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

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R. Muralikrishnan aus Madras, Indien

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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 dativesubjects 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.

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— * —

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

- Swami Vivekananda

To my Parents.

ഉ

ഭഗവതി സഹായം 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 ஊரர்தம் 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!

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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.

 \clubsuit 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.

 \clubsuit 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.

- * -

— **1** —

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

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 Undergoerlike 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 wordorder 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, wordorder 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 inturn 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 casemarking 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-lingusitic 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 Agentlike 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'.
- öküzü aldı. (1.4) Hasan [Hasan]_{NOM} [ox]_{ACC} bought. 'Hasan bought the ox'.

'Kumar has eaten a mango'.

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 casealignment 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	1 ई
Kuma:r	a:m	kha:-th-a:	hai
[Kumar] _{NOM}	[Mango] _{NOM}	[eat] _{Imperfective}	[exist] _{Auxiliary}
'Kumar eats a mango'.			
कुमार ने	आम	खाया	। र्त
Kuma:r ne:	a:m	kha:-y-a:	hai
[Kumar] _{ERG}	[Mango] _{NOM}	[eat] _{Perfective}	[exist] _{Auxiliary}

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 socalled 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 argument (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, malefactives, 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 caseambiguous (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 eyemovements and the electrical activity recorded at the scalp (Sereno, Rayner, & Posner, 1998; Knoeferle, Habets, Crocker, & Münte, 2008; Kretzschmar, Bornkessel-Schlesewsky, & Schlesewsky, 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 casemarking, 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 & Schlesewsky (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 & Schlesewsky, 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.

— **2** —

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 μ V at the scalp as opposed to the spontaneous (background) electrical activity of the brain (EEG), which is upwards of 10 μ V and up to 100 μ 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 unidimensional 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 reponses 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 & Schlesewsky, 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.

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 pines 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 tulips 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 linedrawings (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 casemarking 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 phrasestructure 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 Detektivhatte die Kommissaringesehen und...[The detective]_{ACC}had[the policewoman]_{AMB}sawand...'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 gardenpath 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 notwith-standing, 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 expectency 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

Lalleu llas

'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 phrasestructure 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 workingmemory 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 domaingeneral components that are engendered by rare, improbable, taskrelevant or informative stimuli (Picton, 1992; Bornkessel-Schlesewsky & Schlesewsky, 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...' sentencets.

'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, & Schlesewsky, 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 *nontarget* 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 pseudoword (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 positivies have been reported for expected completions of collocations 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 temporalparietal 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 & Schlesewsky (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 wordorder phenomena to accomplish the form-to-meaning mapping. A small sample of studies that exploited morphological richness, flexible wordorder 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 utterred 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, Schlesewsky, & Friederici, 2002; Schlesewsky, 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 distintions' 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 replicited 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 negativites 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 noncanonical structures. However, this is not without exceptions. For instance, Wolff, Schlesewsky, Hirotani, & 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 mainclause 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 relativeclause, 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 constructionspecific 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.

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- 3 -

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 parallely 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 morphophonolgical 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 rootnode, 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 & Schlesewsky, 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 (LS^{24}) 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 lexicalsemantic 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 timecourse 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 undegoer 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 function 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, availablity 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.

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- 4 -

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 pronounciation. 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 delimitaion '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	
Kamala:	Kuma:r-ai~th	
[Kamala] ^S _{NOM-An.F}	[Kumar] ⁰ _{ACC-An.M}	
'Kamala made Kumar a leader'.		

தலைவன் thalaiv-an [Leader]^{OC}_{NOM-An.M} **ஆக்கினாள்**. a:kk-in-a:l. [make]_{Past-3singular.Feminine}

குமார்	பால்
Kuma:r	pa:l
[Kumar] ^S _{NOM-An.M}	[Milk] ⁰ _{NOM-In}
'Kumar drank milk	,

குடித்தான். kudi-thth-a:n [drink]_{Past-3singular.Masculine}

^{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 morphologic-ally 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

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.
 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.

interpreted as indefinite or unspecific in the absence of accusative casemarking. 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] ⁰ _{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] ⁰ _{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	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] ⁰ _{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] ⁰ _{ACC-An.M}	[see] _{Past-3singular.Masculine}
'Kumar saw a/the	e 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-inlaw'/'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}	$[drink]_{\tt Past-3singular.Masculine}$

*'Ravi drank milk'. (Intended meaning)

பாலை	ரவி	குடித்தான்.	
Pa:l-ai	Ravi	kudi-thth-a:n	
[Milk]0 _{ACC-In}	[Ravi] ^S _{NOM-An.M}	[drink] _{Past-3singular.Masculine}	
'Ravi drank the milk'.			

(4.7) Intransitive and pro-dropped transitive sentences

பால்கொதித்தது.Pa:lkodhi-thth-adhu'[Milk]SNOM-In[boil]Past-3singular.Neuter'(The) Milk boiled'.

ווויס) פאָרָאָכָראָסי Pa:l kudi-thth-e:n [Milk]⁰_{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 purposes: 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.

1	(<u>1</u> 2)	Datino	Indiroct	Ohiocte	Inanimate	direct	objects
	(4.0)	Dullve	maneci	Objects.	manimale	ullect	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] ⁰ _{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] ⁰ _{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

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

கமலாகுமாருக்குமாலாவைக்காட்டினாள்.Kamala:Kuma:r~u'-kku'Ma:la:~v-ai~kka:tt-in-a:l.[Kamala]^SNOM-An.F</sup>[Kumar]^{IO}DAT-An.M[Mala]^OACC-An.F</sub>[show]Past-3singular.Feminine'Kamala showed Wala 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] ⁰ _{ACC-An.F}	[I] ^S _{NOM-An}	[introduce] _{Past-1singular}
'I introduced Mala	to Kumar'.		0
குமாருக்கு	மாலாவை	ஞாபகட்	படுத்தினேன்.
குமாருக்கு Kuma:r~u'-kku'	மாலாவை Ma:la:~v-ai	<u> </u>	படுத்தினேன். uppaduthth-in-e:n
0 0 0		nya:baga	• / /

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 stativeverbs 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'), posession ('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 குளிர்கிறது. 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 headac	che'.

(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] ⁰ _{ACC-An.F}	[know] _{Future-3singular.Neuter}
'Kumar knows M	Iala'.	Ŭ
காவேரிக்கு	குமாரைப்	பிடிக்கும்.
Ka:ve:ri-kku'	Kuma:r-ai~p	pidi-kk-um
[Kaveri] ^S _{DAT-An.F}	[Kumar] ⁰ _{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 posession 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 o	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)'.		5

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 dativestative 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 subject-hood. 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 nonnominative case for a subject-like nominal in the languages mentioned above is mostly lexical, thus 'quirky' in nature, whereas the Tamil dativestative 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 dativesubjects, 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 following 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 dativestative 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.

– 5 –

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-protypical 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.

Factor	Level	Conditions
WO : Word-Order	S0 : Subject initial OS : Object initial	DAS, NIA, NAA ADS, SAI, SAA
ST : Subject-Type	DS : Dative Animate NI : Nominative Inanimate NA : Nominative Animate	DAS, ADS NIA, SAI NAA, SAA

Table 5.1: Experiment 1: Factors and Levels

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 seventytwo 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: Criticial Conditions

DAS	ஷங்கருக்கு	குருவைத்	தெரியும்.
	Shankar~u'-kku'	Guru~v-ai~th	theri~y-um
	[Shankar] _{DAT-An.M} 'Shankar knows Gu	[Guru] _{ACC-An.M} ru'.	[know] _{Future-3singular.Neuter}

ADS குருவை ஷங்கருக்குத் தெரியும். Guru~v-ai Shankar~u'-kku'~th theri~y-um [Guru]_{ACC-An.M} [Shankar]_{DAT-An.M} [know]_{Future-3singular.Neuter} 'Shankar knows Guru'.

- NIAவெளிச்சம்கருவைஎழுப்பியது.Vel.ichchamGuru~v-aiezhupp-i~y-adhu'[Brightness]_{NOM-In}[Guru]_{ACC-An.M}[wake-up]_{Past-3singular.Neuter}'Brightness woke Guru up'.
- NAAഎங்கர்குருவைவணங்கினான்.ShankarGuru~v-aivan.ang-in-a:n[Shankar]_{NOM-An.M}[Guru]_{ACC-An.M}[greet]_{Past-3singular.Masculine}'Shankar greeted Guru'.

