued on next page ...

7.5. RESULTS

... Table 7.9 continued

Factor		DF	Lateral Regions	DF	Midline Regions
L _{ROI} = RP	L _{CT} = WQ+NQ ♦ CT	1,33	48.56 ***		
	♦ ST x CT	3,99	4.99 **		
	L _{ST} = DS			♦ CT	3,99 28.07 ***
				L _{CT} = CQ+NQ ♦ CT	1,33 40.19 ***
				L _{CT} = VQ+NQ ♦ CT	1,33 35.51 ***
				L _{CT} = WQ+NQ ♦ CT	1,33 41.32 ***
	L _{ST} = DI			♦ CT	3,99 14.28 ***
				L _{CT} = CQ+NQ ♦ CT	1,33 15.82 ***
				L _{CT} = VQ+NQ ♦ CT	1,33 24.78 ***
				L _{CT} = WQ+NQ ♦ CT	1,33 28.65 ***

7.5.3 Summary of Results

We compared the processing of dative-stative verbs in comparison to ditransitive verbs under differing context-induced expectations about the stimulus.

To summarise the effects at the position of the verb, some of the effects observed were common to both verb-types, whilst others are specific to the dative-stative verbs. Common effects included the early positivities with a posterior maximum in the correct contexts, the early positivities with an anterior maximum in the verb-class and wrong-verb contexts, and the late positivities in the verb-class and wrong-verb contexts, regardless of word-order differences. The effects specific to dative-stative sentences were the apparently graded negativity followed by the late positivities in all three non-neutral conditions. These results appear to have provided a first indication of effects specific to dative-stative verbs, and in turn the processing of dative-subjects and default-agreement.

7.6 Discussion

Experiment 3 attempted to observe the effects at the position of the verb in detail by exploiting the context design to evoke expectations about the stimulus that either matched or mismatched the actual stimulus. As the focus of this experiment was to gain insights into the processing of dative-stative verbs and ditransitive verbs, such that effects specific to a certain verb-type could be observed given these differing expectations, the argument positions were not considered for analysis in Experiment 3 from the outset. Accordingly, the hypotheses in Experiment 3 were solely for the position of the verb.

Given the prior results at the position of the verb in Experiment 2, stimuli were presented in four contexts in Experiment 3, which included the correct and neutral contexts, as well as two mismatch contexts. The verb in these mismatch context questions were either from the same verb-class of that in the stimulus, but lexically different (VQ), or from the opposite verb-class (WQ). In other words, these mismatch contexts induce the expectation for a certain lexical item, which would then not be met with the forthcoming stimulus sentence.

Unlike in Experiment 2, a judgement task to rate the acceptability of the context+stimulus combination was introduced in Experiment 3, such that participants had to pay attention to the context question in order to

perform well in the task. The judgement task was crucial, because in the absence of such a task, one could easily blend the context question out, as it were, only to attend to the stimulus to perform the comprehension task. The consequence of such a judgement task is that, we must expect task-related effects such as the P300, or variants thereof.

Further, we expected to observe at least minimal differences between the two sentence-types at the position of the verb, for the following reasons. First, the results⁵⁸ at the position of the verb in Experiment 2 suggest that the two verb-types behave differently in the later stages of processing, whereby the dative-stative verbs are much more positive-going than the ditransitive verbs. Second, the two verb-types are indeed different with respect to their agreement patterns and the subject that they take. Third, the stative verbs have an alternative meaning, that is a literal non-stative meaning (see [Appendix C](#)), whereas the ditransitive verbs do not have an alternative meaning.

As for the neutral context, it was not clear whether the additional contexts and the judgement task would have an influence in Experiment 3, such that the neutral context behaved differently from others. We nevertheless did not expect significant differences between the neutral and the correct contexts.

The results obtained at the position of the verb in Experiment 3 show a complex pattern of effects, some of which are common to both sentence-types, with others differing between the sentence-types. A reasonable question to raise at this point before venturing into the interpretation of the data is, why are the data so different between Experiment 2 and Experiment 3, given that the stimuli used in both experiments were identical. If the ERPs at the verb look very different in Experiment 2 and Experiment 3, it is not only because the tasks were different in these experiments, but also because of the differences in the experimental (context) conditions. A crucial difference between Experiment 2 and Experiment 3 lies in the fact that in the former, if the context question happened to be non-neutral, stimuli following it *always* met the expectations induced by the context question, whereas in the latter, the stimulus that followed a non-neutral context question might match in some cases and might not match in other cases.

Contrary to what we expected, the ERPs in the neutral context in both

58. These results from Experiment 2, whilst indicative of a processing difference between the two verb-types, must however be interpreted with caution in view of the significant acoustic differences between the two. See discussion in [Chapter 6, Section 6.7.2](#)

sentence-types, whilst similar to those in Experiment 2, differed considerably in comparison to the non-neutral contexts in Experiment 3. The ERPs in the non-neutral contexts were more negative right at the onset of the verb than those in the neutral context, regardless of word-order or sentence-type. A first and obvious question that this gives rise to is the following. Could this be due to the fact that the judgement task was somehow irrelevant in the neutral context? Whilst this could have been a possibility, the behavioural data suggest that participants indeed performed some sort of judgement in the neutral context, too. The ratings in the behavioural data for the context+stimulus combinations for the critical conditions in the neutral context seem to clearly illustrate this fact (see Table 7.2 in Section 7.5). The neutral context conditions, whilst relatively less acceptable than the correct context conditions (> 95%), were indeed rated as highly acceptable (> 77%) than the mismatch context conditions (< 12%). Such graded ratings would not have resulted when the judgement task were irrelevant in the neutral context, especially given that all our stimuli were acceptable and well-formed sentences in Tamil.

Furthermore, whilst the non-neutral contexts always induced a strong expectation for a verb, no such expectation ensued in the neutral context, because the forthcoming sentence could be any of the critical or filler sentences. Thus, following a dative-accusative or accusative-dative structure in the auditory stream, any stative or ditransitive verb would render a proper closure to the sentence unfolding. Support for such an expectancy-based interpretation stems from the fact that the ERPs in the non-neutral contexts were more negative⁵⁹ right before the onset of the verb than those in the neutral context, regardless of word-order or sentence-type. However, such a difference could not be observed from the onset of the sentence.

On closer inspection, the ERPs in the non-neutral contexts actually begin to appear more negative compared to those in the neutral context just about when the case-marker of NP2 is encountered in the auditory stream. A possible interpretation for this could be the following. All non-neutral contexts were double questions with a clause-final verb, and the non-neutral context question and the corresponding stimulus that followed were always in the identical word-order. However, it was only after encountering the case-marker of NP2 that the argument order was indeed confirmed to be as expected. At that point, the context-induced expectation for a particular verb becomes more relevant, but

59. As stated in Section 7.5.2, this is the reason why we used a baseline correction from -200–0 ms for the ERPs at the position of the verb.

only in the non-neutral contexts, because the processing system does not have a strong expectation for a particular verb in the neutral context. Similar expectancy-based sustained negative variations have been described as Contingent Negative Variation, or CNV in short (Grey Walter, Cooper, Aldridge, McCallum, & Winter, 1964). Whilst we think that such an interpretation fits our data quite well, we do not claim it to be conclusive. A possible counter-argument for such an interpretation would be the absence of a sustained effect over the entire duration of the sentence in our data. However, the absence of a specific expectation for the argument positions in all contexts might explain this. In any case, none of the interpretations of other effects depend upon the interpretation of this difference between contexts as a CNV.

A second question with regard to the ERPs in the neutral context is about the apparent absence of a sentence-closure positivity in the neutral context conditions unlike in Experiment 2. We argue that this is because the other later effects are much more positive in both sentence-types compared to the neutral context, such that any closure positivity in the neutral context could not become apparent—neither visually nor statistically—in comparison.

As for the non-neutral contexts, the results at the verb showed striking similarities between sentence-types in an early time-window (250–350 ms), whilst the differences between the two verb-types became apparent in later time-windows (350–450 ms and 500–700 ms). The ERPs in the neutral context served as the baseline with which to compare those in the non-neutral contexts. In view of the complex pattern of data obtained, we discuss two possible interpretations thereof. Each of the two interpretations has its own merits, whilst at the same time each one gives rise to several questions.

7.6.1 Categorisation-based Account

7.6.1.1 Categorisation Positivities

A first interpretation for the early positivities elicited by CQ and the late positivities elicited by the mismatch contexts VQ and WQ is along the lines of task-related stimulus categorisation that Roehm et al. (2007) and Kretschmar (2010) propose for their data obtained using antonymies to evoke strong expectations about the stimuli. As per this idea, the processing system tries to categorise forthcoming stimuli as meeting or not meeting prior expectations, eliciting a positivity with posterior

maximum in both cases, but with one crucial difference: when the expectations are met, this positivity is evoked earlier, whereas it is elicited later in the case when the expectation about the stimulus is not met. They further argue that both these positivities must be variants of the P300 component, particularly the P3b.

In the present case, expectations about forthcoming stimuli are evoked by the various non-neutral contexts. Since one of the tasks was to judge whether the context+stimulus combination was acceptable, there is good reason to believe that participants attended to the verb in the context question, in turn developing expectations about the stimulus verb. A comparison of the judgement ratings for the CQ conditions with those for the mismatch conditions VQ and WQ reveal this fact clearly (see Table 7.2).

Therefore, given that participants had clear expectations as to the verb, and given that the stimulus verb either fully matched with or mismatched entirely from that of the context, the early positivity for CQ in both sentence-types could be plausibly interpreted to reflect the fact that the expectation about the stimulus verb is fully met. As for the mismatch contexts VQ and WQ, in which the stimulus verb is lexically different regardless of whether it is from the identical or the other verb-class, these contexts necessitate a full lexical access in order for the stimulus to be convincingly categorised as not meeting the expectations. Accordingly, the positivities elicited by the mismatch contexts reflect this delay. The fact that the neutral context did not evoke a similar response is explained by the fact that it was, after all, neutral such that there was no specific expectation for a certain lexical item, and thus in line with this line of argumentation.

7.6.1.2 Other Effects

The other effects not directly related to the categorisation account are the apparent graded negativity that the stative verbs elicited in the non-neutral contexts and a second positivity ensuing for these verbs in the correct context. As for the early positivities with an anterior distribution for both sentence-types in the mismatch contexts, they are not predicted by the categorisation account as such. However, we argue that all the effects mentioned here are specific to the stative verbs, the motivations for and interpretations of which we discuss in detail when presenting the alternative account for our data in sections further below.

7.6.1.3 Categorisation-based Account: Summary

To summarise the categorisation-based account, the early positivities in CQ as well as the late positivities in VQ and WQ for both sentence-types are said to reflect the process of stimulus categorisation. The positivity ensues earlier in CQ because the stimulus could be categorised as matching the expectations as soon as the first syllable(s) are clear in the auditory stream, and because full lexical processing was already accomplished when processing the context question. However, the positivity ensues later in VQ and WQ because stimuli could not be categorised without a full lexical access.

7.6.1.4 Categorisation-based Account: Open Questions

Whilst such an account for our data seems to be quite plausible, it is not without its weaknesses. It leaves us with more open questions than it answers. The first and most obvious one amongst these would be the following. Regardless of what the exact interpretation of the second positivity in the late time-window for the dative-stative verbs in CQ would be, it appears to be specific to the processing of stative verbs, and unrelated to the experimental task⁶⁰. The other non-neutral contexts VQ and WQ also show an identical positive peak for the dative-stative verbs. The question is, contrary to what the categorisation account would predict, why is there no difference observable between CQ on the one hand, and the mismatch contexts VQ and WQ on the other?

The second question that derives from the above is, whether the late positivities in VQ and WQ for the stative verbs are perhaps a variant of the second positivity in CQ for these verbs. If so, are these positivities in VQ and WQ a combination of the positivity ensuing due to stimulus categorisation and that resulting from the specific process(es) related to processing stative verbs? That is, whether the late positivities in VQ and WQ reflect an overlap of effects reflecting two distinct processes?

The third question relates to the early positivities with an anterior distribution for both sentence-types in the mismatch contexts VQ and WQ. Whilst the stimulus categorisation based account would predict positivities with a posterior maximum, that is the P3b class of P300s, it is

60. Recall that the stative verbs elicited more positive-going ERPs in Experiment 2, in which there was no judgement task. Moreover, the neutral context in Experiment 3, whilst still much different from the other contexts, nevertheless shows a slight positive peak for the dative-subject sentences.

not clear how this account would explain the anterior positivities that obtained in our data.

7.6.2 Match-Mismatch Account

7.6.2.1 Basic Idea

In view of the questions that the categorisation-based account raises, we propose an alternative interpretation for our data that partly coincides with the previous interpretation but differs in important ways. Dubbed the match-mismatch account, it harks back to results from extensive studies on the P300 using the three-stimulus variant of the oddball paradigm involving a standard stimulus, a target stimulus and a distractor that is a non-target, and tries to provide a relatively more parsimonious account for the pattern of results in our data.

The basic idea is to view our stimuli broadly along the following lines. Given a non-neutral context question, there is an expectation for a specific type of verb, in fact a specific lexical item. This lexical item then would be the *target* in the oddball paradigm parlance. Unlike the oddball paradigm using tones though, there is no standard stimulus in the present case, given the linguistic nature of the stimuli. So the actual forthcoming stimulus could either match this expectation fully or mismatch it altogether, with no other option to reckon with. Moreover, given the number of possible context+stimulus combinations, the target and non-targets are dynamic, in that they differ from trial to trial. For a particular trial, the lexical item identical to the verb in the context question is the target, whilst all other verbs are non-targets. Recall that there is equal probability (33.33 %) for the verb to turn out to be identical to that in the context (CQ), or from the same verb-class of the context verb but a different lexical item (VQ), or even a totally different kind of verb (WQ). Further, all verbforms are equally probable in the context questions as well as the stimuli, and for a given word-order and sentence-type, combinations of a certain context verb and a stimulus verb across contexts are also equally probable.

7.6.2.2 Task-relevant Effects

Observing the pattern of results in our data with this idea in the background, let us consider the effects that are common to both sentence-types in a certain context to begin with. These are the early positivities

with a posterior maximum in the correct context CQ, the early positivities with an anterior distribution in the mismatch contexts VQ and WQ, and the late positivities with a posterior distribution in the mismatch contexts VQ and WQ. Of these, we argue that the early positivities are task-relevant effects, whilst the late positivities are sentence-type specific effects. We discuss the task-relevant common effects in the following sections.

7.6.2.2.1 Posterior Early Positivity: CQ

As mentioned earlier, given that one of the tasks was a judgement about the context+stimulus combination, participants attended to the verb in the context questions and developed expectations about the stimulus verb. Stimuli in the correct context contained verbs that matched the expectation for a certain lexical item fully, and were detected as such, thereby eliciting an early positivity with a posterior maximum. This is in line with previous findings for stimuli meeting prior expectations. For instance, detected target stimuli in the oddball paradigm have been consistently found to elicit early positivities with posterior maxima, that is the P3b (Polich & Criado, 2006; Katayama & Polich, 1999, for example). Similar results have been found for linguistic stimuli, whereby expected completions in a highly restricted sentence context (antonyms) elicited an early positivity with a posterior distribution (Roehm et al., 2007; Kretschmar, 2010). Thus, the early positivity that we found for both sentence-types in the correct context CQ could be plausibly classified as an instance of the P3b component.

7.6.2.2.2 Anterior Early Positivity: VQ and WQ

The opposite situation arises in the mismatch contexts VQ and WQ. In these contexts, the forthcoming stimulus sentence deviates from the expectation induced by the context at the position of the verb. That the stimulus verb is different from what is expected becomes apparent already after attending to the first syllable of the verb, because all the verbs used in both sentence-types were phonologically distinct at their onsets. Stimuli in these mismatch contexts contained verbs that mismatched the context verb lexically in one of two different ways: in VQ, the verb was a different verb from the same verb-type, whilst in WQ, the verb was from the other verb-type. However, the fact that both mismatch contexts elicited an early positivity with an anterior distribution seems

to suggest that what mattered was whether there was a mismatch, and not what kind of a mismatch.

Nevertheless, the slightly larger positivity for WQ than for VQ turns out to be significant in the statistics regardless of sentence-type. There is a simple effect of context in the pairwise-comparison VQ+WQ in the time-window 250–350 ms in the anterior regions alone. A first explanation for this could be that the type of mismatch indeed played a role after all, but not to the extent as to influence the eliciting of the positivity in the first place. Alternatively, if it is true that the verbs could be distinguished right after their first syllable became clear, the constrained set of verbs used in our study and the fact that the onsets of the stative verbs were distinctive from those of the ditransitive verbs in our stimuli might also explain the difference. Either way, the exact reason for the difference does not play a role for the interpretation of the anterior positivity at the moment (but see the discussion in Chapter 8, Section 8.1.3).

Anterior early positivities of this sort have not been observed for linguistic stimuli until now. However, these are known to be elicited in the three-stimulus oddball paradigm not only by novel non-target stimuli (Courchesne et al., 1975), but also by non-novel non-target stimuli which are hard to distinguish from target stimuli (Katayama & Polich, 1998; Comerchero & Polich, 1999; Wronka et al., 2008). All of these studies argued that the anterior positivities that they found were P3a or variants thereof. In view of the fact that part of the task in our study involved attending to the verb for judgements purposes, and given the anterior distribution of the early positivities in the mismatch contexts VQ and WQ, it could be plausibly argued that these effects directly reflect the mismatch between the expectation for a certain lexical item and the actual stimulus verb that is a non-target that does not match this expectation. Thus, the anterior early positivities could be plausibly classified as the P3a component.

Before discussing the other effects, we acknowledge that such an interpretation (especially of the anterior early positivities) could be quite controversial, given that there are no other results from the linguistic domain to support this claim. However, given our experimental design, and the robust pattern of these anterior effects with virtually no difference between the two sentence-types as far as the mismatch contexts in the early time-window are concerned, any other kind of interpretation would leave much to be desired as to its parsimony. Moreover, with the data that is at hand, no other plausible interpretation is readily forthcoming for why a conflict between the expectation for a particu-

lar lexical item induced by the context and the actual stimulus verb at such a relatively early stage of processing should elicit such robust anterior positivities very different from the other two contexts, namely CQ and NQ. Nevertheless, whilst we claim that such an interpretation is the most plausible parsimonious account for the anterior early positivities at this stage, it clearly requires further examination (see the discussion on task-related effects in [Chapter 8](#), [Section 8.1.3](#), and [Chapter 9](#)).

One could argue at this point about the validity of our interpretation in view of its inconsistency with regard to studies in the linguistic domain mentioned above that reported posterior early positivities when expectation were met (Roehm et al., 2007; Kretzschmar, 2010), which however did not find anterior positivities of any sort when expectations were not met. These studies used highly restrictive sentence contexts, namely antonyms, which thus induce strong expectations about the potential sentence completion. By virtue of the property of antonymy, there is always a concrete decision of whether the completion matched or mismatched the induced expectation. Given this, the question is why did they not find an anterior early positivity effect comparable to ours when the expectations were not met.

To this, we answer by arguing that there is simply no condition in these studies comparable and equivalent to the mismatch context conditions in our study. This is because of the inherent property of antonymy, which is that there is usually a single lexical item that is the antonym of another, and any other item is going to be a mismatch and ‘not correct’ at the same time. For instance, consider the colour ‘black’, the opposite of which is clearly ‘white’, at least as far as the general consensus and usual knowledge about the world is concerned. Although ‘yellow’ is quite close and related to the concept of ‘white’, a sentence such as ‘*The opposite of black is yellow.*’ is not felicitous, and in a sense ‘not correct’ because in fact it violates the general knowledge about the world for most of us. A sentence such as ‘*The opposite of black is nice.*’ only makes it worse, again due to the inherent property of antonymy. Whilst these conditions indeed introduced a mismatch, they could do so only by violating the general property of antonyms, and thus world-knowledge. It is also crucial that this known fact about antonyms is true regardless of the experimental set up. Simply put, any lexical item other than the actual antonym is bound to render such a sentence infelicitous.

By contrast, recall that all the critical stimuli in our study are grammatical, acceptable, well-formed and felicitous sentences in Tamil. The mismatch in the contexts VQ and WQ is induced simply by virtue of the verb

in the stimulus not lexically matching with that in the context question that preceded. Such a mismatch notwithstanding, none of the stative or ditransitive verbs used in our stimuli would render the stimulus sentence infelicitous in spite of their being not identical to the context verb. In other words, participants are led to expect to encounter the identical verb that they heard in the context question in the stimulus sentence as well. However, if the actual verb happens to be different, which it does in the mismatch context conditions, this indeed is a mismatch to what one was led to expect, but nevertheless acceptable, felicitous and well-formed. Thus the mismatch is simply on a lexical semantic level rather than a violation of world knowledge or the like. This property of our design is very unlike the related and unrelated conditions in the antonym studies referred to above, in which case such a manipulation is not possible due to the inherent property of antonyms.

Simply put, in case of a mismatch with the contextual expectations, if the stimulus violates world-knowledge (as in the antonym studies), no anterior early positivity ensues⁶¹. On the other hand, if there is no violation involved but only a mismatch with prior expectations (as in Experiment 3), an anterior early positivity obtains. Our results thus seem to suggest that the context in which a stimulus occurs as well as the property of the stimulus itself do matter.

7.6.2.3 Sentence-type specific effects

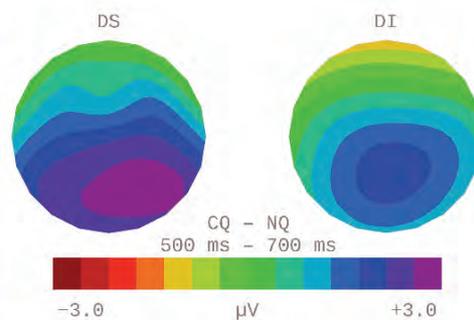
Although both sentence-types in the mismatch contexts VQ and WQ elicited late positivities with a posterior distribution, a sentence-type specific interpretation appears to be more plausible rather than treating them as a common context-dependent effect. This is for the following reasons. In the time-window between the early and late positivities, a statistically significant graded negativity is observable in the frontal electrodes for the dative-stative verbs, whilst no such difference in the ERPs is apparent for the ditransitive verbs. The late positivities elicited by the mismatch contexts are almost identical to the late positivity observable for the correct context in case of the dative-stative verbs, whereas the distribution of the late positivities is very different between contexts for

61. Such a conclusion does not appear to be specific to world-knowledge violations. It also seems to hold for stimuli that engender a violation in the context of the prior discourse, but are otherwise semantically acceptable in isolation and do not engender a world-knowledge violation. See for instance van Berkum, Hagoort, & Brown (1999); van Berkum, Zwitserlood, Hagoort, & Brown (2003). The different focus of these articles notwithstanding, their data however do not show anterior early positivities.

the ditransitive verbs, which show a three-way distinction between the non-neutral contexts. Results at the position of the verb from Experiment 2, in which the stimuli were identical to those in Experiment 3, also support such an interpretation, given that the ditransitive verbs in that experiment showed no sign of a positivity in this time-window. And perhaps the most compelling motivation supporting a sentence-type specific interpretation of effects in the late time-window is the topography pertaining to the correct context in the two sentence-types.

Figure 7.7 shows the topographic map⁶² of the ERPs at the position of the verb in the time-window 500–700 ms for the two sentence-types in the correct context, after the effects for the neutral context in each case has been subtracted. As the topographic map illustrates, the late positivity for the dative-stative verbs in the correct context is focussed towards right-posterior electrode sites, whereas the effect for the ditransitive verbs is bilaterally distributed. This suggests that the effect elicited by the dative-stative verbs in this time-window, although superficially appearing to be similar, is indeed different from that elicited by the ditransitive verbs. A possible confound for such an interpretation could

Figure 7.7: Topographic Map for the ERPs at the Verb: 500–700 ms.



be the vast difference between the durations of the verbs concerned. As the acoustic analysis shows (see Chapter 6, Section 6.4, Table 6.2), the ditransitive verbs are doubly longer than the stative verbs. This is one of the crucial motivations for not comparing the two verb-types directly in Experiments 2 and 3. In Experiment 3, due to the task-related early positivities, it is relatively difficult to decide whether the rightmost

62. Topographic maps for all the non-neutral contexts after subtracting the effects for the neutral context from them are shown in Appendix G.2.3 separately for the four time-windows selected for the statistical analysis.

flank of the ERP curve for the ditransitive verbs in the correct context is actually a positivity without a clear peak or rather it results from the task-related early positivity receding towards the baseline relatively slowly due to the duration differences between the verb-types. However, a quick comparison of the ERPs pertaining to the two verb-types in Experiment 2 would be of help here, given that there was no judgement task and accordingly no task-related early positivities were observed in that experiment. By extension, this of course meant that any effect observed there was due specifically to the difference between the verb-types. Indeed, such a comparison reveals that the two verb-types behave radically differently in the time-window 500–700 ms, in which the effect of sentence-type was highly significant in all the regions in Experiment 2, whereby the ERPs for the stative verbs are positive-going, whereas those for the ditransitive verbs are not.

To be sure, both Experiment 2 and Experiment 3 include potential confounds for the interpretation of the later effects. In Experiment 2, it was the need to compare the verb-types directly, whereas in Experiment 3, it was the early effects that are task-related. Nevertheless, the overall evidence appears to be compatible with an additional late positivity specific to the dative-stative verbs. Thus, effects in the late time-window could be reasonably argued to be sentence-type specific rather than dependent upon context.

7.6.2.3.1 Later effects for DS

The late positivities observed for the dative-stative verbs in all three non-neutral contexts, we argue, are specific to the stative verbs rather than task-driven in some way. However, let us begin by discussing the late positivity observed for CQ in the dative-stative conditions first, given that evidence for a sentence-type specific interpretation for the effects in the later time-windows is strongest in this condition, as motivated in the previous section.

The late positivity for the dative-stative verbs in the correct context CQ is a novel and surprising finding, in that it is elicited by a well-formed stimulus sentence that fully meets prior expectations. A possible clue for such an effect lies in the fact that no such clear second positive peak could be observed for the ditransitive conditions in the correct context. That is, the difference in this effect could be convincingly attributed to the difference between processing a dative-stative verb as opposed to processing a ditransitive verb.

Recall that a crucial difference between the ditransitive verbs and dative-stative verbs is that, the former agree with the person, number and gender features of their overt or covert nominative subject, whilst the latter do not with their dative counterpart. Thus, the second positive peak observed for the dative-stative verbs in the correct context could perhaps be argued to reflect the processing of default-agreement. Given that default-agreement is rather an exception than the rule in case of an overwhelming majority of Tamil verbs, there could indeed be a mechanism whereby this is processed slightly differently from other verbs, which could then elicit this positivity. The fact that no such positivity ensued for the ditransitive verbs seems to support this argument.

If we indeed interpret that the second positivity to reflect the processing of default-agreement, a potential explanation for the effect seems to be the following. When the dative-stative verb is encountered, the bottom-up agreement information indicates a third-person neuter singular noun to be the subject of the sentence. However, because the sentence expresses a state of affairs involving two animate participants, the only possibility to express it is the dative-accusative pattern of stative sentences, in which the presence of a nominative noun (which would be a subject with which the verb agreement information would have matched) would render it ungrammatical. The processing system is thus confronted with conflicting information from the context and the already encountered clause on the one hand, and the bottom-up verb information on the other. The former suggests a dative-subject, whilst the latter a third-person neuter singular noun as the nominative subject.

One could argue at this point that such a conflict is not plausible, given that stative verbs always show default-agreement. However, as indicated earlier in the section on Tamil Dative case in [Chapter 4](#), the stative verbs also have a literal non-stative meaning, in which case the subject would be nominative. So the processing system must first realise, as it were, that it is dealing with the stative meaning that calls for the exceptional agreement rather than the literal meaning.

Thus, once the conflict is recognised, the non-literal stative meaning is retrieved. This process results in an enriched composition process, whereby the final interpretation of the sentence is arrived at based upon the non-literal stative meaning of the verb. Alternatively, given that the context and stimulus combination resembled a dialogue, one could argue that the discourse context is updated with the information inferred from the stative meaning. Whilst both processes have been shown to elicit a late positivity ([Burkhardt, 2007](#); [Schumacher, 2011](#)), we find the

enrichment account more promising for our data. This is due to the fact that, although the context and stimulus combinations indeed sounded like dialogues, there is no *new information* that needs to be or could be *inferred* from the ‘dialogue’ in a given trial to update the discourse. Rather, abandoning the literal meaning, the interpretation must be enriched with the stative meaning.

Therefore, the second positive peak that the dative-stative verbs elicited in the correct context could potentially reflect indirectly⁶³ the processing of default-agreement. If it is true, then given that the sentences were identical in all contexts, there is good reason to believe that the late positivities ensuing for stative verbs in the mismatch contexts VQ and WQ also reflect the same underlying mechanism, namely the processing of default-agreement. Such an interpretation draws support from the fact that the positive peaks in all three contexts almost coincide with each other. However, the question raised earlier in Section 7.6.1.4 about whether the positivities in the mismatch contexts reflect an overlap of effects reflecting two distinct processes remains. In view of the findings from previous studies (Roehm et al., 2007; Kretzschmar, 2010, for instance) for stimuli that do not match prior expectations, one might argue that the late positivities in VQ and WQ could at least in part reflect the late categorisation of stimuli as mismatching. In this respect, they may not be specific to a sentence-type.

7.6.2.3.2 Graded negativity for DS

Converging evidence for this line of argumentation stems from what appears to be a graded frontal negativity for the non-neutral conditions in the dative-subject conditions in the order $NQ = CQ > VQ > WQ$. This effect appears quite counter-intuitive in the first instance, and seems to go entirely in the opposite direction when we consider previous accounts of the N400 into account. However, it may not be the first time that an expected completion of a well-formed sentence in an entailing context elicited a negativity. Indeed, it has been shown that contextual expectation interacts with semantic integration, for instance, when a figurative meaning of an idiomatic collocation is involved. These expected completions in an entailing sentence context elicited a frontally distributed N400 for collocations with figurative meanings (Molinaro & Carreiras, 2010).

63. Default-agreement provides the crucial information for enrichment to take place. However, the positivity is thought to reflect the enriched composition rather than the processing of agreement per se.

Whilst we do not claim the negativity the present case to be an instance of the N400, it is however quite clear that parallels could be drawn to the above-mentioned study. The following points seem to support such an interpretation. Firstly, it is the most expected completion (CQ) that elicited the largest negativity. Secondly, retrieval of a non-literal meaning is involved in the present case, too, albeit not a figurative meaning but a stative meaning. Thirdly, the verb-class context showed a decreased negativity, which could be explained by the fact that, even though the lexical item is different, the expectation for the verb-class that requires the retrieval of the non-literal meaning is met. The ERPs for the WQ context are the least negative-going, because accessing the non-literal meaning was not entailed by that context, that is, there was no expectation evoked by WQ in case of dative-stative sentences to the effect that there might be a non-literal meaning involved.

An obvious question that such an interpretation would give rise to is, whether the bottom-up information (that is, the agreement information in the present case) is indeed capable of evoking such an apparently strong conflict with prior expectations so as to modulate the negativity based upon the context. Indeed, a recent study submitted for publication has found that implausible words that otherwise elicit a larger negativity may elicit an N400 smaller in amplitude, provided there was some bottom-up information suggesting that the word, albeit unexpected, was going to be highly informative. In their study, Lotze et al. (Submitted) presented participants with sentences with implausible completions, and found that the N400 was significantly smaller when the implausible word was presented in upper case in a sentence that was presented in lower case prior to the implausible word. The opposite condition, in which the sentence was in uppercase and the implausible word was in lower case did not modulate the N400. They argue that such a result reflects the influence of the bottom-up orthographic information (change to uppercase), which suggests that the word was going to be informative, which in turn modulates the N400.

Given these insights, it is quite plausible to argue that the modulated frontal negativity in the present case reflects the fact that the processing system is confronted with conflicting information from the context information on the one hand, and the bottom-up agreement information on the other. The modulation itself results from the difference between the contexts, each evoking varying expectations about a completion with a potential non-literal meaning.

7.6.2.3.3 Later effects for DI

The late positivities with a posterior distribution observed for the ditransitive verbs in the non-neutral contexts are discussed here. These positivities appear to be graded in the non-neutral contexts unlike those elicited by the stative verbs, whereby the ERPs in the mismatch contexts VQ and WQ are the most positive-going, with those for the correct context less positive. The effect in the correct context is especially interesting in that it shows no clear positive peak, but still turns out to be significant in comparison to the neutral context. The difference between the effects in the non-neutral contexts is telling, given that the stimuli are, again, identical across contexts in a given sentence-type. Thus, there is good reason to believe that these late positivities reflect an identical process in all non-neutral contexts. If it is indeed the case, then the graded effect suggests that the process had been most taxing in the wrong-verb context WQ, whereas it was relatively less taxing in the verb-class context VQ, and was almost facilitated in the correct context CQ such that the effect is only positive compared to the neutral context, without a clear peak.

One might argue that the positivities in the three non-neutral contexts do not coincide (unlike for DS) because of the relatively large variance in the duration of the ditransitive verbs across items ($SD > 376$, see [Chapter 6, Section 6.4](#)). This is especially relevant when the variance in duration of the dative-stative verbs ($SD < 151$) are considered. However, this argument does not hold good, given the fact that all the four ditransitive verbs, like the stative verbs, were each presented equal number of times in our stimuli and context questions, both individually and in combination with each other. Therefore, all things being equal, all non-neutral contexts must show the same effect, which is clearly not the case here.

A plausible explanation for such a difference between the non-neutral contexts, we think, seems to stem from the following. In order for all the critical conditions in a certain word-order to resemble each other structurally prior to the verb, the nominative subject in our ditransitive conditions was not realised overtly. Nevertheless, since the ditransitive verbs agree with their subjects in their person, number and gender features, the dropped subject pronoun could always be inferred from the agreement information. Given that this covert subject was always the first person singular pronoun 'I' in all our ditransitive stimuli, the context questions with ditransitive verbs always contained the second person singular pronoun covertly. This would mean that, the inference of the covert subject pronoun will be facilitated by context questions

that contained the identical verb as that of the forthcoming stimuli (as in CQ), whereas such a facilitation would be considerably less if the verb was ditransitive, but did not match lexically (as in VQ). When the context question induced an expectation for a stative-verb, but the stimulus happens to be a ditransitive sentence (as in WQ), there would have been no facilitation at all in inferring the covert subject. Support for such an interpretation stems from a recent dissertation on the processing of subject drop in Japanese (Wolff, 2010), in which the amplitude of the positivity was said to be apparently reflecting the difficulty of reconstructing the subject based on the accessibility of the referent in context and a possible competition between referents.

It might look at the first instance that such a context-dependent interpretation of the graded late-positivity for the ditransitive verbs would question the validity of our context-independent interpretation for the stative verbs. If the different contexts, and the different expectations that these in turn induce, indeed influenced the processing of the ditransitive verbs in the late time-window so as to modulate the effect observed, then why was there no such context-based difference observed in the same time-window for the dative-stative verbs? As already discussed in the preceding section, these two verb-types are very different in more than one way. Firstly, whilst the ditransitives follow the usual agreement pattern, the dative-stative verbs always only show default-agreement. Secondly, the covert nominative pronoun must be inferred and processed for the ditransitive sentences in our study to be well-formed, whereas for the dative-stative sentences, the bottom-up agreement information suggesting a potential third-person singular neuter nominative subject must be ‘ignored’ in order to derive the stative meaning of the verb and process the sentence as well-formed. Thirdly and crucially, the ditransitive verbs used in our study do not offer a potential alternative interpretation, whereas the stative verbs do, in that they have a literal non-stative meaning (see Appendix C). Due to these reasons, and the fact that the stative verbs also elicited a graded negativity in the frontal regions before the late-positive peaks, which the ditransitives did not, it appears reasonable to assume that the context manipulation has influenced the two sentence-types in a slightly different manner.

7.6.2.4 Match-Mismatch Account: Summary

To summarise the match-mismatch account, the early positivities in CQ for both sentence-types are said to reflect the match between context-induced expectations and the actual stimulus verb, whilst the anterior

early positivities in VQ and WQ for both sentence-types are said to reflect the mismatch between the expectations induced by the context verb and the actual stimulus verb. Such a stimulus matching is said to be the result of the judgement task, which required participants to rate the acceptability of the context+stimulus combination after each trial.

All later effects are said to be sentence-type specific, the superficial similarities of the late-positivities in VQ and WQ between the sentence-types notwithstanding. To be specific, the graded frontal negativity for the dative-stative verbs is said to reflect the level of conflict between the expectation for a dative-subject—and thus a non-literal meaning for the verb—on the one hand, and the bottom-up agreement information suggesting a third-person singular neuter nominative subject on the other. The stative meaning is eventually retrieved regardless of context. However, the expectedness of such a potential non-literal completion of the sentence is highest in CQ and lowest in WQ. In a further stage, as a result of processing default-agreement, the final correct interpretation of the sentence is said to ensue, whereby the non-neutral contexts elicit almost identical late-positivities, which we argue reflects enriched composition of the stative meaning.

As for the ditransitive verbs, the only later effects are the late-positivities in the non-neutral contexts, because they do not give rise to an alternative non-literal completion. However, since the nominative subject pronoun is only covertly present in the sentences of this type in our study, it has to be inferred from the agreement markers. We argue that the three non-neutral contexts influence this process differentially such that there is a facilitation in the correct context versus less or no facilitation in the mismatch contexts.

7.6.2.5 Match-Mismatch Account: Open Questions

Notwithstanding its adequacy in accounting for our data, the Match-Mismatch account raises at least a couple of questions, too. A first question concerns the interpretation of the later effects as sentence-type specific rather than context-dependent or even task-specific effects. Given that the effects in a given non-neutral context for both sentence-types show at least superficial similarity, could the later effects for both sentence-types, too, be simply task-relevant? Whilst we cannot rule out this possibility outright with the data at hand, several points speak against such a simple non-functional interpretation of the late positivities. First and foremost is the number of differences mentioned

earlier between the stative and ditransitive verb-types, namely, default-agreement versus normal agreement, dative-subject versus overt or covert nominative subject, availability of alternative meanings versus none, respectively. Second, whilst the late positivities in the non-neutral contexts temporally coincide⁶⁴ almost perfectly in case of the stative verbs, the ditransitive verbs neither elicit a clear peak nor do these coincide even superficially. Third, in the absence of a judgement task in Experiment 2, there was indeed an indication that the ERPs for the dative-stative verbs were much more positive in the late time-window compared to the ditransitives. Fourth, as mentioned earlier, the topographic map for the ERPs at the verb for the effect pertaining to the correct context in the late time-window supports the view that the later effects, at least in considerable part, could potentially be sentence-type specific.

The second question concerns the validity of the account itself in general. Given that the latency difference between the anterior and posterior early positivities is minimal (the anterior positivities are slightly earlier), and given that the stimuli are linguistic in nature, would an explanation along the lines of results from the oddball paradigm really stand? To be specific, whilst many earlier studies using linguistic stimuli have found posterior early positivities of the P3b type, why is there no linguistic⁶⁵ study that reported an anterior early positivity of the P3a type? We argue that such an interpretation is not completely implausible due to the following reasons. None of the previous linguistic studies included experimental conditions of the sort that we have. That is to say, none of the other studies that found task-related posterior positivities included stimuli that introduced a mismatch with the expectation *without also simultaneously violating world knowledge* about the stimulus concerned.