SAI குருவை வெளிச்சம் எ Guru~v-ai vel.ichcham எ [Guru]_{ACC-An.M} [Brightness]_{NOM-In} 'Brightness woke Guru up'.

எழுப்பியது. ezhupp-i~y-adhu' [wake-up]_{Past-3singular.Neuter}

SAA	குருவை	ஷங்கர்	வணங்கினான்.
	Guru~v-ai	Shankar	van.ang-in-a:n
	[Guru] _{ACC-An.M}	[Shankar] _{NOM-An.M}	[greet] _{Past-3singular.Masculine}
	'Shankar greeted Gu	Ū.	

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 preceeded. 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 (F₀) 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.

NP1 ms	SD	NP2 ms	SD	Verb ms	SD
954.70	97.31	733.89	80.74	739.15	92.47
779.36	79.22	857.69	102.93	735.95	100.73
662.43	89.15	740.31	79.62	1021.64	187.26
658.15	85.01	736.82	95.85	841.12	124.64
762.46	92.82	619.88	96.78	1027.82	189.76
786.57	82.93	641.60	79.38	847.87	118.48
	954.70 779.36 662.43 658.15 762.46	954.70 97.31 779.36 79.22 662.43 89.15 658.15 85.01 762.46 92.82	954.7097.31733.89779.3679.22857.69662.4389.15740.31658.1585.01736.82762.4692.82619.88	954.7097.31733.8980.74779.3679.22857.69102.93662.4389.15740.3179.62658.1585.01736.8295.85762.4692.82619.8896.78	954.7097.31733.8980.74739.15779.3679.22857.69102.93735.95662.4389.15740.3179.621021.64658.1585.01736.8295.85841.12762.4692.82619.8896.781027.82

Table 5.2: Mean Duration

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 wordorders. 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.

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.

F	actor		DF	NP	°1	NP	2	Verb)
♦ WO			1,71			6.29	*		
♦ ST			2,142	263.21	***	138.73	***	86.03	***
L _{ST} = NA+DS	♦ ST		1,71	469.40	***	204.96	***	31.40	***
L _{ST} = NI+DS	♦ ST		1,71	338.53	***	187.40	***	159.57	***
L _{ST} = NI+NA	♦ ST		1,71					55.23	***
♦ WO x ST			2,142	224.10	***	148.71	***		
L _{WO} = SO	♦ ST		2,142	353.63	***				
	Lst = NA+DS	♦ ST	1,71	712.62	***				
	L _{ST} = NI+DS	♦ ST	1,71	467.92	***				
L _{WO} = OS	♦ ST		2,142	4.02	*	188.07	***		
	L _{ST} = NA+DS	♦ ST	1,71			304.97	***		
	Lst = NI+DS	♦ ST	1,71			234.82	***		
	L _{ST} = NI+NA	♦ ST	1,71	7.28	**				

Table 5.3: ANOVA: Duration

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 subjecttype 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.

F	actor		DF	N	P1	NI	P2	Ver	Verb	
◆ WO			1,71	54.39	***	19.25	***	3.82	*	
♦ ST			2,142	6.12	**	7.29	***	3.60	*	
L _{ST} = NA+DS	♦ ST		1,71	6.40	*	10.05	**			
L _{ST} = NI+DS	♦ ST		1,71	13.04	***	10.15	**	8.70	**	
♦ WO x ST			2,142	14.78	***	11.89	***			
Lwo = so	♦ ST		2,142	12.87	***	20.41	***			
	L _{ST} = NA+DS	♦ ST	1,71	29.41	***	29.03	***			
	L _{ST} = NI+DS	♦ ST	1,71	13.90	***	25.63	***			
L _{WO} = OS	♦ ST		2,142	7.03	**					
	Lst = NA+DS	♦ ST	1,71	9.01	**					
	L _{ST} = NI+NA	♦ ST	1,71	12.74	***					

Table 5.4: ANOVA: Intensity

5.4.3 Fundamental Frequency

As the fundamental frequency (F₀) differences between the words give rise to the perception of intonation or prosody, the F₀ values at the onset and offset of each constituent as well as the maximum and minimum values of the F₀ between the onset and offset of each constituent 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

Cond	dition	Onset	SD	Max.	SD	Min.	SD	Offset	SD
	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
NP1	NIA	202.20	37.34	321.06	37.05	158.81	35.75	239.63	72.37
INP1	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
	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
NP2	NIA	224.97	46.42	297.12	33.64	149.97	39.02	217.13	50.16
INPZ	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
	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
Verb	NIA	220.40	46.73	264.51	64.99	130.58	32.33	163.18	51.02
verb	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

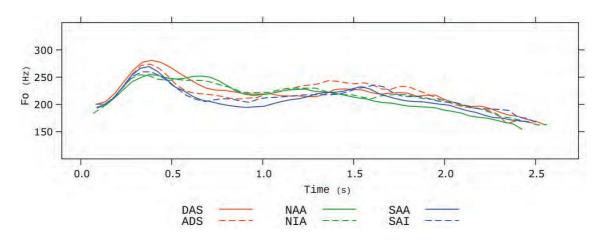
Table 5.5: Mean Fo

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 F₀, whilst this effect was significant on the timepoint of minimum F₀. The main effect of subject-type was significant on the timepoint of maximum F₀, 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 F₀ 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 Fo

	Factor		DF	Maxim	Maximum		ım
	♦ WO		1,71	3.73	*	24.75	***
NP1	♦ ST		2,142	3.32	*		
	L _{ST} = NA+DS	♦ ST	1,71	5.78	*		
	L _{ST} = NI+NA	♦ ST	1,71	4.96	*		
	♦ WO x ST		2,142			3.01	*
NP2	♦ WO		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 soundproof 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 frequencybased 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 flatscreen 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.

*	二 六 六 六 六 六	×	?	·	-
500 ms	Stimulus	500 ms	≤ 4000 ms	1000 ms	

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 interstimulus 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 recored 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 elecrodes 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).

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

Table 5.7: Answering Accuracy and Mean Reaction Time

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 subjecttype, 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.

Facto	DF	F1:Part	cicipants	DF	F2:Ite	ems	
♦ 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	**
L _{ST} = NI+NA	♦ ST	1,26	11.31	**			

Table 5.8: ANOVA: Answering Accuracy

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.

Factor DF F1:Participants DF F2:Items • WO x ST 2,52 3.59 + $L_{WO} = OS$ ST 2,52 7.03 ** LST = NI+DS ST 1,26 10.24 ** \downarrow ST = NI+NA \blacklozenge ST 1,26 5.82 *

Table 5.9: ANOVA: Reaction Time

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	Lat	Lateral Electrodes					
LA : Left-Anterior	F7	F3	FC5	FC1			
LP : Left-Posterior	Ρ7	Р3	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

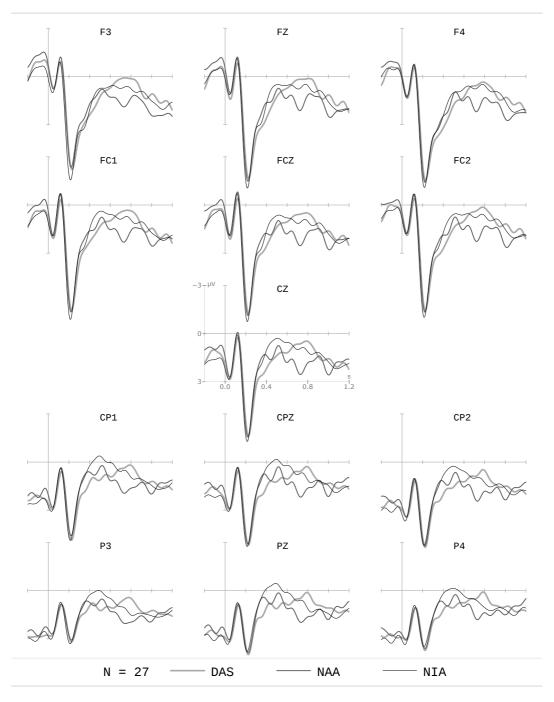


Figure 5.3: ERPs at NP1: Conditions in SO word-order.