7.6.3 Summary

Whilst results from Experiment 3 have indeed contributed to a better insight into the processing of dative-stative verbs in particular, and in turn dative-subjects in general, some of the difficulties in interpreting the complex pattern of data obtained have been the following. To be adequate, any account for our data must explain the three-way difference between the non-neutral contexts for the ditransitive verbs as op-

64. Seen absolutely, there is a very slight positive peak even in the neutral context that temporally coincides with the late positivities in other contexts.

65. By linguistic study, we mean studies that used full-fledged sentence manipulations. But see [Chapter 8, Section 8.1.3.2](#), in which we discuss a study using individual words that reported a P3a effect.

posed to no difference at all between them for the stative verbs. For instance, an account that interprets all late positivities as task dependent would not explain the differences between the sentence-types in the late time-windows. The clear second positive peak observed for the stative verbs in the correct context with no equivalent in case of the ditransitive verbs beckons a sentence-type specific interpretation. Interpreting identical effects for identical sentences in differing contexts as context-dependent would not hold. However, an account that interprets all the later effects as sentence-type specific neatly explains the differences, thereby also accounting for the gradedness of the positivities for the ditransitive verbs (normal agreement, thus context-dependent facilitation) versus identical positivities for the dative-stative verbs (contexts do not influence processing default agreement, which is an exception), as well as the graded anterior negativity for the stative verbs (contexts influence the expectation for a stative meaning, and thus have a varying effect on the conflict based on the agreement information). Nevertheless, several questions remain, and neither of the two interpretations that we provided could be claimed as conclusive at the moment.

A first question concerns the interpretation of the late positivity in the correct context for dative-stative sentences. If everything about the stimulus verb is known beforehand if it happened to follow a correct context question, then what is there to enrich when processing the verb? We argue that the high level of conflict induced by the bottom-up information suggestive of a nominative subject is key to this. Given that an overwhelming majority of Tamil verbs require their subject to be nominative, and that they agree with their subject in their person, number and gender features, it is reasonable to believe that the bottom-up agreement information plays a crucial role when processing a Tamil verb. This is because, if the information suggested by this does not match the features of the subject nominal, then the sentence must be analysed as ill-formed. However, this rule is not without its exceptions, as in the case of a handful of verbs expressing stative meanings that instead only show the default agreement, and require their subjects to be dative. This might at first appear to suggest that the agreement information is not useful for these verbs as such. But this could not be true, because many of these verbs have a literal meaning, to express which they must agree with their nominative subjects, in which case the agreement information, as usual, becomes crucial in determining the well-formedness of the sentence. In other words, the bottom-up agreement information must never be discarded without considering it as crucial. Under these circumstances, it is only logical that the processing systems heavily re-

lies on agreement information, even if the verb is clearly expected to be expressing a stative meaning, as in the correct context in our design. The correct context suggests a stative meaning, whereas the highly reliable bottom-up agreement information indicates a nominative subject. Since both context and agreement become equally relevant, a high level of conflict ensues between these. The processing system must overcome this difficulty without analysing it as ill-formed, and must enrich the sentence with the intended stative meaning.

The second question concerns the interpretation of the late positivities in all non-neutral contexts in general. Could the late positivities simply be explained much more generally along the lines of sentence closure effects, thus neither resorting to sentence-type specific nor context-dependent accounts? At least two facts in our data speak against such a simple closure account for the late positivities in the non-neutral context. First, such an interpretation does not account for the differences in the late positivities between contexts for the ditransitive conditions as opposed to no such difference for dative-stative verbs. Whereas, interpreting the positivities as sentence-type specific explains the differences in a straightforward manner. Second, in view of the fact that stimuli following a non-neutral context question always were in the same word-order as that of the question and always were of the identical pattern, namely two NPs followed by a verb, it is reasonable to assume that at least some information was available about the stimuli in all non-neutral contexts. By contrast, the neutral context presented greater difficulty, given the number of continuations possible and given that the known information in this context about the forthcoming stimulus was nil. If the late positivities in the non-neutral contexts were to reflect a general sentence closure rather than related to verb-type specific processing or the task, a comparable late positivity must have ensued in the neutral context as well, which is clearly not the case. Converging evidence for this stems from the results at the position of the verb in Experiment 2, which indicate that, if anything, the neutral context as opposed to non-neutral contexts is the one that must elicit a positivity reflecting the proper closure of the stimulus. However, the judgement task could be the reason why this was not the case.

In spite of this consensus, given the data at hand, we argue that the Match-Mismatch account, albeit not entirely conclusive, offers a relatively more plausible and straightforward interpretation of our results at the moment.

— * —

General Discussion

8.1 General Discussion

The results from the three experiments reported in this dissertation could be broadly classified to belong to three different categories based on what caused the elicitation of a certain effect. Thus, there are effects specific to the processing of dative nominals that are subjects, those that were elicited by the verb, and others that were task-related. We discuss each of these in separate sections here.

8.1.1 Processing of Dative Nominals

Dative nominals are interesting in many respects. They are considered to be core-arguments, yet as noted in the introductory chapter, they do not represent a prototypical macrorole, unlike nominative, ergative or accusative nominals. Tamil dative nominals are especially interesting in this regard for reasons stated in [Chapter 4, Section 4.3](#).

Experiment 1 investigated the processing of dative-subjects in comparison to that of animate and inanimate nominative subjects. Experiment 2 included ditransitive sentences into the experimental design so as to investigate the processing of dative nominals that are subjects as opposed to that of morphologically identical dative nominals that are indirect objects. The results at the argument positions from these experiments offer a first indication of the processing of dative-subjects in a language in which dative-stative or dative-subject constructions are highly frequent.

Results from Experiment 1 suggest that animate dative nominals are processed in the first stages prior to encountering the case-marker like animate nominative nouns. This might suggest that animate nouns are interpreted as volitional agents or Actors, which is in line with previous research (Holisky, 1987). However, it could also simply be due to late availability of the dative case-marker. Once the case-marker becomes available, ERPs for the dative nominals become aligned to those for the inanimate nominative subjects, suggesting that these are processed similarly at this later stage⁶⁶ of processing. Taken together, these results appear to suggest that the animacy of Tamil nominals that are subjects plays a crucial role in determining how they are processed. Further, Actor arguments that are non-prototypical due to various reasons, namely either because they are inanimate or because they are marked dative, seem to be processed in a qualitatively similar way.

Results from Experiment 2 appear to indicate that different kinds of dative nominals, namely subjects versus indirect objects, are processed differently from each other, if their role is clear at the outset. This is in line with previous findings from behavioural studies on child language acquisition. Lakshmi Bai (2004) studied the acquisition of dative case in general and dative subjects in particular in three young native-speakers of Tamil, and reported that they differentiate ‘the syntactic function of dative as subject of a sentence from its use to encode different case-like roles right from their early speech’⁶⁷, and that they ‘perceive datives in their subject function differently from other functions in their early syntax’ (Lakshmi Bai, 2004, p. 261).

If it is true that native-speakers of Tamil indeed perceive dative-subjects and indirect objects differently right from their childhood, then the question is, why significant neurophysiological processing differences reflecting the same ensued only sentence-initially in our data and not at the second argument position. A quick comparison of results from Experiment 1 reveals that such an asymmetry between the argument positions does not appear to be specific to Experiment 2. In Experiment 1, whilst the dative-subjects elicited a negativity as opposed to animate nominative subjects at NP1, this effect did not reach significance

66. The dative case-marker becomes available at NP1 at an average duration of about 465 ms post-onset, whereas at NP2, it becomes available at about 449 ms after the onset of NP2 in Experiment 1. See Appendix E.4 for the durations of bare NPs.

67. By contrast, Leuckefeld (2004) studied the development of processing mechanisms in school-aged German children using ERP measures, and reported that 8-year old children ‘did not differentiate between verb types, such as accusative, dative active, and dative object-experiencer verbs’ (Leuckefeld, 2004, p. 127) in German, whereas 11-year old children did.

at NP2. These observations might suggest that the difference in processing seems to additionally depend upon the linear position of the dative nominal in the sentence (but, see below).

Thus, the context-based negativity for the dative-stative sentences Experiment 2, despite its absence at NP2, might indeed be indicative of something specific about dative-subjects. Taken together, these results are suggestive of the fact that, on the one hand, dative-subjects and nominative subjects behave similarly at least in some stages of processing owing most probably to animacy rather than subjecthood, and on the other hand, dative nominals that are subjects and those that are indirect objects differ. It remains to be seen if more differences between the two types of dative nominals would emerge given an experimental design that is better-suited to study these.

However, the results from Experiment 1 and Experiment 2 at the argument positions raise an important question regarding the position-based asymmetry of effects for dative-subjects. How could this asymmetry be explained? A possible hint for the position-based asymmetry stems from Kutas, Van Petten, & Besson (1988), who extensively investigated hemispheric asymmetries of especially the N400. They proposed that ‘all content words elicit N400s’ (Kutas et al., 1988, p. 229), and found N400s that declined in their amplitude as a function of word position, with the largest of these observed for the sentence-initial (content) word. Whilst we could potentially explain the presence of a negativity for the dative-subjects at NP1 and its absence at the position of NP2 in this manner in both Experiment 1 and Experiment 2, this could only be speculative, for the following reason. Such a decline in the effect in our results seems to be specific to the dative-subjects, whereas the inanimate nominative subjects in Experiment 1 elicited a negativity at both positions.

An effect specific to word-order permutations, namely the scrambling negativity, has previously been reported for German⁶⁸ (Rösler et al., 1998; Bornkessel et al., 2002; Schlesewsky et al., 2003). However, it is clear that the negativity for the dative-subjects in our data cannot possibly be explained along those lines, because Tamil allows subject-drop. Previous findings from languages that allow subject-drop, such as Turkish (Demiral, Schlesewsky, & Bornkessel-Schlesewsky, 2008; Demiral et al., 2008), Japanese⁶⁹ (Wolff et al., 2008) and Tamil (Muralikrishnan, 2007, for accusative objects) attest to the fact that languages that allow subject-

68. Even in German, permuted accusative objects alone elicit the scrambled negativity, dative objects do not (Bornkessel et al., 2002)

69. However, Wolff et al. (2008) found a negativity of this type, but only when there was a prosodic boundary that clearly ruled out the possibility of subject-drop.

drop do not elicit scrambling negativities. Further support against a scrambling negativity analysis of our results stems from the availability of intransitive structures in Tamil involving dative-subjects as their sole argument (see [Chapter 4, Section 4.2.3.2](#) for an example).

An explanation for the asymmetry along the lines of a strict sentence-initial subject-position also seems untenable, for Tamil allows flexible argument-order in addition to subject-drop. Thus, a sentence-initial noun can be the only object of a subject-dropped sentence or the object of a sentence with a non-canonical argument order. Whilst native-speaker intuitions⁷⁰ of the author tend to suggest that dative-stative constructions are often dative-initial, tagged corpus data⁷¹ supporting such a claim are not currently available for Tamil.

On the other hand, previous findings from languages such as Turkish ([Demiral, 2007](#)), which is morphologically to some extent similar to Tamil, and Mandarin Chinese ([Wang, 2011](#)), which has no case morphology, show that, although there need not be a strict subject-position (like for example in English), the processing system shows a preference such that sentence-initial ambiguous arguments are analysed as subjects, the so-called subject-preference. In view of these findings, it is quite conceivable that such a preference might exist in Tamil, too.

One could argue that Tamil dative-subjects (regardless of their linear position) are unambiguous by their very nature. It is true that they are not case-ambiguous (unlike Hindi dative / accusative nouns, for instance), but they are nevertheless ambiguous for their subject role in the sentence. Whereas an accusative argument can be ruled out at the outset for a potential subject role, this is not the case for Tamil dative arguments, because they could be subjects as well as indirect objects.

Assuming that there is a preference in Tamil to analyse sentence-initial arguments (that could in theory be subjects in Tamil, such as nominative, dative and instrumental NPs) as subjects, the negativities for the dative-subjects in the sentence-initial position could perhaps be explained as follows. Given the preference for analysing sentence-initial arguments as the subject, the processing system expects an ideal Actor (that is, an animate argument capable of volition, thus a nominative animate nominal) at NP1. Although the dative-subjects used in our studies are

70. Given the diglossic nature of Tamil, such intuitions could only be about the spoken variety of Tamil, and not the formal variety used in our studies. However, using the spoken variety for studies like ours is not unproblematic. See [Chapter 9](#) for details.

71. Even if such resources were available, differences between the formal and spoken varieties would not be readily forthcoming, unless there is a separate written and spoken corpus.

animate, they are not ideal, because they are non-prototypical Actors owing to their dative-marking, as a consequence of which they lack the property of volition. Thus an argument that is unambiguously lower in its prototypicality for Actorhood needs to be integrated in the preferred position for the subject at NP1. This is however not the case at NP2, because that is not the preferred position for the subject. Whilst such an explanation along the lines of a possible subject-preference in Tamil seems plausible, it can only be a tentative explanation at the moment.

Therefore, further investigation seems inevitable to address the results. A study that induces the expectations for a verb and thus indicate whether the dative nominal in the forthcoming stimulus is going to be a subject or not in an indirect manner rather than by employing questions of the sort used in our studies might be worthwhile exploring in this regard. See [Chapter 9, Section 9.1](#) for a potential experimental design that could address this issue.

8.1.2 Processing of Stative Verbs

Dative-stative verbs express a state of affairs rather than an active event, and require their subjects to be in the dative case. They also differ from other Tamil verbs in that they do not show full agreement with the person, number and gender features of their dative-subject. Experiment 2 enabled studying the processing of Tamil dative-stative verbs— and thus default-agreement— using a design involving preceding context questions that disambiguated for the role of the dative-nominal in the forthcoming stimulus sentence. This design was further extended in Experiment 3 to include context questions, the verbs of which did not match those of the stimuli, such that the processing at the position of the verb could be observed under context-induced expectations that may or may not match the stimulus.

Results from Experiment 2 are the first as far as the online processing of Tamil verbs are concerned. They appear to suggest that stative verbs and ditransitive verbs are processed differently in the later stages, whereby the dative-stative verbs elicit a frontal negativity and a late positivity, whereas the ditransitive verbs do not. However, since the stimulus verb never mismatched the context verb in this study, it was not possible to observe the effect of expecting a stative verb but encountering a ditransitive verb, and vice versa. This is a crucial impediment, because this meant that context-dependent effects could not be readily differentiated from effects due to the processing of a specific verb-type.

This issue was addressed in the design of Experiment 3, the results of which complement Experiment 2 and corroborate our interpretation of the later effects in Experiment 2. The stative verbs in Experiment 3 elicited a graded frontal negativity, which we interpreted as reflecting the strength of the conflict between the context-induced expectation for a given verb and the bottom-up agreement information from the stimulus verb. Further, almost identical late positivities ensued in all non-neutral contexts. By contrast, the late positivities in the ditransitive conditions were smaller and graded, with the correct context being the least positive amongst the non-neutral contexts, without a well-defined peak. That is, there was a three-way gradation in the late-positivities for the ditransitive conditions.

The early positivities observed in Experiment 3 are indicative of the influence of the judgement task in this experiment. On the other hand, the later effects obtained, at least in part, are due to differences in processing the two verb-types. As we indicated during the discussion of results in [Chapter 7](#), the two interpretations that we presented for the complex pattern of data obtained are far from conclusive. They instead provide a good starting point from which to approach studying the processing of stative verbs further.

One of the crucial aspects of Tamil stative verbs concerns the processing of default-agreement. As described a number of times, stative verbs do not agree with their dative-subjects, instead showing only the third-person singular neuter agreement. Whilst this is indeed a deviation from the norm when the overwhelming majority of Tamil verbs are considered, it is not a violation⁷² of any sort. Our results at the position of the verb in Experiment 2 and Experiment 3 seem to suggest at least some processing differences between stative and non-stative verbs. A potential reason for this might perhaps be that stative verbs do not agree with their dative-subjects, whereas other verbs agree with the person, number and gender features of their nominative subjects. In this respect, these results are possibly a first indication of the processing of default-agreement⁷³.

Whilst results from both Experiment 2 and Experiment 3 show a positive deflection in the late time-window for the stative verbs as opposed to the ditransitive verbs, they look different in the two experiments mainly

72. See for instance [Osterhout & Mobley \(1995\)](#); [Roehm, Bornkessel, Haider, & Schlesewsky \(2005\)](#); [Nevins, Dillon, Malhotra, & Phillips \(2007\)](#) for some of the previous studies on subject-verb agreement violations.

73. Nevertheless, this is only one of the possibilities, and the processing difference could also be due to a number of other differences between these verbs.

due to the fact that results from Experiment 3 are also influenced by the experimental task in addition to the change in the experimental design. A study that employs the design of Experiment 3, but at the same time avoids a judgement task would be ideal to address this issue (see [Chapter 9, Section 9.1](#) for potential designs).

A question that we alluded to but did not consider further when interpreting the results at the verb in Experiment 3 is the following. In spite of the common factors that let us group the stative verbs together on the one hand and the ditransitive verbs together on the other, what is the contribution of the individual differences between the verbs in each group to our results? The relevance of this question quickly becomes clear especially when the four ditransitive verbs are considered. Given their vast individual differences in duration ($SD > 376$, see [Chapter 6, Section 6.4](#)), and the differences between them on the derivational and morphological levels⁷⁴, it is reasonable to argue that they also come with their own individual differences. However, that is the only way possible, if we need to compare dative-accusative structures that are identical prior to the verb. See [Chapter 9, Section 9.1](#) for a different method of analysis that might address the issue of individual differences.

8.1.3 Influence of Experimental Design and Task

Differences between the results of Experiment 2 and Experiment 3 at the position of the verb nicely illustrate that the experimental task has quite some influence on the final outcome of effects observed. The slight late positivities at the argument positions in the correct context conditions in Experiment 2, and the early positivities at the position of the verb in Experiment 3 appear to be purely due to the experimental design and task requirements.

8.1.3.1 Effects at NP1 and NP2 in Experiment 2

The design of Experiment 2 meant that, the stimuli that followed non-neutral context questions would always contain the identical verb as in

74. Three of the four ditransitive verbs used in our stimuli were noun-verb complexes with a causative meaning and the remaining one was the only simple verb in this regard. This is inevitable so as to render the ditransitive conditions identical to the stative conditions prior to the verb. Moreover, there are only a handful of Tamil verb complexes with a ditransitive—and causative—reading that could take three animate arguments, and we used the three best of the four we could come up with. And the agglutinative morphology of Tamil meant that they became very long.

the context question. However, the arguments in the stimulus sentence became specifically focussed due to the fact that they were questioned for by the *wh*-phrases in the context question. Thus, a stimulus in the same argument-order as the question would be the best fit. Whilst all our stimuli indeed were in the same argument-order as the non-neutral context question, this fact would not be clear prior to actually encountering the arguments in the forthcoming stimulus. Similarly, whilst any animate noun would fit as an argument for the *wh*-phrases in the question, the confirmation for whether they indeed answer the question in the best possible manner⁷⁵ would not be forthcoming prior to encountering the case-marker for each argument.

Recall that, as indicated earlier, posterior positivities of this kind have been reported earlier in studies that induced context-based expectations about forthcoming stimuli, both in the visual and auditory modalities (Bornkessel et al., 2003; Cowles et al., 2007, see for instance). The fact that the effects mentioned above are the result of the experimental design is clear from the fact that they are observed at both argument positions in both sentence-types, and for both dative (see for instance Figure F.1 and Figure F.6 in Chapter 6) as well as accusative (see for instance Figure F.2 and Figure F.7 in Appendix F.5) arguments.

8.1.3.2 Effects at the Verb in Experiment 3

One of the interesting findings in Experiment 3 with regard to task influences is the anterior early positivity effect observed in the mismatch context conditions at the position of the verb, regardless of sentence-type. This effect appears to be a novel finding in ERP studies that used linguistic stimuli. Other studies that used stimuli that mismatched with prior induced expectations, such as those that studied the processing of antonyms (Roehm et al., 2007; Kretzschmar, 2010), did not find a comparable effect, because as discussed earlier in Chapter 7, none of these studies consisted of a mismatching sentence context in which the expectation was not met *without* also simultaneously violating world-knowledge. That is, by virtue of the property of antonymy, each lexical item has a unique antonym, which is part of the world-knowledge of participants. Thus, in a sentence context such as ‘*The opposite of black is ...*’, the only correct word would be ‘*white*’ as per world-knowledge.

75. By best possible manner, we mean that the stimulus unfolds in the same argument-order as the question. The alternative argument-order would also be acceptable, but in view of the expectation induced by the context question, it would not be the best argument-order in which to answer the question.

Any other word in such a context is a violation of this knowledge. By contrast, our stimuli did not match expectations, but crucially did not pose any sort of violation either.

Discussing the Match-Mismatch Account for our results in Experiment 3, we argued in [Chapter 7](#) for an interpretation of this effect along the lines of the P3a effect found for deviant non-target non-novel stimuli in cognitive studies that employed the three-stimulus oddball paradigm ([Katayama & Polich, 1998](#); [Comerchero & Polich, 1999](#); [Wronka et al., 2008](#)). Whilst the P3a effect has not been found in previous ERP studies on language, it is however not because the P3a is exclusive in some way to detecting novel stimuli, deviant tones and other non-speech stimuli. For instance, words in a three-stimulus oddball paradigm with an infrequent non-target phoneme deviating from the standard in the stimulus train have been shown to elicit a P3a effect.

[Winkler et al. \(2003\)](#) presented Hungarian native-speakers who are very fluent in Finnish with rarely occurring target words amongst two other words that served as very frequent standard and less frequent deviant stimuli. The standard and deviant stimuli were either a verb and inanimate object in Finnish respectively, or a person's diminutive name in Hungarian, and only different in their second phoneme, which was either the vowel /æ/ or /e/ respectively. Whilst word pairs with these vowels are semantically distinct and phonetically perceived as distinct by Finnish native-speakers and Hungarian speakers who are fluent in Finnish, they are allophones of the vowel /ɛ/ in Hungarian, and do not introduce a semantic difference in Hungarian words unlike in Finnish. The task was to detect a certain kind of target stimuli based on animacy, and register the same by pressing a button. Amongst other results, the authors reported a P3a effect for the infrequent non-target word with the deviant phoneme /e/.

Whilst this result confirms that complex speech stimuli indeed elicit P3a under specific task environments, it also leads to the following question. Given that the stimuli and experimental conditions in our study involved were sentences that are relatively more complex and varied than a typical oddball stimulus train, is it still tenable to interpret the anterior positivities in our data as a P3a? A possible hint to answer this question lies in the difference between the anterior positivities elicited by the two mismatch contexts VQ and WQ.

Recall that the anterior positivity was slightly larger in the WQ context compared to that in the VQ context for both sentence-types, and that this difference turned out to be significant in the statistics. We noted

two possible alternative reasons for why this difference ensued. One of these was that it is because the verbs in the two sentence-types in our stimuli were distinct at their onsets. The onset phonemes of the stative verbs used in our stimuli were either 'p' or 'th', whereas the onsets of the ditransitive verbs were 'a', 'k', 'm' or 'ny'. Therefore, in the mismatch contexts it would have become clear as soon as the first syllable of the verb was encountered that it was different than what was expected. However, a potential mismatch is easier to detect in the case when a dative-stative verb is expected, as opposed to when a ditransitive verb is expected. This is because, there are only two possible onsets for the stative verbs, whereas there were four for the ditransitive verbs. This in turn translates to a potentially more accurate and confident detection⁷⁶ of mismatching onsets in the stative conditions in Experiment 3 than in the ditransitive conditions. Indeed, the difference in the ERPs between the contexts VQ and WQ in the time-window concerned is slightly larger for the dative-stative conditions than the ditransitive conditions.

A further result that could / should be considered here as part of the discussion of task-related effects would be the late-positivities observed in the non-neutral contexts in Experiment 3. Given the number of linguistic differences between the stative and ditransitive verbs, and in view of the very clear peaks for the stative verbs versus gradual graded positivities for the ditransitive verbs, we interpreted some (Categorisation-based account) or none (Match-Mismatch account) of these effects as task-related. Amongst other specific motivations (see Chapter 7, Section 7.6 for details) discussed earlier that justify such an interpretation, it was also in view of the fact that the results in Experiment 2 are indicative of the fact that the ERPs for the stative verbs are much more positive-going in the late time-window than those for the ditransitive verbs.

Nevertheless, just considering the stative verbs alone for the moment, the following is clear. On the one hand, the late-positivities in the correct

76. Observing the data at hand, we can even go a step further to reinforce this point, but it is admittedly much more questionable to do so. It is with regard to the slight negative deflections prior to the elicitation of the anterior positivity in the ERPs in the mismatch contexts, clearly visible for the stative verbs in particular, and it is as follows. Could it be that these negative deflections before the positive peak is a variant of Mismatch Negativity, an effect that is known in the literature to be a 'measure of sound-discrimination accuracy' (Näätänen, Tervaniemi, Sussman, Paavilainen, & Winkler, 2001, p. 284)? Whilst this might be considered plausible in light of the relevance of this effect in the perception of speech sounds, ranging from the level of phonemes to syllables and words (see Näätänen, 2001, and references therein), this is merely a speculation worth mentioning at present. Alternatively, given that our stimuli were equiprobable, it could be described as a variant of Phonological Mismatch Negativity (see Connolly & Phillips, 1994, and references therein).

context for the stative verbs in Experiment 2 and Experiment 3 look very different from each other. On the other, the late-positivities in all non-neutral contexts in Experiment 3 are almost identical. Therefore, could the late-positivities in Experiment 3 for the stative verbs well be task-related, after all? And by extension, could such an explanation also apply to the ditransitive verbs?

A judgement task-related account for the late-positivities in Experiment 3 would be the following. Given that the processing system has gleaned during an early processing stage whether the stimulus verb is correct (that is, it is identical to that in the context question) or not, thereby eliciting posterior and anterior early positivities respectively (as per the Match-Mismatch account), what remains to be confirmed is the verb-ending. That is to say, if the verb is marked affirmative or negative, whether it denotes past, present, or future tense and any other information of this sort becomes available at the end of a Tamil verb. This information might well turn out to be crucial for the task at hand. For instance, if the context question was affirmative and the stimulus was negative⁷⁷ (or vice-versa), the acceptability of the context+stimulus combination might be accordingly different. Thus, once the onset of the verb is clear, this leads to expectations about the verb-ending. In other words, encountering the verb-ending means that a decision can be made so as to judge the acceptability of the context+stimulus combination, thereby eliciting positivities of the P3b type.

Assuming we answer yes to the questions raised above, the vast differences in the durations of the verbs might appear to explain the differences in the late-positivities between the sentence-types. However, such a simple account is not without its weaknesses and leaves much to be desired in other respects. To reiterate our earlier arguments, we believe there are many crucial points that speak for a sentence-type specific interpretation of the late-positivities that such a task-based account ignores (see discussion in [Chapter 7, Section 7.6.2](#)). This is true even when leaving aside the linguistic differences between the two verb-types and considering only the data at hand at the face value.

First, such an account cannot explain the similarity of results at the verb between Experiment 2 and Experiment 3 in the later stages of processing. A frontal negativity for the dative-stative verbs as well as a late-positivity obtained in both Experiment 2 and Experiment 3. Second, the verb-form in the stimulus sentence was either fully identical to that

77. This is a possibility only in the mismatch contexts, never in the correct context conditions in Experiment 3.

in the context question, or it was a different verb altogether. That is to say, mismatching verbs were always different lexical items and not the identical verb with an alternative ending. Third, although the differences in the durations of the ditransitive verbs are relatively large, these should not matter across contexts, because all verbs are equiprobable in all contexts. Thus, differences in the effects between contexts for a certain verb-type, such as the graded late-positivity for the ditransitive verbs, cannot be explained based on differences in the duration of the verbs. Therefore, whilst we cannot rule out a probable effect of the judgement task such that the late-positivities are relatively larger, it appears very questionable in view of the arguments above, to explain the late-positivities obtained in Experiment 3 fully and uniformly on the basis of task requirements.

8.2 Consequences of our Results

Experiment 1 and Experiment 2 studied the processing of Tamil dative-subjects, comparing them to nominative subjects and dative indirect objects respectively, which enabled to gain a first insight into the processing of Tamil dative-subjects. Experiment 2 and Experiment 3 examined the processing of dative-stative verbs, revealing a complex picture of the processing of these verbs, and possibly default-agreement.

One of the consequences of our results is that, in order to have a broad scope and to account for cross-linguistic variation in effects, neurocognitive models of sentence processing must be able to not only predict effects elicited by language-specific processes, but also take the experimental design and task influences into account. This appears inevitable in view of our results from Experiment 2 and Experiment 3. Although the materials used in these two experiments were acoustically identical, the additional judgement task in Experiment 3 seems to have influenced the effects greatly.

Let us consider the models reviewed in [Chapter 3](#) here to illustrate this. Although Friederici's neurocognitive model ([Friederici, 2002](#); [Friederici & Alter, 2004](#)) is underspecified as far as predictions related to the processing of dative nominals are concerned, it would appear to account for the negativities observed for the dative-stative verbs as part of its Phase 2, in which semantic and morphosyntactic information are said to be integrated, semantic relations are established and thematic roles are assigned. Whilst the model does not provide predictions for task-based effects, it appears to be capable of accounting for at least the late

positivities obtained in our data for the mismatch contexts in the Phase 3, in which syntactic integration takes place.

The DP Model (Ullman, 2001, 2004), probably owing to its view of the language system as part of more general cognitive systems, provides very general predictions. Problems arising due to declarative memory related processes, such as lexical processing, are said to elicit N400s, whereas difficulties due to procedural memory related processes, such as morpho-syntactic processing, are said to elicit P600s. Predictions such as these, apparently based on traditional one-to-one mapping of components and language domains, may not account for the negativity found for acoustically identical dative-subjects in Experiment 2. Similarly, the DP Model does not seem to predict effects that are purely task-related, such as the early positivities in Experiment 3. Nevertheless, it appears that the DP model would conceive of the task-related effects as part of the procedural memory system.

As for the MUC Framework (Hagoort, 2003, 2005), it posits a Memory component that deals with words stored in long-term memory along with their structural frames, a Unification component comprising of a unification workspace in which multi-word utterances are built and the meaning of individual words is integrated into the preceding context, and a control component that serves the purpose of relating language to action in a given context. Whilst it does not provide predictions for the processing of sentences involving dative nominals, it could perhaps account for some of the effects observed in our studies. For instance, the effects related to the processing of stative verbs might be accounted for as part of the unification component, because it is in this component that a multi-word structure is built. Due to the highly interactive nature of the model, it might also account for the early task-related effects, perhaps as part of the control component. However, since the MUC framework does not specify how exactly different processes interact and elicit various ERP effects, further specification of the model seems inevitable to account for cross-linguistic variation.

The eADM (Bornkessel & Schleewsky, 2006) appears to be better-suited to predict and account for results like ours in general, perhaps due its cross-linguistic approach. For instance, the eADM provides specific predictions about structures involving dative nominals, with which our results broadly agree (see further below). As far as the task-related effects are concerned, the eADM (Bornkessel & Schleewsky, 2006, p. 813) posits a phase that could accommodate these effects. The latest version of the eADM specifies that '[d]epending on the experimental en-

vironment and the task, a late positivity may be elicited' (Bornkessel-Schlesewsky & Schlesewsky, 2008, p. 67) in this phase as part of checking well-formedness. By specifying that the well-formedness checking is dependent on task requirements, the eADM thus accounts for the late-positivities in the mismatch contexts, insofar as they are at least in part task-related.

However, the eADM in its present formulation does not appear to predict the early positivities that ensued as a result of the judgement task. Nevertheless, this is not to say that it could not account for these effects. For instance, the latest architecture of the eADM (Bornkessel-Schlesewsky & Schlesewsky, 2008) could account for these early effects as part of the 'Discourse environment' processing in Stage 2, which now accounts for the task-related late positivities. This phase could be further specified to account for early task-related effects as well, perhaps by extending its applicability to the earlier and later processing phase(s). This appears to be entirely conceivable given the cascaded architecture of the model. For instance, if the Discourse environment processing becomes active already at Stage 1 (in which word-category information is processed), this could account for the fact that the early positivities in our data obtained in the time-window in which only the first syllable of the verb would have become clear in the auditory stream. It would further enable the model to predict and account for effects that are based on expectations that the prior context induced.

To briefly reiterate our findings that are relevant here, we found posterior early positivities when the stimuli matched with the context-induced expectation, which is consistent with findings in a number of earlier studies (Roehm et al., 2007; Kretzschmar, 2010, for instance, the antonym studies). However, the mismatching conditions in these studies did not elicit an early anterior positivity, because these conditions involved a world-knowledge violation (e.g., '?The opposite of black is yellow'). By contrast, since the stimuli in Experiment 3 did not engender any such violation, but simply mismatched with the context-induced expectation, we observed anterior early positivities in the mismatch contexts.

These results would seem to suggest that 'listeners apparently need very little' (van Berkum et al., 2003, p. 716) to integrate inter-, intra- and extra-sentential information immediately and simultaneously. That is, they appear to be consistent with proposals suggesting that local word-level information is integrated with global world-knowledge and discourse-contextual information simultaneously without delay during language comprehension (Hagoort, Hald, Bastiaansen, & Petersson, 2004;

van Berkum et al., 1999; Hagoort & van Berkum, 2007). By contrast, models that posit that discourse-level information and sentence-level information are processed one after the other in an exclusive manner would not be able to account for such results.

Another important consequence of our results is that, they have once again shown that traditional one-to-one mappings between ERP components and various domains of language processing are untenable.

From a neurotypological point of view, the set of studies reported here is the first of its kind in at least two respects. However, this has also meant that there are quite some difficulties in comparing our results directly with previous electrophysiological studies. First, this is the first time the processing of dative-subject constructions was studied in this detail in any language in which these constructions abound. Second, previous online studies involving the dative case were on languages such as German or Icelandic. However, neither German nor Icelandic has an exact equivalent of the Dative-Accusative pattern of stative sentences in Tamil, a language unrelated to other languages studied to date.

Nevertheless, there is at least one existing prediction with respect to the online processing of structures involving dative nominals, with which our results are broadly in agreement. Amongst the neurocognitive models of language processing introduced in Chapter 3, the eADM appears to be unique in specifically predicting that ‘constructions including a dative argument should give rise to processing behaviour that is measurably distinct from that observable for nominative-accusative structures’ (Bornkessel & Schlesewsky, 2006, p. 792). Whilst such a prediction appears to have been made at the time specifically with respect to dative-nominative structures found in languages such as German, our results from Experiment 1 could be taken to suggest that it might be broadly true about dative-accusative structures, too. Further, since the processing of default-agreement has not been investigated neurophysiologically until now, our results specific to the processing of stative verbs, and thus default-agreement, from Experiment 2 and Experiment 3 add detail to the picture available until now.

Thus, the results from the three experiments presented here, we believe, have served a very important purpose for model-theoretic approaches that strive to arrive at a neurocognitive model of language processing that has broad scope and applicability. This is due to the following reasons. First, in spite of fairly recent approaches that have a cross-linguistic perspective from the outset (see Bornkessel & Schlesewsky, 2006, for instance), the bulk of the studies on online language compre-

hension are still conducted in Indo-European languages such as English, German etc. In this regard, our studies add an important dimension to those approaches that strive to model cross-linguistic similarities and differences, given that Tamil is from a different language family that has not been examined using online methods until now. Second, as already pointed out in [Chapter 4, Section 4.3](#) when motivating the use of Tamil for our studies, the dative-accusative pattern of stative sentences in Tamil makes it unnecessary to consider a debate as to whether the dative nominal is indeed a subject in these constructions, because it is the most subject-like argument, and there cannot be a nominative noun in these sentences. Third, we believe studying dative-subject constructions in one of the South Asian languages, in which these constructions abound, is an important contribution to the study of these languages in a broader context, especially given that there are only a handful of online studies ([Nevins et al., 2007](#); [Muralikrishnan, 2007](#); [Choudhary, 2011](#), for instance) on different aspects of these languages.

Furthermore, the task-related effects have provided new insights into processing sentences under strong context-based expectations. This is particularly true of the anterior early positivities obtained in the mismatch contexts in Experiment 3, for our study appears to be the first amongst electrophysiological studies on language to report an effect of this sort, thanks to the context design.

In sum, the results of the three experiments presented in this dissertation have provided a considerable insight into the processing of Tamil dative-subjects and stative verbs. On the one hand, factors like case and animacy interact at each stage of processing prior to encountering the verb, as results from Experiment 1 at the position of the arguments show. On the other hand, verb-type specific processing differences start to emerge at the position of the verb, whereby bottom-up information seems to be a factor of considerable importance when it comes to processing agreement information, as the effects of processing the stative verbs—and thus default-agreement—show in Experiment 2 and Experiment 3. Similarly, expectations about forthcoming stimuli interact with the experimental design as well as task requirements in a complex manner, as results of Experiment 2 and Experiment 3 show. Nevertheless, a number of questions remain, which need to be addressed in further studies, potential ideas for which are discussed in detail in [Chapter 9](#).

— * —

Outlook

9.1 Future Directions

The set of studies presented in this dissertation have provided an initial indication of the processing of Tamil dative-subject and stative verbs. Nevertheless, the results of the studies reported in this dissertation have also raised a number of questions. As a result, further investigation becomes inevitable so as to answer at least some of these questions.

Before exploring several potential design changes as well as new designs that might help us achieve a better understanding of the online processing of Tamil dative-subjects and stative verbs, we first address a more general issue involved in designing online studies of sentence comprehension in Tamil. Discussing results at the position of the dative nominals in [Chapter 8, Section 8.1.1](#), we raised the point about native-speaker intuitions and the use of formal variety of Tamil in our studies.

It is true that the diglossic nature of Tamil presents a general challenge in studying the online comprehension of the language. To address this issue, although presenting stimuli in the spoken variety might appear to be a viable and perhaps a more natural alternative, a number of points speak against such an option. First, there is no fixed standard for spoken Tamil. Speakers tend to choose slightly different varieties depending upon the interlocutor or the informal audience, with relatively more or relatively less markers indicating their social class, education etc. Second, given that participants may come from different regions and social backgrounds, no single spoken variety would be suitable for everyone, and one cannot rule out confounds at the outset. Third, as [Asher](#)

& Keane (2005, cited here from Keane, 2006, p. 315) point out, ‘it is difficult to elicit genuinely colloquial Tamil in a recording situation ... and different speakers appear to fall at different points on a continuum of formality’. Fourth and most important of all, if the opinion of our participants about using the spoken variety for our stimuli suggests anything, then the spoken variety is clearly not an alternative at all. Almost all participants asked about this issue typically consider the spoken variety as ‘incorrect Tamil’, and that the stimuli have to be in the formal variety to be ‘correct’. Therefore, it is clear that any future study on Tamil would almost certainly employ the formal variety to avoid these issues.

9.1.1 Designs focussing on Dative Nominals

One of the consequences of the context design that we employed in Experiment 2 and Experiment 3 in order to induce specific expectations about the structure of the forthcoming stimulus is that, contrary to what we hypothesised, we could not observe reliable cues of differences in processing between dative-subjects and dative indirect objects. This is surprising given the stark differences between the roles of a dative-subject versus other dative nominals. Further, as we noted in the General Discussion, such a result is in clear contrast to the one available study on the acquisition of dative-subjects in Tamil. A possible reason for such a result in our study could be the following. Due to the fact that the context sentences were simple questions using *wh*-phrases in the same argument-order as that of the stimuli, it is plausible that the processing system could have treated the arguments in the stimulus in a slightly (in)different manner than what is usual. On the one hand, we need to induce specific expectations about the verb-type, otherwise dative nominals are ambiguous for their role. On the other, a direct method to achieve it by way of context questions of the sort used in our studies was, it seems, too direct to unravel the subtle differences between the two verb-types.

Thus, any potential design that strives to address this issue must be able to induce specific expectations about the verb-type, but in a more subtle and indirect manner⁷⁸. A possibility to achieve this would be to use preceding discourse rather than direct questions. Stimuli that are presented as part of short narrations or stories rather than as individual sentences would serve well in this regard. Furthermore, using stories will invari-

78. Such a design using indirect methods of inducing expectations would also, we think, influence the task-related anterior early positivities that we found in the mismatch contexts. See the next section for details.

ably render the experimental setting relatively more natural. However, presenting stories in the auditory medium for ERP studies would have its own limitations, especially when it comes to artefacts due to eye movements. But these can be overcome by asking participants to close their eyes when listening to stimuli. This idea is not new and worth exploring, because several studies have presented short stories embedded with critical stimuli in the auditory domain (see [Haupt et al., 2008](#), for instance) with success. Such a design would also avoid any task-related influences. The expectation would then be that, if native-speakers of Tamil indeed perceive dative nominals differently based on their subject or indirect object role in the sentence, we must be able to observe corresponding processing differences. By contrast, if the results are more similar to our study, this would then imply that there are no differences between processing Tamil dative-subject and indirect objects.

Given the complexities involved in coming up with stories that accommodate the kinds of sentences that we are interested in, it might be worthwhile to attempt to approach it in a simpler manner, getting more out of the stimuli and design at hand instead. As is perhaps noticeable, each experiment in this dissertation is quite a leap from its predecessor in terms of experimental design. For instance, Experiment 2 introduced ditransitive conditions that were not present in Experiment 1, but it also additionally introduced the context design. This was of course inevitable given the ambiguous nature of dative nominals if the verb is not known beforehand. However, a design involving dative-stative and ditransitive conditions as in Experiment 2 but without the context questions is an option to explore. Any acoustic difference between the two sentence-types at the dative nominals would then matter much more than when there was a context question. The results would then either rule out or confirm an interpretation based on acoustic differences.

If the sole purpose of the design is to exclude an explanation based on acoustic differences between the stimuli in the two sentence-types, then an even simpler option would be a separate acoustic gating study involving a part of our auditory stimuli, in which participants need to judge whether the sentence they are encountering is dative-stative or ditransitive at different points in time of the auditory stream. If the results at the two arguments positions show significant above-chance tendencies towards detecting the sentence as one or the other sentence-type, then the explanation based on acoustic differences would hold. It would be nullified otherwise.

9.1.2 Designs focussing on the Verb

An ERP study that strives to tease apart the task-related effects observed in Experiment 3 from sentence-type specific effects would be very useful in view of the complex pattern of results at hand. This is because results from Experiment 3 need further investigation in order to rule out task influences. An ideal design would involve the design of Experiment 3 as such, that is preserving the context design, but with the crucial difference that there would not be any judgement task of any sort. Results at the position of the verb in such a study would not be task-dependent, at least not to the extent of Experiment 3.

Assuming that such a study also finds a late-positivity for the dative-stative verbs, it would be a corroboration of the sentence-type specific interpretation of these later effects. Nevertheless, it would give rise to another questions, namely, whether it is due to the processing of default-agreement and thereby also interpreting the dative nominal as the subject, or by contrast, whether it is simply due to the processing of default-agreement per se. In other words, whilst such a result will confirm that stative verbs always elicit late-positivities, the exact functional specification of the effect would still be elusive.

A possible way to approach this problem would be to further extend the number of conditions, whereby stimuli that contain the literal variant of the stative verbs could be included. That way, it would be possible to compare the identical verb(form) in two different sentences, one with the stative meaning and the other one with the non-stative literal meaning respectively. Such a design would not be without its problems though. For instance, the new sentences with the literal meaning of the verb must be in such a way that the agreement pattern is identical to default-agreement, which would mean that the nominative subject in such sentences should be inanimate. The object nouns in these sentences must be suitable to the action described involving the inanimate subject. Due to these reasons, the length of the new sentences could not be easily matched with that of the three-word stative sentences (see [Appendix C](#) for examples), and thus they may not be comparable prior to the verb. However, at the position of the verb, they would be identical and fully comparable.

Under these circumstances, if the processing of the verbs turns out to be different in the late time-window, this would suggest that the stative and non-stative meanings are indeed processed differently. By contrast, if both verbs elicit identical effects in spite of the differences in their

meaning, then it would mean that the effect is purely due to the processing of the agreement information per se, and as an extension, not special to the stative meaning, and thus processing dative-subjects.

Another potential method to tease apart the effect of processing an exceptional agreement, and the effect of processing dative-subjects— or, more precisely, interpreting a dative nominal as the subject—would be to conduct a similar study in another language that has stative constructions but without the complexities related to agreement. Malayalam would be an ideal option in this regard, because on the one hand, it is the closest linguistic neighbour to Tamil, whilst on the other, Malayalam is possibly a unique exception amongst the languages of India in that, it does not mark the verb based on the person, number and gender features of the subject nominal. Instead, all verbs show an equivalent of a default-agreement, from which only the tense and aspect could be inferred. Thus, a stative verb is not an exception in Malayalam, unlike in Tamil, as far as agreement is concerned.

The hypothesis for a Malayalam study involving stative verbs would then be the following. In the absence of differences in agreement markers on the different verbs, virtually no difference must be observed between stative and other verbs. The corollary of this would be that any difference in the effects at the verb would mean that it is almost certainly due to the fact that stative verbs are indeed processed differently because of their stative meaning, and that this is regardless of its agreement pattern.

A further issue that we discussed in [Chapter 8](#) relates to the significant differences in the duration between the verbs in one and the same sentence-type. As mentioned earlier, the experimental conditions with restrictions on the animacy of arguments compounded with the agglutinative nature of the language necessitate using verbs of varying lengths, and perhaps characteristics (say, causative versus simple ditransitives). Even amongst verbs of the same type and of almost identical lengths, individual differences are simply unavoidable. In fact, it is these differences that make them what they are, that is, a verb of a certain type with a certain meaning. In order to address the slightly individual processing differences that these different verbs perhaps elicit, a mixed-effects model of analysis rather than, or in addition to, ANOVAs could be employed. Mixed-effects models address the question of individual variation in the items, which would mean for data like ours that the effect(s) of each verb can be individually statistically analysed. Such an analysis, then, would enable ruling out potential confounds due to the individual variation in the interpretation of the data.

As for the task-related anterior early positivities at the verb, it would be interesting to see in a further study, if our assumptions and interpretations about these effects are correct. If our current interpretation of these effects along the lines of the P3a effect is correct, then in a study with identical critical conditions as in Experiment 3 but without direct context questions, that is, either when there is no context question at all, or when the contextual expectation is induced in a subtle and indirect manner, we should not observe the anterior early positivities that we observed in the mismatch contexts in Experiment 3. This is in spite of the judgement task, because we think a subtle context, whilst inducing an expectation for a specific type of verb, may not induce as strong an expectation for a very specific phonemic onset of the verb as the direct instance of the verb in our context questions did. In other words, the phonemic onset of the stimulus verb could not function in such a design as a reliable indicator for a potential match or mismatch, simply because there is no uniquely expected onset from which to discriminate the stimulus onset. This is very unlike Experiment 3, in which a stimulus verb with a certain onset would match the expectation fully, whereas any other onset would simply be a mismatch, albeit not a violation of any sort, with prior expectations.

9.2 Concluding Remarks

The present dissertation investigated the online processing of Tamil dative-subject constructions. This is the first time the processing of dative-subject constructions was studied in this detail in a language in which these constructions abound.

The results of the three auditory ERP Experiments reported here suggest processing differences at the sentence-initial position between dative-subjects and nominative subjects as well as dative indirect objects. They further suggest that dative-stative verbs are processed differently from non-stative verbs, possibly due to default-agreement. In addition, the context in which a stimulus sentence occurs, as well as the experimental task requirements appear to have a significant impact on the ERP effects obtained. In sum, these results appear to suggest that neurocognitive models of language comprehension need to take both linguistic and extra-linguistic factors into account in order for their predictions to have a broad scope.

Furthermore, given the fact that our studies are on a language that is typologically different from languages that have been studied relatively

9.2. CONCLUDING REMARKS

extensively to date, we believe our studies add an important dimension to those approaches that strive to model cross-linguistic similarities and differences.

To conclude, we believe that the insight that the studies presented here have provided — however meagre — and the questions that they have raised — however intriguing — would serve well for further examination of dative-subjects and stative verbs in future.

— * —

Appendices

— A —

ERP Curves

It is conventional to plot ERP curves ‘upside-down’ in the sense that negative voltages are plotted above the zero-line and positive voltages below it, unlike the positive-up and negative-down convention followed in all other fields of science. Luck (2005), discussing how this convention could have come into being, quotes Manny Donchin who apparently told him that ‘the early neurophysiologists plotted negative upward, possibly because this allows an action potential to be plotted as an upward-going spike’. The ERP curves from the present study, too, shall be plotted following this convention, that is negative-up and positive-down.

Glossing Conventions

Tamil is written in its own alphasyllabic script. Like in all other Brahmi-derived Indic writing systems, each basic symbol or grapheme in the Tamil alphasyllabary represents either a vowel, or a consonant with the inherent vowel /a/. The traditional inventory consists of 12 vowel signs, two of which are diphthongs, 18 consonant signs, and a special sign that represents an equivalent of a glottal stop that is usually listed along with the vowels. The inherent vowel in the consonants can be changed by diacritics placed to the left and / or to the right of the basic consonantal grapheme, whilst suppressing its inherent vowel altogether is achieved by placing a dot above it, a diacritic that is perhaps a derivative of the special sign mentioned above. Unlike other Indic writing systems, Tamil orthography does not differentiate voiced and voiceless consonants; this is inferred instead based on the phonemic environment. Further, Tamil does not combine partial forms of consonants nor employs consonant diacritics to represent consonant conjuncts, but instead achieves the same effect using the dotted form of the consonants. The traditional inventory thus consists of 247 unique letter forms or glyphs. However, this does not include several other consonants representing non-native (Sanskrit) phonemes, some of which are still widely used whilst others are seldom used. Indian numerals as used in the Latin script are the standard for writing numerals in Tamil; their variants in the Tamil script are almost never used.

The phonetic gloss for the Tamil examples in this dissertation follow the conventions illustrated in [Table B.1](#), which shows the basic vowel and consonant signs in the traditional order, as well as several non-native phonemes, and an example of vowel diacritics on the consonant /m/.

APPENDIX B. GLOSSING CONVENTIONS

Table B.1: Conventions used for phonetic glossing

TAMIL	IPA	GLOSS	TAMIL	IPA	GLOSS	TAMIL	IPA	GLOSS
அ	[ʌ]	a	க்	[k], [g], [x], [h]	k, g	ம	[mʌ]	ma
ஆ	[a:]	a:	ங்	[ŋ]	n(k,g)	மா	[ma:]	ma:
இ	[i]	i	ச்	[tʃ], [s], [dʒ], [ʃ]	ch, s	மி	[mi]	mi
ஈ	[i:]	i:	ஞ்	[ɲ]	ny	மி	[mi:]	mi:
உ	[u], [ʊ]	u,u'	ட்	[t̪], [d̪], [ɾ]	t,d	மு	[mu], [mu]	mu,mu'
ஊ	[u:]	u:	ண்	[ɳ]	n.	மு	[mu:]	mu:
எ	[e]	e	த்	[t̪], [d̪], [ð]	th, dh	மெ	[me]	me
ஏ	[e:]	e:	ந்	[ɳ]	n(dh)	மே	[me:]	me:
ஐ	[ʌy]	ai	ப்	[p], [b], [β]	p, b	மை	[mʌy]	mai
ஓ	[o]	o	ம்	[m]	m	மொ	[mo]	mo
ஔ	[o:]	o:	ய்	[j]	y	மொ	[mo:]	mo:
ஔ	[ʌʊ]	au	ர்	[r]	r	மொள	[mʌʊ]	mau
ஃ	[(?)]	(akh)	ல்	[l]	l	ம்	[m]	m
			வ்	[v]	v			
			ழ்	[ʒ]	zh			
			ள்	[ɻ]	l.			
			ற்	[r], [t], [d]	(t)r			
			ன்	[n]	n			
			ஜ்	[dʒ]	j			
			ஷ்	[ʃ]	sh			
			ஸ்	[s]	s			
			ஹ்	[h]	h			
			க்ஷ்	[kʃ]	ksh			

- The phoneme or phoneme cluster that follows is a grammatical suffix.
- ~ The phoneme or phoneme cluster that follows is not a suffix but the result of a morpho(phono)logical (sandhi) rule or a glide between two vowels.

The morphological gloss for the Tamil examples in this dissertation indicate the grammatical roles, case and animacy of the nouns concerned, as well as the tense and person-number-gender agreement features of the verbs concerned. These are indicated using superscripts and subscripts, the abbreviations and meanings of which are listed in Table B.2.

Table B.2: Conventions used for morphological glossing

Morphological Gloss	Meaning
[...] ^D	Determiner: Noun-modifiers, specifiers or quantifiers; not articles proper
[...] ^S	Subject
[...] ^O	Direct Object
[...] ^P	Predicate
[...] ^{IO}	Indirect Object
[...] ^{QS}	Quasi-Subject: an NP with some, but not all, subject properties
[...] ^{SC}	Subject-Complement
[...] ^{OC}	Object-Complement
[...] ^{ADJ}	Adjective
[...] _{NOM}	Nominative form of the noun
[...] _{ACC}	Accusative-marked noun
[...] _{DAT}	Dative-marked noun
[...] _{ABL}	Ablative-marked noun
[...] _{In}	Inanimate (irrational, neuter) question-word, pronoun or noun
[...] _{An}	Animate gender non-specific question-word or pronoun
[...] _{An.M}	Animate masculine noun
[...] _{An.F}	Animate feminine noun
[...] _{ADV}	Adverb
[...] _{Past}	Past-tense agreement
[...] _{Present}	Present-tense agreement
[...] _{Future}	Future-tense agreement
[...] _{Conditional}	Conditional, affirmative
[...] _{1singular}	1st person singular agreement; gender non-specific
[...] _{2singular}	2nd person singular agreement; gender non-specific, non-reverential
[...] _{3singular.Masculine}	3rd person singular agreement; Masculine, non-reverential
[...] _{3singular.Feminine}	3rd person singular agreement; Feminine, non-reverential
[...] _{3singular.Neuter}	3rd person singular agreement; Neuter

Stative Versus Literal Meanings

Many stative verbs have two possible meanings, which are unrelated, namely a stative meaning and a non-stative meaning that we term as the ‘literal meaning’ throughout this dissertation. We think the use of the term ‘literal’ is justified, because we feel that the meaning expressed by the verb in its non-stative reading is much more tangible, direct and yes, literal, being rendered in the nominative-accusative pattern that is the norm for the overwhelming majority of verbs in Tamil. We believe it also offers a relatively broader scope for interpretation, evidenced by the fact that the subject must be in the nominative case with the verb showing agreement with its person, number and gender features.

By contrast, the stative meaning is a special meaning that is restricted in its scope, requiring the subject to be in the dative case, with which the verb does not agree in spite of the fact that it is not morphologically defective, instead only showing the 3rd person, singular neuter agreement by default. In some cases, with some extrapolation, the stative meaning could perhaps be derived from the literal meaning in a distant figurative sort of way. This is perhaps what [Verma & Mohanan \(1990, p. 3\)](#) mean when they say ‘no underived verb assigns dative case to its agent’. This is particularly true of the stative verbs that can potentially incorporate two animate nouns in the obligatorily dative-accusative structure.

The sentences in (C.1) correspond to the stative and literal meanings of the two stative verbs used in our experiments. The arguments in these sentences were chosen so as to best illustrate their two very different readings, in spite of identical agreement markings on the verbs. Thus, the sentences with a dative nominal are stative, whereas their respective counterparts with the nominative nominals ‘town’ and ‘monkey’ are not.

APPENDIX C. STATIVE VERSUS LITERAL MEANINGS

(C.1) Stative versus Literal Meanings

குமாருக்கு மாலாவைத் தெரியும்.
 Kuma:r~u'~kku' Ma:la:~v-ai~th theri~y-um
 [Kumar]_{DAT-An.M} [Mala]_{ACC-An.F} [know]_{Future-3singular.Neuter}
 'Kumar knows Mala'.

மலைஉச்சியிலிருந்து பார்த்தால் ஊர் தெரியும்.
 Malai-uchchi~y-il-irundhu' pa:r-thth-a:l u:r theri~y-um
 [Hilltop]_{ABL-In} [see]_{Conditional} [town]_{NOM-In} [be visible]_{Future-3singular.Neuter}
 'The town will be visible from the hilltop'.

காவேரிக்கு குமாரைப் பிடிக்கும்.
 Ka:ve:ri~kku' Kuma:r-ai~p pidi-kk-um
 [Kaveri]_{DAT-An.F} [Kumar]_{ACC-An.M} [like]_{Future-3singular.Neuter}
 'Kaveri likes Kumar'.

பழத்தைப் போட்டால் குரங்கு அதைப் பிடிக்கும்.
 Pazha~thth-ai~p po:t.t.-a:l kurangu' adh-ai~p pidi-kk-um
 [Fruit]_{ACC-In} [throw]_{Conditional} [Monkey]_{NOM-In} [that]_{ACC-In} [catch]_{Future-3singular.Neuter}
 'Throw the banana, and the monkey will catch it'.

The agreement pattern in the sentences with a dative-subject in (C.1) is what is called as the default-agreement, because the agreement marking will be by default as shown regardless of the person, number and gender features of the dative-subject, whereas in the sentences with a nominative subject, the markings are as such owing to the inanimacy of the nominative subject nouns 'town' and 'monkey'⁷⁹, and not due to default-agreement.

Such a differentiation in agreement marking on the verb based on the animacy (gender) of the nominative subject becomes clear when we consider the acceptable sentences with the literal meaning of the verbs in (C.2), in which the verb is in the past tense so as to illustrate the difference in agreement clearly. These examples also show that the stative verbs used in our experiment are not defective morphologically. That is, they are basically capable of showing agreement with the subject.

On the other hand, the unacceptable / ungrammatical sentences in (C.2) show that, if the literal meaning of the verb is intended, then the subject

79. Recall that, as described in Chapter 4, the gender of Tamil nouns is determined naturally, but only if the noun concerned is capable of rational thought. Things incapable of higher rational thought, including human babies and animals, take the neuter gender in Tamil.

must be in the nominative case and the verb must agree with its in person, number and gender features fully. Alternatively, if the stative meaning is intended, then the subject noun must be in the dative case with which the verb must not agree, instead defaulting to the 3rd-person singular neuter agreement.

(C.2) *Stative versus Literal Meanings: Past tense*

குரங்கு	பந்தைப்	பிடித்தது.
Kurangu'	pandh-ai~p	pidi-thth-adhu'
[Monkey] _{NOM-In}	[Ball] _{ACC-In}	[catch] _{Past-3singular.Neuter}
'The monkey caught the ball'.		

ரவி	பந்தைப்	பிடித்தான்.
Ravi	pandh-ai~p	pidi-thth-a:n
[Ravi] _{NOM-An.M}	[Ball] _{ACC-In}	[catch] _{Past-3singular.Masculine}
'Ravi caught the ball'.		

*ரவி	பந்தைப்	பிடித்தது.
Ravi	pandh-ai~p	pidi-thth-adhu'
[Ravi] _{NOM-An.M}	[Ball] _{ACC-In}	[catch] _{Past-3singular.Neuter}
*'Ravi caught the ball'. (<i>Intended meaning</i>)		

*ரவிக்கு	பந்தைப்	பிடித்தான்.
Ravi-kku'	pandh-ai~p	pidi-thth-a:n
[Ravi] _{DAT-An.M}	[Ball] _{ACC-In}	[catch] _{Past-3singular.Masculine}
*'Ravi caught the ball'. (<i>Intended meaning</i>)		

Statistical Tables

Table D.1 shows the conventions used in the statistical tables in this thesis for reporting repeated measures analyses of variance (ANOVAs). An effect is reported only if it is at least marginally significant. This also applies to resolutions for interactions: when a certain resolution is missing from the table, this usually means that that resolution turned out to be insignificant.

Table D.1: Conventions used in the statistical tables in this thesis

Example Table Entry	Meaning
◆ WO	Effect of factor WO
◆ WO × ST	Effect of the interaction of factors WO and ST
↳ _{WO} = SO	Resolving for WO; Simple effect of ST when WO = SO
↳ _{ST} = NI+NA	Resolving further for ST by comparing NI and NA pairwise
◆ ROI × WO	Effect of the interaction of ROI and WO
↳ _{ROI} = LA FZ	Resolving for ROI; Simple effect of WO in the . . .
	Left-Anterior lateral region and / or Frontal midline region
1,23 45.79	Degree(s) of freedom and the F-value
*	Marginally significant effect; $p \leq 0.085$
*	Significant effect; $p \leq 0.055$
**	Very significant effect; $p \leq 0.015$
***	Highly significant effect; $p \leq 0.0015$

Experiment 1 : Supplement

E.1 Condition Codes

Table E.1: Explanation of Condition Codes

Condition Code	NP1	NP2	Verb
DAS	DAT-An Subject	ACC-An Object	Dative-Stative
ADS	ACC-An Object	DAT-An Subject	Dative-Stative
NIA	NOM-In Subject	ACC-An Object	Transitive
NAA	NOM-An Subject	ACC-An Object	Transitive
SAI	ACC-An Object	NOM-In Subject	Transitive
SAA	ACC-An Object	NOM-An Subject	Transitive

E.2 Items Distribution Scheme

Table E.2 shows the distribution of the critical items in Experiment 1.

Table E.2: Experiment 1: Distribution scheme for critical items

List	Sentence Sets					
	01-12	13-24	25-36	37-48	49-60	61-72
X	DAS	ADS	ADS	DAS	ADS	DAS
	NIA	NAA	NIA	SAI	NIA	NAA
	SAI	SAA	NAA	SAA	SAA	SAI
Y	ADS	DAS	DAS	ADS	DAS	ADS
	NAA	NIA	SAI	NIA	NAA	NIA
	SAA	SAI	SAA	NAA	SAI	SAA

E.3 Experimental Stimuli

In the following pages, the critical sentences used in the study are listed with their item numbers and condition codes. In the interest of space, only translations are provided and not the full phonological and morphological gloss. See [Chapter 5](#) example (5.1) for details about the condition codes. Note that although some of the English translations could sound a little odd owing to difficulties in translating some of the sentences, the sentences are fully acceptable in Tamil.

E.3. EXPERIMENTAL STIMULI

01DAS	முருகனுக்கு ரவியைப் பிடிக்கும்.	Murugan likes Ravi.
01ADS	ரவியை முருகனுக்குப் பிடிக்கும்.	Murugan likes Ravi.
01NIA	தண்ணீர் ரவியை நனைத்தது.	Water drenched Ravi.
01NAA	முருகன் ரவியை நினைத்தான்.	Murugan thought about Ravi.
01SAI	ரவியைத் தண்ணீர் நனைத்தது.	Water drenched Ravi.
01SAA	ரவியை முருகன் நினைத்தான்.	Murugan thought about Ravi.
02DAS	ராதாவுக்கு சோமுவைப் பிடிக்காது.	Radha doesn't like Somu.
02ADS	சோமுவை ராதாவுக்குப் பிடிக்காது.	Radha doesn't like Somu.
02NIA	உணவு சோமுவைத் தூங்கவைத்தது.	Food made Somu feel sleepy.
02NAA	ராதா சோமுவைக் காதலித்தாள்.	Radha loved Somu.
02SAI	சோமுவை உணவு தூங்கவைத்தது.	Food made Somu feel sleepy.
02SAA	சோமுவை ராதா காதலித்தாள்.	Radha loved Somu.
03DAS	டாக்டருக்கு குணாவைத் தெரியும்.	The doctor knows Guna.
03ADS	குணாவை டாக்டருக்குத் தெரியும்.	The doctor knows Guna.
03NIA	மருந்து குணாவை குணமாக்கியது.	The medicine cured Guna.
03NAA	டாக்டர் குணாவை குணமாக்கினார்.	The doctor cured Guna.
03SAI	குணாவை மருந்து குணமாக்கியது.	The medicine cured Guna.
03SAA	குணாவை டாக்டர் குணமாக்கினார்.	The doctor cured Guna.
04DAS	மருத்துவருக்கு செல்வியைத் தெரியாது.	The doctor doesn't know Selvi.
04ADS	செல்வியை மருத்துவருக்குத் தெரியாது.	The doctor doesn't know Selvi.
04NIA	மாத்திரை செல்வியை குணப்படுத்தியது.	The tablet cured Selvi.
04NAA	மருத்துவர் செல்வியை குணப்படுத்தினார்.	The doctor cured Selvi.
04SAI	செல்வியை மாத்திரை குணப்படுத்தியது.	The tablet cured Selvi.
04SAA	செல்வியை மருத்துவர் குணப்படுத்தினார்.	The doctor cured Selvi.
05DAS	சிவாவுக்கு மனோவைப் பிடிக்கும்.	Siva likes Mano.
05ADS	மனோவை சிவாவுக்குப் பிடிக்கும்.	Siva likes Mano.
05NIA	ஆட்டோ மனோவை மோதியது.	The auto-rickshaw hit Mano.
05NAA	சிவா மனோவை மிரட்டினான்.	Siva threatened Mano.
05SAI	மனோவை ஆட்டோ மோதியது.	The auto-rickshaw hit Mano.
05SAA	மனோவை சிவா மிரட்டினான்.	Siva threatened Mano.
06DAS	பையனுக்கு மோஹனைப் பிடிக்காது.	The boy doesn't like Mohan.
06ADS	மோஹனை பையனுக்குப் பிடிக்காது.	The boy doesn't like Mohan.
06NIA	பந்து மோஹனைக் காயப்படுத்தியது.	The ball hurt Mohan.
06NAA	பையன் மோஹனைத் திட்டினான்.	The boy scolded Mohan.
06SAI	மோஹனைப் பந்து காயப்படுத்தியது.	The ball hurt Mohan.
06SAA	மோஹனைப் பையன் திட்டினான்.	The boy scolded Mohan.
07DAS	மீனாவுக்கு வள்ளியைத் தெரியும்.	Meena knows Valli.
07ADS	வள்ளியை மீனாவுக்குத் தெரியும்.	Meena knows Valli.
07NIA	புத்தகம் வள்ளியை மகிழ்த்தியது.	The book made Valli happy.
07NAA	மீனா வள்ளியைக் காப்பாற்றினாள்.	Meena saved Valli.
07SAI	வள்ளியைப் புத்தகம் மகிழ்த்தியது.	The book made Valli happy.
07SAA	வள்ளியை மீனா காப்பாற்றினாள்.	Meena saved Valli.
08DAS	குமாருக்கு ஷீலாவைத் தெரியாது.	Kumar doesn't know Sheela.
08ADS	ஷீலாவை குமாருக்குத் தெரியாது.	Kumar doesn't know Sheela.
08NIA	புடவை ஷீலாவை அழகுபடுத்தியது.	The saree beautified Sheela.
08NAA	குமார் ஷீலாவை மணந்தான்.	Kumar married Sheela.
08SAI	ஷீலாவைப் புடவை அழகுபடுத்தியது.	The saree beautified Sheela.
08SAA	ஷீலாவைக் குமார் மணந்தான்.	Kumar married Sheela.
09DAS	கீதாவுக்கு மாலாவைப் பிடிக்கும்.	Geetha likes Mala.

APPENDIX E. EXPERIMENT 1 : SUPPLEMENT

09ADS	மாலாவை கீதாவுக்குப் பிடிக்கும்.	Geetha likes Mala.
09NIA	அரிவாள் மாலாவைக் குத்தியது.	The sickle stabbed Mala.
09NAA	கீதா மாலாவைத் துன்புறுத்தினாள்.	Geetha hurt Mala.
09SAI	மாலாவை அரிவாள் குத்தியது.	The sickle stabbed Mala.
09SAA	மாலாவை கீதா துன்புறுத்தினாள்.	Geetha hurt Mala.
10DAS	லதாவுக்கு சூர்யாவைப் பிடிக்காது.	Latha doesn't like Surya.
10ADS	சூர்யாவை லதாவுக்குப் பிடிக்காது.	Latha doesn't like Surya.
10NIA	முள் சூர்யாவைக் குத்தியது.	The thorn pricked Surya.
10NAA	லதா சூர்யாவை உதைத்தாள்.	Latha kicked Surya.
10SAI	சூர்யாவை முள் குத்தியது.	The thorn pricked Surya.
10SAA	சூர்யாவை லதா உதைத்தாள்.	Latha kicked Surya.
11DAS	விஜய்ப்புக்கு சிறுமியைத் தெரியும்.	Vijay knows the little girl.
11ADS	சிறுமியை விஜய்ப்புக்குத் தெரியும்.	Vijay knows the little girl.
11NIA	புயல் சிறுமியை பயமுறுத்தியது.	The storm frightened the girl.
11NAA	விஜய் சிறுமியைக் கொஞ்சினான்.	Vijay cuddled the little girl.
11SAI	சிறுமியைப் புயல் பயமுறுத்தியது.	The storm frightened the girl.
11SAA	சிறுமியை விஜய் கொஞ்சினான்.	Vijay cuddled the little girl.
12DAS	சுரேஷுக்கு சிறுவனைத் தெரியாது.	Suresh doesn't know the little boy.
12ADS	சிறுவனை சுரேஷுக்குத் தெரியாது.	Suresh doesn't know the little boy.
12NIA	அம்பு சிறுவனைத் தாக்கியது.	The arrow hurt the little boy.
12NAA	சுரேஷ் சிறுவனை முறைத்தான்.	Suresh frowned at the little boy.
12SAI	சிறுவனை அம்பு தாக்கியது.	The arrow hurt the little boy.
12SAA	சிறுவனை சுரேஷ் முறைத்தான்.	Suresh frowned at the little boy.
13DAS	மோஹனாவுக்கு சேகரைப் பிடிக்கும்.	Mohana likes Sekar.
13ADS	சேகரை மோஹனாவுக்குப் பிடிக்கும்.	Mohana likes Sekar.
13NIA	விவேகம் சேகரைக் காப்பாற்றியது.	Prudence saved Sekar.
13NAA	மோஹனா சேகரைக் காப்பாற்றினாள்.	Mohana saved Sekar.
13SAI	சேகரை விவேகம் காப்பாற்றியது.	Prudence saved Sekar.
13SAA	சேகரை மோஹனா காப்பாற்றினாள்.	Mohana saved Sekar.
14DAS	ரமேஷுக்கு உமாவைப் பிடிக்காது.	Ramesh doesn't like Uma.
14ADS	உமாவை ரமேஷுக்குப் பிடிக்காது.	Ramesh doesn't like Uma.
14NIA	தேங்காய் உமாவைக் காயப்படுத்தியது.	The coconut hurt Uma.
14NAA	ரமேஷ் உமாவைக் கைப்பிடித்தான்.	Ramesh married Uma.
14SAI	உமாவைத் தேங்காய் காயப்படுத்தியது.	The coconut hurt Uma.
14SAA	உமாவை ரமேஷ் கைப்பிடித்தான்.	Ramesh married Uma.
15DAS	ரஞ்சித்துக்கு உஷாவைத் தெரியும்.	Ranjith knows Usha.
15ADS	உஷாவை ரஞ்சித்துக்குத் தெரியும்.	Ranjith knows Usha.
15NIA	தோணி உஷாவைக் காப்பாற்றியது.	The boat saved Usha.
15NAA	ரஞ்சித் உஷாவைக் காப்பாற்றினான்.	Ranjith saved Usha.
15SAI	உஷாவைத் தோணி காப்பாற்றியது.	The boat saved Usha.
15SAA	உஷாவை ரஞ்சித் காப்பாற்றினான்.	Ranjith saved Usha.
16DAS	வாசுவுக்கு கமலாவைத் தெரியாது.	Vasu doesn't know Kamala.
16ADS	கமலாவை வாசுவுக்குத் தெரியாது.	Vasu doesn't know Kamala.
16NIA	மழை கமலாவை நனைத்தது.	The rain drenched Kamala.
16NAA	வாசு கமலாவை மணந்தான்.	Vasu married Kamala.
16SAI	கமலாவை மழை நனைத்தது.	The rain drenched Kamala.
16SAA	கமலாவை வாசு மணந்தான்.	Vasu married Kamala.
17DAS	வினித்துக்கு ரமாவைப் பிடிக்கும்.	Vinith likes Ramaa.
17ADS	ரமாவை வினித்துக்குப் பிடிக்கும்.	Vinith likes Ramaa.

E.3. EXPERIMENTAL STIMULI

17NIA	சாவி ரமாவைக் கீறியது.	The key scratched Ramaa.
17NAA	வினித் ரமாவைத் திட்டினான்.	Vinith scolded Ramaa.
17SAI	ரமாவைச் சாவி கீறியது.	The key scratched Ramaa.
17SAA	ரமாவை வினித் திட்டினான்.	Vinith scolded Ramaa.
18DAS	தேவிகாவுக்கு சீதாவைப் பிடிக்காது.	Devi doesn't like Geetha.
18ADS	சீதாவை தேவிகாவுக்குப் பிடிக்காது.	Devi doesn't like Geetha.
18NIA	ரோட்ரோலர் சீதாவை இடித்தது.	The road-roller hit Seetha.
18NAA	தேவிகா சீதாவைத் திட்டினாள்.	Devika scolded Seetha.
18SAI	சீதாவை ரோட்ரோலர் இடித்தது.	The road-roller hit Seetha.
18SAA	சீதாவை தேவிகா திட்டினாள்.	Devika scolded Seetha.
19DAS	உழவனுக்கு சுதாவைத் தெரியும்.	The farmer knows Sudha.
19ADS	சுதாவை உழவனுக்குத் தெரியும்.	The farmer knows Sudha.
19NIA	டிராக்டர் சுதாவை இடித்தது.	The tractor hit Sudha.
19NAA	உழவன் சுதாவைப் பார்த்தான்.	The farmer looked at Sudha.
19SAI	சுதாவை டிராக்டர் இடித்தது.	The tractor hit Sudha.
19SAA	சுதாவை உழவன் பார்த்தான்.	The farmer looked at Sudha.
20DAS	சரிதாவுக்கு அருணைத் தெரியாது.	Saritha doesn't know Arun.
20ADS	அருணை சரிதாவுக்குத் தெரியாது.	Saritha doesn't know Arun.
20NIA	கோபம் அருணை மடமாக்கியது.	Anger made Arun stupid.
20NAA	சரிதா அருணை மணந்தாள்.	Saritha married Arun.
20SAI	அருணைக் கோபம் மடமாக்கியது.	Anger made Arun stupid.
20SAA	அருணை சரிதா மணந்தாள்.	Saritha married Arun.
21DAS	சுந்தருக்கு மஞ்சுவைப் பிடிக்கும்.	Sundar likes Manju.
21ADS	மஞ்சுவை சுந்தருக்குப் பிடிக்கும்.	Sundar likes Manju.
21NIA	கப்பல் மஞ்சுவைக் காப்பாற்றியது.	The ship saved Manju.
21NAA	சுந்தர் மஞ்சுவை அடித்தான்.	Sundar hit Manju.
21SAI	மஞ்சுவைக் கப்பல் காப்பாற்றியது.	The ship saved Manju.
21SAA	மஞ்சுவை சுந்தர் அடித்தான்.	Sundar hit Manju.
22DAS	ரகுவுக்கு ஆஷாவைப் பிடிக்காது.	Raghu doesn't like Asha.
22ADS	ஆஷாவை ரகுவுக்குப் பிடிக்காது.	Raghu doesn't like Asha.
22NIA	கடிதம் ஆஷாவைப் புகழ்ந்தது.	The letter praised Asha.
22NAA	ரகு ஆஷாவை விரும்பினான்.	Ragu loved Asha.
22SAI	ஆஷாவைக் கடிதம் புகழ்ந்தது.	The letter praised Asha.
22SAA	ஆஷாவை ரகு விரும்பினான்.	Ragu loved Asha.
23DAS	விக்ரமுக்கு பாலுவைத் தெரியும்.	Vikram knows Balu.
23ADS	பாலுவை விக்ரமுக்குத் தெரியும்.	Vikram knows Balu.
23NIA	பிரேக் பாலுவை உலுக்கியது.	The brakes shook Balu.
23NAA	விக்ரம் பாலுவைக் கிள்ளினான்.	Vikram pinched Balu.
23SAI	பாலுவை பிரேக் உலுக்கியது.	The brakes shook Balu.
23SAA	பாலுவை விக்ரம் கிள்ளினான்.	Vikram pinched Balu.
24DAS	பிரபுவுக்கு விசுவைத் தெரியாது.	Prabhu doesn't know Visu.
24ADS	விசுவை பிரபுவுக்குத் தெரியாது.	Prabhu doesn't know Visu.
24NIA	கத்தி விசுவைக் கீறியது.	The knife scratched/slit Visu.
24NAA	பிரபு விசுவைக் கோபித்தான்.	Prabhu told Visu off.
24SAI	விசுவைக் கத்தி கீறியது.	The knife scratched/slit Visu.
24SAA	விசுவைப் பிரபு கோபித்தான்.	Prabhu told Visu off.
25DAS	விஷாலுக்கு தீபாவைப் பிடிக்கும்.	Vishal likes Deepa.
25ADS	தீபாவை விஷாலுக்குப் பிடிக்கும்.	Vishal likes Deepa.
25NIA	காற்று தீபாவைத் தள்ளியது.	The wind pushed Deepa over.