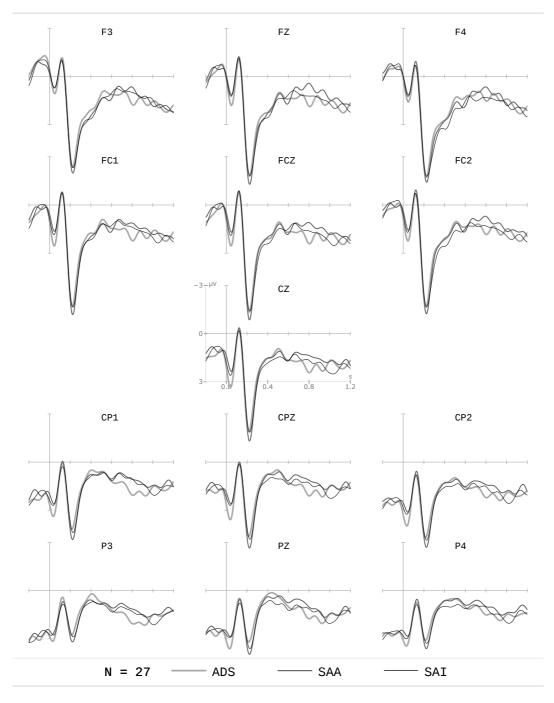


Figure 5.4: ERPs at NP1: Conditions in OS word-order.

		Factor			DF L	ateral Re	egions	DF Mi	dline Reg	gions
♦ WO					1,26	6.40	*			
♦ ROI × WO								5,130	2.63	*
L _{ROI} =	FZ	♦ WO						1,26	7.19	**
L _{ROI} =	CZ	♦ WO						1,26	4.18	*
♦ ST								2,52	2.96	*
L _{ST} = NI+[DS	♦ ST						1,26	4.38	*
♦ WO X ST					2,52	8.51	***	2,52	9.20	***
L _{WO} = SO		♦ ST			2,52	7.02	**			
		Lst = NA+DS	♦ ST		1,26	4.38	*			
		L _{ST} = NI+DS	♦ ST		1,26	15.33	***			
◆ ROI × WO	X ST							10,260	2.30	*
L _{ROI} =	FZ	♦ WO × ST						2,52	4.80	*
		Lwo = so	♦ ST					2,52	5.08	**
			L _{ST} = NA+DS	♦ ST				1,26	4.14	*
			L _{ST} = NI+DS	♦ ST				1,26	11.90	**
L _{R0I} =	FCZ	♦ WO × ST						2,52	4.76	*
		Lwo = so	♦ ST					2,52	4.40	*
			L _{ST} = NI+DS	♦ ST				1,26	9.91	**
L _{ROI} =	CZ	♦ WO × ST						2,52	8.71	***
		Lwo = so	♦ ST					2,52	9.88	***
			L _{ST} = NA+DS	♦ ST				1,26	5.12	*
			L _{ST} = NI+DS	♦ ST				1,26	20.11	***
			LST = NI+NA	♦ ST				1,26	4.64	*
L _{R0I} =	CPZ	♦ WO × ST						2,52	10.42	***
		Lwo = so	♦ ST					2,52	13.21	***
			L _{ST} = NA+DS	♦ ST				1,26	7.95	*
			L _{ST} = NI+DS	♦ ST				1,26	25.98	***
			LST = NI+NA	♦ ST				1,26	5.46	*
L _{ROI} =	ΡZ	♦ WO x ST						2,52	12.24	***
		Lwo = so	♦ ST					2,52	16.91	***
			L _{ST} = NA+DS	♦ ST				1,26	6.82	*
			L _{ST} = NI+DS	♦ ST				1,26	34.81	***

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

Continued on next page . . .

5.6. RESULTS

		Factor	r	DF Lateral Regions	DF Midline Regi 1,26 10.19 2,52 8.22 2,52 12.66		gions
			LST = NI+NA ♦ ST		1,26	10.19	**
L _{R0I} =	P0Z	♦ WO × ST			2,52	8.22	**
		Lwo = so	♦ ST		2,52	12.66	***
			LST = NI+DS ♦ ST		1,26	17.99	***
			LST = NI+NA ♦ ST		1,26	17.71	***

... Table 5.12 continued

parietal midline regions. The comparison NI + DS was significant in all the midline regions. Comparing NI + NA, the simple effect of subjecttype 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 dativesubjects, 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 subjecttypes 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

	Factor			DF La	teral Reg	gions	DF M	1idline Re	egions
◆ W0							1,26	3.55	*
♦ ST				2,52	3.18	*			
L _{ST} = NA+DS	♦ ST			1,26	5.52	*			
♦ WO X ST				2,52	13.56	***	2,52	19.51	***
L _{WO} = SO	♦ ST						2,52	12.89	***
	L _{ST} = NA+DS	♦ ST					1,26	24.61	***
	L _{ST} = NI+NA	♦ ST					1,26	12.32	**
Lwo = os	♦ ST						2,52	5.66	**
	L _{ST} = NA+DS	♦ ST					1,26	10.34	**
◆ ROI × WO X ST				6,156	3.23	**			
L _{R0I} = LA	♦ WO × ST			2,52	10.84	***			
	Lwo = so	♦ ST		2,52	10.01	***			
		L _{ST} = NA+DS	♦ ST	1,26	15.51	***			
		L _{ST} = NI+DS	♦ ST	1,26	4.89	*			
		LST = NI+NA	♦ ST	1,26	6.78	*			
L _{ROI} = LP	♦ WO × ST			2,52	13.07	***			
	Lwo = so	♦ ST		2,52	8.04	**			
		L _{ST} = NA+DS	♦ ST	1,26	10.94	**			
		LST = NI+NA	♦ ST	1,26	14.08	**			
L _{ROI} = RA	♦ WO × ST			2,52	9.74	***			
	Lwo = so	♦ ST		2,52	11.12	***			
		L _{ST} = NA+DS	♦ ST	1,26	12.50	**			
		LST = NI+NA	♦ ST	1,26	19.51	***			
LROI = RP	♦ WO × ST			2,52	8.43	***			
	Lwo = so	♦ ST		2,52	7.45	**			
		$L_{ST} = NA+DS$	♦ ST	1,26	14.16	**			
		LST = NI+NA	♦ ST	1,26	7.49	*			

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

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 subjecttypes 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 subjecttype 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

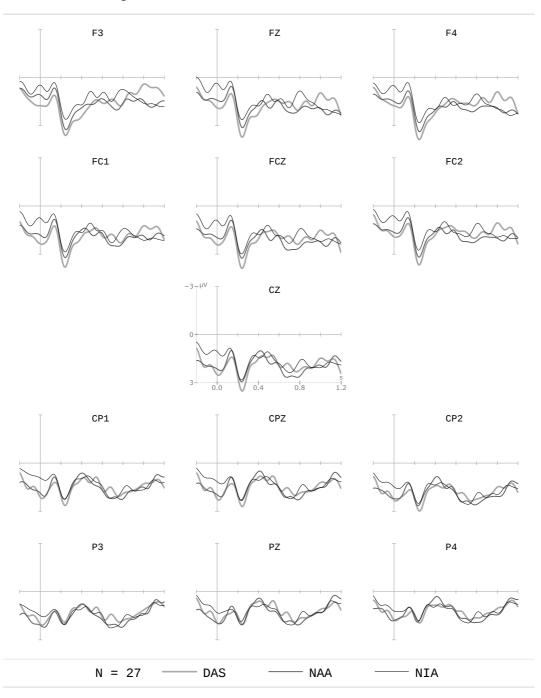


Figure 5.5: ERPs at NP2: Conditions in SO word-order.



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

		Facto	r		DF L	ateral Re	egions	DF Mi	dline Reg	jions
♦ WO					1,26	19.03	***	1,26	8.96	**
♦ ROI X WO	X ST							10,260	2.59	*
L _{ROI} =	ΡZ	♦ WO x ST						2,52	4.32	*
		Lwo = os	♦ ST					2,52	6.89	**
			└ST = NI+DS	♦ ST				1,26	7.42	*
			└ST = NI+NA	♦ ST				1,26	13.43	**
L _{ROI} =	P0Z	♦ WO x ST						2,52	6.62	**
		Lwo = os	♦ ST					2,52	7.00	**
			└ST = NI+DS	♦ ST				1,26	5.26	*
			L _{ST} = NI+NA	♦ ST				1,26	12.60	**

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

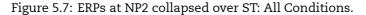
parieto-occipital midline regions. This interaction was further resolved for word-order in each ROI concerned, which showed an effect of subjecttype in all the midline regions for the object-initial word-order alone. In both the regions concerned, the comparisons NI + DS and NI + NA reached significance,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

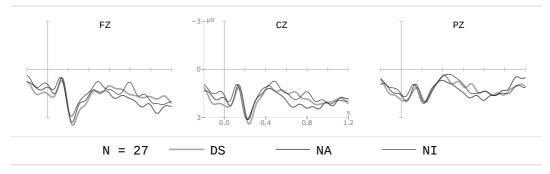
5.6.2.2.2 NP2: Time Window 600-900 ms

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.