APPENDIX E. EXPERIMENT 1 : SUPPLEMENT

25NAA	விஷால் தீபாவைக் கேலிசெய்தான்.	Vishal made fun of Deepa.
25SAI	தீபாவைக் காற்று தள்ளியது.	The wind pushed Deepa over.
25SAA	தீபாவை விஷால் கேலிசெய்தான்.	Vishal made fun of Deepa.
26DAS	சஷிலுக்கு தேவியைப் பிடிக்காது.	Sushil doesn't like Devi.
26ADS	தேவியை சஷிலுக்குப் பிடிக்காது.	Sushil doesn't like Devi.
26NIA	வெயில் தேவியை வாட்டியது.	The sunshine made Devi tired.
26NAA	சஷில் தேவியைத் தடுத்தான்.	Sushil hindered Devi.
26SAI	தேவியை வெயில் வாட்டியது.	The sunshine made Devi tired.
26SAA	தேவியை சஷில் தடுத்தான்.	Sushil hindered Devi.
27DAS	ரம்யாவுக்கு ராஜுவைத் தெரியும்.	Ramya knows Raju.
27ADS	ராஜுவை ரம்யாவுக்குத் தெரியும்.	Ramya knows Raju.
27NIA	தர்மம் ராஜுவைக் காத்தது.	Charity saved Raju.
27NAA	ரம்யா ராஜுவைத் தேடினாள்.	Ramya looked for Raju.
27SAI	ராஜுவை தர்மம் காத்தது.	Charity saved Raju.
27SAA	ராஜுவை ரம்யா தேடினாள்.	Ramya looked for Raju.
28DAS	ஹரிக்கு சனிலைத் தெரியாது.	Hari doesn't know Sunil.
28ADS	சனிலை ஹரிக்குத் தெரியாது.	Hari doesn't know Sunil.
28NIA	நெருப்பு சனிலைக் காயப்படுத்தியது.	The fire hurt/wounded Sunil.
28NAA	ஹரி சனிலை அடித்தான்.	Hari hit Sunil.
28SAI	சனிலை நெருப்பு காயப்படுத்தியது.	The fire hurt/wounded Sunil.
28SAA	சனிலை ஹரி அடித்தான்.	Hari hit Sunil.
29DAS	சௌமியாவுக்கு சச்சினைப் பிடிக்கும்.	Sowmya likes Sachin.
29ADS	சச்சினை சௌமியாவுக்குப் பிடிக்கும்.	Sowmya likes Sachin.
29NIA	புல்டோஸர் சச்சினை இடித்தது.	The bulldozer hit Sachin.
29NAA	சௌமியா சச்சினைப் பார்த்தாள்.	Sowmya looked at Sachin.
29SAI	சச்சினை புல்டோஸர் இடித்தது.	The bulldozer hit Sachin.
29SAA	சச்சினை சௌமியா பார்த்தாள்.	Sowmya looked at Sachin.
30DAS	முகேஷுக்கு நர்லைப் பிடிக்காது.	Mukesh doesn't like the Nurse.
30ADS	நர்லை முகேஷுக்குப் பிடிக்காது.	Mukesh doesn't like the Nurse.
30NIA	ஊசி நர்லைக் குத்தியது.	The needle pricked the nurse.
30NAA	முகேஷ் நர்லை முறைத்தான்.	Mukesh frowned at the nurse.
30SAI	நர்லை ஊசி குத்தியது.	The needle pricked the nurse.
30SAA	நர்லை முகேஷ் முறைத்தான்.	Mukesh frowned at the nurse.
31DAS	ஷங்கருக்கு குருவைத் தெரியும்.	Shankar knows Guru.
31ADS	குருவை ஷங்கருக்குத் தெரியும்.	Shankar knows Guru.
31NIA	வெளிச்சம் குருவை எழுப்பியது.	Brightness wooke Guru up.
31NAA	ஷங்கர் குருவை வணங்கினான்.	Shankar greeted Guru.
31SAI	குருவை வெளிச்சம் எழுப்பியது.	Brightness wooke Guru up.
31SAA	குருவை ஷங்கர் வணங்கினான்.	Shankar greeted Guru.
32DAS	விஜயாவுக்கு பாரியைத் தெரியாது.	Vijaya doesn't know Paari.
32ADS	பாரியை விஜயாவுக்குத் தெரியாது.	Vijaya doesn't know Paari.
32NIA	சோம்பல் பாரியைக் கெடுத்தது.	Laziness spoilt Pari.
32NAA	விஜயா பாரியைத் தொட்டாள்.	Vijaya touched Pari.
32SAI	பாரியைச் சோம்பல் கெடுத்தது.	Laziness spoilt Pari.
32SAA	பாரியை விஜயா தொட்டாள்.	Vijaya touched Pari.
33DAS	பிரேமாவுக்கு ராமுவைப் பிடிக்கும்.	Prema likes Ramu.
33ADS	ராமுவை பிரேமாவுக்குப் பிடிக்கும்.	Prema likes Ramu.
33NIA	கனவு ராமுவை பயமுறுத்தியது.	The dream frightened Ramu.
33NAA	பிரேமா ராமுவை நினைத்தாள்.	Prema thought about Ramu.

E.3. EXPERIMENTAL STIMULI

33SAI	ராமுவைக் கனவு பயமுறுத்தியது.	The dream frightened Ramu.
33SAA	ராமுவைப் பிரேமா நினைத்தாள்.	Prema thought about Ramu.
34DAS	வருணுக்கு ரதியைப் பிடிக்காது.	Varun doesn't like Rathi.
34ADS	ரதியை வருணுக்குப் பிடிக்காது.	Varun doesn't like Rathi.
34NIA	விமானம் ரதியை வியக்கவைத்தது.	The plane surprised Rathi.
34NAA	வருண் ரதியைப் பார்த்தான்.	Varun saw Rathi.
34SAI	ரதியை விமானம் வியக்கவைத்தது.	The plane surprised Rathi.
34SAA	ரதியை வருண் பார்த்தான்.	Varun saw Rathi.
35DAS	ரம்பாவுக்கு தருணைத் தெரியும்.	Ramba likes Tarun.
35ADS	தருணை ரம்பாவுக்குத் தெரியும்.	Ramba likes Tarun.
35NIA	ரயில் தருணைக் கொண்டுசேர்த்தது.	The train made Tarun reach safely.
35NAA	ரம்பா தருணை காதலித்தாள்.	Ramba loved Tarun.
35SAI	தருணை ரயில் கொண்டுசேர்த்தது.	The train made Tarun reach safely.
35SAA	தருணை ரம்பா காதலித்தாள்.	Ramba loved Tarun.
36DAS	உமேஷுக்கு சீனுவைத் தெரியாது.	Umesh doesn't know Seenu.
36ADS	சீனுவை உமேஷுக்குத் தெரியாது.	Umesh doesn't know Seenu.
36NIA	சோப் சீனுவை மகிழ்த்தியது.	The soap amused Seenu.
36NAA	உமேஷ் சீனுவைக் கேலிசெய்தான்.	Umesh made fun of Seenu.
36SAI	சீனுவை சோப் மகிழ்த்தியது.	The soap amused Seenu.
36SAA	சீனுவை உமேஷ் கேலிசெய்தான்.	Umesh made fun of Seenu.
37DAS	சோமுவுக்கு கீதாவைப் பிடிக்கும்.	Somu likes Geetha.
37ADS	கீதாவை சோமுவுக்குப் பிடிக்கும்.	Somu likes Geetha.
37NIA	தாகம் கீதாவை வாட்டியது.	The thirst made Geetha tired.
37NAA	சோமு கீதாவை நினைத்தான்.	Somu thought about Geetha.
37SAI	கீதாவைத் தாகம் வாட்டியது.	The thirst made Geetha tired.
37SAA	கீதாவை சோமு நினைத்தான்.	Somu thought about Geetha.
38DAS	சுதாவுக்கு தேவிகாவைப் பிடிக்காது.	Sudha doesn't like Devika.
38ADS	தேவிகாவை சுதாவுக்குப் பிடிக்காது.	Sudha doesn't like Devika.
38NIA	பசி தேவிகாவை வாட்டியது.	The hunger made Devika tired.
38NAA	சுதா தேவிகாவைக் கிள்ளினாள்.	Sudha pinched Devika.
38SAI	தேவிகாவைப் பசி வாட்டியது.	The hunger made Devika tired.
38SAA	தேவிகாவை சுதா கிள்ளினாள்.	Sudha pinched Devika.
39DAS	மனோவுக்கு சஷிலைத் தெரியும்.	Mano knows Sushil.
39ADS	சஷிலை மனோவுக்குத் தெரியும்.	Mano knows Sushil.
39NIA	வலி சஷிலைக் கொன்றது.	The pain killed Sushil.
39NAA	மனோ சஷிலை மிறட்டினான்.	Mano threatened Sushil.
39SAI	சஷிலை வலி கொன்றது.	The pain killed Sushil.
39SAA	சஷிலை மனோ மிறட்டினான்.	Mano threatened Sushil.
40DAS	மஞ்சுவுக்கு குமாரைத் தெரியாது.	Manju doesn't know Kumar.
40ADS	குமாரை மஞ்சுவுக்குத் தெரியாது.	Manju doesn't know Kumar.
40NIA	நோய் குமாரைப் பயமுறுத்தியது.	Disease frightened Kumar.
40NAA	மஞ்சு குமாரைத் திட்டினாள்.	Manju scolded Kumar.
40SAI	குமாரை நோய் பயமுறுத்தியது.	Disease frightened Kumar.
40SAA	குமாரை மஞ்சு திட்டினாள்.	Manju scolded Kumar.
41DAS	சிறுமிக்கு விக்ரமைப் பிடிக்கும்.	The little girl likes Vikram.
41ADS	விக்ரமை சிறுமிக்குப் பிடிக்கும்.	The little girl likes Vikram.
41NIA	கல் விக்ரமைத் தாக்கியது.	The stone hurt Vikram.
41NAA	சிறுமி விக்ரமைப் பார்த்தாள்.	The little girl looked at Vikram.
41SAI	விக்ரமைக் கல் தாக்கியது.	The stone hurt Vikram.

APPENDIX E. EXPERIMENT 1 : SUPPLEMENT

41SAA	விக்ரமைச் சிறுமி பார்த்தாள்.	The little girl looked at Vikram.
42DAS	குணாவுக்கு பையனைப் பிடிக்காது.	Guna doesn't like the little boy.
42ADS	பையனை குணாவுக்குப் பிடிக்காது.	Guna doesn't like the little boy.
42NIA	கடல் பையனை மூழ்கடித்தது.	The sea made the boy drown.
42NAA	குணா பையனைக் காப்பாற்றினாள்.	Guna saved the boy.
42SAI	பையனைக் கடல் மூழ்கடித்தது.	The sea made the boy drown.
42SAA	பையனை குணா காப்பாற்றினாள்.	Guna saved the boy.
43DAS	மோஹனாவுக்கு லதாவைத் தெரியும்.	Mohana knows Latha.
43ADS	லதாவை மோஹனாவுக்குத் தெரியும்.	Mohana knows Latha.
43NIA	கண்ணாடி லதாவைக் கீறியது.	The glass scratched/slit Latha.
43NAA	மோஹன் லதாவை விரும்பினான்.	Mohan loved Latha.
43SAI	லதாவைக் கண்ணாடி கீறியது.	The glass scratched/slit Latha.
43SAA	லதாவை மோஹன் விரும்பினான்.	Mohan loved Latha.
44DAS	வள்ளிக்கு மருத்துவரைத் தெரியாது.	Valli doesn't know the doctor.
44ADS	மருத்துவரை வள்ளிக்குத் தெரியாது.	Valli doesn't know the doctor.
44NIA	அறிவு மருத்துவரை புகழடையச்செய்தது.	The intellect made the doctor famous.
44NAA	வள்ளி மருத்துவரை மணந்தாள்.	Valli married the doctor.
44SAI	மருத்துவரை அறிவு புகழடையச்செய்தது.	The intellect made the doctor famous.
44SAA	மருத்துவரை வள்ளி மணந்தாள்.	Valli married the doctor.
45DAS	உமாவுக்கு சுரேஷைப் பிடிக்கும்.	Uma likes Suresh.
45ADS	சுரேஷை உமாவுக்குப் பிடிக்கும்.	Uma likes Suresh.
45NIA	பழம் சுரேஷை மகிழவைத்தது.	The fruit made Suresh happy.
45NAA	உமா சுரேஷை மணந்தாள்.	Uma married Suresh.
45SAI	சுரேஷைப் பழம் மகிழவைத்தது.	The fruit made Suresh happy.
45SAA	சுரேஷை உமா மணந்தாள்.	Uma married Suresh.
46DAS	பாலுவுக்கு ரஞ்சித்தைப் பிடிக்காது.	Balu doesn't like Ranjith.
46ADS	ரஞ்சித்தை பாலுவுக்குப் பிடிக்காது.	Balu doesn't like Ranjith.
46NIA	வயல் ரஞ்சித்தை வியக்கவைத்தது.	The field surprised Ranjith.
46NAA	பாலு ரஞ்சித்தைக் கேலிசெய்தான்.	Balu made fun of Ranjith.
46SAI	ரஞ்சித்தை வயல் வியக்கவைத்தது.	The field surprised Ranjith.
46SAA	ரஞ்சித்தை பாலு கேலிசெய்தான்.	Balu made fun of Ranjith.
47DAS	சச்சினுக்கு ரமேஷைத் தெரியும்.	Sachin knows Ramesh.
47ADS	ரமேஷை சச்சினுக்குத் தெரியும்.	Sachin knows Ramesh.
47NIA	கவனம் ரமேஷைக் காப்பாற்றியது.	Attention saved Ramesh.
47NAA	சச்சின் ரமேஷைக் கோபித்தான்.	Sachin was angry at Ramesh.
47SAI	ரமேஷை கவனம் காப்பாற்றியது.	Attention saved Ramesh.
47SAA	ரமேஷை சச்சின் கோபித்தான்.	Sachin was angry at Ramesh.
48DAS	சிறுவனுக்கு மோஹனாவைத் தெரியாது.	The little boy doesn't know Mohana.
48ADS	மோஹனாவை சிறுவனுக்குத் தெரியாது.	The little boy doesn't know Mohana.
48NIA	பூட்டு மோஹனாவைக் காயப்படுத்தியது.	The lock hurt Mohana.
48NAA	சிறுவன் மோஹனாவை அடித்தான்.	The little boy hit Mohana.
48SAI	மோஹனாவைப் பூட்டு காயப்படுத்தியது.	The lock hurt Mohana.
48SAA	மோஹனாவைச் சிறுவன் அடித்தான்.	The little boy hit Mohana.
49DAS	சூர்யாவுக்கு ஹரியைப் பிடிக்கும்.	Surya likes Hari.
49ADS	ஹரியை சூர்யாவுக்குப் பிடிக்கும்.	Surya likes Hari.
49NIA	காகிதம் ஹரியை எழுதத்தூண்டியது.	The paper tempted Hari to write.
49NAA	சூர்யா ஹரியை வெறுத்தான்.	Surya hated Hari.
49SAI	ஹரியைக் காகிதம் எழுதத்தூண்டியது.	The paper tempted Hari to write.
49SAA	ஹரியை சூர்யா வெறுத்தான்.	Surya hated Hari.

E.3. EXPERIMENTAL STIMULI

50DAS	உஷாவுக்கு பிரேமாவைப் பிடிக்காது.	Usha doesn't like Prema.
50ADS	பிரேமாவை உஷாவுக்குப் பிடிக்காது.	Usha doesn't like Prema.
50NIA	கதை பிரேமாவை அழவைத்தது.	The story made Prema cry.
50NAA	உஷா பிரேமாவைத் திட்டினாள்.	Usha scolded Prema.
50SAI	பிரேமாவைக் கதை அழவைத்தது.	The story made Prema cry.
50SAA	பிரேமாவை உஷா திட்டினாள்.	Usha scolded Prema.
51DAS	சேகருக்கு மீனாவைத் தெரியும்.	Sekar knows Meena.
51ADS	மீனாவை சேகருக்குத் தெரியும்.	Sekar knows Meena.
51NIA	சேலை மீனாவை அழகுபடுத்தியது.	The saree beautified Meena.
51NAA	சேகர் மீனாவை விரும்பினான்.	Sekar loved Meena.
51SAI	மீனாவை சேலை அழகுபடுத்தியது.	The saree beautified Meena.
51SAA	மீனாவை சேகர் விரும்பினான்.	Sekar loved Meena.
52DAS	ரமாவுக்கு பிரபுவைத் தெரியாது.	Ramaa doesn't know Prabhu.
52ADS	பிரபுவை ரமாவுக்குத் தெரியாது.	Ramaa doesn't know Prabhu.
52NIA	மரம் பிரபுவை வியக்கவைத்தது.	The tree surprised Prabhu.
52NAA	ரமா பிரபுவைத் தடுத்தாள்.	Ramaa hindered Prabhu.
52SAI	பிரபுவை மரம் வியக்கவைத்தது.	The tree surprised Prabhu.
52SAA	பிரபுவை ரமா தடுத்தாள்.	Ramaa hindered Prabhu.
53DAS	ராஜுவுக்கு விஜயாவைப் பிடிக்கும்.	Raju likes Vijaya.
53ADS	விஜயாவை ராஜுவுக்குப் பிடிக்கும்.	Raju likes Vijaya.
53NIA	கயிறு விஜயாவைக் காப்பாற்றியது.	The rope saved Vijaya.
53NAA	ராஜு விஜயாவைக் காப்பாற்றினான்.	Raju saved Vijaya.
53SAI	விஜயாவைக் கயிறு காப்பாற்றியது.	The rope saved Vijaya.
53SAA	விஜயாவை ராஜு காப்பாற்றினான்.	Raju saved Vijaya.
54DAS	கமலாவுக்கு விஷாவைப் பிடிக்காது.	Kamala doesn't like Vishal.
54ADS	விஷாவை கமலாவுக்குப் பிடிக்காது.	Kamala doesn't like Vishal.
54NIA	விபத்து விஷாவைக் கொன்றது.	The accident killed Vishal.
54NAA	கமலா விஷாவைக் காதலித்தாள்.	Kamala loved Vishal.
54SAI	விஷாவை விபத்து கொன்றது.	The accident killed Vishal.
54SAA	விஷாவை கமலா காதலித்தாள்.	Kamala loved Vishal.
55DAS	ராமுவுக்கு ரம்யாவைத் தெரியும்.	Ramu knows Ramya.
55ADS	ரம்யாவை ராமுவுக்குத் தெரியும்.	Ramu knows Ramya.
55NIA	ஆறு ரம்யாவை மூழ்கடித்தது.	The river made Ramya drown.
55NAA	ராமு ரம்யாவைக் கைப்பிடித்தான்.	Ramu married Ramya.
55SAI	ரம்யாவை ஆறு மூழ்கடித்தது.	The river made Ramya drown.
55SAA	ரம்யாவை ராமு கைப்பிடித்தான்.	Ramu married Ramya.
56DAS	சீதாவுக்கு டாக்டரைத் தெரியாது.	Seetha doesn't know the doctor.
56ADS	டாக்டரை சீதாவுக்குத் தெரியாது.	Seetha doesn't know the doctor.
56NIA	தக்காளி டாக்டரைச் சிரிக்கவைத்தது.	The tomato made the doctor laugh.
56NAA	சீதா டாக்டரைத் திட்டினாள்.	Seetha scolded the doctor.
56SAI	டாக்டரைத் தக்காளி சிரிக்கவைத்தது.	The tomato made the doctor laugh.
56SAA	டாக்டரை சீதா திட்டினாள்.	Seetha scolded the doctor.
57DAS	மாலாவுக்கு சரிதாவைப் பிடிக்கும்.	Mala likes Saritha.
57ADS	சரிதாவை மாலாவுக்குப் பிடிக்கும்.	Mala likes Saritha.
57NIA	ஆட்டம் சரிதாவை மகிழ்த்தியது.	The match amused Saritha.
57NAA	மாலா சரிதாவை நம்பினாள்.	Mala trusted Saritha.
57SAI	சரிதாவை ஆட்டம் மகிழ்த்தியது.	The match amused Saritha.
57SAA	சரிதாவை மாலா நம்பினாள்.	Mala trusted Saritha.
58DAS	பாரிக்கு ராதாவைப் பிடிக்காது.	Paari doesn't like Radha.

APPENDIX E. EXPERIMENT 1 : SUPPLEMENT

58ADS	ராதாவை பாரிக்குப் பிடிக்காது.	Paari doesn't like Radha.
58NIA	சாலை ராதாவை வழக்கிவிழவைத்தது.	The road made Radha fall.
58NAA	பாரி ராதாவைக் காதலித்தான்.	Pari loved Radha.
58SAI	ராதாவைச் சாலை வழக்கிவிழவைத்தது.	The road made Radha fall.
58SAA	ராதாவைப் பாரி காதலித்தான்.	Pari loved Radha.
59DAS	ரதிக்கு சுந்தரைத் தெரியும்.	Rathi knows Sundar.
59ADS	சுந்தரை ரதிக்குத் தெரியும்.	Rathi knows Sundar.
59NIA	கார் சுந்தரை இடித்தது.	The car hit Sundar.
59NAA	ரதி சுந்தரை ஏமாற்றினாள்.	Rathi cheated Sundar.
59SAI	சுந்தரை கார் மோதியது.	The car hit Sundar.
59SAA	சுந்தரை ரதி ஏமாற்றினாள்.	Rathi cheated Sundar.
60DAS	சுனிலுக்கு வருணைத் தெரியாது.	Sunil doesn't know Varun.
60ADS	வருணை சுனிலுக்குத் தெரியாது.	Sunil doesn't know Varun.
60NIA	நூல் வருணை வியக்கவைத்தது.	The thread surprised Varun.
60NAA	சுனில் வருணை எழுப்பினான்.	Sunil woke Varun up.
60SAI	வருணை நூல் வியக்கவைத்தது.	The thread surprised Varun.
60SAA	வருணை சுனில் எழுப்பினான்.	Sunil woke Varun up.
61DAS	தீபாவுக்கு முருகனைப் பிடிக்கும்.	Deepa likes Murugan.
61ADS	முருகனை தீபாவுக்குப் பிடிக்கும்.	Deepa likes Murugan.
61NIA	விளக்கு முருகனைச் சுட்டது.	The lamp hurt Murugan.
61NAA	தீபா முருகனைத் தொட்டாள்.	Deepa touched Murugan.
61SAI	முருகனை விளக்கு சுட்டது.	The lamp hurt Murugan.
61SAA	முருகனை தீபா தொட்டாள்.	Deepa touched Murugan.
62DAS	விசுவுக்கு உழவனைப் பிடிக்காது.	Visu doesn't like the farmer.
62ADS	உழவனை விசுவுக்குப் பிடிக்காது.	Visu doesn't like the farmer.
62NIA	செடி உழவனை மகிழ்த்தியது.	The plant amused the farmer.
62NAA	விசு உழவனை முறைத்தான்.	Visu frowned at the farmer.
62SAI	உழவனைச் செடி மகிழ்த்தியது.	The plant amused the farmer.
62SAA	உழவனை விசு முறைத்தான்.	Visu frowned at the farmer.
63DAS	தேவிக்கு வினித்தைத் தெரியும்.	Devi knows Vinith.
63ADS	வினித்தை தேவிக்குத் தெரியும்.	Devi knows Vinith.
63NIA	வீடு வினித்தைக் காப்பாற்றியது.	The house saved Vinith.
63NAA	தேவி வினித்தை அடித்தாள்.	Devi hit Vinith.
63SAI	வினித்தை வீடு காப்பாற்றியது.	The house saved Vinith.
63SAA	வினித்தை தேவி அடித்தாள்.	Devi hit Vinith.
64DAS	ஆஷாவுக்கு வாசுவைத் தெரியாது.	Asha doesn't know Vasu.
64ADS	வாசுவை ஆஷாவுக்குத் தெரியாது.	Asha doesn't know Vasu.
64NIA	குப்பை வாசுவை ஓடவைத்தது.	The litter made Vasu run (away).
64NAA	ஆஷா வாசுவை நினைத்தாள்.	Asha thought about Vasu.
64SAI	வாசுவைக் குப்பை ஓடவைத்தது.	The litter made Vasu run (away).
64SAA	வாசுவை ஆஷா நினைத்தாள்.	Asha thought about Vasu.
65DAS	தருணுக்கு ரம்பாவைப் பிடிக்கும்.	Tarun likes Ramba.
65ADS	ரம்பாவை தருணுக்குப் பிடிக்கும்.	Tarun likes Ramba.
65NIA	சுவர் ரம்பாவைத் தடுத்தது.	The wall hindered Ramba.
65NAA	தருண் ரம்பாவைக் கேலிசெய்தான்.	Tarun made fun of Ramba.
65SAI	ரம்பாவைச் சுவர் தடுத்தது.	The wall hindered Ramba.
65SAA	ரம்பாவைத் தருண் கேலிசெய்தான்.	Tarun made fun of Ramba.
66DAS	சீனுவுக்கு விஜயைப் பிடிக்காது.	Seenu doesn't like Vijay.
66ADS	விஜயை சீனுவுக்குப் பிடிக்காது.	Seenu doesn't like Vijay.

E.3. EXPERIMENTAL STIMULI

66NIA	பலூன் விஜயை மகிழ்த்தியது.	The balloon amused Vijay.
66NAA	சீனு விஜயை நினைத்தான்.	Seenu thought about Vijay.
66SAI	விஜயை பலூன் மகிழ்த்தியது.	The balloon amused Vijay.
66SAA	விஜயை சீனு நினைத்தான்.	Seenu thought about Vijay.
67DAS	ரவிக்கு செளம்யாவைத் தெரியும்.	Ravi knows Sowmya.
67ADS	செளம்யாவை ரவிக்குத் தெரியும்.	Ravi knows Sowmya.
67NIA	இருள் செளம்யாவைப் பயமுறுத்தியது.	Darkness frightened Sowmya.
67NAA	ரவி செளம்யாவைப் பார்த்தான்.	Ravi looked at Sowmya.
67SAI	செளம்யாவை இருள் பயமுறுத்தியது.	Darkness frightened Sowmya.
67SAA	செளம்யாவை ரவி பார்த்தான்.	Ravi saw Sowmya.
68DAS	ஷீலாவுக்கு உமேஷைத் தெரியாது.	Sheela doesn't know Umesh.
68ADS	உமேஷை ஷீலாவுக்குத் தெரியாது.	Sheela doesn't know Umesh.
68NIA	வேலை உமேஷை சோர்வடையச்செய்தது.	Work made Umesh tired.
68NAA	ஷீலா உமேஷை நம்பினாள்.	Sheela trusted Umesh.
68SAI	உமேஷை வேலை சோர்வடையச்செய்தது.	Work made Umesh tired.
68SAA	உமேஷை ஷீலா நம்பினாள்.	Sheela trusted Umesh.
69DAS	செல்விக்கு முகேஷைப் பிடிக்கும்.	Selvi likes Mukesh.
69ADS	முகேஷை செல்விக்குப் பிடிக்கும்.	Selvi likes Mukesh.
69NIA	தூக்கம் முகேஷைத் தெளிவுபடுத்தியது.	Sleep made Mukesh feel better.
69NAA	செல்வி முகேஷை உதைத்தாள்.	Selvi kicked Mukesh.
69SAI	முகேஷைத் தூக்கம் தெளிவுபடுத்தியது.	Sleep made Mukesh feel better.
69SAA	முகேஷைச் செல்வி உதைத்தாள்.	Selvi kicked Mukesh.
70DAS	குருவுக்கு ரகுவைப் பிடிக்காது.	Guru doesn't like Ragu.
70ADS	ரகுவை குருவுக்குப் பிடிக்காது.	Guru doesn't like Ragu.
70NIA	தரை ரகுவை வழக்கிவிழவைத்தது.	The floor made Ragu slip and fall.
70NAA	குரு ரகுவை கெஞ்சினான்.	Guru pleaded Ragu (for something).
70SAI	ரகுவைத் தரை வழக்கிவிழவைத்தது.	The floor made Ragu slip and fall.
70SAA	ரகுவை குரு கெஞ்சினான்.	Guru pleaded Ragu (for something).
71DAS	நர்ஸுக்கு சிவாவைத் தெரியும்.	The nurse knows Siva.
71ADS	சிவாவை நர்ஸுக்குத் தெரியும்.	The nurse knows Siva.
71NIA	மின்னல் சிவாவை பயமுறுத்தியது.	The lightning frightened Siva.
71NAA	நர்ஸ் சிவாவை குணப்படுத்தினாள்.	The nurse cured Siva.
71SAI	சிவாவை மின்னல் பயமுறுத்தியது.	The lightning frightened Siva.
71SAA	சிவாவை நர்ஸ் குணப்படுத்தினாள்.	The nurse cured Siva.
72DAS	அருணுக்கு ஷங்கரைத் தெரியாது.	Arun doesn't know Shankar.
72ADS	ஷங்கரை அருணுக்குத் தெரியாது.	Arun doesn't know Shankar.
72NIA	அழுக்கு ஷங்கரை அழவைத்தது.	The dirt made Shankar cry.
72NAA	அருண் ஷங்கரை அடித்தான்.	Arun beat Shankar.
72SAI	ஷங்கரை அழுக்கு அழவைத்தது.	The dirt made Shankar cry.
72SAA	ஷங்கரை அருண் அடித்தான்.	Arun beat Shankar.

E.4 Duration of Bare NPs and Pauses

Table E.3 shows the duration of the bare NPs in the critical conditions. In the dative-subject conditions, the bare NPs at NP2 are slightly shorter in duration than their counterparts at NP1.

Table E.3: Mean Duration of Bare NPs

Condition	Bare NP1 ms	SD	Bare NP2 ms	SD
NIA	662.43	89.15	459.14	80.77
NAA	658.15	85.01	467.55	87.58
SAI	461.34	84.39	619.88	96.78
SAA	472.68	83.47	641.60	79.38
DAS	465.93	75.08	459.41	83.76
ADS	460.93	80.55	449.04	71.43

Table E.4 shows the duration of the pauses intervening between NP1 and NP2, and NP2 and the verb in the critical conditions. Results of the statistical analysis of these data are shown in Table E.5. For the pause intervening NP1 and NP2, there was a main effect of subject-type, and the interaction word-order x subject-type was marginal. Resolving this interaction for the individual word-orders showed an effect of subject-type for the object-initial conditions alone. Comparing the subject-types pairwise in the object-initial conditions revealed a simple effect of subject-type in the comparisons NI + DS and NA + DS. For the pause intervening NP2 and the verb, there were main effects of word-order and subject-type. Further, the interaction word-order x subject-type was significant. Resolving this for the individual word-orders showed an effect of subject-type in the object-initial word-order. Comparing the subject-types pairwise in the object-initial conditions revealed a simple effect of subject-type for the comparisons NI + DS and NA + DS, whereas this effect was marginal for the comparison NI + NA.

E.4. DURATION OF BARE NPS AND PAUSES

Table E.4: Mean Duration of the intervening pauses

Condition	Pause1 ms	SD	Pause2 ms	SD
DAS	122.30	76.12	128.61	32.71
ADS	113.19	55.12	113.59	41.17
NIA	136.90	68.66	79.68	47.26
NAA	134.19	65.26	102.74	85.26
SAI	162.24	67.64	116.88	61.15
SAA	142.02	74.73	118.91	77.82

Table E.5: Effects on the Duration of the intervening pauses

Factor	DF	Pause1	Pause2
◆ WO	1,71		5.39 *
◆ ST	2,142	8.71 ***	4.97 **
◆ WO x ST	2,142	2.56 *	6.30 **
↳ _{WO = OS} ◆ ST	2,142	9.75 ***	12.57 ***
↳ _{ST = NI+NA} ◆ ST	1,71		4.17 *
↳ _{ST = NI+DS} ◆ ST	1,71	22.24 ***	51.92 ***
↳ _{ST = NA+DS} ◆ ST	1,71	8.07 **	5.94 *

— * —

Experiment 2 : Supplement

F.1 Condition Codes

Table F.1: Explanation of Condition Codes

Condition Code	NP1	NP2	Verb
DAS	DAT-An Subject	ACC-An Object	Dative-Stative
DAI	DAT-An Indirect Object	ACC-An Object	Ditransitive
ADS	ACC-An Object	DAT-An Subject	Dative-Stative
ADI	ACC-An Object	DAT-An Indirect Object	Ditransitive

Note that the condition codes in Experiment 3 are identical to those in Experiment 2.

F.2 Items Distribution Scheme

Table F.2 shows the distribution scheme for the critical items and fillers in Experiment 2. The condition codes FII and FPI indicate the intransitive and subject-dropped transitive filler conditions.

Table F.2: Experiment 1: Distribution scheme for critical items and Fillers

List	Sentence Sets					
	01-12	13-24	25-36	37-48	49-60	61-72
A	ADS	DAS	DAI	DAS	DAI	DAS
	ADI	DAI	ADI	ADS	ADS	ADI
	NIA	NAA	NIA	SAI	NIA	NAA
	SAI	SAA	NAA	SAA	SAA	SAI
	FII	FIA	FII	FPI	FII	FIA
	FPI	FPA	FIA	FPA	FPA	FPI
B	DAS	ADS	DAS	DAI	DAS	DAI
	DAI	ADI	ADS	ADI	ADI	ADS
	NAA	NIA	SAI	NIA	NAA	NIA
	SAA	SAI	SAA	NAA	SAI	SAA
	FIA	FII	FPI	FII	FIA	FII
	FPA	FPI	FPA	FIA	FPI	FPA

F.3 Experimental Stimuli

Identical stimuli were used in Experiment 2 and Experiment 3. All the critical sentences are listed in the following pages, following which the context questions are listed, which are also common to Experiment 2 and Experiment 3, with a note specific to Experiment 3.

F.3. EXPERIMENTAL STIMULI

01DAS	முருகனுக்கு ரவியைப் பிடிக்கும்.	Murugan likes Ravi.
01DAI	முருகனுக்கு ரவியைக் காட்டினேன்.	I showed Ravi to Murugan.
01ADS	ரவியை முருகனுக்குப் பிடிக்கும்.	Murugan likes Ravi.
01ADI	ரவியை முருகனுக்கு ஞாபகப்படுத்தினேன்.	I reminded Murugan about Ravi.
02DAS	ராதாவுக்கு சோமுவைப் பிடிக்காது.	Radha doesn't like Somu.
02DAI	ராதாவுக்கு சோமுவை மணம்செய்துவைத்தேன்.	I married Somu to Radha.
02ADS	சோமுவை ராதாவுக்குப் பிடிக்காது.	Radha doesn't like Somu.
02ADI	சோமுவை ராதாவுக்கு அறிமுகப்படுத்தினேன்.	I introduced Somu to Radha.
03DAS	டாக்டருக்கு குணாவைத் தெரியும்.	The doctor knows Guna.
03DAI	டாக்டருக்கு குணாவை அறிமுகப்படுத்தினேன்.	I introduced Guna to the doctor.
03ADS	குணாவை டாக்டருக்குத் தெரியும்.	The doctor knows Guna.
03ADI	குணாவை டாக்டருக்குக் காட்டினேன்.	I showed Guna to the doctor.
04DAS	மருத்துவருக்கு செல்வியைத் தெரியாது.	The doctor doesn't know Selvi.
04DAI	மருத்துவருக்கு செல்வியை ஞாபகப்படுத்தினேன்.	I reminded the doctor about Selvi.
04ADS	செல்வியை மருத்துவருக்குத் தெரியாது.	The doctor doesn't know Selvi.
04ADI	செல்வியை மருத்துவருக்கு மணம்செய்துவைத்தேன்.	I married Selvi off to the doctor.
05DAS	சிவாவுக்கு மனோவைப் பிடிக்கும்.	Siva likes Mano.
05DAI	சிவாவுக்கு மனோவைக் காட்டினேன்.	I showed Mano to Siva.
05ADS	மனோவை சிவாவுக்குப் பிடிக்கும்.	Siva likes Mano.
05ADI	மனோவை சிவாவுக்கு ஞாபகப்படுத்தினேன்.	I reminded Siva about Mano.
06DAS	பையனுக்கு மோஹனைப் பிடிக்காது.	The boy doesn't like Mohan.
06DAI	பையனுக்கு மோஹனை ஞாபகப்படுத்தினேன்.	I reminded the boy about Mohan.
06ADS	மோஹனை பையனுக்குப் பிடிக்காது.	The boy doesn't like Mohan.
06ADI	மோஹனை பையனுக்கு அறிமுகப்படுத்தினேன்.	I introduced Mohan to the boy.
07DAS	மீனாவுக்கு வள்ளியைத் தெரியும்.	Meena knows Valli.
07DAI	மீனாவுக்கு வள்ளியை அறிமுகப்படுத்தினேன்.	I introduced Valli to Meena.
07ADS	வள்ளியை மீனாவுக்குத் தெரியும்.	Meena knows Valli.
07ADI	வள்ளியை மீனாவுக்குக் காட்டினேன்.	I showed Valli to Meena.
08DAS	குமாருக்கு ஷீலாவைத் தெரியாது.	Kumar doesn't know Sheela.
08DAI	குமாருக்கு ஷீலாவை மணம்செய்துவைத்தேன்.	I married Sheela off to Kumar.
08ADS	ஷீலாவை குமாருக்குத் தெரியாது.	Kumar doesn't know Sheela.
08ADI	ஷீலாவை குமாருக்குக் காட்டினேன்.	I showed Sheela to Kumar.
09DAS	கீதாவுக்கு மாலாவைப் பிடிக்கும்.	Geetha likes Mala.
09DAI	கீதாவுக்கு மாலாவைக் காட்டினேன்.	I showed Mala to Geetha.
09ADS	மாலாவை கீதாவுக்குப் பிடிக்கும்.	Geetha likes Mala.
09ADI	மாலாவை கீதாவுக்கு அறிமுகப்படுத்தினேன்.	I introduced Mala to Geetha.
10DAS	லதாவுக்கு சூர்யாவைப் பிடிக்காது.	Latha doesn't like Surya.
10DAI	லதாவுக்கு சூர்யாவை மணம்செய்துவைத்தேன்.	I married Surya off to Latha.
10ADS	சூர்யாவை லதாவுக்குப் பிடிக்காது.	Latha doesn't like Surya.
10ADI	சூர்யாவை லதாவுக்கு அறிமுகப்படுத்தினேன்.	I introduced Surya to Latha.
11DAS	விஜய்க்கு சிறுமியைத் தெரியும்.	Vijay knows the little girl.
11DAI	விஜய்க்கு சிறுமியை அறிமுகப்படுத்தினேன்.	I introduced the little girl to Vijay.
11ADS	சிறுமியை விஜய்க்குத் தெரியும்.	Vijay knows the little girl.
11ADI	சிறுமியை விஜய்க்கு ஞாபகப்படுத்தினேன்.	I reminded Vijay abt. the ltl. girl.
12DAS	சுரேஷுக்கு சிறுவனைத் தெரியாது.	Suresh doesn't know the little boy.
12DAI	சுரேஷுக்கு சிறுவனை ஞாபகப்படுத்தினேன்.	I reminded Suresh abt. the ltl. boy.
12ADS	சிறுவனை சுரேஷுக்குத் தெரியாது.	Suresh doesn't know the little boy.
12ADI	சிறுவனை சுரேஷுக்குக் காட்டினேன்.	I showed the little boy to Suresh.
13DAS	மோஹனாவுக்கு சேகரைப் பிடிக்கும்.	Mohana likes Sekar.

APPENDIX F. EXPERIMENT 2 : SUPPLEMENT

13DAI	மோஹனாவுக்கு சேகரைக் காட்டினேன்.	I showed Sekar to Mohana.
13ADS	சேகரை மோஹனாவுக்குப் பிடிக்கும்.	Mohana likes Sekar.
13ADI	சேகரை மோஹனாவுக்கு மணம்செய்துவைத்தேன்.	I married Sekar off to Mohana.
14DAS	ரமேஷுக்கு உமாவைப் பிடிக்காது.	Ramesh doesn't like Uma.
14DAI	ரமேஷுக்கு உமாவை அறிமுகப்படுத்தினேன்.	I introduced Uma to Ramesh.
14ADS	உமாவை ரமேஷுக்குப் பிடிக்காது.	Ramesh doesn't like Uma.
14ADI	உமாவை ரமேஷுக்கு மணம்செய்துவைத்தேன்.	I married Uma off to Ramesh.
15DAS	ரஞ்சித்துக்கு உஷாவைத் தெரியும்.	Ranjith knows Usha.
15DAI	ரஞ்சித்துக்கு உஷாவை மணம்செய்துவைத்தேன்.	I married Usha off to Ranjith.
15ADS	உஷாவை ரஞ்சித்துக்குத் தெரியும்.	Ranjith knows Usha.
15ADI	உஷாவை ரஞ்சித்துக்கு ஞாபகப்படுத்தினேன்.	I reminded Ranjith about Usha.
16DAS	வாசுவுக்கு கமலாவைத் தெரியாது.	Vasu doesn't know Kamala.
16DAI	வாசுவுக்கு கமலாவை ஞாபகப்படுத்தினேன்.	I reminded Vasu about Kamala.
16ADS	கமலாவை வாசுவுக்குத் தெரியாது.	Vasu doesn't know Kamala.
16ADI	கமலாவை வாசுவுக்கு அறிமுகப்படுத்தினேன்.	I introduced Kamala to Vasu.
17DAS	வினித்துக்கு ரமாவைப் பிடிக்கும்.	Vinith likes Ramaa.
17DAI	வினித்துக்கு ரமாவை அறிமுகப்படுத்தினேன்.	I introduced Vinith about Ramaa.
17ADS	ரமாவை வினித்துக்குப் பிடிக்கும்.	Vinith likes Ramaa.
17ADI	ரமாவை வினித்துக்கு மணம்செய்துவைத்தேன்.	I married Ramaa off to Vinith.
18DAS	தேவிகாவுக்கு சீதாவைப் பிடிக்காது.	Devi doesn't like Geetha.
18DAI	தேவிகாவுக்கு சீதாவைக் காட்டினேன்.	I showed Seetha to Devika.
18ADS	சீதாவை தேவிகாவுக்குப் பிடிக்காது.	Devi doesn't like Geetha.
18ADI	சீதாவை தேவிகாவுக்கு ஞாபகப்படுத்தினேன்.	I reminded Devika about Seetha.
19DAS	உழவனுக்கு சுதாவைத் தெரியும்.	The farmer knows Sudha.
19DAI	உழவனுக்கு சுதாவை ஞாபகப்படுத்தினேன்.	I reminded the farmer about Sudha.
19ADS	சுதாவை உழவனுக்குத் தெரியும்.	The farmer knows Sudha.
19ADI	சுதாவை உழவனுக்கு மணம்செய்துவைத்தேன்.	I married Sudha off to the farmer.
20DAS	சரிதாவுக்கு அருணைத் தெரியாது.	Saritha doesn't know Arun.
20DAI	சரிதாவுக்கு அருணை மணம்செய்துவைத்தேன்.	I married Arun off to Saritha.
20ADS	அருணை சரிதாவுக்குத் தெரியாது.	Saritha doesn't know Arun.
20ADI	அருணை சரிதாவுக்குக் காட்டினேன்.	I showed Arun to Saritha.
21DAS	சுந்தருக்கு மஞ்சுவைப் பிடிக்கும்.	Sundar likes Manju.
21DAI	சுந்தருக்கு மஞ்சுவைக் காட்டினேன்.	I showed Manju to Sundar.
21ADS	மஞ்சுவை சுந்தருக்குப் பிடிக்கும்.	Sundar likes Manju.
21ADI	மஞ்சுவை சுந்தருக்கு அறிமுகப்படுத்தினேன்.	I introduced Manju to Sundar.
22DAS	ரகுவுக்கு ஆஷாவைப் பிடிக்காது.	Raghu doesn't like Asha.
22DAI	ரகுவுக்கு ஆஷாவை மணம்செய்துவைத்தேன்.	I married Asha off to Raghu.
22ADS	ஆஷாவை ரகுவுக்குப் பிடிக்காது.	Raghu doesn't like Asha.
22ADI	ஆஷாவை ரகுவுக்குக் காட்டினேன்.	I showed Asha to Raghu.
23DAS	விக்ரமுக்கு பாலுவைத் தெரியும்.	Vikram knows Balu.
23DAI	விக்ரமுக்கு பாலுவை அறிமுகப்படுத்தினேன்.	I introduced Balu to Vikram.
23ADS	பாலுவை விக்ரமுக்குத் தெரியும்.	Vikram knows Balu.
23ADI	பாலுவை விக்ரமுக்கு ஞாபகப்படுத்தினேன்.	I reminded Vikram about Balu.
24DAS	பிரபுவுக்கு விசுவைத் தெரியாது.	Prabhu doesn't know Visu.
24DAI	பிரபுவுக்கு விசுவை ஞாபகப்படுத்தினேன்.	I reminded Prabhu about Visu.
24ADS	விசுவை பிரபுவுக்குத் தெரியாது.	Prabhu doesn't know Visu.
24ADI	விசுவை பிரபுவுக்கு மணம்செய்துவைத்தேன்.	I married Visu off to Prabhu.
25DAS	விஷாலுக்கு தீபாவைப் பிடிக்கும்.	Vishal likes Deepa.
25DAI	விஷாலுக்கு தீபாவைக் காட்டினேன்.	I showed Deepa to Vishal.

F.3. EXPERIMENTAL STIMULI

25ADS	தீபாவை விஷாலுக்குப் பிடிக்கும்.	Vishal likes Deepa.
25ADI	தீபாவை விஷாலுக்கு மணம்செய்துவைத்தேன்.	I married Deepa off to Vishal.
26DAS	சுஷிலுக்கு தேவியைப் பிடிக்காது.	Sushil doesn't like Devi.
26DAI	சுஷிலுக்கு தேவியை ஞாபகப்படுத்தினேன்.	I reminded Sushil about Devi.
26ADS	தேவியை சுஷிலுக்குப் பிடிக்காது.	Sushil doesn't like Devi.
26ADI	தேவியை சுஷிலுக்கு அறிமுகப்படுத்தினேன்.	I introduced Devi to Sushil.
27DAS	ரம்யாவுக்கு ராஜுவைத் தெரியும்.	Ramya knows Raju.
27DAI	ரம்யாவுக்கு ராஜுவை மணம்செய்துவைத்தேன்.	I married Raju off to Ramya.
27ADS	ராஜுவை ரம்யாவுக்குத் தெரியும்.	Ramya knows Raju.
27ADI	ராஜுவை ரம்யாவுக்கு ஞாபகப்படுத்தினேன்.	I reminded Ramya about Raju.
28DAS	ஹரிக்கு சுனிலைத் தெரியாது.	Hari doesn't know Sunil.
28DAI	ஹரிக்கு சுனிலை அறிமுகப்படுத்தினேன்.	I introduced Sunil to Hari.
28ADS	சுனிலை ஹரிக்குத் தெரியாது.	Hari doesn't know Sunil.
28ADI	சுனிலை ஹரிக்குக் காட்டினேன்.	I showed Sunil to Hari.
29DAS	செளமியாவுக்கு சச்சினைப் பிடிக்கும்.	Sowmya likes Sachin.
29DAI	செளமியாவுக்கு சச்சினை மணம்செய்துவைத்தேன்.	I married Sachin off to Sowmya.
29ADS	சச்சினை செளமியாவுக்குப் பிடிக்கும்.	Sowmya likes Sachin.
29ADI	சச்சினை செளமியாவுக்குக் காட்டினேன்.	I showed Sachin to Sowmya.
30DAS	முகேஷுக்கு நர்லைப் பிடிக்காது.	Mukesh doesn't like the Nurse.
30DAI	முகேஷுக்கு நர்லை அறிமுகப்படுத்தினேன்.	I introduced the nurse to Mukesh.
30ADS	நர்லை முகேஷுக்குப் பிடிக்காது.	Mukesh doesn't like the Nurse.
30ADI	நர்லை முகேஷுக்கு ஞாபகப்படுத்தினேன்.	I reminded Mukesh about the nurse.
31DAS	ஷங்கருக்கு குருவைத் தெரியும்.	Shankar knows Guru.
31DAI	ஷங்கருக்கு குருவை ஞாபகப்படுத்தினேன்.	I reminded Shankar about Guru.
31ADS	குருவை ஷங்கருக்குத் தெரியும்.	Shankar knows Guru.
31ADI	குருவை ஷங்கருக்கு அறிமுகப்படுத்தினேன்.	I introduced Guru to Shankar.
32DAS	விஜயாவுக்கு பாரியைத் தெரியாது.	Vijaya doesn't know Paari.
32DAI	விஜயாவுக்கு பாரியைக் காட்டினேன்.	I showed Paari to Vijaya.
32ADS	பாரியை விஜயாவுக்குத் தெரியாது.	Vijaya doesn't know Paari.
32ADI	பாரியை விஜயாவுக்கு மணம்செய்துவைத்தேன்.	I married Paari off to Vijaya.
33DAS	பிரேமாவுக்கு ராமுவைப் பிடிக்கும்.	Prema likes Ramu.
33DAI	பிரேமாவுக்கு ராமுவை மணம்செய்துவைத்தேன்.	I married Ramu off to Prema.
33ADS	ராமுவை பிரேமாவுக்குப் பிடிக்கும்.	Prema likes Ramu.
33ADI	ராமுவை பிரேமாவுக்குக் காட்டினேன்.	I showed Ramu to Prema.
34DAS	வருணுக்கு ரதியைப் பிடிக்காது.	Varun doesn't like Rathi.
34DAI	வருணுக்கு ரதியை அறிமுகப்படுத்தினேன்.	I introduced Rathi to Varun.
34ADS	ரதியை வருணுக்குப் பிடிக்காது.	Varun doesn't like Rathi.
34ADI	ரதியை வருணுக்கு ஞாபகப்படுத்தினேன்.	I reminded Varun about Rathi.
35DAS	ரம்பாவுக்கு தருணைத் தெரியும்.	Ramba likes Tarun.
35DAI	ரம்பாவுக்கு தருணை ஞாபகப்படுத்தினேன்.	I reminded Ramba about Tarun.
35ADS	தருணை ரம்பாவுக்குத் தெரியும்.	Ramba likes Tarun.
35ADI	தருணை ரம்பாவுக்கு மணம்செய்துவைத்தேன்.	I married Tarun off to Ramba.
36DAS	உமேஷுக்கு சீனுவைத் தெரியாது.	Umesh doesn't know Seenu.
36DAI	உமேஷுக்கு சீனுவைக் காட்டினேன்.	I showed Seenu to Umesh.
36ADS	சீனுவை உமேஷுக்குத் தெரியாது.	Umesh doesn't know Seenu.
36ADI	சீனுவை உமேஷுக்கு அறிமுகப்படுத்தினேன்.	I introduced Seenu to Umesh.
37DAS	சோமுவுக்கு கீதாவைப் பிடிக்கும்.	Somu likes Geetha.
37DAI	சோமுவுக்கு கீதாவை மணம்செய்துவைத்தேன்.	I married Geetha off to Somu.
37ADS	கீதாவை சோமுவுக்குப் பிடிக்கும்.	Somu likes Geetha.

APPENDIX F. EXPERIMENT 2 : SUPPLEMENT

37ADI	கீதாவை சோமுவுக்குக் காட்டினேன்.	I showed Geetha to Somu.
38DAS	சுதாவுக்கு தேவிகாவைப் பிடிக்காது.	Sudha doesn't like Devika.
38DAI	சுதாவுக்கு தேவிகாவைக் காட்டினேன்.	I showed Devika to Sudha.
38ADS	தேவிகாவை சுதாவுக்குப் பிடிக்காது.	Sudha doesn't like Devika.
38ADI	தேவிகாவை சுதாவுக்கு ஞாபகப்படுத்தினேன்.	I reminded Sudha about Devika.
39DAS	மனோவுக்கு சுஷிலைத் தெரியும்.	Mano knows Sushil.
39DAI	மனோவுக்கு சுஷிலை ஞாபகப்படுத்தினேன்.	I reminded Mano about Sushil.
39ADS	சுஷிலை மனோவுக்குத் தெரியும்.	Mano knows Sushil.
39ADI	சுஷிலை மனோவுக்கு அறிமுகப்படுத்தினேன்.	I introduced Sudhil to Mano.
40DAS	மஞ்சுவுக்கு குமாரைத் தெரியாது.	Manju doesn't know Kumar.
40DAI	மஞ்சுவுக்கு குமாரை அறிமுகப்படுத்தினேன்.	I introduced Kumar to Manju.
40ADS	குமாரை மஞ்சுவுக்குத் தெரியாது.	Manju doesn't know Kumar.
40ADI	குமாரை மஞ்சுவுக்கு மணம்செய்துவைத்தேன்.	I married Kumar off to Manju.
41DAS	சிறுமிக்கு விக்ரமைப் பிடிக்கும்.	The little girl likes Vikram.
41DAI	சிறுமிக்கு விக்ரமை ஞாபகப்படுத்தினேன்.	I reminded the ltl. girl abt. Vikram.
41ADS	விக்ரமை சிறுமிக்குப் பிடிக்கும்.	The little girl likes Vikram.
41ADI	விக்ரமை சிறுமிக்குக் காட்டினேன்.	I showed Vikram to the little girl.
42DAS	குணாவுக்கு பையனைப் பிடிக்காது.	Guna doesn't like the little boy.
42DAI	குணாவுக்கு பையனைக் காட்டினேன்.	I showed the boy to Guna.
42ADS	பையனை குணாவுக்குப் பிடிக்காது.	Guna doesn't like the little boy.
42ADI	பையனை குணாவுக்கு அறிமுகப்படுத்தினேன்.	I introduced the boy to Guna.
43DAS	மோஹனாவுக்கு லதாவைத் தெரியும்.	Mohana knows Latha.
43DAI	மோஹனாவுக்கு லதாவை அறிமுகப்படுத்தினேன்.	I introduced Latha to Mohana.
43ADS	லதாவை மோஹனாவுக்குத் தெரியும்.	Mohana knows Latha.
43ADI	லதாவை மோஹனாவுக்கு ஞாபகப்படுத்தினேன்.	I reminded Mohana about Latha.
44DAS	வள்ளிக்கு மருத்துவரைத் தெரியாது.	Valli doesn't know the doctor.
44DAI	வள்ளிக்கு மருத்துவரை மணம்செய்துவைத்தேன்.	I married the doctor off to Valli.
44ADS	மருத்துவரை வள்ளிக்குத் தெரியாது.	Valli doesn't know the doctor.
44ADI	மருத்துவரை வள்ளிக்குக் காட்டினேன்.	I showed the doctor to Valli.
45DAS	உமாவுக்கு சுரேஷைப் பிடிக்கும்.	Uma likes Suresh.
45DAI	உமாவுக்கு சுரேஷை மணம்செய்துவைத்தேன்.	I married Suresh off to Uma.
45ADS	சுரேஷை உமாவுக்குப் பிடிக்கும்.	Uma likes Suresh.
45ADI	சுரேஷை உமாவுக்கு அறிமுகப்படுத்தினேன்.	I introduced Suresh to Uma.
46DAS	பாலுவுக்கு ரஞ்சித்தைப் பிடிக்காது.	Balu doesn't like Ranjith.
46DAI	பாலுவுக்கு ரஞ்சித்தைக் காட்டினேன்.	I showed Ranjith to Balu.
46ADS	ரஞ்சித்தை பாலுவுக்குப் பிடிக்காது.	Balu doesn't like Ranjith.
46ADI	ரஞ்சித்தை பாலுவுக்கு அறிமுகப்படுத்தினேன்.	I introduced Ranjith to Balu.
47DAS	சச்சினுக்கு ரமேஷைத் தெரியும்.	Sachin knows Ramesh.
47DAI	சச்சினுக்கு ரமேஷை அறிமுகப்படுத்தினேன்.	I introduced Ramesh to Sachin.
47ADS	ரமேஷை சச்சினுக்குத் தெரியும்.	Sachin knows Ramesh.
47ADI	ரமேஷை சச்சினுக்கு ஞாபகப்படுத்தினேன்.	I reminded Sachin to Ramesh.
48DAS	சிறுவனுக்கு மோஹனாவைத் தெரியாது.	The little boy doesn't know Mohana.
48DAI	சிறுவனுக்கு மோஹனாவை ஞாபகப்படுத்தினேன்.	I reminded the ltl. boy abt. Mohana.
48ADS	மோஹனாவை சிறுவனுக்குத் தெரியாது.	The little boy doesn't know Mohana.
48ADI	மோஹனாவை சிறுவனுக்குக் காட்டினேன்.	I showed Mohana to the little boy.
49DAS	சூர்யாவுக்கு ஹரியைப் பிடிக்கும்.	Surya likes Hari.
49DAI	சூர்யாவுக்கு ஹரியை அறிமுகப்படுத்தினேன்.	I introduced Hari to Surya.
49ADS	ஹரியை சூர்யாவுக்குப் பிடிக்கும்.	Surya likes Hari.
49ADI	ஹரியை சூர்யாவுக்கு ஞாபகப்படுத்தினேன்.	I reminded Surya about Hari.

F.3. EXPERIMENTAL STIMULI

50DAS	உஷாவுக்கு பிரேமாவைப் பிடிக்காது.	Usha doesn't like Prema.
50DAI	உஷாவுக்கு பிரேமாவை ஞாபகப்படுத்தினேன்.	I reminded Usha about Prema.
50ADS	பிரேமாவை உஷாவுக்குப் பிடிக்காது.	Usha doesn't like Prema.
50ADI	பிரேமாவை உஷாவுக்கு மணம்செய்துவைத்தேன்.	I married Prema off to Usha.
51DAS	சேகருக்கு மீனாவைத் தெரியும்.	Sekar knows Meena.
51DAI	சேகருக்கு மீனாவை மணம்செய்துவைத்தேன்.	I married Meena off to Sekar.
51ADS	மீனாவை சேகருக்குத் தெரியும்.	Sekar knows Meena.
51ADI	மீனாவை சேகருக்கு அறிமுகப்படுத்தினேன்.	I introduced Meena to Sekar.
52DAS	ரமாவுக்கு பிரபுவைத் தெரியாது.	Ramaa doesn't know Prabhu.
52DAI	ரமாவுக்கு பிரபுவைக் காட்டினேன்.	I showed Prabhu to Ramaa.
52ADS	பிரபுவை ரமாவுக்குத் தெரியாது.	Ramaa doesn't know Prabhu.
52ADI	பிரபுவை ரமாவுக்கு மணம்செய்துவைத்தேன்.	I married Prabhu off to Ramaa.
53DAS	ராஜுவுக்கு விஜயாவைப் பிடிக்கும்.	Raju likes Vijaya.
53DAI	ராஜுவுக்கு விஜயாவைக் காட்டினேன்.	I showed Vijaya to Raju.
53ADS	விஜயாவை ராஜுவுக்குப் பிடிக்கும்.	Raju likes Vijaya.
53ADI	விஜயாவை ராஜுவுக்கு மணம்செய்துவைத்தேன்.	I married Vijaya off to Raju.
54DAS	கமலாவுக்கு விஷாவை மணம்செய்துவைத்தேன்.	Kamala doesn't like Vishal.
54DAI	கமலாவுக்கு விஷாவை மணம்செய்துவைத்தேன்.	I married Vishal off to Kamala.
54ADS	விஷாவை கமலாவுக்குப் பிடிக்காது.	Kamala doesn't like Vishal.
54ADI	விஷாவை கமலாவுக்கு ஞாபகப்படுத்தினேன்.	I reminded Kamala about Vishal.
55DAS	ராமுவுக்கு ரம்யாவைத் தெரியும்.	Ramu knows Ramya.
55DAI	ராமுவுக்கு ரம்யாவை ஞாபகப்படுத்தினேன்.	I reminded Ramu about Ramya.
55ADS	ரம்யாவை ராமுவுக்குத் தெரியும்.	Ramu knows Ramya.
55ADI	ரம்யாவை ராமுவுக்குக் காட்டினேன்.	I showed Ramya to Ramu.
56DAS	சீதாவுக்கு டாக்டரைத் தெரியாது.	Seetha doesn't know the doctor.
56DAI	சீதாவுக்கு டாக்டரை அறிமுகப்படுத்தினேன்.	I introduced the doctor to Seetha.
56ADS	டாக்டரை சீதாவுக்குத் தெரியாது.	Seetha doesn't know the doctor.
56ADI	டாக்டரை சீதாவுக்கு மணம்செய்துவைத்தேன்.	I married the doctor off to Seetha.
57DAS	மாலாவுக்கு சரிதாவைப் பிடிக்கும்.	Mala likes Saritha.
57DAI	மாலாவுக்கு சரிதாவை ஞாபகப்படுத்தினேன்.	I reminded Mala about Saritha.
57ADS	சரிதாவை மாலாவுக்குப் பிடிக்கும்.	Mala likes Saritha.
57ADI	சரிதாவை மாலாவுக்கு அறிமுகப்படுத்தினேன்.	I introduced Sarigtha to Mala.
58DAS	பாரிக்கு ராதாவைப் பிடிக்காது.	Paari doesn't like Radha.
58DAI	பாரிக்கு ராதாவைக் காட்டினேன்.	I showed Radha to Paari.
58ADS	ராதாவை பாரிக்குப் பிடிக்காது.	Paari doesn't like Radha.
58ADI	ராதாவை பாரிக்கு மணம்செய்துவைத்தேன்.	I married Radha off to Paari.
59DAS	ரதிக்கு சுந்தரைத் தெரியும்.	Rathi knows Sundar.
59DAI	ரதிக்கு சுந்தரை மணம்செய்துவைத்தேன்.	I married Sundar off to Rathi.
59ADS	சுந்தரை ரதிக்குத் தெரியும்.	Rathi knows Sundar.
59ADI	சுந்தரை ரதிக்கு அறிமுகப்படுத்தினேன்.	I introduced Sundar to Rathi.
60DAS	சுனிலுக்கு வருணைத் தெரியாது.	Sunil doesn't know Varun.
60DAI	சுனிலுக்கு வருணை ஞாபகப்படுத்தினேன்.	I reminded Sunil about Varun.
60ADS	வருணை சுனிலுக்குத் தெரியாது.	Sunil doesn't know Varun.
60ADI	வருணை சுனிலுக்குக் காட்டினேன்.	I showed Varun to Sunil.
61DAS	தீபாவுக்கு முருகனைப் பிடிக்கும்.	Deepa likes Murugan.
61DAI	தீபாவுக்கு முருகனை அறிமுகப்படுத்தினேன்.	I introduced Murugan to Deepa.
61ADS	முருகனை தீபாவுக்குப் பிடிக்கும்.	Deepa likes Murugan.
61ADI	முருகனை தீபாவுக்குக் காட்டினேன்.	I showed Murugan to Deepa.
62DAS	விசுவாவுக்கு உழவனைப் பிடிக்காது.	Visu doesn't like the farmer.

APPENDIX F. EXPERIMENT 2 : SUPPLEMENT

62DAI	விசுவக்கு உழவனைக் காட்டினேன்.	I showed the farmer to Visu.
62ADS	உழவனை விசுவக்குப் பிடிக்காது.	Visu doesn't like the farmer.
62ADI	உழவனை விசுவக்கு அறிமுகப்படுத்தினேன்.	I introduced the farmer to Visu.
63DAS	தேவிக்கு வினித்தைத் தெரியும்.	Devi knows Vinith.
63DAI	தேவிக்கு வினித்தை மணம்செய்துவைத்தேன்.	I married Vinith off to Devi.
63ADS	வினித்தை தேவிக்குத் தெரியும்.	Devi knows Vinith.
63ADI	வினித்தை தேவிக்கு ஞாபகப்படுத்தினேன்.	I reminded Devi about Vinith.
64DAS	ஆஷாவுக்கு வாசவைத் தெரியாது.	Asha doesn't know Vasu.
64DAI	ஆஷாவுக்கு வாசவை ஞாபகப்படுத்தினேன்.	I reminded Asha about Vasu.
64ADS	வாசவை ஆஷாவுக்குத் தெரியாது.	Asha doesn't know Vasu.
64ADI	வாசவை ஆஷாவுக்கு மணம்செய்துவைத்தேன்.	I married Vasu off to Asha.
65DAS	தருணுக்கு ரம்பாவைப் பிடிக்கும்.	Tarun likes Ramba.
65DAI	தருணுக்கு ரம்பாவை மணம்செய்துவைத்தேன்.	I married Ramba off to Tarun.
65ADS	ரம்பாவை தருணுக்குப் பிடிக்கும்.	Tarun likes Ramba.
65ADI	ரம்பாவை தருணுக்குக் காட்டினேன்.	I showed Ramba to Tarun.
66DAS	சீனுவுக்கு விஜயைப் பிடிக்காது.	Seenu doesn't like Vijay.
66DAI	சீனுவுக்கு விஜயை அறிமுகப்படுத்தினேன்.	I introduced Vijay to Seenu.
66ADS	விஜயை சீனுவுக்குப் பிடிக்காது.	Seenu doesn't like Vijay.
66ADI	விஜயை சீனுவுக்கு ஞாபகப்படுத்தினேன்.	I reminded Seenu about Vijay.
67DAS	ரவிக்கு செளம்யாவைத் தெரியும்.	Ravi knows Sowmya.
67DAI	ரவிக்கு செளம்யாவை ஞாபகப்படுத்தினேன்.	I reminded Ravi about Sowmya.
67ADS	செளம்யாவை ரவிக்குத் தெரியும்.	Ravi knows Sowmya.
67ADI	செளம்யாவை ரவிக்கு மணம்செய்துவைத்தேன்.	I married Sowmya off to Ravi.
68DAS	ஷீலாவுக்கு உமேஷைத் தெரியாது.	Sheela doesn't know Umesh.
68DAI	ஷீலாவுக்கு உமேஷைக் காட்டினேன்.	I showed Umesh to Sheela.
68ADS	உமேஷை ஷீலாவுக்குத் தெரியாது.	Sheela doesn't know Umesh.
68ADI	உமேஷை ஷீலாவுக்கு அறிமுகப்படுத்தினேன்.	I introduced Umesh to Sheela.
69DAS	செல்விக்கு முகேஷைப் பிடிக்கும்.	Selvi likes Mukesh.
69DAI	செல்விக்கு முகேஷை மணம்செய்துவைத்தேன்.	I married Mukesh off to Selvi.
69ADS	முகேஷை செல்விக்குப் பிடிக்கும்.	Selvi likes Mukesh.
69ADI	முகேஷை செல்விக்குக் காட்டினேன்.	I showed Mukesh to Selvi.
70DAS	குருவுக்கு ரகுவைப் பிடிக்காது.	Guru doesn't like Raghu.
70DAI	குருவுக்கு ரகுவை அறிமுகப்படுத்தினேன்.	I introduced Raghu to Guru.
70ADS	ரகுவை குருவுக்குப் பிடிக்காது.	Guru doesn't like Raghu.
70ADI	ரகுவை குருவுக்கு ஞாபகப்படுத்தினேன்.	I reminded Guru about Raghu.
71DAS	நர்ஸுக்கு சிவாவைத் தெரியும்.	The nurse knows Siva.
71DAI	நர்ஸுக்கு சிவாவைக் காட்டினேன்.	I showed Siva to the nurse.
71ADS	சிவாவை நர்ஸுக்குத் தெரியும்.	The nurse knows Siva.
71ADI	சிவாவை நர்ஸுக்கு மணம்செய்துவைத்தேன்.	I married Siva off to the nurse.
72DAS	அருணுக்கு ஷங்கரைத் தெரியாது.	Arun doesn't know Shankar.
72DAI	அருணுக்கு ஷங்கரை ஞாபகப்படுத்தினேன்.	I reminded Arun about Shankar.
72ADS	ஷங்கரை அருணுக்குத் தெரியாது.	Arun doesn't know Shankar.
72ADI	ஷங்கரை அருணுக்கு அறிமுகப்படுத்தினேன்.	I introduced Shankar to Arun.

F.3. EXPERIMENTAL STIMULI

CQPmDAS	யாருக்கு யாரைப் பிடிக்கும்?	Who likes whom?
CQPuDAS	யாருக்கு யாரைப் பிடிக்காது?	Who doesn't like whom?
CQTMdAS	யாருக்கு யாரைத் தெரியும்?	Who knows whom?
CQTuDAS	யாருக்கு யாரைத் தெரியாது?	Who doesn't know whom?
CQArDAI	யாருக்கு யாரை அறிமுகப்படுத்தினாய்?	Whom did you introduce to whom?
CQKaDAI	யாருக்கு யாரைக் காட்டினாய்?	Whom did you show to whom?
CQMaDAI	யாருக்கு யாரை மணம்செய்துவைத்தாய்?	Whom did you marry off to whom?
CQNYDAI	யாருக்கு யாரை ஞாபகப்படுத்தினாய்?	Whom did you remind about whom?
CQPmADS	யாரை யாருக்குப் பிடிக்கும்?	Who likes whom?
CQPuADS	யாரை யாருக்குப் பிடிக்காது?	Who doesn't like whom?
CQTMADS	யாரை யாருக்குத் தெரியும்?	Who knows whom?
CQTUADS	யாரை யாருக்குத் தெரியாது?	Who doesn't know whom?
CQArADI	யாரை யாருக்கு அறிமுகப்படுத்தினாய்?	Whom did you introduce to whom?
CQKaADI	யாரை யாருக்குக் காட்டினாய்?	Whom did you show to whom?
CQMaADI	யாரை யாருக்கு மணம்செய்துவைத்தாய்?	Whom did you marry off to whom?
CQNYADI	யாரை யாருக்கு ஞாபகப்படுத்தினாய்?	Whom did you remind about whom?
NQ00SVS	சொல்லவந்ததை சுருக்கமாகச் சொல்.	Say what you wanted to briefly!

The context codes are as follows. The first two letters indicate the type of context. The next two letters indicate the verb in the non-neutral context. The last three letters in the context codes in CQ context questions above indicate the word-order and sentence-type for which the CQ would be a correct context. For instance, CQArDAI would be a legitimate CQ for a DAI stimulus sentence with the verb 'to introduce' in Experiment 2 and Experiment 3. In addition in Experiment 3, it would also be the VQ for any DAI sentence that does not contain the verb 'to introduce', as well as the WQ for any DAS stimulus sentence.

F.4 Duration of Bare NPs and Pauses

Table F.3 shows the duration of the bare NPs in the critical conditions. Accusative NPs appear slightly longer in both positions.

Table F.3: Mean Duration of Bare NPs

Condition	Bare NP1 ms	SD	Bare NP2 ms	SD
DAS	556.71	101.17	547.07	103.74
DAI	555.73	98.02	550.38	99.23
ADS	571.34	106.78	527.55	103.47
ADI	576.41	106.76	535.72	99.09

Table F.4 summarises the duration of the intervening pauses in the critical conditions. The statistical analysis of these data is shown in Table F.5 . For the pause intervening NP1 and NP2, there was a main effect of subject-type, whereas for the pause intervening NP2 and the vern, there was a main effect of word-order.

Table F.4: Mean Duration of the intervening pauses

Condition	Pause1 ms	SD	Pause2 ms	SD
DAS	277.81	119.50	258.00	77.44
DAI	306.89	120.62	246.20	84.56
ADS	275.10	106.10	220.77	66.19
ADI	312.09	100.12	218.65	87.84

Table F.5: Effects on the Duration of the intervening pauses

Factor	DF	Pause1	Pause2
♦ W0	1,71		10.28 **
♦ ST	1,71	6.65 *	

F.5 Supplementary ERP Plots

F.5.1 ERPs at NP1

F.5. SUPPLEMENTARY ERP PLOTS

Figure F.1: ERPs at NP1: DA Conditions.

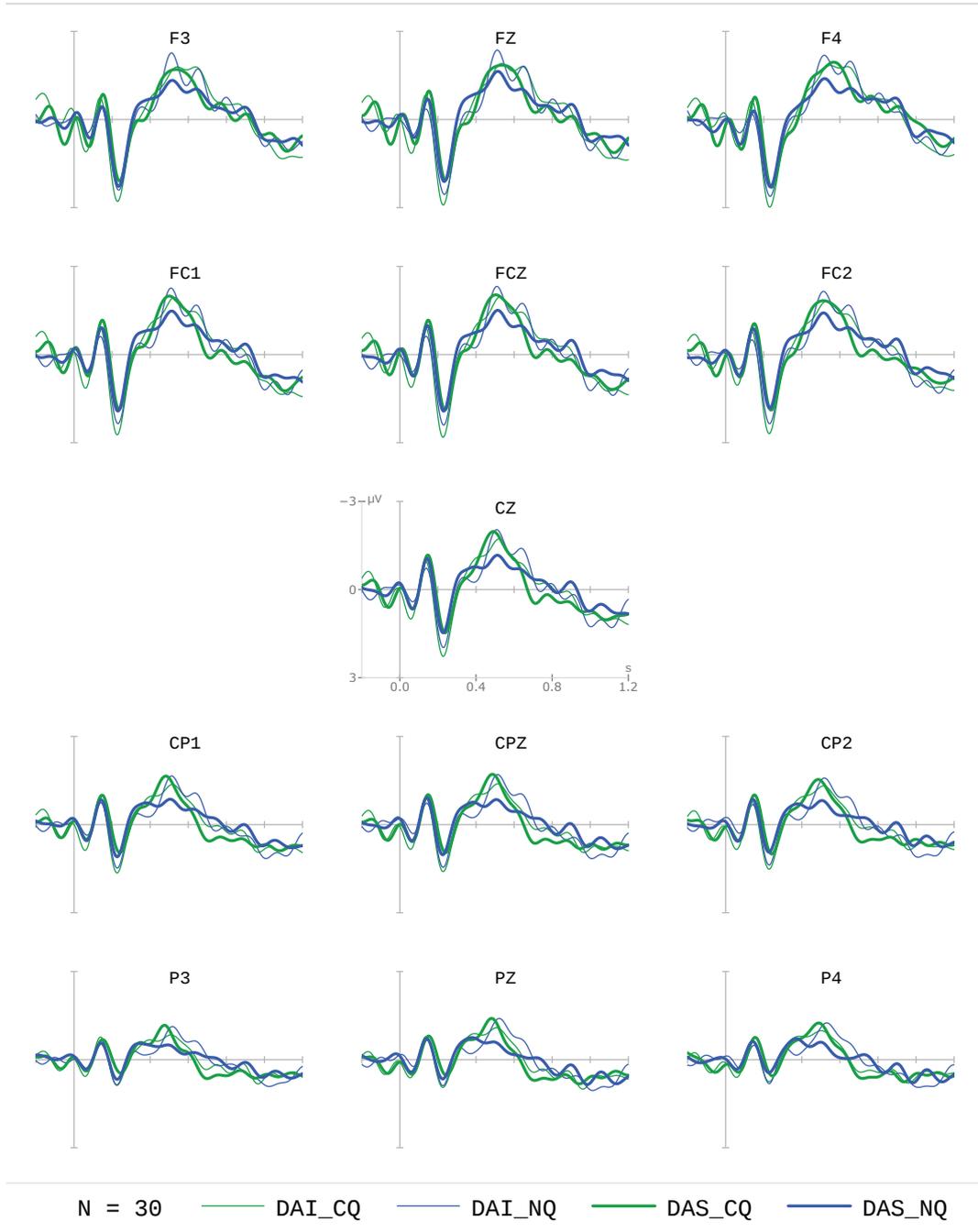
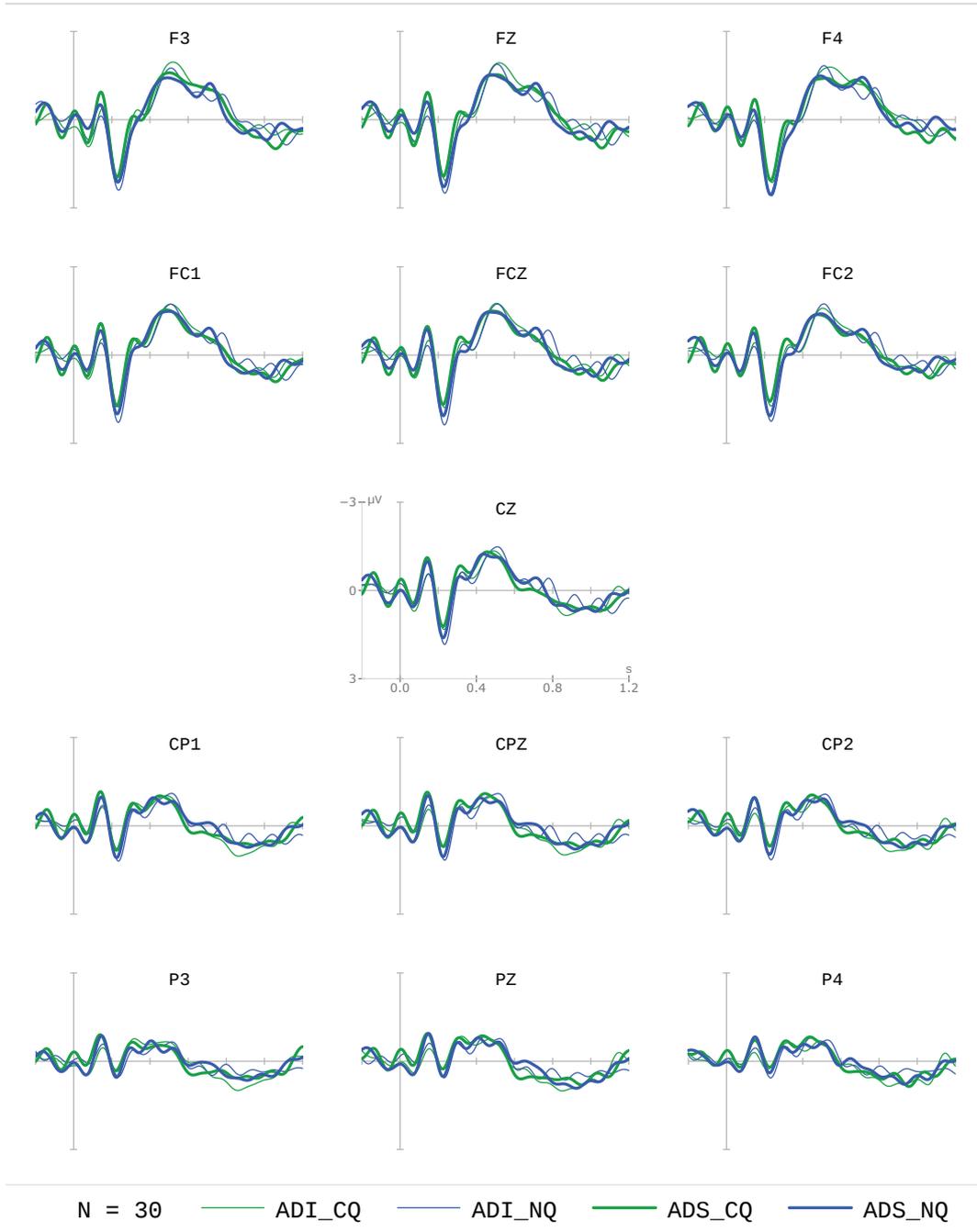


Figure F.2: ERPs at NP1: AD Conditions.



F.5. SUPPLEMENTARY ERP PLOTS

Figure F.3: ERPs at NP1 - Collapsed over CT: AD Conditions.

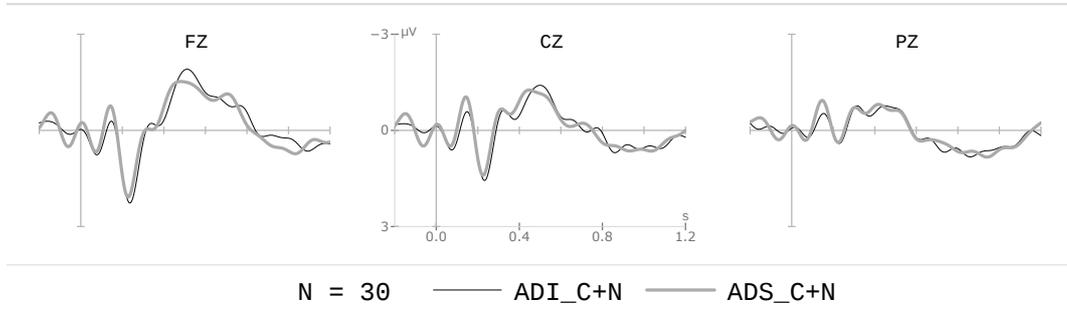


Figure F.4: ERPs at NP1 - Onset of the case-marker: DAS Conditions.