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-type spairwise. 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.





F	actor		DF La	teral Reg	gions	DF Mi	dline Reg	jions
◆ WO			1,26	18.22	***	1,26	17.78	***
♦ ROI X WO			3,78	2.67	*	5,130	2.52	*
L _{ROI} = LA∥FZ	◆ WO		1,26	3.55	*	1,26	8.16	**
L _{ROI} = LP ∥ FCZ	◆ WO		1,26	14.31	***	1,26	10.44	**
L _{ROI} = RA∥CZ	◆ WO		1,26	16.24	***	1,26	21.76	***
L _{ROI} = RP ∥ CPZ	◆ WO		1,26	29.86	***	1,26	23.06	***
L _{ROI} = PZ	◆ WO					1,26	17.04	***
L _{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	*
L _{ROI} = LA ∥ FZ	♦ ST		2,52	3.65	*	2,52	5.35	**
	Lst = NA+DS	♦ ST	1,26	5.14	*	1,26	6.02	*
	└ST = NI+NA	♦ ST	1,26	5.63	*	1,26	9.84	**
L _{ROI} = LP ∥ FCZ	♦ ST		2,52	3.22	*	2,52	7.45	***
	L _{ST} = NA+DS	♦ ST	1,26	4.56	*	1,26	8.23	*
	LST = NI+NA	♦ ST	1,26			1,26	13.46	**
L _{ROI} = RA∥CZ	♦ ST		2,52	9.06	***	2,52	7.96	***
	L _{ST} = NA+DS	♦ ST	1,26	8.56	*	1,26	9.58	**
	LST = NI+NA	♦ ST	1,26	19.09	***	1,26	13.71	**
L _{ROI} = RP ∥ CPZ	♦ ST		2,52	4.61	*	2,52	3.67	*
	L _{ST} = NA+DS	♦ ST	1,26	6.48	*	1,26	4.39	*
	L _{ST} = NI+NA	♦ ST	1,26	5.78	*	1,26	6.02	*
L _{ROI} = PZ	♦ ST					2,52	3.32	*
	L _{ST} = NA+DS	♦ ST				1,26	5.42	*

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

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 timewindow, 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 timewindow 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 timewindows 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 sentenceinitial 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

See Frenzel, Schlesewsky, Primus, & Bornkessel-Schlesewsky (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.

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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 dativesubjects, 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 defaultagreement (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 clausefinal 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 pronoundropped 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.

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

Table 6.1: Experiment 2: Factors and Levels

The seventy-two sets of dative-subject sentences from Experiment 1 were adopted as they are. The corresponding sets of ditranstive 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} 'Shankar knows Gu	குருவைத் Guru~v-ai~th [Guru] _{ACC-An.M} ru'.	தெரியும். theri~y-um [know] _{Future-3singular.Neuter}
DAI	ஷங்கருக்கு Shankar~u'-kku' [Shankar] _{DAT-An.M} '(I) reminded Shank	குருவை Guru~v-ai [Guru] _{ACC-An.M} ar about Guru'.	ஞாபகப்படுத்தினேன் . nya:bagappaduthth-in-e:n [remind] _{Past-1singular}
ADS	குருவை Guru~v-ai [Guru] _{ACC-An.M} 'Shankar knows Gus	ஷங்கருக்குத் Shankar~u'-kku'~th [Shankar] _{DAT-An.M} ru'.	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}

6.3.2 Context Questions

'(I) introduced Guru to Shankar'.

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
-------	---------------	-----------------	------	------------------

. , 1		•		
CQDAS	Ya:r~u'-kku'	யாரைத் ya:r-ai~th [who] _{ACC-An} s whom'?		um
CQDAI	Ya:r~u'-kku' [Who] _{DAT-An}	யாரை ya:r-ai [who] _{ACC-An} (you) remind to	nya:bag [remind]	படுத்தினாய்? appaduthth-in-a:y _{Past-2singular}
CQADS	Ya:r-ai	யாருக்குத் ya:r~u'-kku'~th [who] _{DAT-An} s whom'?	theri~y-	um
CQADI	Ya:r-ai [Who] _{ACC-An}		arimuga [introdu	0
(6.3) Exp	eriment 2: Ne	utral Context (N	Q)	
So	lla-vandh-adh	த சுருக்கமா n-ai surukkam _{ACC-In} [briefly] _{AE}	1-a:ga s	சொல்! sol tell] _{Imperative-2singular}

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 happenend?' 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

'Say what you wanted to briefly'!

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 preceeded 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 nativespeaker 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 (F₀) 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.

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

Table 6.2: Mean Duration

ANOVAs were computed for the critical conditions in order to observe the effects of the within-participants factors word-order and sentencetype 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.

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

Table 6.3: ANOVA: Duration

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.

Condi	tion	Onset	SD	Max.	SD	Min.	SD	Offset	SD
	DAS	274.36	51.63	358.87	53.93	215.72	30.41	264.43	46.89
NP1	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
	DAS	260.13	32.25	316.94	21.50	206.91	33.87	261.47	50.35
NP2	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
	DAS	240.38	44.07	285.90	83.43	160.72	50.67	198.23	86.38
Verb	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

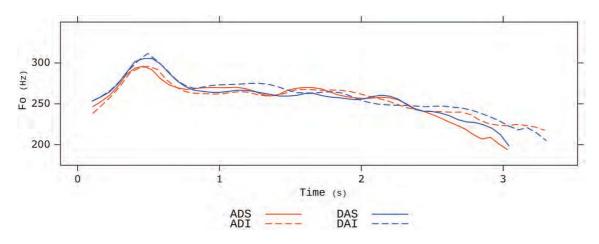
Table 6.4: Mean Fo

Table 6.5: ANOVA: Timepoint of Maximum and Minimum Fo

	Factor		DF	Maxim	านm	Minimum
	♦ WO		1,71	7.51	**	
NP1	♦ ST		1,71	5.61	*	
כסא	♦WO x ST		1,71	4.14	*	
NP2	♦ WO x ST Lwo = 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





constituent per condition so as to obtain the pitch contour plot. Figure 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.

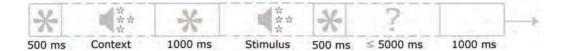
6.5.1 Experimental Trial Structure

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

Condition		AC %	SD	RT s	SD
	DAS	97.96	3.00	2.44	0.48
<u> </u>	DAI	96.48	4.31	2.64	0.52
CQ	ADS	97.03	3.71	2.51	0.51
	ADI	96.20	5.02	2.65	0.49
	DAS	98.24	2.67	2.51	0.49
NO	DAI	95.92	3.84	2.69	0.53
NQ	ADS	96.94	4.39	2.61	0.49
	ADI	96.75	3.79	2.74	0.49

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

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	F F2:Items	
◆ ST	1,29	7.69	**	1,71	6.22	*
♦ WO × ST	1,29	3.88	*			
Lwo = 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 ditranstive 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 sentencetype 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.

Factor	DF	F1:Partic	F1:Participants		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 × ST	1,29	7.18	*			
└wo = da ♦ st	1,29	108.37	***			
└wo = AD ♦ ST	1,29	49.14	***			

CHAPTER 6. EXPERIMENT 2

Table 6.8: ANOVA: Reaction Time

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, whereby the ditransitive sentences are more positive than their dativesubject counterparts. Figure 6.5 illustrates this difference for the dativeinitial conditions (see Appendix F.5 for a similar plot for the accusativeinitial conditions). Prosodic differences between the sentece-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 L	DF Lateral Regions			DF Midline Regions		
♦ ST			1,29	6.24	*	1,29	8.34	**
♦ ROI X ST						5,145	8.12	**
L _{ROI} =	FZ	♦ ST				1,29	9.55	**
L _{R0I} =	FCZ	♦ ST				1,29	11.98	**
L _{ROI} =	CZ	♦ ST				1,29	11.61	**
L _{R0I} =	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 broadlydistributed 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 dativesubject sentences in both the lateral and midline regions.

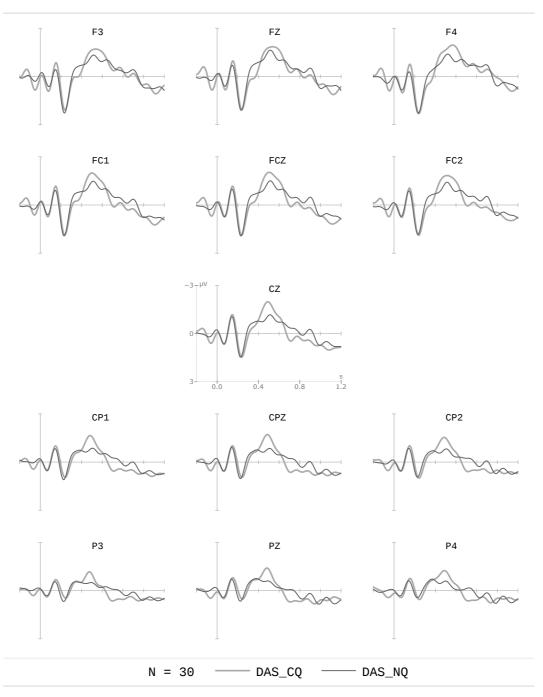
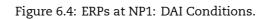
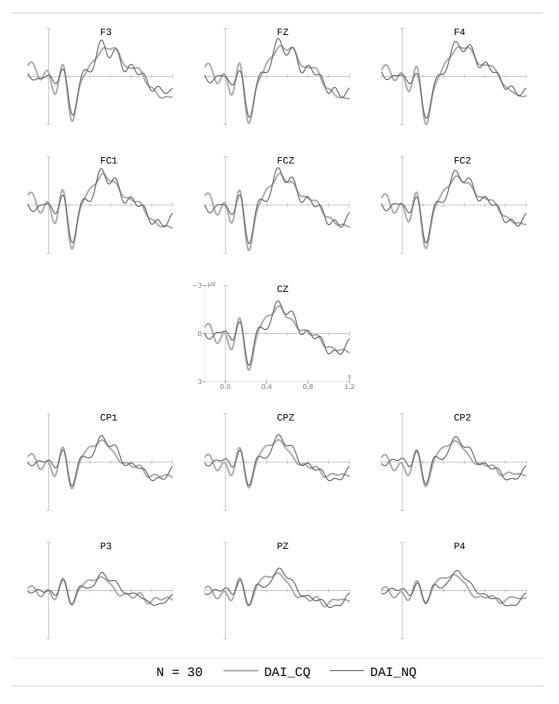


Figure 6.3: ERPs at NP1: DAS Conditions.





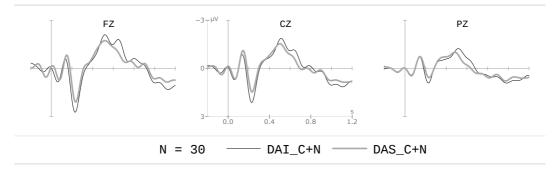


Figure 6.5: ERPs at NP1 - Collapsed over CT: DA Conditions.

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 *
L _{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.

Factor		DF L	ateral F	Regions	DF Mi	dline Re	gions
◆ ROI X ST					5,145	3.46	**
L _{ROI} = FZ	♦ ST				1,29	3.60	*
◆ CT					1,29	5.52	*
◆ ROI X CT		3,87	4.44	**	5,145	2.82	*
L _{ROI} = LP	♦ CT	1,29	7.96	**			
L _{ROI} = CZ	♦ CT				1,29	6.03	*
└ _{ROI} = RP # CPZ	♦ CT	1,29	7.60	**	1,29	9.87	**
L _{ROI} = PZ	♦ CT				1,29	7.56	**
L _{ROI} = POZ	♦ CT				1,29	6.93	**
♦ ST X CT					1,29	4.30	*
L _{ST} = DS	♦ CT				1,29	9.10	**

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

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 accusativeinitial 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.

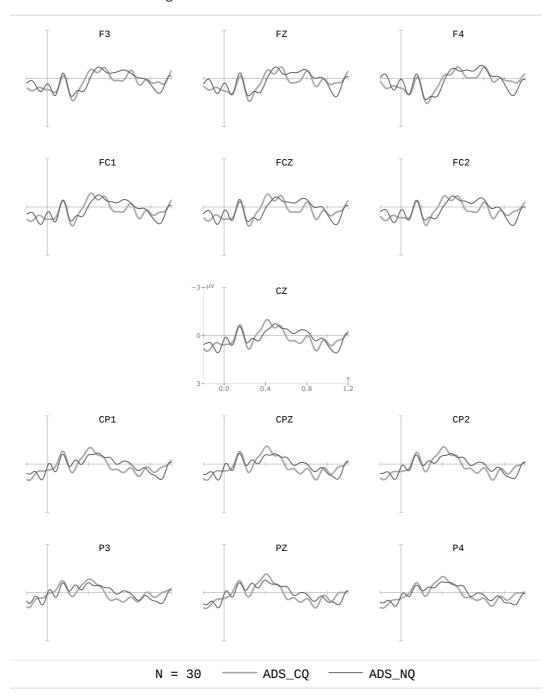


Figure 6.6: ERPs at NP2: ADS Conditions.

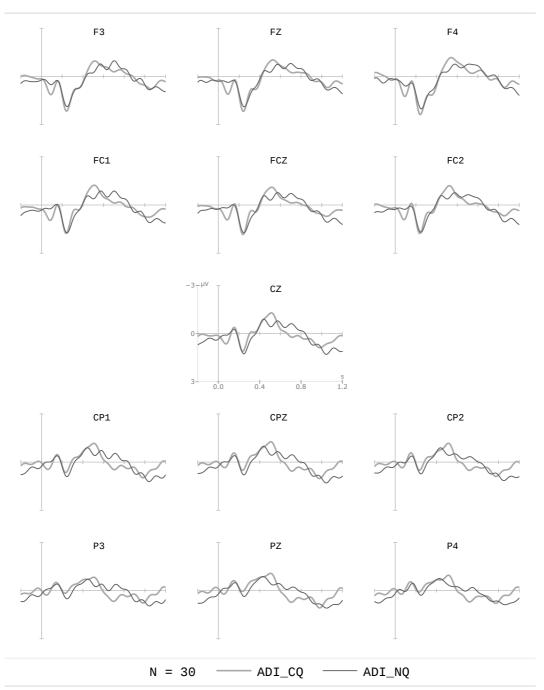


Figure 6.7: ERPs at NP2: ADI Conditions.

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	*

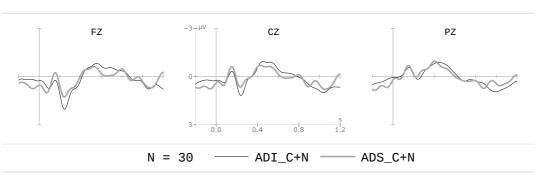


Figure 6.8: ERPs at NP2 - Collapsed over CT: AD Conditions.

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 L	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.

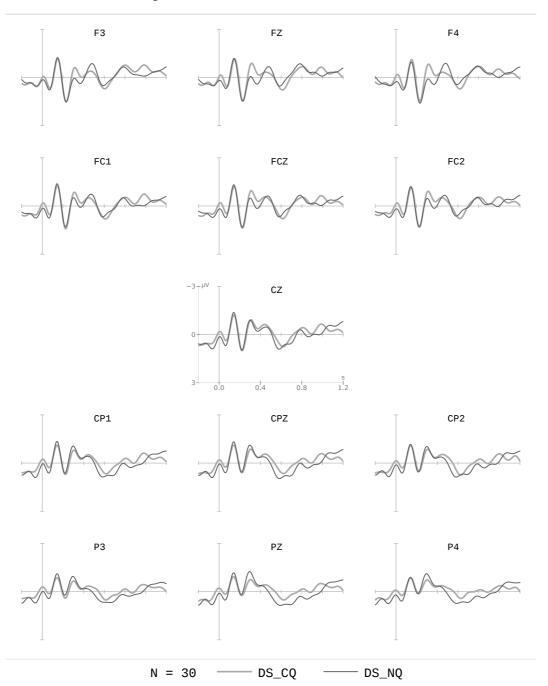


Figure 6.9: ERPs at the Verb: DS Conditions.