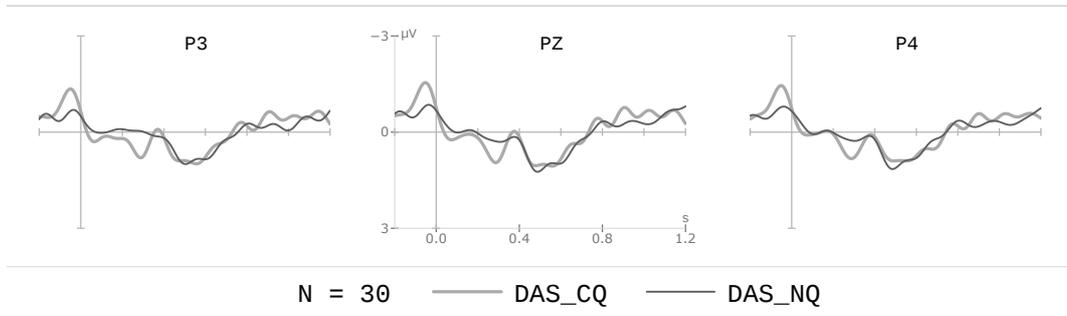
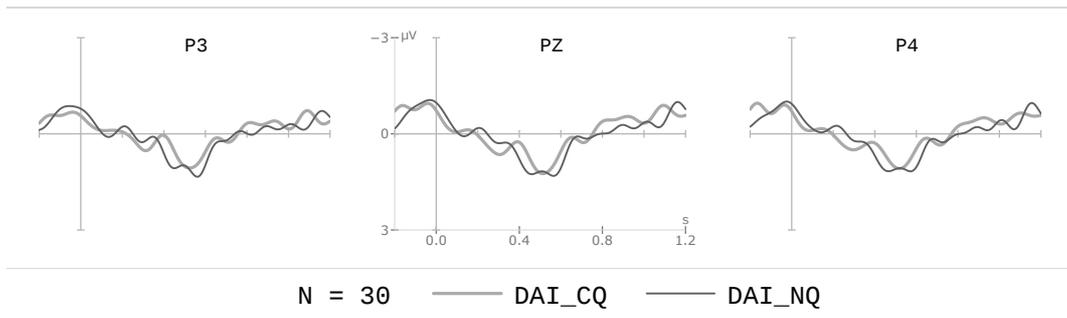
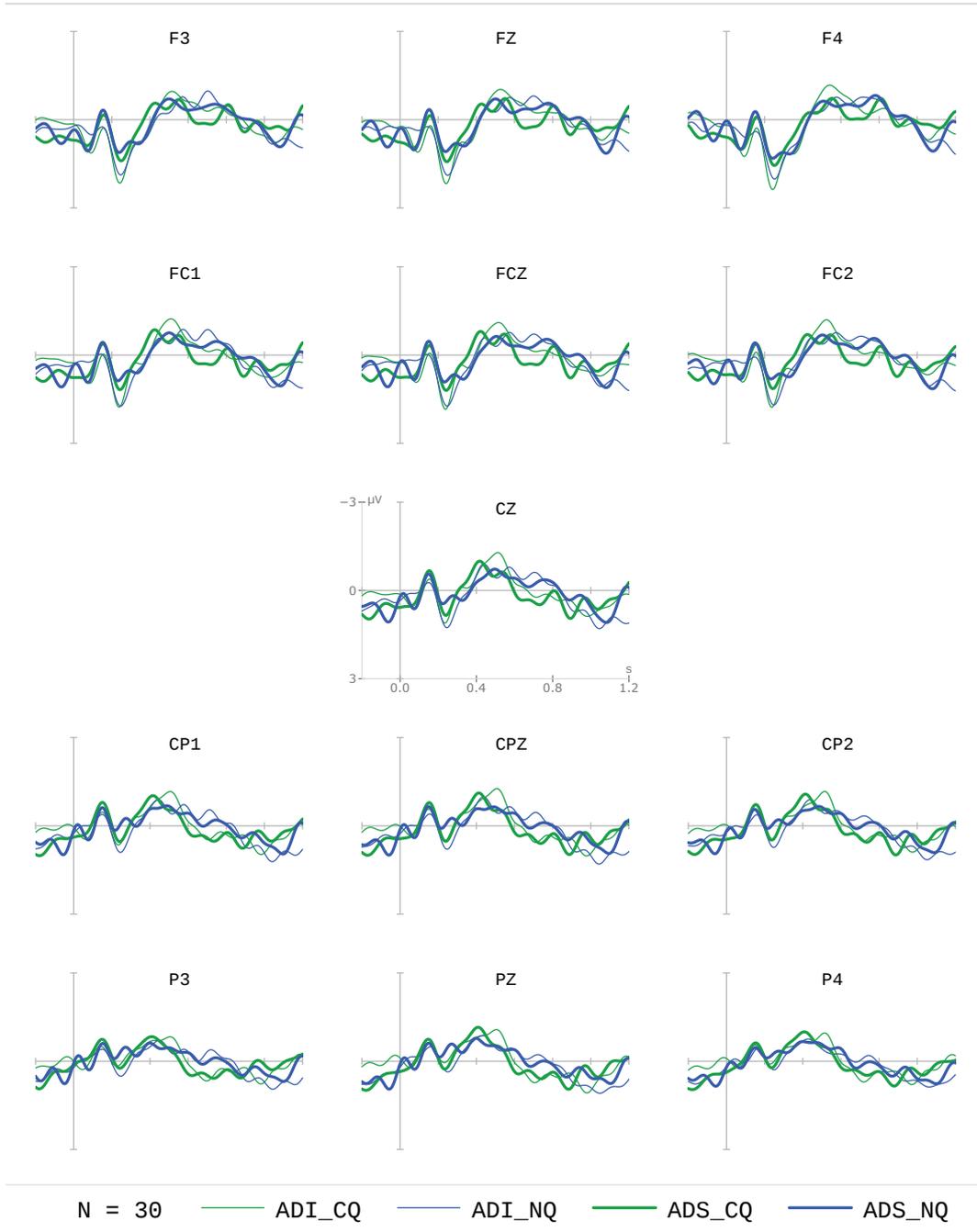


Figure F.5: ERPs at NP1 - Onset of the case-marker: DAI Conditions.



F.5.2 ERPs at NP2

Figure F.6: ERPs at NP2: AD Conditions.



F.5. SUPPLEMENTARY ERP PLOTS

Figure F.7: ERPs at NP2: DA Conditions.

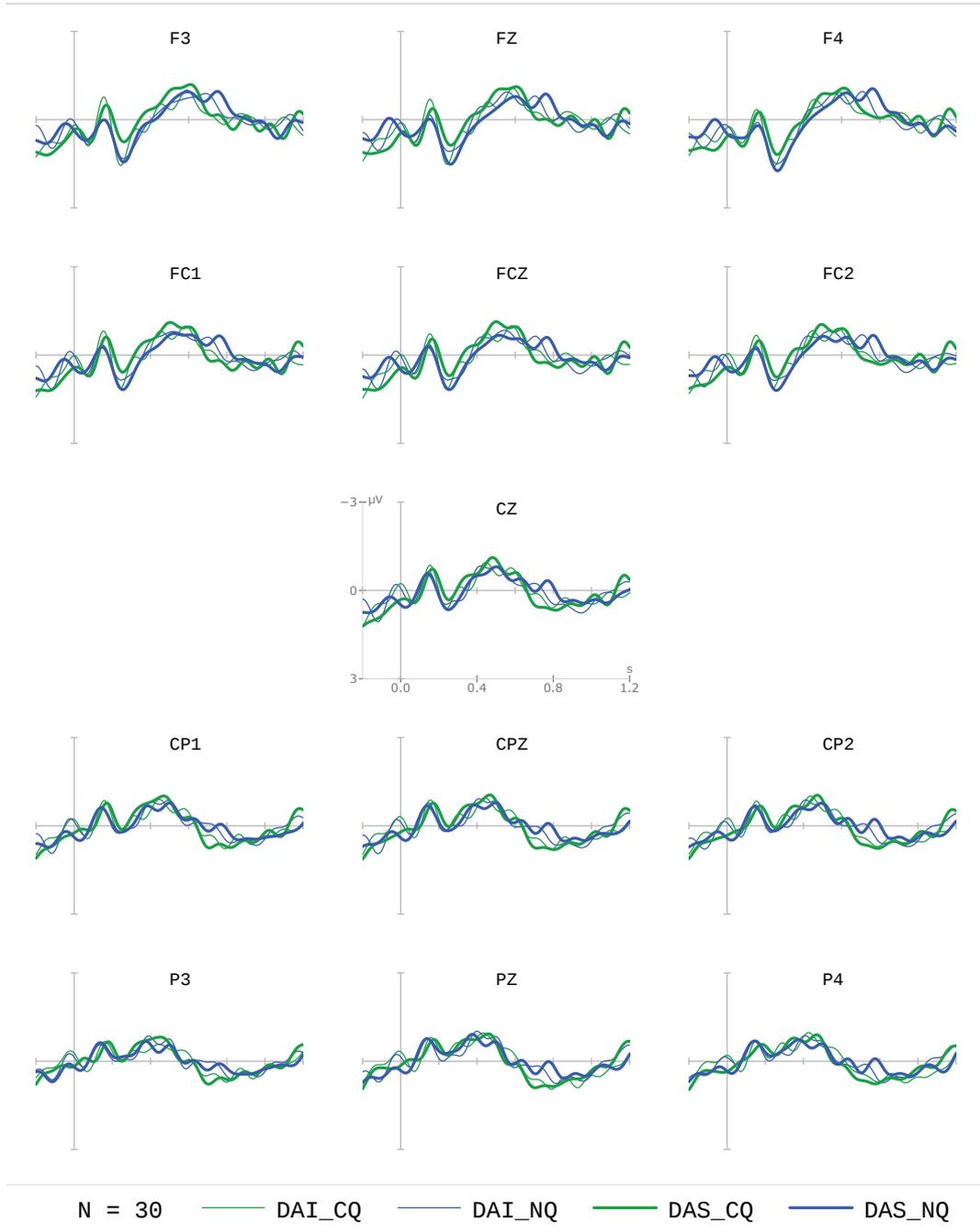


Figure F.8: ERPs at NP2 - Collapsed over CT: DA Conditions.

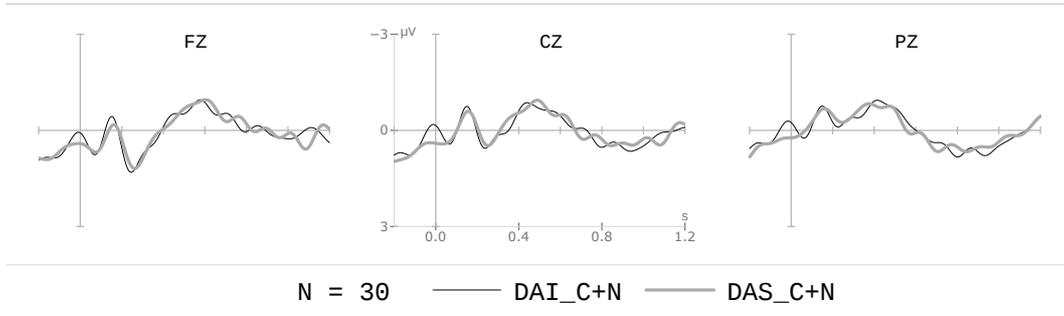


Figure F.9: ERPs at NP2 - Onset of the case-marker: ADS Conditions.

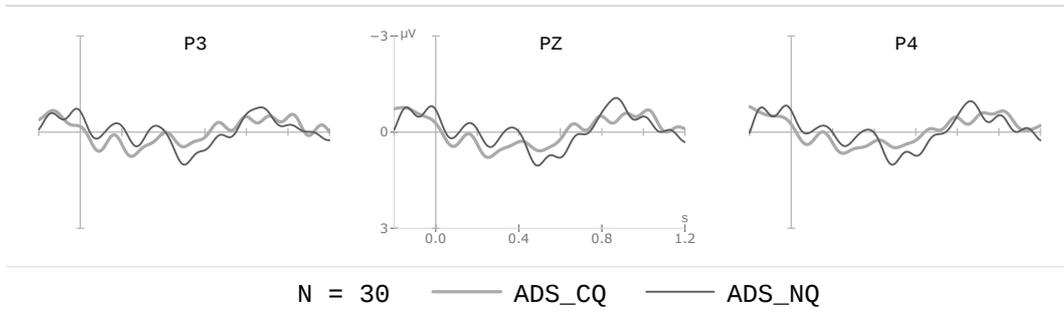
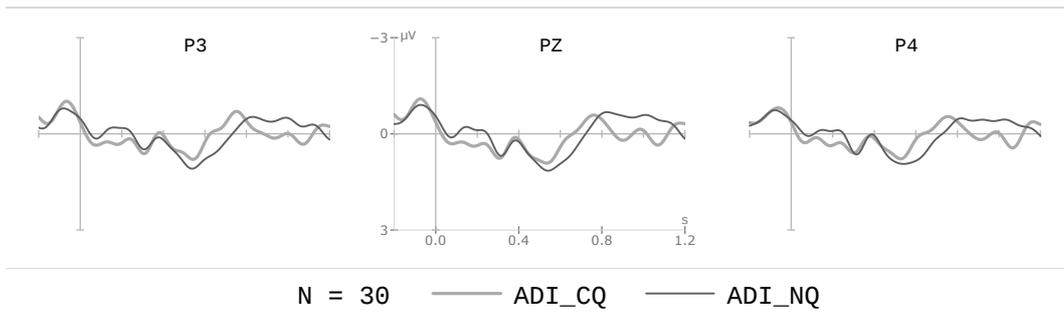


Figure F.10: ERPs at NP2 - Onset of the case-marker: ADI Conditions.



F.5.3 ERPs at the Verb

F.5. SUPPLEMENTARY ERP PLOTS

Figure F.11: ERPs at the Verb - Collapsed over WO: All Conditions.

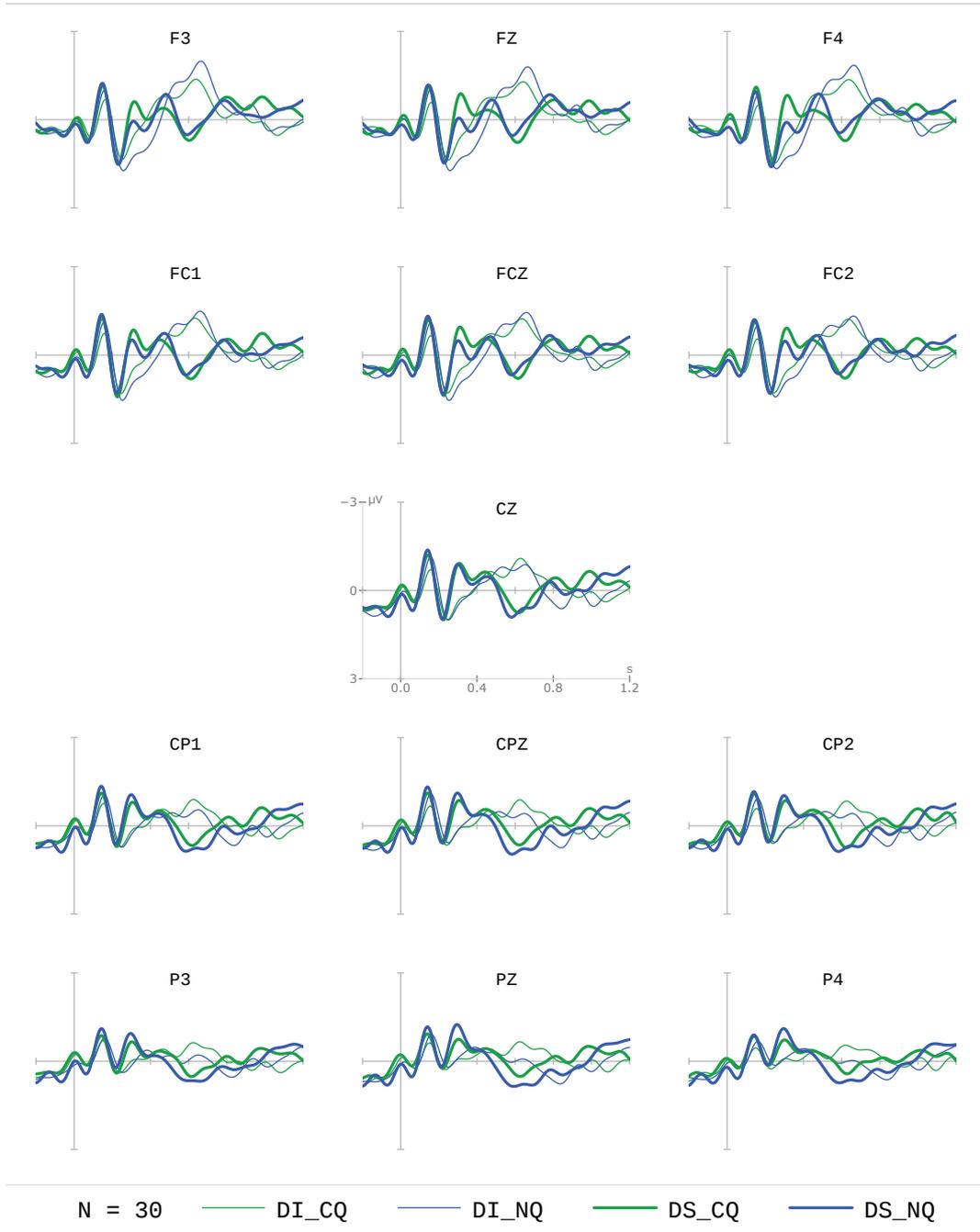


Figure F.12: ERPs at the Verb - Not Collapsed over WO: DS Conditions.

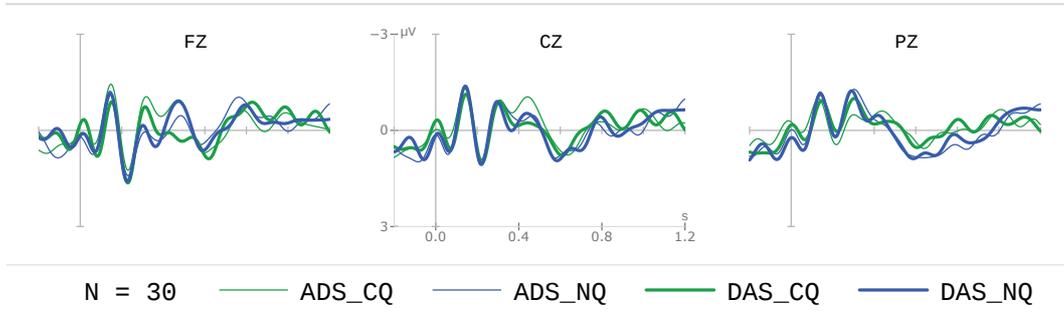
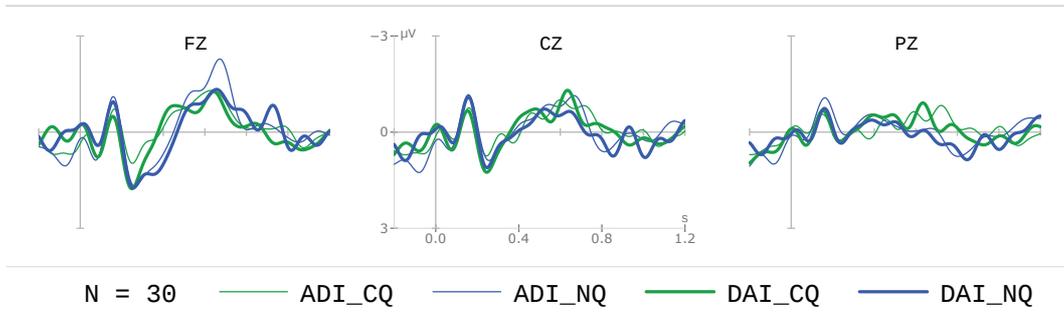


Figure F.13: ERPs at the Verb - Not Collapsed over WO: DI Conditions.



— * —

Experiment 3 : Supplement

G.1 Items Distribution Scheme

As described in [Chapter 7, Section 7.3.4](#), the distribution of critical items for Experiment 3 was done in two stages such that the stimuli are equiprobable in all four contexts across the four sets. This was also in order to ensure that, across the four sets, each stimulus sentence is equifrequent. This is illustrated in [Figure G.1](#) schematically. The condition codes NII, NIA, FII and FPA in the scheme correspond to filler conditions.

APPENDIX G. EXPERIMENT 3 : SUPPLEMENT

Figure G.1: Items Distribution Scheme

Context	Correct context:	Verbs of context and stimulus are identical
Context	Neutral context:	No specific information about the stimulus
Context	Verb-class context:	Verbs mismatch, but verb-classes match
Context	Wrong-verb context:	Verbs mismatch, and verb-classes mismatch
Set	18 sentences per context	9 sentences per context
01	01-18 19-36 37-54 55-72	01-09 10-18 19-27 28-36 37-45 46-54 55-63 64-72
DAS	C N V W	W V N C
DAI	N V W C	C W V N
ADS	V W C N	N C W V
ADI	W C N V	V N C C
NII		C N C N
NIA		N C N C
FII		N N
FPA		N N
Set	18 sentences per context	9 sentences per context
02	01-18 19-36 37-54 55-72	01-09 10-18 19-27 28-36 37-45 46-54 55-63 64-72
DAS	N V W C	C W C N
DAI	V W C N	C N V W
ADS	W C N V	N V W C
ADI	C N V W	V W C N
NII		C N C N
NIA		C N C N
FII		N N
FPA		N N
Set	18 sentences per context	9 sentences per context
03	01-18 19-36 37-54 55-72	01-09 10-18 19-27 28-36 37-45 46-54 55-63 64-72
DAS	V W C N	N C W V
DAI	W C N V	N V W C
ADS	C N V W	W V N C
ADI	N V W C	C W V N
NII		N C N C
NIA		N C N C
FII		N N
FPA		N N
Set	18 sentences per context	9 sentences per context
04	01-18 19-36 37-54 55-72	01-09 10-18 19-27 28-36 37-45 46-54 55-63 64-72
DAS	W C N V	N V W C
DAI	C N V W	V W C N
ADS	N V W C	W C N V
ADI	V W C N	C N V W
NII		N C N C
NIA		C N C N
FII		N N
FPA		N N

G.2 Supplementary ERP Plots

G.2.1 ERPs at NP1

Figure G.2: ERPs at NP1: DAS Conditions.

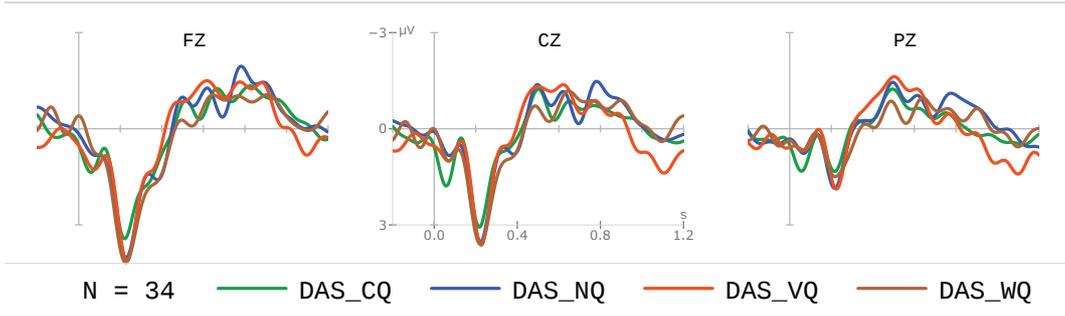


Figure G.3: ERPs at NP1: DAI Conditions.

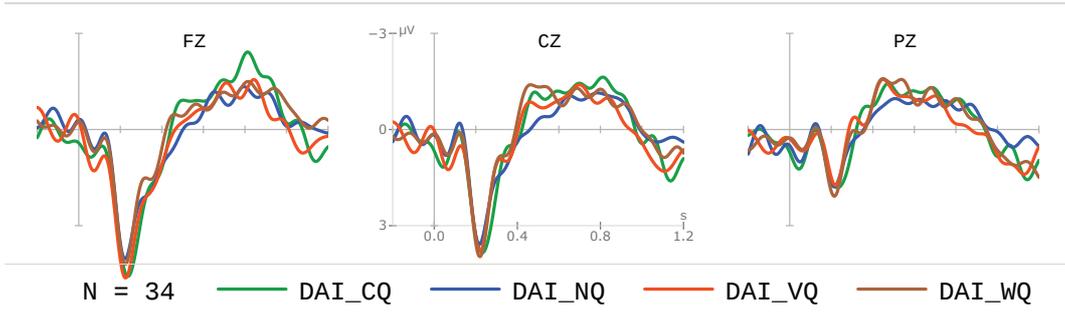


Figure G.4: ERPs at NP1: ADS Conditions.

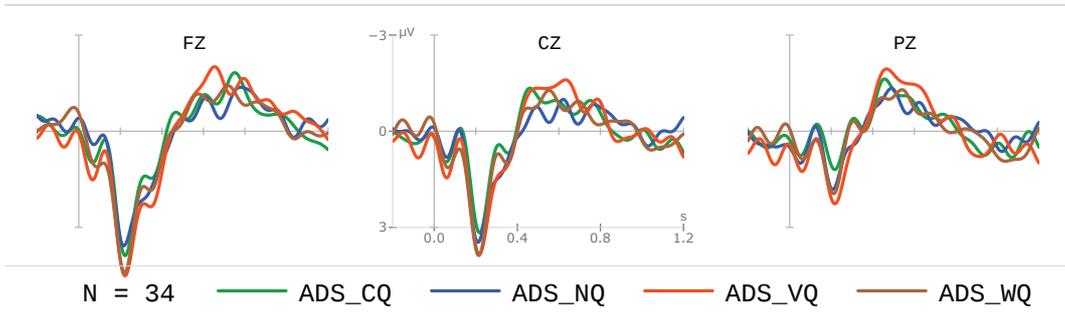
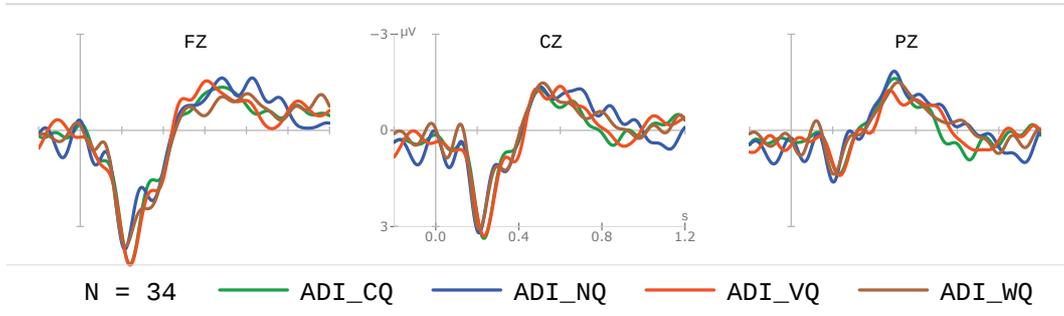


Figure G.5: ERPs at NP1: ADI Conditions.



G.2.2 ERPs at NP2

Figure G.6: ERPs at NP2: ADS Conditions.

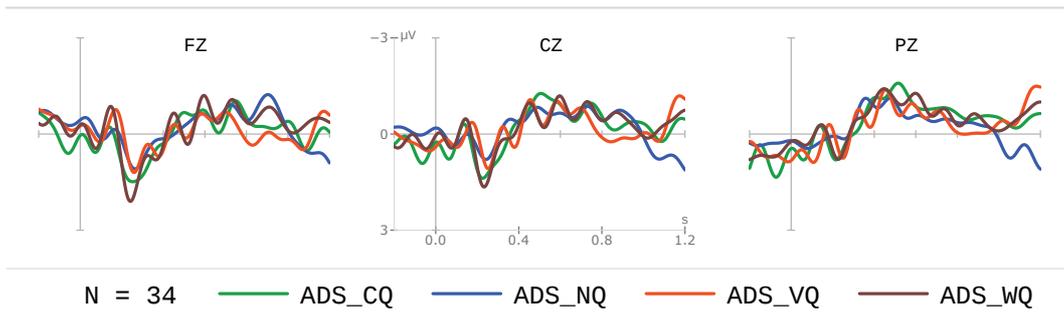
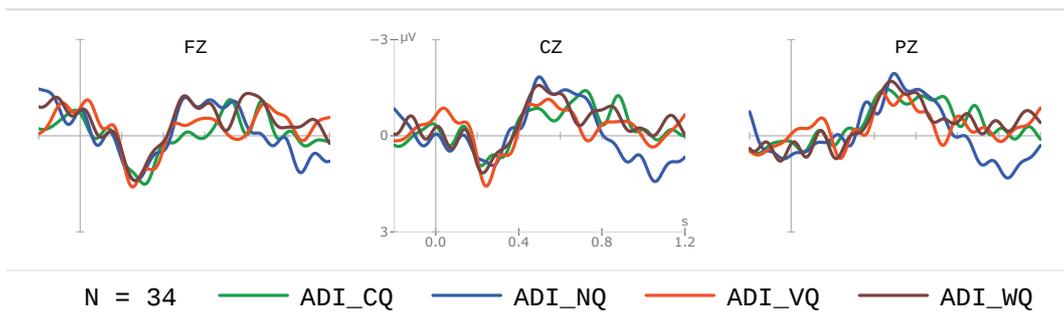


Figure G.7: ERPs at NP2: ADI Conditions.



G.2. SUPPLEMENTARY ERP PLOTS

Figure G.8: ERPs at NP2: DAS Conditions.

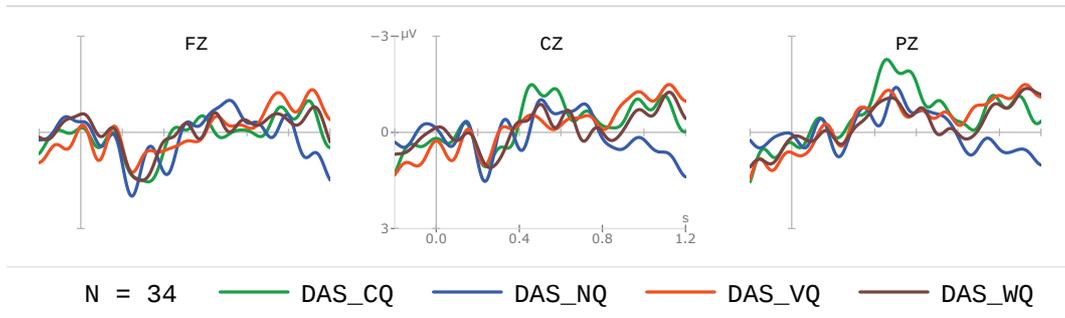
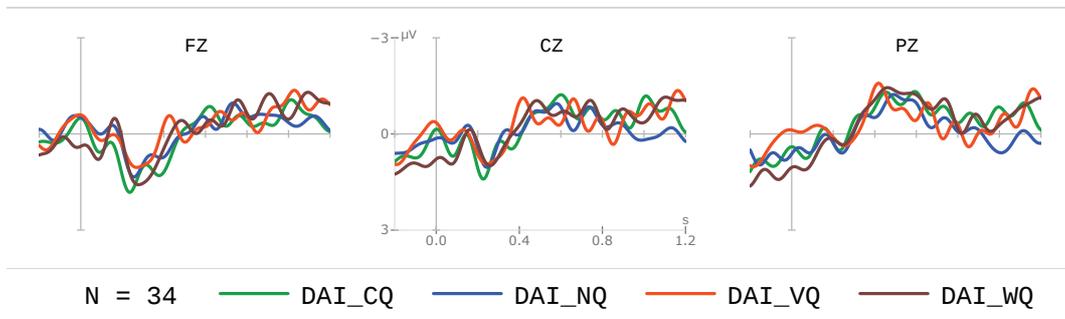
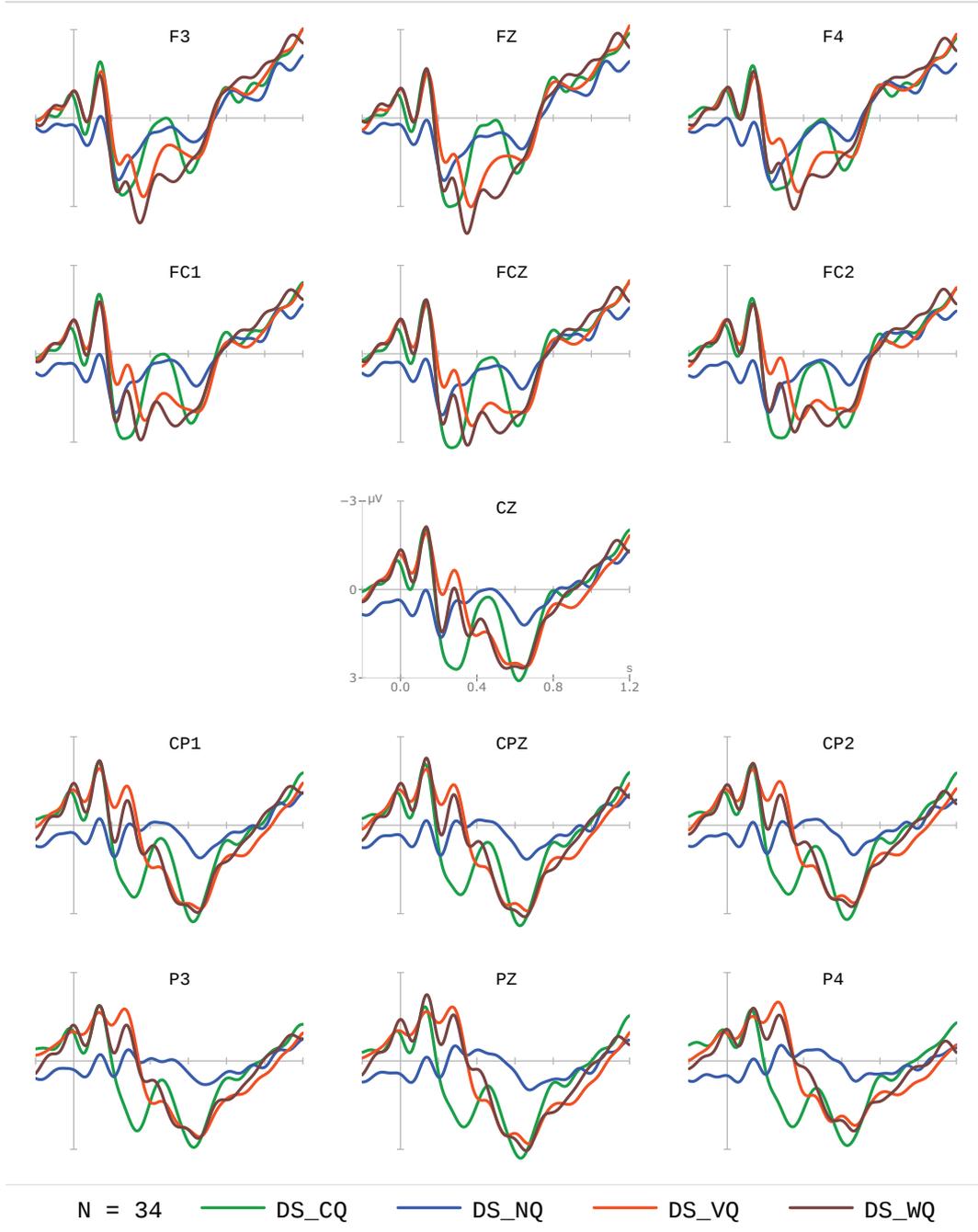


Figure G.9: ERPs at NP2: DAI Conditions.



G.2.3 ERPs at the Verb

Figure G.10: ERPs at the Verb without Baseline Correction: DS Conditions.



G.2. SUPPLEMENTARY ERP PLOTS

Figure G.11: ERPs at the Verb without Baseline Correction: DI Conditions.

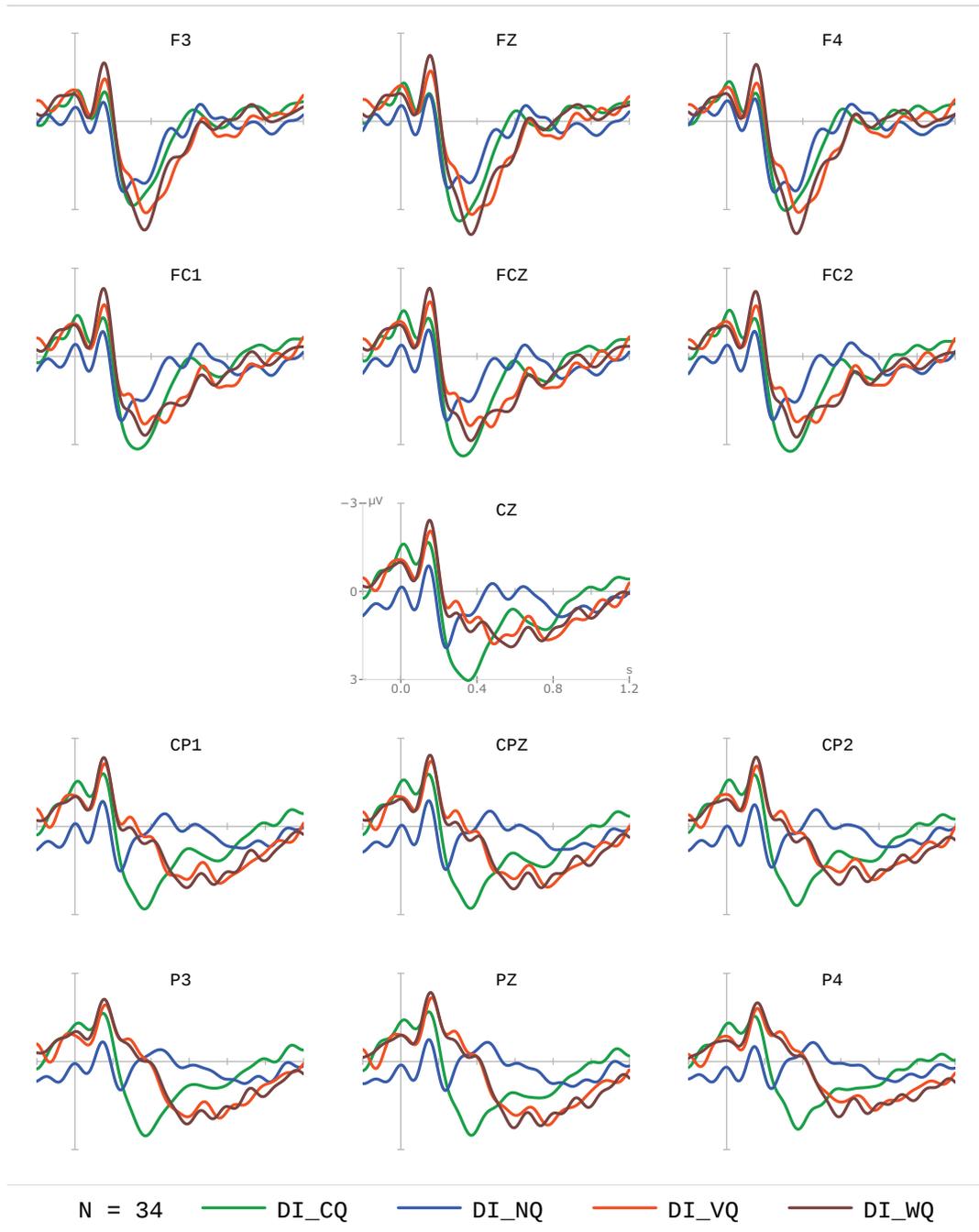


Figure G.12: Baseline Corrected ERPs at the Verb: DAS Conditions.