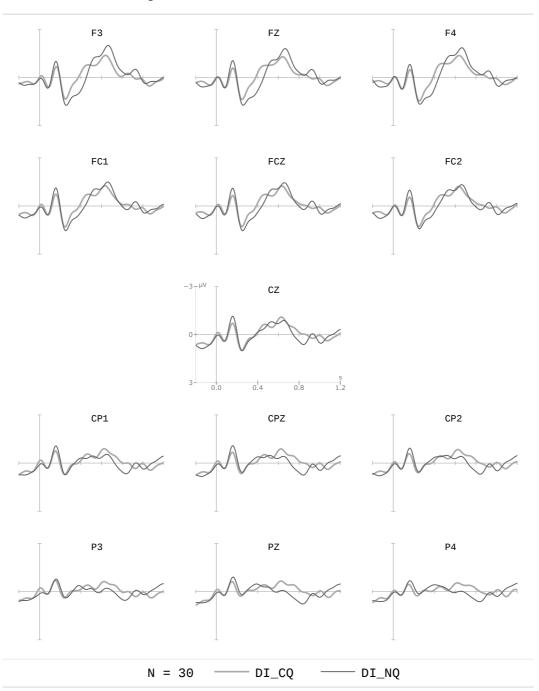


Figure 6.10: ERPs at the Verb: DI Conditions.

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. l	RESULTS
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Fa	ctor		DF L	ateral Re	egions	DF Mi	dline Reg	gions
◆ ROI × WO			3,87	5.13	**	5,145	5.77	**
L _{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	***
LROI = PZ	♦ ST					1,29	16.78	***
L _{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	**			
L _{R0I} = POZ	♦ CT					1,29	7.64	**
◆ ROI × WO × CT			3,87	5.71	**	5,145	8.03	**
└ROI = RA	♦ WO × CT		1,29	3.18	*			
	Lwo = da	+ CT	1,29	5.30	*			
	Lwo = AD	+ CT	1,29	12.19	**			
• ROI X ST X CT			3,87	2.54	*			
♦ WO x ST x CT			3,87	5.80	**			

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

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 wordorder 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 parietooccipital midline region. Resolving this interaction further for wordorder 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.

	Factor			DF L	ateral Re	egions	DF Mi	dline Reg	gions
◆ ROI × WO				3,87	3.42	*	5,145	4.42	*
L _{ROI} = LA	◆ WO			1,29	4.83	*			
◆ ST				1,29	3.38	*	1,29	5.18	*
◆ ROI × ST				3,87	3.38	*			
L _{R0I} = LA	♦ ST			1,29	4.04	*			
L _{ROI} = RA	♦ ST			1,29	5.32	*			
◆ ROI × CT				3,87	10.62	***	5,145	4.69	*
L _{R0I} = PZ	♦ CT						1,29	3.75	*
L _{R0I} = POZ	♦ CT						1,29	6.48	*
♦ ROI X ST X CT				3,87	4.10	*	5,145	5.29	*
L _{R0I} = RP	♦ ST X CT			1,29	6.17	*			
	Lst = ds	♦ CT		1,29	3.55	*			
L _{ROI} = POZ	♦ ST X CT						1,29	6.00	*
	Lst = 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	**
	Lwo = da	♦ ST X CT		1,29	6.65	**	1,29	8.06	**
		Lst = ds	♦ CT	1,29	12.68	***	1,29	8.68	**
L _{ROI} = FCZ	♦ WO x ST x CT						1,29	3.18	*
L _{ROI} = RA	♦ WO x ST x CT			1,29	7.88	**			
	Lwo = da	♦ ST X CT		1,29	8.56	**			
		L _{ST} = DS	♦ CT	1,29	13.14	***			

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

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.

Factor	r	DF L	ateral Reg	jions	DF Mi	dline Reg	gions
◆ ROI × WO		3,87	4.07	**	5,145	4.77	*
LROI = LA∥FZ	♦ WO	1,29	3.96	÷	1,29	4.46	*
L _{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	***
L _{ROI} = RP ∥ CPZ	♦ ST	1,29	46.14	***	1,29	79.60	***
L _{ROI} = PZ	♦ ST				1,29	48.49	***
L _{ROI} = POZ	♦ ST				1,29	23.14	***
◆ ROI × CT		3,87	38.98	***	5,145	31.21	***
└ROI = LA # FZ	♦ CT	1,29	12.36	***	1,29	4.06	*
L _{ROI} = LP	♦ CT	1,29	8.58	**			
LROI = RA	◆ CT	1,29	8.83	**			
L _{ROI} = RP ∥ CPZ	♦ CT	1,29	8.04	**	1,29	7.43	**
L _{ROI} = PZ	◆ CT				1,29	13.45	***
L _{ROI} = POZ	♦ CT				1,29	19.90	***

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

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 dativesubjects 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 postive 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 F₀ at NP1 is significantly different between the sentence-types, although the maximum F₀ 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 F₀ at NP2.

Given that the correct context conditions in the respective sentencetypes 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 timewindow, 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 nonneutral 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 whquestions to induce a focused constiutent 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 casemarker 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 casemarker 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 positivegoing 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 contextdependent 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 sentencetypes in the neutral context as opposed to the correct context seems to be the one effect that could be interpreted conclusively as a contextdependent 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, inspite 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 expecations. 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 expectaction 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.

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

(7.1) Experiment 3: Critical Conditions

'Shankar knows Guru'.

DAS	ஷங்கருக்கு Shankar~u'-kku' [Shankar] _{DAT-An.M} 'Shankar knows Gu	குருவைத் Guru~v-ai~th [Guru] _{ACC-An.M} வ'.	தெரியும். theri~y-um [know] _{Future-3singular.Neuter}
DAI	ஷங்கருக்கு Shankar~u'-kku' [Shankar] _{DAT-An.M} ' (I) reminded Shank	குருவை Guru~v-ai [Guru] _{ACC-An.M} ar about Guru'.	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	ஷங்கருக்கு	அறிமுகப்படுத்தினேன்.
	Guru~v-ai	Shankar~u'-kku'	arimugappaduthth-in-e:n
	[Guru] _{ACC-An.M}	[Shankar] _{DAT-An.M}	[introduce] _{Past-1singular}
	'(I) introduced Gu	ru to Shankar'.	

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) Experim	ent 3: Context	Questions for	DAS Condi	itions
CQTmDAS	யாருக்கு Ya:r~u'-kku' [Who] _{DAT-An} 'Who knows ?	ya:r-ai~th [who] _{ACC-An}	theri~y-un	
NQOOSVS			kkam-a:ga fly] _{ADV}	சொல்! sol [tell] _{Imperative-2singular}
VQ PmDAS	யாருக்கு Ya:r~u'-kku' [Who] _{DAT-An} 'Who likes wl	ya:r-ai~p [who] _{ACC-An}	pidi-kk-un	n
WQArDAI		ya:r-ai [who] _{ACC-An}	arimugapı [introduce]	0

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

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

Cor	dition	JUDG %	SD	AC %	SD	RT s	SD
	DAS	95.38	9.31	96.48	3.80	2.15	0.52
<u> </u>	DAI	95.66	7.50	94.53	5.10	2.34	0.53
CQ	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
D	DAS	80.84	29.91	95.74	4.75	2.17	0.55
NO	DAI	77.95	34.70	93.19	5.74	2.33	0.59
NQ	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
	DAS	5.90	11.73	95.84	4.37	2.29	0.53
VO	DAI	9.98	14.14	94.76	5.00	2.47	0.56
VQ	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
	DAS	6.75	10.81	95.07	4.27	2.28	0.55
140	DAI	5.99	8.42	93.11	4.67	2.44	0.52
WQ	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

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

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:Partic	cipants	DF	F2:Item	าร
♦ CT			3,99	246.79	***	3,213	12477.00	***
└ct = cQ+NQ	♦ CT		1,33	10.60	**	1,71	716.45	***
L _{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	***
└oct = vq+wq	◆ CT		1,33	6.71	*	1,71	15.27	***
◆ ST x CT			3,99	7.85	***	3,213	5.66	***
Lst = ds	◆ CT		3,99	275.74	***	3,213	4069.50	***
	└oct = cQ+NQ	♦ CT	1,33	9.37	**	1,71	117.04	***
	L₀CT = 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	***
L _{ST} = DI	◆ CT		3,99	204.26	***	3,213	3232.60	***
	└oct = cQ+NQ	♦ CT	1,33	11.24	**	1,71	179.90	***
	L₀ct = cQ+VQ	♦ CT	1,33	778.71	***	1,71	5366.70	***
	$L_{CT} = VQ + NQ$	♦ CT	1,33	110.51	***	1,71	3225.90	***
	└ct = cQ+WQ	♦ CT	1,33	1549.10	***	1,71	17265.00	***
	$L_{CT} = WQ + NQ$	♦ CT	1,33	136.62	***	1,71	2793.40	***
	$L_{CT} = VQ + WQ$	♦ CT	1,33	13.35	**	1,71	19.63	***

7.5. RESULTS

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 wordorder 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.

Factor	DF	F1:Participants		F1:Participant		F1:Participants		F1:Participants		F1:Participants		DF	F2:Ite	ms
♦ WO	1,33	4.16	*											
♦ ST	1,33	24.36	***	1,71	6.13	*								
♦ WO × ST	1,33	3.18	*											
└wo = da ◆ st	1,33	17.91	***											

Table 7.4: Repeated Measures ANOVA: Answering Accuracy

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 context 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.

Factor	DF	F1:Partic	ipants	DF	ems		
♦ WO		1,33	9.06	**			
♦ ST		1,33	173.56	***	1,71	58.69	***
♦ CT		3,99	23.76	***	3,213	19.94	***
L _{CT} = CQ+VQ	♦ CT	1,33	26.15	***	1,71	20.27	***
└ct = vq+nq	♦ CT	1,33	21.00	***	1,71	49.88	***
$L_{CT} = CQ + WQ$	♦ CT	1,33	39.15	***	1,71	16.47	***
└→CT = WQ+NQ	♦ CT	1,33	35.11	***	1,71	42.71	***

Table 7.5: Repeated Measures ANOVA: Reaction Time

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

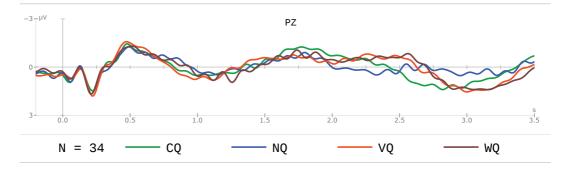
The analysis at the position of the verb was performed based on all the factors WO, ST and CT, and their levels. The statistical analysis was carried out on the ERP data after applying a baseline correction from -200 ms to 0 ms (verb onset), because there seemed to be a general difference⁵⁶ shortly prior 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.

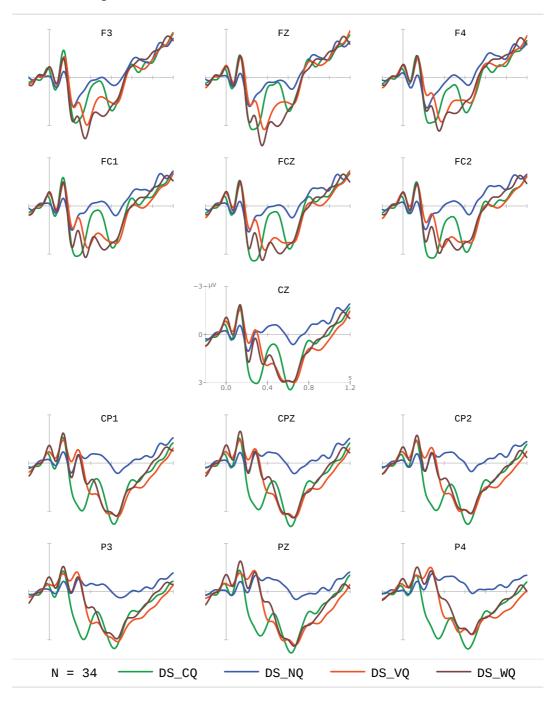


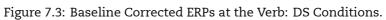


7.5.2.1.1 Verb: Time Window 250-350 ms

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 statisticts 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





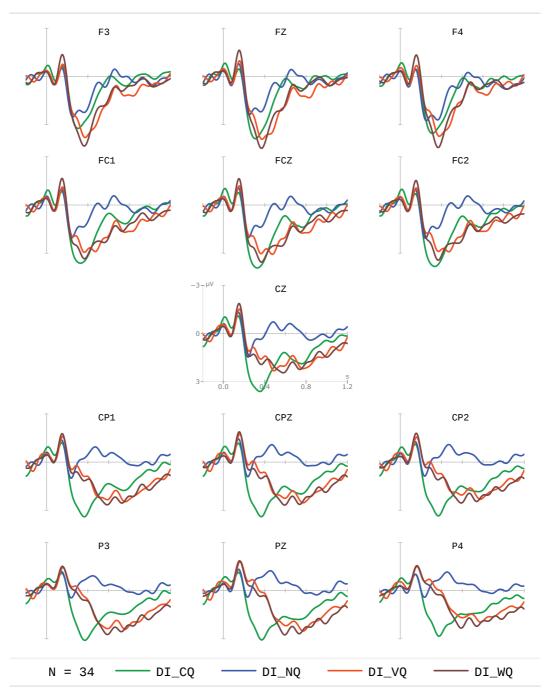


Figure 7.4: Baseline Corrected ERPs at the Verb: DI Conditions.

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 leftanterior 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

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l	Factor		DF La	ateral Reg	gions	DF Midline Regions			
◆ WO			1,33	20.63	***	1,33	25.71	***	
◆ ROI × 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	***	
L _{ROI} = RP ∥ CPZ	♦ WO		1,33	12.19	***	1,33	21.89	***	
L _{ROI} = PZ	◆ WO					1,33	9.05	**	
L _{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	**	
L _{ROI} = RA∥CZ	♦ ST		1,33	13.17	***	1,33	8.60	**	
L _{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	***	
	L→CT = CQ+VQ	♦ CT				1,33	7.08	*	
	L→CT = WQ+NQ	♦ CT	1,33	15.33	***	1,33	15.09	***	
	└→C⊤ = VQ+WQ	♦ CT	1,33	27.96	***	1,33	27.79	***	
↓ROI = LP # FCZ	◆ CT		3,99	32.04	***	3,99	13.81	***	
	L→CT = CQ+NQ	♦ CT	1,33	44.30	***	1,33	25.16	***	
	L→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	***	
	L→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	*	

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

	Factor		DF La	ateral Reg	gions	DF Mi	dline Reg	gions
L _{ROI} = RP ∥ CP	Z + CT		3,99	35.53	***	3,99	30.65	***
	└ct = cQ+NQ	♦ CT	1,33	47.13	***	1,33	43.23	***
	L _{CT} = CQ+VQ	♦ CT	1,33	79.46	***	1,33	65.53	***
	└₀ct = cQ+WQ	♦ CT	1,33	52.25	***	1,33	44.80	***
L _{R0I} = PZ	• CT					3,99	33.58	***
	└ct = cQ+NQ	♦ CT				1,33	44.14	***
	L₀ct = cQ+VQ	♦ CT				1,33	76.07	***
	└ct = cQ+WQ	♦ CT				1,33	52.60	***
LROI = PC	Z + CT					3,99	37.17	***
	└ct = cQ+NQ	♦ CT				1,33	46.26	***
	L _{CT} = CQ+VQ	♦ CT				1,33	83.92	***
	└ct = cQ+WQ	♦ CT				1,33	63.04	***
♦ WO × CT			3,99	2.37	*	3,99	2.85	*
L _{WO} = DA	♦ CT		3,99	15.60	***	3,99	23.57	***
	└ct = cQ+NQ	♦ CT	1,33	23.17	***	1,33	37.49	***
	L _{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	**			
Lwo = 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 C	т					15,495	2.48	*

... Table 7.6 continued

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 midline regions.