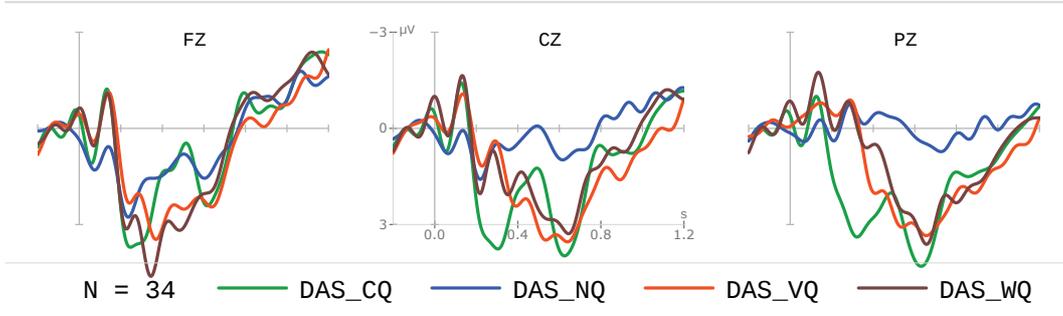


Figure G.13: Baseline Corrected ERPs at the Verb: DAI Conditions.

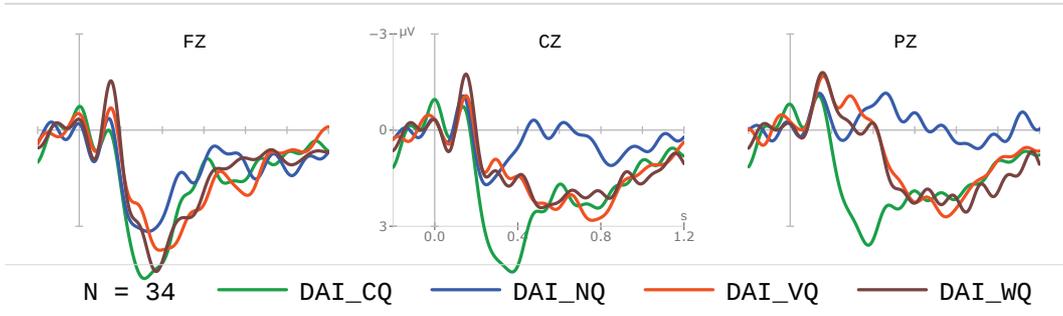


Figure G.14: Baseline Corrected ERPs at the Verb: ADS Conditions.

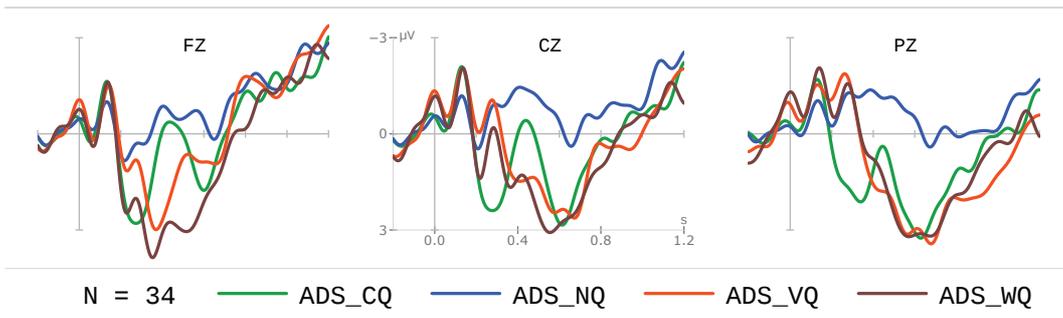


Figure G.15: Baseline Corrected ERPs at the Verb: ADI Conditions.

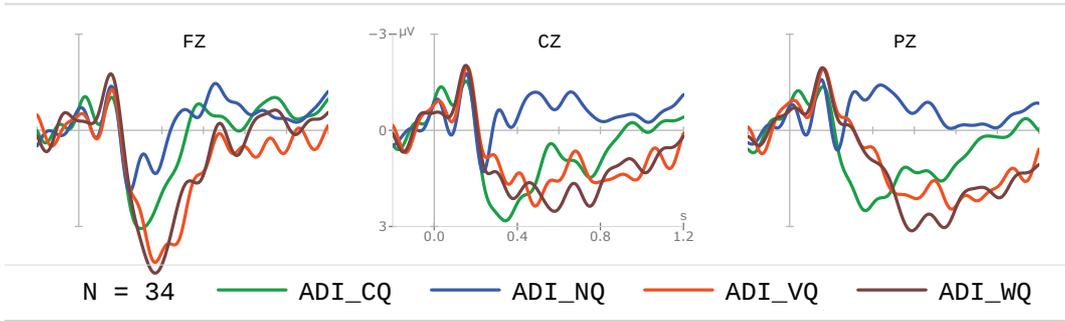


Figure G.16: Topographic Map for the ERPs at the Verb: CQ-NQ

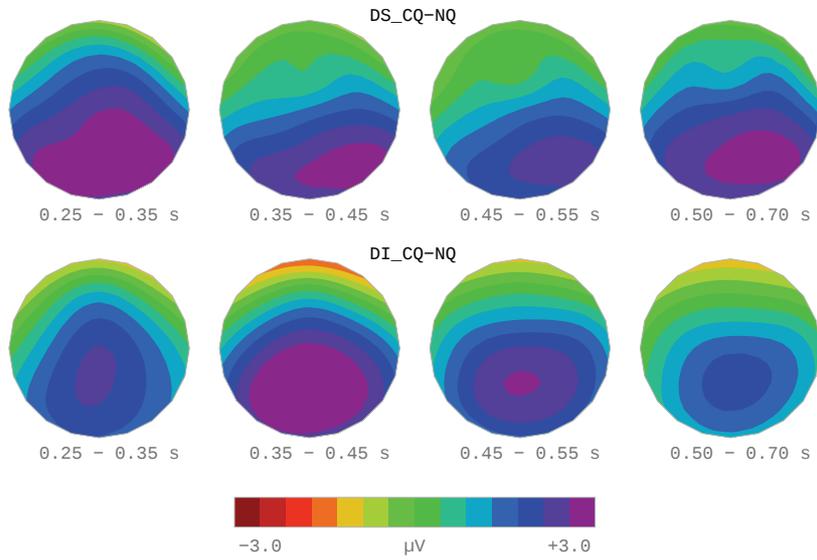


Figure G.17: Topographic Map for the ERPs at the Verb: VQ-NQ

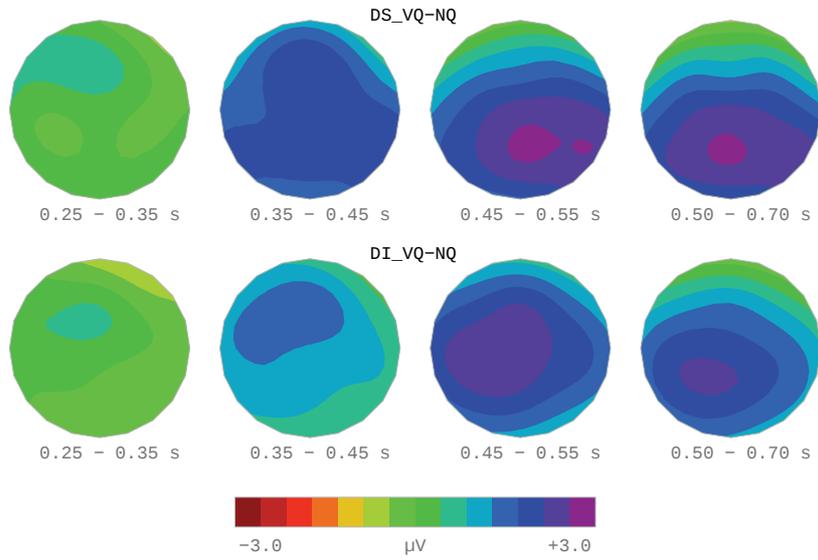
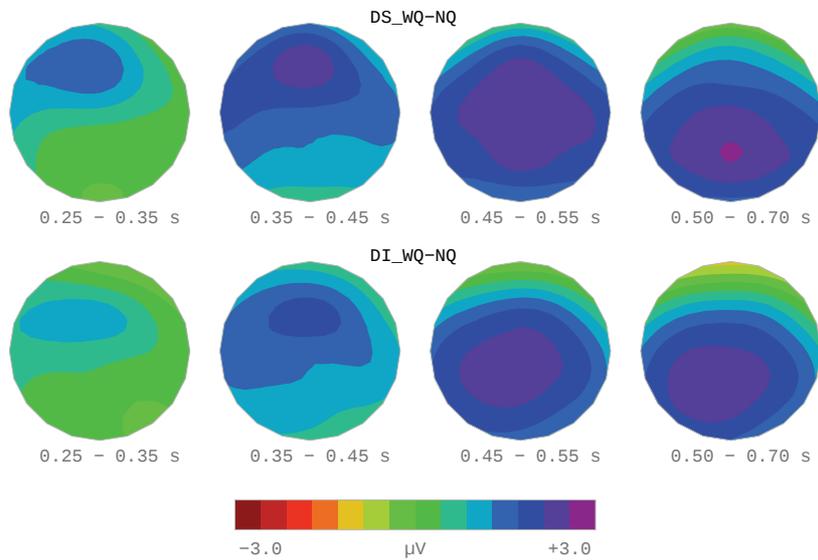


Figure G.18: Topographic Map for the ERPs at the Verb: WQ-NQ



G.2. SUPPLEMENTARY ERP PLOTS

— * —

Bibliography

- Altmann, G. T. (1998). Ambiguity in sentence processing. *Trends in Cognitive Sciences*, 2(4), 146–151. [Cited at p. 28]
- Altmann, G. T., & Kamide, Y. (1999). Incremental interpretation at verbs: restricting the domain of subsequent reference. *Cognition*, 73(3), 247–264. [Cited at p. 17]
- Altmann, G. T., & Kamide, Y. (2007). The real-time mediation of visual attention by language and world knowledge: Linking anticipatory (and other) eye movements to linguistic processing. *Journal of Memory and Language* (In Press). [Cited at p. 18]
- Amritavalli, R. (2004). Experiencer datives in Kannada. In P. Bhaskararao & K. Subbarao (Eds.), *Non-nominative Subjects*, vol. 1 (p. 1–24). Amsterdam, Philadelphia: John Benjamins. [Cited at p. 74]
- Arden, A. H. (1942). *A Progressive Grammar of the Tamil*. Here from the webpage: <http://ccat.sas.upenn.edu/~haroldfs/drawing/case/node1.html>. Madras, India: Christian Literature Society. [Cited at p. 60]
- Asher, R. E., & Keane, E. (2005). Diphthongs in colloquial Tamil. In W. J. Hardcastle & J. M. Beck (Eds.), *A figure of speech: A festschrift for John Laver* (p. 147–171). Hillsdale, NJ: Lawrence Erlbaum. [Cited at p. 225]
- Barðal, J., & Eythórsson, T. (2003). Icelandic vs. German: Oblique subjects, agreement and expletives. *Chicago Linguistic Society*, 39, 755–773. [Cited at p. 72]
- Bates, E., & MacWhinney, B. (1989). Functionalism and the competition model. In B. MacWhinney & E. Bates (Eds.), *The crosslinguistic study of sentence processing* (p. 3–76). New York: Cambridge University Press. [Cited at p. 9]

BIBLIOGRAPHY

- Bates, E., McNew, S., Devescovi, A., & Wulfeck, B. (2001). Psycholinguistics: A cross-language perspective. *Annual Review of Psychology*, 52, 369–396. [Cited at p. 9]
- Bates, E., McNew, S., MacWhinney, B., Devescovi, A., & Smith, S. (1982). Functional constraints on sentence processing: A cross-linguistic study. *Cognition*, 11, 245–299. [Cited at p. 9, 39]
- Bhaskararao, P., & Subbarao, K. (Eds.). (2004). *Non-nominative Subjects*, vol. 1 & 2. Amsterdam, Philadelphia: John Benjamins. [Cited at p. 72]
- Blake, B. J. (2001). *Case* (2nd ed.). Cambridge: Cambridge University Press. [Cited at p. 5, 6, 12, 13, 15, 16, 18]
- Blake, B. J. (2009). History of the research on case. In A. Malchukov & A. Spencer (Eds.), *The Oxford Handbook of Case* (p. 13–26). Oxford: Oxford University Press. [Cited at p. 5, 13]
- Blake, F. R. (1930). A semantic analysis of case. In J. T. Hatfield, W. Leopold, & A. J. Friedrich Zieglschmid (Eds.), *Curme volume of linguistic studies (Language monographs 7)* (p. 34–49). Baltimore: Linguistic Society of America. [Cited at p. 6]
- Bornkessel, I., McElree, B., Schlesewsky, M., & Friederici, A. D. (2004). Multi-dimensional contributions to garden path strength: Dissociating phrase structure from case marking. *Journal of Memory and Language*, 51(4), 495–522. [Cited at p. 26, 27]
- Bornkessel, I., & Schlesewsky, M. (2006). The Extended Argument Dependency Model: A neurocognitive approach to sentence comprehension across languages. *Psychological Review*, 113(4), 787–821. [Cited at p. 53, 55, 56, 57, 221, 223]
- Bornkessel, I., Schlesewsky, M., & Friederici, A. D. (2002). Grammar overrides frequency: evidence from the online processing of flexible word order. *Cognition*, 85(Issue 2), B21–B30. [Cited at p. 40, 211]
- Bornkessel, I., Schlesewsky, M., & Friederici, A. D. (2003). Contextual information modulates initial processes of syntactic integration: The role of inter- vs. intra-sentential predictions. *Journal of Experimental Psychology: Learning, Memory and cognition*, 29(5), 871–882. [Cited at p. 143, 216]
- Bornkessel-Schlesewsky, I., Kretzschmar, F., Tune, S., Wang, L., Genç, S., Philipp, M., et al. (2011). Think globally: Cross-linguistic variation

-
- in electrophysiological activity during sentence comprehension. *Brain and Language*. [Cited at p. 31]
- Bornkessel-Schlesewsky, I., & Schlesewsky, M. (2008). An alternative perspective on 'semantic P600' effects in language comprehension. *Brain Research Reviews*, 59, 55–73. [Cited at p. 24, 31, 53, 57, 222]
- Bornkessel-Schlesewsky, I., & Schlesewsky, M. (2009a). *Processing Syntax and Morphology: A Neurocognitive Perspective* (R. Van Valin Jr., Ed.). Oxford: Oxford University Press. [Cited at p. 34, 143]
- Bornkessel-Schlesewsky, I., & Schlesewsky, M. (2009b). The Role of Prominence Information in the Real-Time Comprehension of Transitive Constructions: A Cross-Linguistic Approach. *Language and Linguistics Compass*, 3(1), 19–58. [Cited at p. 18, 19, 39, 54, 57]
- Burkhardt, P. (2006). Inferential bridging relations reveal distinct neural mechanisms: Evidence from event-related brain potentials. *Brain and Language*, 98, 159–168. [Cited at p. 32]
- Burkhardt, P. (2007). The p600 reflects cost of new information in discourse memory. *Neuroreport*, 18(17), 1851–1854. [Cited at p. 32, 199]
- Butt, M. (2009). Terminology of case. In A. Malchukov & A. Spencer (Eds.), *The Oxford Handbook of Case* (p. 27–43). Oxford: Oxford University Press. [Cited at p. 6, 11, 13, 18]
- Choudhary, K. K. (2011). *Incremental argument interpretation in a split ergative language: Neurophysiological evidence from Hindi*. Unpublished doctoral dissertation, University of Leipzig, Leipzig, Germany. [Cited at p. 14, 224]
- Comerchero, M. D., & Polich, J. (1998). P3a, perceptual distinctiveness, and stimulus modality. *Cognitive Brain Research*, 7, 41–48. [Cited at p. 36]
- Comerchero, M. D., & Polich, J. (1999). P3a and P3b from typical auditory and visual stimuli. *Clinical Neurophysiology*, 110, 24–30. [Cited at p. 36, 194, 217]
- Comrie, B. (1989). *Language Universals and Linguistic Typology: Syntax and Morphology* (2nd ed.). Oxford: Blackwell. [Cited at p. 11, 12, 13, 14]
- Connolly, J. F., & Phillips, N. A. (1994). Event-related potential components reflect phonological and semantic processing of the terminal word of spoken sentences. *Journal of Cognitive Neuroscience*, 6(3), 256–266. [Cited at p. 218]

BIBLIOGRAPHY

- Coulson, S., King, J. W., & Kutas, M. (1998). Expect the Unexpected: Event-related Brain Response to Morphosyntactic Violations. *Language and Cognitive Processes*, 13(1), 21–58. [Cited at p. 31, 38]
- Coulson, S., & Kutas, M. (2001). Getting it: Human event-related brain response to jokes in good and poor comprehenders. *Neuroscience Letters*, 316, 71–74. [Cited at p. 27]
- Coulson, S., & Van Petten, C. (2002). Conceptual integration and metaphor: An event-related potential study. *Memory and Cognition*, 30(6), 958–968. [Cited at p. 27]
- Courchesne, E., Hillyard, S. A., & Galambos, R. (1975). Stimulus novelty, task relevance and visual evoked potential in man. *Electroencephalography and Clinical Neurophysiology*, 39, 131–143. [Cited at p. 36, 194]
- Cowles, H., Kluender, R., Kutas, M., & Polinsky, M. (2007). Violations of information structure: An electrophysiological study of answers to wh-questions. *Brain and Language*, 102, 228–242. [Cited at p. 143, 216]
- Crocker, M. W. (1992). *A Logical Model of Competence and Performance in the Human Sentence Processor*. Unpublished doctoral dissertation, University of Edinburgh, Edinburgh. [Cited at p. 17]
- Crocker, M. W. (1999). Mechanisms for Sentence Processing. In S. Garrod & M. Pickering (Eds.), *Language Processing*. London: Psychology Press. [Cited at p. 1, 4]
- Crocker, M. W. (2005). Relational models of comprehension: Addressing the performance paradox. In A. Cutler (Ed.), *Twenty-First Century Psycholinguistics: Four Cornerstones*. Hillsdale, NJ: Lawrence Erlbaum Associates. [Cited at p. 4]
- DeLancey, S. (1981). An interpretation of split ergativity and related patterns. *Language*, 57(3), 626–657. [Cited at p. 10, 12]
- Demiral Şükrü Barış. (2007). *Incremental Argument Interpretation in Turkish Sentence Comprehension*. Unpublished doctoral dissertation, University of Leipzig, Leipzig, Germany. [Cited at p. 212]
- Demiral Şükrü Barış, Schlesewsky, M., & Bornkessel-Schlesewsky, I. (2008). On the universality of language comprehension strategies: Evidence from Turkish. *Cognition*, 106(1), 484–500. [Cited at p. 211]
- Dixon, R. M. W. (1979). An interpretation of split ergativity and related patterns. *Language*, 55(1), 59–138. [Cited at p. 11]

-
- Donchin, E. (1981). Presidential address, 1980: Surprise!...Surprise? *Psychophysiology*, 18(5), 493–513. [Cited at p. 35]
- Dowty, D. R. (1989). On the semantic content of the notion of ‘thematic role’. In G. Chierchia, B. H. Partee, & R. Turner (Eds.), *Properties, types and meaning, II* (p. 69–130). Dordrecht: Kluwer. [Cited at p. 6]
- Dowty, D. R. (1991). Thematic proto-roles and argument selection. *Language*, 67(3), 547–619. [Cited at p. 5, 6, 7, 8]
- Dryer, M. S. (2008). Order of subject, object and verb. In M. Haspelmath, M. S. Dryer, D. Gil, & B. Comrie (Eds.), *The World Atlas of Language Structures Online* (p. Available online at <http://wals.info/feature/81>. Accessed on 20.03.2011). Munich: Max Planck Digital Library. [Cited at p. 10, 14]
- Evans, N., & Levinson, S. C. (2009). The myth of language universals: Language diversity and its importance for cognitive science. *Behavioral and Brain Sciences*, 32, 429–492. [Cited at p. 1, 8]
- Federmeier, K. D., & Kutas, M. (1999). A rose by any other name: Long-term memory structure and sentence processing. *Journal of Memory and Language*, 41(4), 469–495. [Cited at p. 24, 25]
- Ferguson, C. F. (1959). Diglossia. *Word*, 15(2), 325–340. [Cited at p. 59]
- Ferretti, T. R., Schwint, C. A., & Katz, A. N. (2007). Electrophysiological and behavioral measures of the influence of literal and figurative contextual constraints on proverb comprehension. *Brain and Language*, 101, 38–49. [Cited at p. 27]
- Fillmore, C. J. (1968). The Case for Case. In E. Bach & R. Harms (Eds.), *Universals in linguistic theory* (p. 1–88). New York: Holt, Rinehart and Winston. [Cited at p. 6]
- Frenzel, S., Schlesewsky, M., Primus, B., & Bornkessel-Schlesewsky, I. (2011). *An experimenter is as good as an actor: The neural underpinnings of linguistic actorhood*. [Cited at p. 108]
- Friederici, A. D. (1995). The time course of syntactic activation during language processing: A model based on neuropsychological and neurophysiological data. *Brain and Language*, 50, 259–281. [Cited at p. 48]
- Friederici, A. D. (1999). The neurobiology of language comprehension. In A. D. Friederici (Ed.), *Language comprehension: A biological perspective* (p. 263–301). New York: Springer. [Cited at p. 48]

BIBLIOGRAPHY

- Friederici, A. D. (2002). Towards a neural basis of auditory sentence processing. *Trends in Cognitive Sciences*, 6, 78–84. [Cited at p. 48, 57, 220]
- Friederici, A. D., & Alter, K. (2004). Lateralization of auditory language functions: A dynamic dual pathway model. *Brain and Language*, 89, 267–276. [Cited at p. 48, 220]
- Friederici, A. D., von Cramon, D. Y., & Kotz, S. A. (2007). Role of the corpus callosum in speech comprehension: Interfacing syntax and prosody. *Neuron*, 53(1), 135–145. [Cited at p. 49]
- Friedman, D., Simson, R., Ritter, W., & Rapin, I. (1975). The late-positive component (p300) and information processing in sentences. *Electroencephalography and Clinical Neurophysiology*, 38(3), 255–262. [Cited at p. 145, 146]
- Frisch, S., Kotz, S., von Cramon, D. Y., & Friederici, A. D. (2003). Why the P600 is not just a P300: The role of the basal ganglia. *Clinical Neurophysiology*, 114, 336–340. [Cited at p. 38]
- Frisch, S., & Schlesewsky, M. (2001). The N400 reflects problems of thematic hierarchizing. *Neuroreport*, 12(15), 3391–3394. [Cited at p. 43, 44, 45]
- Frisch, S., Schlesewsky, M., Saddy, D., & Alpermann, A. (2002). The P600 as an indicator of syntactic ambiguity. *Cognition*, 85, B83–B92. [Cited at p. 28, 29, 42]
- Gordon Jr., R. G. (Ed.). (2005). *Ethnologue: Languages of the World (15th ed.)*. Online version. http://www.ethnologue.com/show_language.asp?code=tam. Dallas, TX: SIL International. [Cited at p. 59]
- Grewe, T., Bornkessel, I., Zysset, S., Wiese, R., von Cramon, D. Y., & Schlesewsky, M. (2005). The Emergence of the Unmarked: A New Perspective on the Language-Specific Function of Broca's Area. *Human Brain Mapping*, 26, 178–190. [Cited at p. 42]
- Grey Walter, W., Cooper, R., Aldridge, V. J., McCallum, W. C., & Winter, A. L. (1964). Contingent negative variation: An electric sign of sensorimotor association and expectancy in the human brain. *Nature*, 203(4943), 380–384. [Cited at p. 189]
- Gruber, J. S. (1965). *Studies in lexical relations*. Unpublished doctoral dissertation, Massachusetts Institute of Technology, Cambridge, MA. [Cited at p. 6]

-
- Gunter, T. C., Friederici, A. D., & Schriefers, H. (2000). Syntactic Gender and Semantic Expectancy: ERPs Reveal Early Autonomy and Late Interaction. *Journal of Cognitive Neuroscience*, 12(4), 556–568. [Cited at p. 31, 34]
- Gunter, T. C., Stowe, L. A., & Mulder, G. (1997). When syntax meets semantics. *Psychophysiology*, 34(6), 660–676. [Cited at p. 31, 38]
- Hagoort, P. (2003). How the brain solves the binding problem for language: A neurocomputational model of syntactic processing. *Neuroimage*, 20(Suppl. 1), S18–S29. [Cited at p. 51, 221]
- Hagoort, P. (2005). On broca, brain, and binding: A new framework. *Trends in Cognitive Sciences*, 9, 416–423. [Cited at p. 51, 221]
- Hagoort, P., Hald, L., Bastiaansen, M., & Petersson, K. M. (2004). Integration of word meaning and world knowledge in language comprehension. *Science*. [Cited at p. 222]
- Hagoort, P., & van Berkum, J. J. (2007). Beyond the sentence given. *Philosophical Transactions of the Royal Society B-Biological Sciences*, 362(1481), 801–811. [Cited at p. 223]
- Hahne, A., & Friederici, A. D. (1999). Electrophysiological evidence for two steps in syntactic analysis: Early automatic and late controlled processes. *Journal of Cognitive Neuroscience*, 11(2), 194–205. [Cited at p. 38]
- Hahne, A., & Friederici, A. D. (2002). Differential task effects on semantic and syntactic processes as revealed by ERPs. *Cognitive Brain Research*, 13(Issue 3), 339–356. [Cited at p. 33]
- Harris, T., Wexler, K., & Holcomb, P. (2000). An ERP Investigation of Binding and Coreference. *Brain and Language*, 75(3), 313–346. [Cited at p. 28]
- Haspelmath, M. (2005). Argument marking in ditransitive alignment types. *Linguistic Discovery*, 3, 1–21. [Cited at p. 13]
- Haspelmath, M. (2008). Ditransitive constructions: The verb ‘Give’. In M. Haspelmath, M. S. Dryer, D. Gil, & B. Comrie (Eds.), *The World Atlas of Language Structures Online* (p. Available online at <http://wals.info/feature/105>. Accessed on 20.03.2011). Munich: Max Planck Digital Library. [Cited at p. 16]
- Haspelmath, M. (2009). Terminology of case. In A. Malchukov & A. Spencer (Eds.), *The Oxford Handbook of Case* (p. 505–517). Oxford: Oxford University Press. [Cited at p. 6, 13, 15]

BIBLIOGRAPHY

- Haupt, F. S., Schlesewsky, M., Roehm, D., Friederici, A. D., & Bornkessel-Schlesewsky, I. (2008). The status of subject-object reanalyses in the language comprehension architecture. *Journal of Memory and Language*, 59, 54–96. [Cited at p. 27, 227]
- Hickok, G., & Poeppel, D. (2000). Towards a functional neuroanatomy of speech perception. *Trends in Cognitive Sciences*, 4, 131–138. [Cited at p. 48]
- Hoeks, J. C., Stowe, L. A., & Doedens, G. (2004). Seeing words in context: the interaction of lexical and sentence level information during reading. *Cognitive Brain Research*, 19(Issue 1), 59–73. [Cited at p. 30]
- Holisky, D. A. (1987). The case of the intransitive subject in Tsova-Tush (batsby). *Linguistic Discovery*, 71, 103–132. [Cited at p. 210]
- Hopf, J.-M., Bayer, J., Bader, M., & Meng, M. (1998). Event-related brain potentials and case information in syntactic ambiguities. *Journal of cognitive neuroscience*, 10(2), 264–280. [Cited at p. 26, 27]
- Hruska, C., & Alter, K. (2004). Prosody in dialogues and single sentences: How prosody can influence speech perception. In A. Steube (Ed.), *Information structure: Theoretical and empirical aspects* (p. 211–226). Berlin: Walter de Gruyter. [Cited at p. 143, 144]
- Jayaseelan, K. (2004). The possessor-experiencer dative in Malayalam. In P. Bhaskararao & K. Subbarao (Eds.), *Non-nominative Subjects*, vol. 1 (p. 227–244). Amsterdam, Philadelphia: John Benjamins. [Cited at p. 74]
- Jespersen, O. (1924). *The Philosophy of Grammar. Here from the University of Chicago Press 1992 reprint*. Chicago: University of Chicago Press. [Cited at p. 13]
- Johnson, D. E. (1977). On Keenan's definition of 'Subject Of'. *Linguistic Inquiry*, 8(4), 673–692. [Cited at p. 72]
- Kaan, E., Harris, A., Gibson, E., & Holcomb, P. (2000). The P600 as an index of syntactic integration difficulty. *Language and Cognitive Processes*, 15(2), 159–201. [Cited at p. 29]
- Kamide, Y., Altmann, G. T., & Haywood, S. L. (2003). The time-course of prediction in incremental sentence processing: Evidence from anticipatory eye movements. *Journal of Memory and Language*, 49(Issue 1), 133–156. [Cited at p. 18]
- Kamide, Y., Scheepers, C., & Altmann, G. T. (2003). Integration of Syntactic and Semantic Information in Predictive Processing: Cross-Linguistic

-
- Evidence from German and English. *Journal of Psycholinguistic Research*, 32(1), 37–55. [Cited at p. 17]
- Katayama, J., & Polich, J. (1998). Stimulus context determines P3a and P3b. *Psychophysiology*, 35, 23–33. [Cited at p. 35, 36, 38, 194, 217]
- Katayama, J., & Polich, J. (1999). Auditory and visual P300 topography from a 3 stimulus paradigm. *Clinical Neurophysiology*, 110, 463–468. [Cited at p. 37, 193]
- Keane, E. (2006). Rhythmic characteristics of colloquial and formal Tamil. *Language and Speech*, 49(3), 299–332. [Cited at p. 226]
- Keenan, E. L. (1976). Towards a Universal Definition of Subject. In C. N. Li (Ed.), *Subject and Topic*. New York: Academic Press. [Cited at p. 7, 71, 72]
- Keppel, G. (1991). *Design and analysis*. Englewood, NJ: Prentice Hall. [Cited at p. 83, 94]
- Kim, A., & Osterhout, L. (2005). The independence of combinatory semantic processing: Evidence from event-related potentials. *Journal of Memory and Language*, 52(Issue 2), 205–225. [Cited at p. 30]
- Kittilä, S., & Malchukov, A. (2009). Varieties of accusative. In A. Malchukov & A. Spencer (Eds.), *The Oxford Handbook of Case* (p. 549–561). Oxford: Oxford University Press. [Cited at p. 15, 18]
- Kluender, R., & Kutas, M. (1993). Bridging the gap: evidence from ERPs on the processing of unbounded dependencies. *Journal of Cognitive Neuroscience*, 5(2), 196–214. [Cited at p. 34]
- Knoeferle, P., Crocker, M. W., Scheepers, C., & Pickering, M. J. (2005). The influence of the immediate visual context on incremental thematic role-assignment: evidence from eye-movements in depicted events. *Cognition*, 95(Issue 1), 95–127. [Cited at p. 17]
- Knoeferle, P., Habets, B., Crocker, M. W., & Münte, T. F. (2008). Visual scenes trigger immediate syntactic reanalysis: evidence from ERPs during spoken comprehension. *Cerebral Cortex*, 18(4), 789–795. [Cited at p. 18, 31]
- Kolk, H. H. J., Chwilla, D. J., van Herten, M., & Oor, P. J. W. (2003). Structure and limited capacity in verbal working memory: A study with event-related potentials. *Brain and Language*, 85(Issue 1), 1–36. [Cited at p. 30]

BIBLIOGRAPHY

- Kretzschmar, F. (2010). *The electrophysiological reality of parafoveal processing: On the validity of language-related erps in natural reading*. Unpublished doctoral dissertation, Philipps University of Marburg, Marburg, Germany. [Cited at p. 18, 35, 37, 38, 144, 189, 193, 195, 200, 216, 222]
- Kretzschmar, F., Bornkessel-Schlesewsky, I., & Schlewsky, M. (2009). Parafoveal versus foveal n400s dissociate spreading activation from contextual fit. *Neuroreport*, 20(18), 1613–1618. [Cited at p. 18]
- Kuperberg, G. R., Sitnikova, T., Caplan, D., & Holcomb, P. J. (2003). Electrophysiological distinctions in processing conceptual relationships within simple sentences. *Cognitive Brain Research*, 17(Issue 1), 117–129. [Cited at p. 30]
- Kutas, M., & Federmeier, K. D. (2000). Electrophysiology reveals semantic memory use in language comprehension. *Trends in Cognitive Sciences*, 4(12), 463–470. [Cited at p. 25]
- Kutas, M., & Hillyard, S. A. (1980). Reading senseless sentences: Brain potentials reflect semantic incongruity. *Science*, 207(4427), 203–205. [Cited at p. 24]
- Kutas, M., & Hillyard, S. A. (1984). Brain potentials during reading reflect word expectancy and semantic association. *Nature*, 307, 161–163. [Cited at p. 25]
- Kutas, M., Van Petten, C., & Besson, M. (1988). Event-related potential asymmetries during the reading of sentences. *Electroencephalography and Clinical Neurophysiology*, 69(3), 218–233. [Cited at p. 211]
- Kutas, M., Van Petten, C. K., & Kluender, R. (2006). Psycholinguistics Electrified II (1994-2005). In M. Gernsbacher & M. Traxler (Eds.), *Handbook of Psycholinguistics*. Amsterdam: Elsevier Press. [Cited at p. 22, 23, 24, 33, 34]
- Lakshmi Bai, B. (2004). Acquisition of dative subject in tamil. In P. Bhaskararao & K. Subbarao (Eds.), *Non-nominative Subjects*, vol. 1 (p. 245–268). Amsterdam, Philadelphia: John Benjamins. [Cited at p. 210]
- Lehmann, T. (1993). *A Grammar of Modern Tamil*. Pondicherry, India: Pondicherry Institute of Linguistics and Culture. [Cited at p. 60, 61, 64, 65, 71, 72]
- Leuckefeld, K. (2004). *The development of argument processing mechanisms in german: An electrophysiological investigation with school-aged children and adults*. Unpublished doctoral dissertation, University of Potsdam, Potsdam, Germany. [Cited at p. 210]

-
- Lotze, N., Tune, S., Schlesewsky, M., & Bornkessel-Schlesewsky, I. (Submitted). Meaningful physical changes mediate lexical-semantic integration: Evidence for the interplay between top-down and bottom-up information sources in N400 responses. [Cited at p. 27, 201]
- Luck, S. J. (2005). *An Introduction to the Event-Related Potential Technique*. Cambridge, MA: MIT Press. [Cited at p. 22, 23, 235]
- MacWhinney, B. (1989). Competition and lexical categorisation. In R. Corrigan, F. Eckman, & M. Noonan (Eds.), *Linguistic categorization* (p. 195–242). New York: Benjamins. [Cited at p. 9]
- MacWhinney, B., & Bates, E. (Eds.). (1989). *The crosslinguistic study of sentence processing*. New York: Cambridge University Press. [Cited at p. 9, 39]
- Malchukov, A., & Spencer, A. (Eds.). (2009). *The Oxford Handbook of Case*. Oxford: Oxford University Press. [Cited at p. 15]
- Marslen-Wilson, W. (1973). Linguistic Structure and Speech Shadowing at Very Short Latencies. *Nature*, 244, 522–523. [Cited at p. 4]
- Masica, C. P. (1976). *Defining a linguistic area: South Asia*. Chicago: University of Chicago Press. [Cited at p. 74]
- Matzke, M., Mai, H., Nager, W., Rüsseler, J., & Münte, T. (2002). The costs of freedom: an ERP study of non-canonical sentences. *Clinical Neurophysiology*, 113(Issue 6), 844–852. [Cited at p. 42]
- Mitchell, D. C. (1994). Sentence Parsing. In M. Gernsbacher (Ed.), *Handbook of Psycholinguistics* (p. 375–409). San Diego: Academic Press. [Cited at p. 4, 8, 47]
- Molinaro, N., & Carreiras, M. (2010). Electrophysiological evidence of interaction between contextual expectation and semantic integration during the processing of collocations. *Biological Psychology*, 86, 176–190. [Cited at p. 27, 38, 200]
- Moore, J., & Perlmutter, D. M. (2000). What does it take to be a dative subject? *Natural Language and Linguistic Theory*, 18, 373–416. [Cited at p. 72]
- Münte, T., Schiltz, K., & Kutas, M. (1998). When temporal terms belie conceptual order. *Nature*, 395(6697), 71–73. [Cited at p. 34]
- Muralikrishnan, R. (2007). *The influence of Word-order and Animacy in processing transitive sentences: Neurophysiological evidence from*

BIBLIOGRAPHY

- Tamil. Unpublished master's thesis, Saarland University, Saarbrücken.
[Cited at p. 45, 77, 78, 79, 104, 107, 211, 224]
- Näätänen, R. (1990). The role of attention in auditory information processing as revealed by event-related potentials and other brain measures of cognitive function. *Behavioral and Brain Sciences*, 13, 201–287.
[Cited at p. 38]
- Näätänen, R. (2001). The perception of speech sounds by the human brain as reflected by the mismatch negativity (MMN) and its magnetic equivalent (MMNm). *Psychophysiology*, 38, 1–21. [Cited at p. 218]
- Näätänen, R., Tervaniemi, M., Sussman, E., Paavilainen, P., & Winkler, I. (2001). 'primitive intelligence' in the auditory cortex. *Trends in Neurosciences*, 24(5), 283–288. [Cited at p. 218]
- Næss, Å. (2009). Varieties of dative. In A. Malchukov & A. Spencer (Eds.), *The Oxford Handbook of Case* (p. 572–580). Oxford: Oxford University Press. [Cited at p. 16]
- Neville, H., Nicol, J. L., Barss, A., Forster, K. I., & Garrett, M. F. (1991). Syntactically Based Sentence Processing Classes: Evidence from Event-Related Brain Potentials. *Journal of Cognitive Neuroscience*, 6, 233–255.
[Cited at p. 33]
- Nevins, A., Dillon, B., Malhotra, S., & Phillips, C. (2007). The role of feature-number and feature-type in processing Hindi verb agreement violations. *Brain Research*, 1164, 81–94. [Cited at p. 214, 224]
- Nigam, A., Hoffman, J., & Simons, R. (1992). N400 to semantically anomalous pictures and words. *Journal of Cognitive Neuroscience*, 4(1), 15–22.
[Cited at p. 25]
- Nizar, M. (2010). *Dative Subject Constructions in South-Dravidian Languages*. Unpublished master's thesis, University of California, Berkeley, Berkeley, CA. [Cited at p. 74]
- 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. [Cited at p. 38]
- Osterhout, L., & Holcomb, P. J. (1992). Event-Related Brain Potentials elicited by Syntactic Anomaly. *Journal of Memory and Language*, 31(6), 785–806. [Cited at p. 28]

-
- Osterhout, L., & Mobley, L. A. (1995). Event-Related Brain Potentials Elicited by Failure to Agree. *Journal of Memory and Language*, 34, 739–773. [Cited at p. 34, 214]
- Otten, L. J., & Rugg, M. D. (2005). Interpreting Event-Related Brain Potentials. In T. C. Handy (Ed.), *Event-Related Brain Potentials: A Methods Handbook*. Cambridge, MA: MIT Press. [Cited at p. 22]
- Paramasivam, K. (1983). *Ikkaalath Thamizh Marabu*. Sivagangai, India: Annam. [Cited at p. 65]
- Philipp, M., Bornkessel-Schlesewsky, I., Bisang, W., & Schlewsky, M. (2008). The role of animacy in the real time comprehension of Mandarin Chinese: Evidence from auditory event-related brain potentials. *Brain and Language*, 105, 112–133. [Cited at p. 44, 45, 142]
- Picton, T. W. (1992). The P300 Wave of the Human Event-Related Potential. *Journal of Clinical Neurophysiology*, 9(4), 456–479. [Cited at p. 34]
- Polich, J. (2007). Updating P300: An integrative theory of P3a and P3b. *Clinical Neurophysiology*, 118, 2128–2148. [Cited at p. 35, 36, 38]
- Polich, J., & Criado, J. (2006). Neuropsychology and neuropharmacology of P3a and P3b. *International Journal of Psychophysiology*, 60, 172–185. [Cited at p. 37, 193]
- Primus, B. (1999). *Case and thematic roles: ergative, accusative and active*. Tübingen: Niemeyer. [Cited at p. 8]
- Pynte, J., Besson, M., Robichon, F.-H., & Poli, J. (1996). The time-course of metaphor comprehension: An event-related potential study. *Brain and Language*, 55, 293–316. [Cited at p. 27]
- Rietveld, A., & Gussenhoven, C. (1985). On the relation between pitch excursion size and prominence. *Journal of Phonetics*, 13, 299–308. [Cited at p. 87, 119]
- Roehm, D., Bornkessel, I., Haider, H., & Schlewsky, M. (2005). When case meets agreement: event-related potential effects for morphology-based conflict resolution in human language comprehension. *Neuroreport*, 16(8), 875–878. [Cited at p. 214]
- Roehm, D., Bornkessel-Schlesewsky, I., Rösler, F., & Schlewsky, 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), 1259–1274. [Cited at p. 35, 37, 189, 193, 195, 200, 216, 222]

BIBLIOGRAPHY

- Roehm, D., Muralikrishnan, R., Philipp, M., & Bornkessel-Schlesewsky, I. (2008). *Comparing erp effects across languages: A frequency-based analysis*. [Cited at p. 45]
- Roehm, D., Schlewsky, M., Bornkessel, I., Frisch, S., & Haider, H. (2004). Fractioning language comprehension via frequency characteristics of the human EEG. *Neuroreport*, 15(3), 409–412. [Cited at p. 44]
- Rösler, F., Pechmann, T., Streb, J., Röder, B., & Hennighausen, E. (1998). 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(Issue 2), 150–176. [Cited at p. 39, 40, 41, 211]
- Ross, J. R. (1967). *Constraints on variables in syntax*. Unpublished doctoral dissertation, MIT. [Cited at p. 40]
- Schiffman, H. F. (1999). *A Reference Grammar of Spoken Tamil*. New York: Cambridge University Press. [Cited at p. 60, 71, 72]
- Schlesewsky, M., Bornkessel, I., & Frisch, S. (2003). The neurophysiological basis of word order variations in german. *Brain and Language*, 86(Issue 1), 116–128. [Cited at p. 40, 41, 211]
- Schumacher, P. B. (2011). The hepatitis called...: Electrophysiological evidence for Enriched Composition. In J. Meibauer & M. Steinbach (Eds.), *Experimental pragmatics / semantics* (p. 199–219). Amsterdam / Philadelphia: John Benjamins. [Cited at p. 32, 199]
- Sereno, S. C., Rayner, K., & Posner, M. I. (1998). Establishing a time-line of word recognition: evidence from eye movements and event-related potentials. *Neuroreport*, 9(10), 2195–2200. [Cited at p. 18]
- Sigurðsson, H. Á. (2002). To be an oblique subject: Russian vs. Icelandic. *Natural Language and Linguistic Theory*, 20, 691–724. [Cited at p. 72]
- Sigurðsson, H. Á. (2004). Icelandic non-nominative subjects. In P. Bhaskararao & K. Subbarao (Eds.), *Non-nominative Subjects*, vol. 2 (p. 137–159). Amsterdam, Philadelphia: John Benjamins. [Cited at p. 72]
- Silverstein, M. (1976). Hierarchy of features and ergativity. In R. M. W. Dixon (Ed.), *Grammatical categories in Australian languages* (p. 112–171). New Jersey, NJ: Humanities Press. [Cited at p. 11, 14]
- Silverstein, M. (1981). Case marking and the nature of language. *Australian Journal of Linguistics*, 1(2), 227–244. [Cited at p. 14, 16]

-
- Silverstein, M. (1993). Of Nominatives and Datives: Universal Grammar from Bottom Up. In R. D. Van Valin Jr. (Ed.), *Advances in role and reference grammar* (p. 465–498). Amsterdam: John Benjamins. [Cited at p. 14]
- Sotillo, M., Carretié, L., Hinojosa, J. A., Tapia, M., Mercado, F., López-Martín, S., et al. (2005). Neural activity with metaphor comprehension: spatial analysis. *Neuroscience Letters*, 373, 5–9. [Cited at p. 27]
- Squires, N., Squires, K. C., & Hillyard, S. A. (1975). Two varieties of long-latency positive waves evoked by unpredictable auditory stimuli in man. *Electroencephalography and Clinical Neurophysiology*, 38, 387–401. [Cited at p. 35]
- Sridhar, S. (1979). Dative subjects and the notion of subject. *Lingua*, 49, 99–125. [Cited at p. 74]
- Steinhauer, K., Alter, K., & Friederici, A. D. (1999). Brain potentials indicate immediate use of prosodic cues in natural speech processing. *Nature Neuroscience*, 2(2), 191–196. [Cited at p. 144]
- Sutton, S., Braren, M., Zubin, J., & John, E. R. (1965). Evoked-Potential Correlates of Stimulus Uncertainty. *Science*, 150, 1187–1188. [Cited at p. 34]
- Tanenhaus, M. K., Spivey-Knowlton, M. J., Eberhard, K. M., & Sedivy, J. C. (1995). Integration of Visual and Linguistic Information in Spoken Language Comprehension. *Science*, 268(5217), 1632–1634. [Cited at p. 17]
- t'Hart, J., Collier, R., & Cohen, A. (1990). *A perceptual study of intonation*. Cambridge: Cambridge University Press. [Cited at p. 87, 119]
- Toepel, U., & Alter, K. (2004). On the independence of information structural processing from prosody. In A. Steube (Ed.), *Information structure: Theoretical and empirical aspects* (p. 227–240). Berlin: Walter de Gruyter. [Cited at p. 144]
- Townsend, D. J., & Bever, T. G. (2001). *Sentence Comprehension: The Integration of Habits and Rules*. Cambridge, MA: MIT Press. [Cited at p. 4]
- Ullman, M. (2001). A neurocognitive perspective on language: The declarative/procedural model. *Nature Reviews Neuroscience*, 2, 717–726. [Cited at p. 50, 221]
- Ullman, M. (2004). Contributions of memory circuits to language: The declarative/procedural model. *Cognition*, 92, 231–270. [Cited at p. 50, 221]

BIBLIOGRAPHY

- van Berkum, J. J., Hagoort, P., & Brown, C. M. (1999). Semantic integration in sentences and discourse: Evidence from the N400. *Journal of Cognitive Neuroscience*, 11(6), 657–671. [Cited at p. 196, 222]
- van Berkum, J. J., Zwitterlood, P., Hagoort, P., & Brown, C. M. (2003). When and how do listeners relate a sentence to the wider discourse? Evidence from the N400 effect. *Cognitive Brain Research*, 17, 701–718. [Cited at p. 196, 222]
- van Herten, M., Kolk, H. H., & Chwilla, D. J. (2005). An ERP study of P600 effects elicited by semantic anomalies. *Cognitive Brain Research*, 22(Issue 2), 241–255. [Cited at p. 30]
- Van Petten, C., & Kutas, M. (1991). Influences of semantic and syntactic context on open- and closed-class words. *Memory and Cognition*, 19(1), 95–112. [Cited at p. 146]
- Van Valin Jr., R. D. (1977). *Aspects of lakhotia syntax*. Unpublished doctoral dissertation, University of California, Berkeley, Berkeley, CA. [Cited at p. 7, 8]
- Van Valin Jr., R. D. (1999). Generalized semantic roles and the syntax-semantics interface. In F. Corblin, C. Dobrovie-Sorin, & J.-M. Marandin (Eds.), *Empirical issues in formal syntax and semantics 2* (p. 373–389). The Hague: Thesus. [Cited at p. 6, 7, 8]
- Van Valin Jr., R. D. (2004a). *An Introduction to Syntax*. Cambridge: Cambridge University Press. [Cited at p. 5]
- Van Valin Jr., R. D. (2004b). Semantic macroroles in role and reference grammar. In R. Kailuweit & M. Hummel (Eds.), *Semantische rollen* (p. 62–82). Tübingen: Narr. [Cited at p. 7, 8]
- Van Valin Jr., R. D. (2005). *Exploring the syntax-semantics interface*. Cambridge: Cambridge University Press. [Cited at p. 7, 8, 15, 16, 55]
- Van Valin Jr., R. D. (2006). Semantic macroroles and language processing. In I. Bornkessel, M. Schlesewsky, B. Comrie, & A. Friederici (Eds.), *Semantic role universals and argument linking: Theoretical, typological and psycholinguistic perspectives* (p. 263–302). Berlin, New York: Mouton de Gruyter. [Cited at p. 8]
- Van Valin Jr., R. D. (2007). The role and reference grammar analysis of three-place predicates. *Contemporary Linguistics*, 63(1), 31–63. [Cited at p. 8]
- Van Valin Jr., R. D., & LaPolla, R. J. (1997). *Syntax: Structure, meaning and function*. Cambridge: Cambridge University Press. [Cited at p. 5, 7]

-
- Verma, M. K., & Mohanan, K. P. (1990). Introduction to the experienter subject construction. In M. K. Verma & K. P. Mohanan (Eds.), *Experienter subjects in South Asian languages* (p. 1–12). Stanford: CSLI Publications. [Cited at p. 19, 74, 241]
- Vespignani, F., Canal, P., Molinaro, N., Fonda, S., & Cacciari, C. (2010). Predictive mechanisms in idiom comprehension. *Journal of Cognitive Neuroscience*, 22(8), 1682–1700. [Cited at p. 38]
- Vosse, T., & Kempen, G. (2000). Syntactic structure assembly in human parsing: a computational model based on competitive inhibition and a lexicalist grammar. *Cognition*, 75(Issue 2), 105–143. [Cited at p. 52]
- Wang, L. (2011). *The influence of animacy and context on word order processing: Neurophysiological evidence from Mandarin Chinese*. Unpublished doctoral dissertation, University of Leipzig, Leipzig, Germany. [Cited at p. 212]
- Weckerly, J., & Kutas, M. (1999). An electrophysiological analysis of animacy effects in the processing of object relative sentences. *Psychophysiology*, 36(5), 559–590. [Cited at p. 42]
- Winkler, I., Kujala, T., Alku, P., & Näätänen, R. (2003). Language context and phonetic change detection. *Cognitive Brain Research*, 17, 833–844. [Cited at p. 36, 217]
- Wolff, S. (2010). *The interplay of free word order and pro-drop in incremental sentence processing: Neurophysiological evidence from Japanese*. Unpublished doctoral dissertation, University of Leipzig, Leipzig, Germany. [Cited at p. 203]
- Wolff, S., Schlesewsky, M., Hirotani, M., & Bornkessel-Schlesewsky, I. (2008). The neural mechanisms of word order processing revisited: Electrophysiological evidence from Japanese. *Brain and Language*, 107(Issue 2), 133–157. [Cited at p. 42, 211]
- Wronka, E., Kaiser, J., & Coenen, A. M. (2008). The auditory P3 from passive and active three-stimulus oddball paradigm. *Acta Neurobiologiae Experimentalis*, 68, 362–372. [Cited at p. 36, 194, 217]

— * —

List of Tables

5.1	Experiment 1: Factors and Levels	79
5.2	Mean Duration	84
5.3	ANOVA: Duration	85
5.4	ANOVA: Intensity	86
5.5	Mean F_0	87
5.6	ANOVA: Timepoint of Maximum and Minimum F_0	88
5.7	Answering Accuracy and Mean Reaction Time	92
5.8	ANOVA: Answering Accuracy	92
5.9	ANOVA: Reaction Time	93
5.10	Lateral Regions of Interest	94
5.11	Midline Regions of Interest	94
5.12	ANOVA: ERPs at NP1 : 350–550 ms	98
5.13	ANOVA: ERPs at NP1 : 600–900 ms	100
5.14	ANOVA: ERPs at NP2 : 350–550 ms	104
5.15	ANOVA: ERPs at NP2 : 600–900 ms	106
6.1	Experiment 2: Factors and Levels	113
6.2	Mean Duration	118
6.3	ANOVA: Duration	118
6.4	Mean F_0	119
6.5	ANOVA: Timepoint of Maximum and Minimum F_0	119

List of Tables

6.6	Accuracy (AC) and Mean Reaction Time (RT)	122
6.7	ANOVA: Answering Accuracy	123
6.8	ANOVA: Reaction Time	124
6.9	ANOVA: ERPs at NP1 in DA conditions : 170–270 ms	125
6.10	ANOVA: ERPs at NP1 in DA conditions : 450–600 ms	128
6.11	ANOVA: ERPs at NP1 in DA conditions : 650–950 ms	129
6.12	ANOVA: ERPs at NP2 in AD conditions : 200–300 ms	132
6.13	ANOVA: ERPs at NP2 in AD conditions : 450–550 ms	133
6.14	ANOVA: ERPs at NP2 in AD conditions : 650–950 ms	133
6.15	ANOVA: ERPs at the Verb : 250–450 ms	137
6.16	ANOVA: ERPs at the Verb : 450–550 ms	139
6.17	ANOVA: ERPs at the Verb : 500–700 ms	140
7.1	Experiment 3: Factors and Levels	153
7.2	Acceptability (JUDG), Accuracy (AC) & Mean Reaction Time (RT)	159
7.3	ANOVA: Acceptability of Context+Stimulus Combination	160
7.4	Repeated Measures ANOVA: Answering Accuracy	161
7.5	Repeated Measures ANOVA: Reaction Time	162
7.6	ANOVA: ERPs at the Verb : 250–350 ms	167
7.7	ANOVA: ERPs at the Verb : 350–450 ms	172
7.8	ANOVA: ERPs at the Verb : 450–550 ms	178
7.9	ANOVA: ERPs at the Verb : 500–700 ms	183
B.1	Conventions used for phonetic glossing	238
B.2	Conventions used for morphological glossing	239
D.1	Conventions used in the statistical tables in this thesis	245
E.1	Explanation of Condition Codes	247
E.2	Experiment 1: Distribution scheme for critical items	248
E.3	Mean Duration of Bare NPs	258

List of Tables

E.4	Mean Duration of the intervening pauses	259
E.5	Effects on the Duration of the intervening pauses	259
F.1	Explanation of Condition Codes	261
F.2	Experiment 1: Distribution scheme for critical items and Fillers	262
F.3	Mean Duration of Bare NPs	270
F.4	Mean Duration of the intervening pauses	270
F.5	Effects on the Duration of the intervening pauses	270

List of Figures

5.1	Experiment 1: Pitch Contour Plot.	88
5.2	Experiment 1: Schematic experimental trial.	89
5.3	ERPs at NP1: Conditions in SO word-order.	96
5.4	ERPs at NP1: Conditions in OS word-order.	97
5.5	ERPs at NP2: Conditions in SO word-order.	102
5.6	ERPs at NP2: Conditions in OS word-order.	103
5.7	ERPs at NP2 collapsed over ST: All Conditions.	105
6.1	Experiment 2: Pitch Contour Plot.	120
6.2	Experiment 2: Schematic experimental trial.	121
6.3	ERPs at NP1: DAS Conditions.	126
6.4	ERPs at NP1: DAI Conditions.	127
6.5	ERPs at NP1 - Collapsed over CT: DA Conditions.	128
6.6	ERPs at NP2: ADS Conditions.	130
6.7	ERPs at NP2: ADI Conditions.	131
6.8	ERPs at NP2 - Collapsed over CT: AD Conditions.	132
6.9	ERPs at the Verb: DS Conditions.	134
6.10	ERPs at the Verb: DI Conditions.	135
7.1	Experiment 3: Schematic experimental trial.	157
7.2	ERPs at Sentence Onset for all WO and ST: All Conditions.	163
7.3	Baseline Corrected ERPs at the Verb: DS Conditions.	164

List of Figures

7.4	Baseline Corrected ERPs at the Verb: DI Conditions.	165
7.5	Baseline Corrected ERPs Collapsed over ST: DA word-order.	171
7.6	Baseline Corrected ERPs Collapsed over ST: AD word-order.	171
7.7	Topographic Map for the ERPs at the Verb: 500–700 ms.	197
F.1	ERPs at NP1: DA Conditions.	271
F.2	ERPs at NP1: AD Conditions.	272
F.3	ERPs at NP1 - Collapsed over CT: AD Conditions.	273
F.4	ERPs at NP1 - Onset of the case-marker: DAS Conditions.	273
F.5	ERPs at NP1 - Onset of the case-marker: DAI Conditions.	273
F.6	ERPs at NP2: AD Conditions.	274
F.7	ERPs at NP2: DA Conditions.	275
F.8	ERPs at NP2 - Collapsed over CT: DA Conditions.	276
F.9	ERPs at NP2 - Onset of the case-marker: ADS Conditions.	276
F.10	ERPs at NP2 - Onset of the case-marker: ADI Conditions.	276
F.11	ERPs at the Verb - Collapsed over WO: All Conditions.	277
F.12	ERPs at the Verb - Not Collapsed over WO: DS Conditions.	278
F.13	ERPs at the Verb - Not Collapsed over WO: DI Conditions.	278
G.1	Items Distribution Scheme	280
G.2	ERPs at NP1: DAS Conditions.	281
G.3	ERPs at NP1: DAI Conditions.	281
G.4	ERPs at NP1: ADS Conditions.	281
G.5	ERPs at NP1: ADI Conditions.	282
G.6	ERPs at NP2: ADS Conditions.	282
G.7	ERPs at NP2: ADI Conditions.	282
G.8	ERPs at NP2: DAS Conditions.	283
G.9	ERPs at NP2: DAI Conditions.	283
G.10	ERPs at the Verb without Baseline Correction: DS Conditions.	284
G.11	ERPs at the Verb without Baseline Correction: DI Conditions.	285

List of Figures

G.12 Baseline Corrected ERPs at the Verb: DAS Conditions. 286
G.13 Baseline Corrected ERPs at the Verb: DAI Conditions. 286
G.14 Baseline Corrected ERPs at the Verb: ADS Conditions. 286
G.15 Baseline Corrected ERPs at the Verb: ADI Conditions. 287
G.16 Topographic Map for the ERPs at the Verb: CQ-NQ 287
G.17 Topographic Map for the ERPs at the Verb: VQ-NQ 288
G.18 Topographic Map for the ERPs at the Verb: WQ-NQ 288

Zusammenfassung

Die vorliegende Dissertation beschäftigt sich mit der Echtzeitverarbeitung der Dativsubjekt Konstruktionen im Tamil, einer der 23 offiziellen Sprachen Indiens. Die Fragestellung war wie folgt: ob und wie die Verarbeitungsmuster der Dativ-Nominalphrasen (Dativ-NPs), die als Subjekt gebraucht werden, sich unterscheiden von anderen Subjekt-NPs. Weiterhin stellt sich die Frage, ob die Verben, die eine Dativ-NP als Subjekt erfordern, unterschiedlich zu den anderen Verben verarbeitet werden.

Tamil ist eine agglutinierende verbfinale Sprache, die mehrheitlich im südindischen Staat Tamil Nadu gesprochen wird. Anders als Handlungsverben (wie z.B. 'machen') berichten die sogenannte stativen Verben in Tamil eher über den Stand der Dinge (z.B. 'mögen') als etwa eine Aktivität. Ferner kongruieren diese stativen Verben nicht mit dem Subjekt des Satzes, wenn dieses im Dativ kodiert ist (sogenanntes Default-Agreement).

Im Rahmen dieser Dissertation wurden drei Experimente durchgeführt. In diesen Experimenten hörten die Probanden einfache transitive Sätze in Tamil, während ihr Elektroenzephalogramm (EEG) gemessen wurde. Aus dem EEG wurden dann die Ereignis-korrelierten Potentiale (EKPs) gemittelt, um die Sprachverarbeitungsprozesse im Gehirn genauer untersuchen zu können. Nach jedem Stimulussatz antworteten die Probanden mit einer Ja-Nein Verständnisfrage.

In Experiment 1 wurde untersucht, wie sich belebte Dativsubjekte von belebten bzw. unbelebten im Nominativ markierten Subjekten unterscheiden. Die Ergebnisse waren wie folgt: wenn die Kasusmarkierung nicht verfügbar ist, ähneln sich die Verarbeitungsmuster der Dativsubjekte und der belebten nominativen Subjekte. In den späteren Verarbeitungsphasen, sobald der Kasus

eindeutig erkennbar geworden ist, ähneln sich die Verarbeitungsmuster der Dativsubjekte und der unbelebten Nominativsubjekte, indem sie im Vergleich zu belebten Nominativsubjekten eine Negativierung erzeugen.

Es stellt sich weiterhin die Frage, inwieweit (oder ob überhaupt) sich NPs im Dativ hinsichtlich ihrer Verarbeitungsmerkmale ähnlich oder unterschiedlich verhalten im Abhängigkeit davon, ob sie als Subjekt oder Objekt gebraucht werden.

Um diese Frage beantworten zu können, wurden in Experiment 2 zusätzlich zu den Dativsubjekt-Sätzen auch ditransitive Sätze verwendet, in denen die Dativ-NP als indirektes Objekt fungierte. Da Tamil erlaubt, Subjekte wegzulassen, ähneln sich die Stimulusätze bis zum Verb. Um die Rolle der Dativ-NP von vornherein zu verdeutlichen, wurden Kontextfragen benutzt. Die Stimuli wurden in zwei möglichen Kontexten präsentiert: entweder stimmte das Verb in der Kontextfrage mit dem Verb im Stimulus (CQ) überein, oder die Kontextfrage war neutral und gab kein Indiz über das Verb im Stimulussatz (NQ). Die Ergebnisse deuteten an, dass die Verarbeitung der Dativsubjekten tatsächlich anders erfolgte als die der indirekten Dativobjekten, indem die Dativsubjekte eine Negativierung an der Position der satz-initialen NP1 auslösten. Dank des Kontext-Designs konnte die Verarbeitung auch am Verb beobachtet werden. Im Vergleich zu den ditransitiven Verben erzeugten die Verben mit einem Dativsubjekt zwar eine späte Positivierung, aber da die zwei Verbtypen sehr unterschiedlichen Wortlänge aufwiesen, wurde ein erweitertes Kontext-Design nötig, um genauere Aussagen machen zu können.

Deswegen kamen in Experiment 3 vier statt nur zwei Kontexte zum Einsatz. Zusätzlich zum CQ- und NQ-Kontext wurden die Stimulusätze aus Experiment 2 auch in zwei weiteren sogenannten Mismatch-Kontexten präsentiert. So stimmte entweder nur der Verbtyp in der Kontextfrage—und nicht das Verblexem selbst—mit dem im Stimulus vorkommenden Verb (VQ) überein, oder aber das Verb in der Kontextfrage war ein statives Verb, wenn das Verb im Stimulus ein ditransitives Verb war (WQ) und vice versa. Probanden mussten die Kontext+Stimulus-Kombination hinsichtlich ihrer Akzeptabilität beurteilen, bevor sie die Verständnisfrage beantworteten.

In Experiment 3 wurden mehrere aufgabenbedingte EKP-Effekte gefunden. Beide Verbtypen erzeugten eine posteriore frühe Positivierung im Kontexttyp CQ, während die Mismatch-Kontexte VQ und WQ anteriore frühe Positivierungen auslösten. Die weiteren Effekte

sind sehr wahrscheinlich Verbtyp bedingt. Eine Negativierung und eine späte Positivierung sind beispielsweise bei den stativen Verben sehr deutlich zu sehen. Da diese Verben mit erforderlichem Dativsubjekten auch in den Mismatch-Kontexten eine abgestufte Negativierung und eine Positivierung erzeugen, sind diese Effekte vermutlich Verbtyp bedingt. Das könnte bedeuten, dass die stativen Verben anders verarbeitet werden, möglicherweise u.a. wegen des Default-Agreement.

Die drei im Rahmen dieser Dissertation vorgestellten Experimente haben einen ersten Eindruck über die Verarbeitungsmerkmale der Dativsubjekt-Konstruktionen im Tamil ermöglicht. Die Ergebnisse in Experiment 1 and Experiment 2 deuten darauf hin, dass Dativsubjekte anders verarbeitet werden als Nominativsubjekte bzw. als indirekte Dativobjekte in der satz-initialen Position. Die Ergebnisse am Verb in Experiment 2 und Experiment 3 deuten an, dass stativ Verben mit erforderlichem Dativsubjekt andere Verarbeitungsmerkmale als Handlungsverben, die ein Nominativsubjekt erfordern, zeigen. Im Vergleich zu Experiment 2 deuten die unterschiedlichen EKP-Effekte am Verb in Experiment 3 deuten außerdem darauf hin, dass die experimentelle Aufgabe eine sehr wichtige Rolle bei der Satzverarbeitung bzw. bei der Verarbeitung dieser Verben spielt. Gleichwohl bleiben viele Fragen offen, die in weiteren Studien zu beantworten sind. Es ist zum Beispiel nicht klar, warum die unterschiedlichen Verarbeitungsmerkmalen zwischen Dativsubjekten und andere NPs nur in der satz-initialen Position aufweisen.

— * —

Summary

The present dissertation concerns the online processing of transitive constructions involving dative nominals in Tamil. One of the 23 official languages of India, Tamil is a verb-final language spoken mainly in the state of Tamil Nadu in southern India. One of the ways in which to study the mechanisms in the brain that enable online language processing is to observe the ongoing electrical activity of the brain that is recordable on the scalp, so as to later deduce interpretations from the thus resulting Event-Related Brain Potentials, or ERPs in short. A non-invasive technique, this allows for a temporal resolution in the range of a millisecond, typically suitable for studying language comprehension as it happens in real time (see [Chapter 2](#)).

Specifically, we exploited the ERP technique in order to study the processing of Tamil dative nouns in constructions involving a class of verbs that serve to express states of affairs rather than active events, which are variously called experiencer-subject or dative-subject constructions. These so-called stative verbs require their subject-like argument to be in the dative case. Unlike active verbs that agree with their nominative subjects for their person, number and gender features, the dative-stative verbs show a third-person, singular, neuter agreement, henceforth called default-agreement, regardless of the person, number and gender features of their dative-subjects. This dissertation thus attempts to investigate the question of whether and in what manner dative nominals that are subjects are processed differently from other dative nominals. It further strives to examine whether verbs that require a dative nominal as their subject are processed differently compared to verbs that require a nominative subject.

We report here, three auditory ERP experiments conducted in this regard. In [Experiment 1](#), we studied the processing of dative-subjects as compared to animate and inanimate nominative subjects. Such a design en-

SUMMARY

abled gaining a first insight into the processing of Tamil dative-subjects, paving the way for further studies. The results of [Experiment 1](#) showed that, prior to the availability of the dative case-marker, the animate dative-subjects and nominative subjects are processed similarly in the sentence-initial position. When the dative case-marker is encountered, this signifies that the noun is not anymore an ideal Actor argument, because its ideal Actorhood property of being maximally agentive is compromised by virtue of its being marked dative. Thus, at this later stage of processing, an animate dative noun is processed in a similar way to another type of non-prototypical Actor argument, namely inanimate nominative nouns.

We augmented the design in [Experiment 2](#) by introducing ditransitive sentence conditions with a dropped subject, such that they resembled the dative-subject sentences prior to the verb, thereby rendering the nouns much more comparable. Additionally, we introduced context questions that preceded each stimulus sentence, such that they either indicated the exact structure and the verb of the forthcoming stimulus, thereby correctly signalling the type of the sentence, namely dative-stative or ditransitive, or remained neutral. Such a context manipulation was necessary so as to observe the effects at the argument positions, for one wouldn't know otherwise whether the sentence being played is a dative-subject sentence or a ditransitive sentence prior to the verb. The correct context question thus disambiguated the two structures prior to the stimulus onset, such that the participant clearly expected one or the other structure. This design also enabled for the first time in our experiments to observe the effects at the position of the verb. Results at the position of the arguments in [Experiment 2](#) further shed light on the previous result, showing that dative-subjects in the sentence-initial position are processed differently from dative nominals that are not subjects. At the position of the verb, a general difference between the stative and ditransitive verbs is apparent, whereby the stative verbs elicit an anterior negativity followed by a late positivity. However, given the differences in the durations of the verbs in the two verb-types amongst other differences between them, a design in which the verb-types are more comparable became necessary.

Thus we extended the context design further in [Experiment 3](#), such that stimuli were presented in one of four possible contexts. These included the correct and neutral context questions mentioned above, with the other two context questions being modelled on the correct context, but with the difference that the verb in these did not match that of the stimulus in qualitatively two different ways. Such an extensive design

enabled observing the effects at the verb in a much more straightforward and elegant manner, thus revealing a better picture of the processing of dative-stative verbs. The results from [Experiment 3](#) at the position of the verb corroborated the processing differences observed in [Experiment 2](#) between the two verb-types. That is, graded negativities and almost identical late positivities ensued for the dative-stative verbs in the non-neutral contexts, whereas for the ditransitive verbs, the late positivities were graded, such that a three-way difference $WQ > VQ > CQ$ obtained. In addition, several (judgement) task-related early positivities ensued, which showed that the experimental task has a strong influence on the final outcome of results.

Whilst these results have provided a first indication on the processing of Tamil dative-subject constructions, they have also raised many questions that need further investigation in future. For instance, it is not clear why the differences between the dative-subjects and other nominals were observed in the sentence-initial position alone. Possible designs that could address such questions are discussed in [Chapter 9](#).

The results of the three auditory ERP Experiments reported here suggest processing differences at the sentence-initial position between dative-subjects and nominative subjects as well as dative indirect objects. They further suggest that dative-stative verbs are processed differently from non-stative verbs, possibly due to default-agreement. In addition, the context in which a stimulus sentence occurs, as well as the experimental task requirements appear to have a significant impact on the ERP effects obtained. In sum, these results appear to suggest that neurocognitive models of language comprehension need to take both linguistic and extra-linguistic factors into account in order for their predictions to have a broad scope.

— * —

Eidesstattliche Erklärung

Hiermit versichere ich, dass ich die vorliegende Dissertation selbst und ohne fremde Hilfe verfasst, nicht andere als die in ihr angegebenen Quellen oder Hilfsmittel benutzt, alle vollständig oder sinngemäß übernommenen Zitate als solche gekennzeichnet sowie die Dissertation in der vorliegenden oder einer ähnlichen Form noch keiner anderen in- oder ausländischen Hochschule anlässlich eines Promotionsgesuches oder zu anderen Prüfungszwecken eingereicht habe.

Marburg

R. Muralikrishnan

Curriculum Vitae

Name	R.Muralikrishnan
Date of Birth	17.04.1979
Place of Birth	Madras, India

Education and Career

04.2010–04.2011	Doctoral Student; Scientific co-worker at Philipps-Universität Marburg, Germany.
01.2008–03.2010	Doctoral Student; Stipend from the Max-Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany.
10.2005–12.2007	Master of Science, Computational Psycholinguistics, Universität des Saarlandes, Germany.
07.2000–09.2005	Senior Software Engineer (Telecom), Alcatel India.
11.1996–05.2000	Bachelor of Engineering, Electrical & Electronics, University of Madras, India.
04.1996	Higher-Secondary School Leaving Certificate, Madras, India

Muralikrishnan, R. (2007). *The influence of Word-order and Animacy in processing transitive sentences: Neurophysiological evidence from Tamil*. Unpublished master's thesis, Saarland University, Saarbrücken.

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 elektro-physiologischer 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 Objektpräsentation: 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 Aufgabenwechselfparadigma 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 get 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 Hirmpotentialen
- 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
Aufgabeneinhibition 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 sensorimotorische Verknüpfungen im lateralen prämotorischen Kortex des Menschen
- 79 Päivi Sivonen
Event-related brain activation in speech perception: From sensory to cognitive processes
- 80 Yun Nan
Music phrase structure perception: the neural basis, the effects of acculturation and musical training
- 81 Katrin Schulze
Neural Correlates of Working Memory for Verbal and Tonal Stimuli in Nonmusicians and Musicians With and Without Absolute Pitch
- 82 Korinna Eckstein
Interaktion von Syntax und Prosodie beim Sprachverstehen: Untersuchungen anhand ereigniskorrelierter Hirnpotentiale
- 83 Florian Th. Siebörger
Funktionelle Neuroanatomie des Textverstehens: Kohärenzbildung bei Witzen und anderen ungewöhnlichen Texten

- 84 Diana Böttger
Aktivität im Gamma-Frequenzbereich des EEG: Einfluss demographischer Faktoren und kognitiver Korrelate
- 85 Jörg Bahlmann
Neural correlates of the processing of linear and hierarchical artificial grammar rules: Electrophysiological and neuroimaging studies
- 86 Jan Zwickel
Specific Interference Effects Between Temporally Overlapping Action and Perception
- 87 Markus Ullsperger
Functional Neuroanatomy of Performance Monitoring: fMRI, ERP, and Patient Studies
- 88 Susanne Dietrich
Vom Brüllen zum Wort – MRT-Studien zur kognitiven Verarbeitung emotionaler Vokalisationen
- 89 Maren Schmidt-Kassow
What's Beat got to do with ist? The Influence of Meter on Syntactic Processing: ERP Evidence from Healthy and Patient populations
- 90 Monika Lück
Die Verarbeitung morphologisch komplexer Wörter bei Kindern im Schulalter: Neurophysiologische Korrelate der Entwicklung
- 91 Diana P. Szameitat
Perzeption und akustische Eigenschaften von Emotionen in menschlichem Lachen
- 92 Beate Sabisch
Mechanisms of auditory sentence comprehension in children with specific language impairment and children with developmental dyslexia: A neurophysiological investigation
- 93 Regine Oberecker
Grammatikverarbeitung im Kindesalter: EKP-Studien zum auditorischen Satzverstehen
- 94 Şükrü Barış Demiral
Incremental Argument Interpretation in Turkish Sentence Comprehension
- 95 Henning Holle
The Comprehension of Co-Speech Iconic Gestures: Behavioral, Electrophysiological and Neuroimaging Studies
- 96 Marcel Braß
Das inferior frontale Kreuzungsareal und seine Rolle bei der kognitiven Kontrolle unseres Verhaltens
- 97 Anna S. Hasting
Syntax in a blink: Early and automatic processing of syntactic rules as revealed by event-related brain potentials
- 98 Sebastian Jentschke
Neural Correlates of Processing Syntax in Music and Language – Influences of Development, Musical Training and Language Impairment
- 99 Amelie Mahlstedt
The Acquisition of Case marking Information as a Cue to Argument Interpretation in German An Electrophysiological Investigation with Pre-school Children
- 100 Nikolaus Steinbeis
Investigating the meaning of music using EEG and fMRI
- 101 Tilmann A. Klein
Learning from errors: Genetic evidence for a central role of dopamine in human performance monitoring
- 102 Franziska Maria Korb
Die funktionelle Spezialisierung des lateralen präfrontalen Cortex: Untersuchungen mittels funktioneller Magnetresonanztomographie
- 103 Sonja Fleischhauer
Neuronale Verarbeitung emotionaler Prosodie und Syntax: die Rolle des verbalen Arbeitsgedächtnisses
- 104 Friederike Sophie Haupt
The component mapping problem: An investigation of grammatical function reanalysis in differing experimental contexts using event-related brain potentials
- 105 Jens Brauer
Functional development and structural maturation in the brain's neural network underlying language comprehension
- 106 Philipp Kanske
Exploring executive attention in emotion: ERP and fMRI evidence
- 107 Julia Grieser Painter
Music, meaning, and a semantic space for musical sounds
- 108 Daniela Sammler
The Neuroanatomical Overlap of Syntax Processing in Music and Language - Evidence from Lesion and Intracranial ERP Studies
- 109 Norbert Zmyj
Selective Imitation in One-Year-Olds: How a Model's Characteristics Influence Imitation
- 110 Thomas Fritz
Emotion investigated with music of variable valence – neurophysiology and cultural influence
- 111 Stefanie Regel
The comprehension of figurative language: Electrophysiological evidence on the processing of irony

- 112 Miriam Beisert
Transformation Rules in Tool Use
- 113 Veronika Krieghoff
Neural correlates of Intentional Actions
- 114 Andreja Bubić
Violation of expectations in sequence processing
- 115 Claudia Männel
Prosodic processing during language acquisition: Electrophysiological studies on intonational phrase processing
- 116 Konstanze Albrecht
Brain correlates of cognitive processes underlying intertemporal choice for self and other
- 117 Katrin Sakreida
Nicht-motorische Funktionen des prämotorischen Kortex: Patientenstudien und funktionelle Bildgebung
- 118 Susann Wolff
The interplay of free word order and pro-drop in incremental sentence processing: Neurophysiological evidence from Japanese
- 119 Tim Raettig
The Cortical Infrastructure of Language Processing: Evidence from Functional and Anatomical Neuroimaging
- 120 Maria Golde
Premotor cortex contributions to abstract and action-related relational processing
- 121 Daniel S. Margulies
Resting-State Functional Connectivity fMRI: A new approach for assessing functional neuroanatomy in humans with applications to neuroanatomical, developmental and clinical questions
- 122 Franziska Süß
The interplay between attention and syntactic processes in the adult and developing brain: ERP evidences
- 123 Stefan Bode
From stimuli to motor responses: Decoding rules and decision mechanisms in the human brain
- 124 Christiane Diefenbach
Interactions between sentence comprehension and concurrent action: The role of movement effects and timing
- 125 Moritz M. Daum
Mechanismen der frühkindlichen Entwicklung des Handlungsverständnisses
- 126 Jürgen Dukart
Contribution of FDG-PET and MRI to improve Understanding, Detection and Differentiation of Dementia
- 127 Kamal Kumar Choudhary
Incremental Argument Interpretation in a Split Ergative Language: Neurophysiological Evidence from Hindi
- 128 Peggy Sparenberg
Filling the Gap: Temporal and Motor Aspects of the Mental Simulation of Occluded Actions
- 129 Luming Wang
The Influence of Animacy and Context on Word Order Processing: Neurophysiological Evidence from Mandarin Chinese
- 130 Barbara Ettrich
Beeinträchtigung frontomedianer Funktionen bei Schädel-Hirn-Trauma
- 131 Sandra Dietrich
Coordination of Unimanual Continuous Movements with External Events