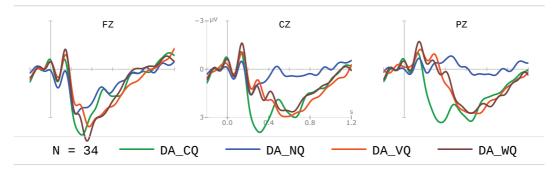
Resolving the interaction word-order x context for the individual levels of word-order showed an effect of context in both the dative-accusative and accusative-dative word-orders. This effect of context was further resolved by comparing the contexts pairwise in each word-order. In the dative-accusative 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 only in the 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 sentencetype 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

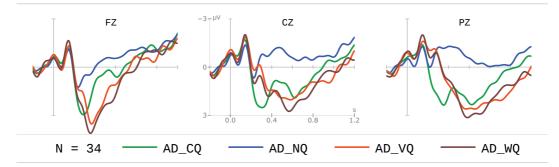
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right-posterior regions. It was also significant in all relevant midline regions for both sentence-types, except the fronto-central midline region in case of dative-subject sentences. Comparing CQ + VQ, the effect of context reached significance in all relevant regions except the frontocentral midline region for the ditransitive sentences. For the dativesubject sentences, on the other hand, it was significant in the frontocentral 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 sentencetypes 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.







	Factor		DF La	ateral Reg	gions	DF Midline Regions			
♦ WO			1,33	17.58	***	1,33	19.98	***	
♦ ROI × WO			3,99	17.87	***	5,165	20.16	***	
LROI = LA ∥ FZ	◆ WO		1,33	29.88	***	1,33	30.22	***	
L _{ROI} = LP ∥ FCZ	◆ WO		1,33	5.58	*	1,33	37.21	***	
L _{ROI} = RA ∥ CZ	♦ WO		1,33	26.02	***	1,33	26.72	***	
L _{ROI} = RP ∥ CPZ	♦ WO		1,33	4.72	*	1,33	14.00	***	
L _{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	***	
L _{ROI} = FCZ	♦ ST					1,33	17.67	***	
L _{ROI} = RA ∥ CZ	♦ ST		1,33	24.75	***	1,33	7.08	**	
L _{R0I} = POZ	♦ ST					1,33	5.09	*	
♦ CT			3,99	15.16	***	3,99	14.63	***	
◆ ROI × 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	*	
	L→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	*				
	└oct = 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	***	
L _{ROI} = RA ∥ CZ	◆ CT		3,99	9.82	***	3,99	12.09	***	
	$L_{CT} = CQ + NQ$	◆ CT	1,33	7.52	*	1,33	32.29	***	
	$L_{CT} = VQ + NQ$	◆ CT	1,33	13.03	**	1,33	16.50	***	
	└→CT = CQ+WQ	♦ CT	1,33	6.54	*				
	└oct = WQ+NQ	♦ CT	1,33	18.40	***	1,33	16.65	***	

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

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... Table 7.7 continued

	Factor		DF La	ateral Reg	gions	DF Mi	dline Reg	gions
L _{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	*
	└oct = 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	***
L _{ROI} = PZ	♦ CT					3,99	23.91	***
	└→CT = CQ+NQ	♦ CT				1,33	62.84	***
	└oct = 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	***
L _{R0I} = POZ	♦ CT					3,99	28.01	***
	└oct = cQ+NQ	♦ CT				1,33	61.43	***
	└oct = cQ+VQ	♦ CT				1,33	19.74	***
	└oct = VQ+NQ	♦ CT				1,33	15.99	***
	└→CT = CQ+WQ	♦ CT				1,33	32.05	***
	└→CT = WQ+NQ	♦ CT				1,33	14.74	***
♦ WO × CT			3,99	5.64	***	3,99	6.93	***
Lwo = da	♦ CT		3,99	9.77	***	3,99	13.04	***
	└ct = cQ+NQ	♦ CT	1,33	28.99	***	1,33	40.39	***
	└oct = cQ+VQ	♦ CT				1,33	6.33	*
	└→CT = VQ+NQ	♦ CT	1,33	12.90	**	1,33	10.58	**
	└→C⊤ = CQ+WQ	◆ CT				1,33	8.76	**
	└→CT = WQ+NQ	♦ CT	1,33	13.90	***	1,33	9.05	**
Lwo = 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	*
L _{ROI} = LP ∥ FCZ	♦ ST X CT		3,99	5.03	**	3,99	4.39	**
	Lst = ds	♦ CT	3,99	14.68	***	3,99	9.10	***

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	Factor			DF La	ateral Reg	gions	DF M	idline Reg	gions
		└oct = 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	***
		└oct = cQ+WQ	♦ CT				1,33	8.45	**
		└→CT = WQ+NQ	♦ CT	1,33	16.03	***	1,33	15.52	***
	L _{ST} = DI	♦ CT		3,99	21.59	***	3,99	8.32	***
		└oct = cQ+NQ	♦ CT	1,33	47.60	***	1,33	19.17	***
		└oct = cq+vq	♦ CT	1,33	16.45	***			
		└→CT = VQ+NQ	♦ CT	1,33	18.95	***	1,33	14.06	***
		└→CT = CQ+WQ	♦ CT	1,33	10.19	**			
		└→CT = WQ+NQ	♦ CT	1,33	23.01	***	1,33	20.01	***
L _{ROI} = CZ	♦ ST X CT						3,99	5.98	***
	Lst = ds	♦ CT					3,99	7.35	***
		└oct = cQ+NQ	♦ CT				1,33	11.20	**
		└ct = VQ+NQ	♦ CT				1,33	15.71	***
		└→CT = WQ+NQ	♦ CT				1,33	10.73	*
	Lst = di	♦ CT					3,99	12.97	***
		└oct = cQ+NQ	♦ CT				1,33	31.58	***
		└→CT = CQ+VQ	♦ CT				1,33	8.48	**
		└→CT = VQ+NQ	♦ CT				1,33	10.78	**
		└oct = cQ+WQ	♦ CT				1,33	5.72	*
		└→CT = WQ+NQ	♦ CT				1,33	13.51	***
L _{ROI} = RP ∥ CPZ	♦ ST X CT			3,99	3.91	**	3,99	5.63	**
	Lst = ds	♦ CT		3,99	17.60	***	3,99	9.93	***
		└ct = cQ+NQ	♦ CT	1,33	36.13	***	1,33	27.58	***
		└ct = VQ+NQ	♦ CT	1,33	21.53	***	1,33	16.62	***
		└→CT = CQ+WQ	♦ CT	1,33	13.75	***			
		└→CT = WQ+NQ	♦ CT	1,33	12.15	**	1,33	8.37	**
		└→CT = VQ+WQ	♦ CT	1,33	9.17	**			
	Lst = di	◆ CT		3,99	18.03	***	3,99	18.37	***
		$L_{CT} = CQ + NQ$	♦ CT	1,33	43.69	***	1,33	42.39	***
		└ _{CT} = CQ+VQ	♦ CT	1,33	17.07	***	1,33	17.18	***
		└→CT = VQ+NQ	♦ CT	1,33	8.85	**	1,33	9.98	**

... Table 7.7 continued

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		Factor			DF La	ateral Reg	jions	DF M	idline Reg	gior
			└→CT = CQ+WQ	♦ CT	1,33	10.40	**	1,33	11.66	*
			└→CT = WQ+NQ	♦ CT	1,33	13.16	**	1,33	11.58	*
→ROI =	ΡZ	♦ ST X CT						3,99	5.30	7
		L _{ST} = DS	♦ CT					3,99	14.61	*
			└→CT = CQ+NQ	♦ CT				1,33	41.18	*
			└→CT = VQ+NQ	♦ CT				1,33	19.30	*
			└→CT = CQ+WQ	♦ CT				1,33	9.22	7
			└→CT = WQ+NQ	♦ CT				1,33	8.88	7
			└→CT = VQ+WQ	♦ CT				1,33	6.95	
		L _{ST} = DI	♦ CT					3,99	21.11	*
			└→CT = CQ+NQ	♦ CT				1,33	44.34	*
			└→CT = CQ+VQ	♦ CT				1,33	23.73	*
			└→CT = VQ+NQ	♦ CT				1,33	8.42	
			└→CT = CQ+WQ	♦ CT				1,33	15.88	*
			└→C⊤ = WQ+NQ	♦ CT				1,33	11.69	,
→ROI =	P0Z	♦ ST X CT						3,99	3.72	
		Lst = ds	♦ CT					3,99	18.09	*
			└→CT = CQ+NQ	♦ CT				1,33	46.18	*
			└→CT = VQ+NQ	♦ CT				1,33	17.38	*
			└→C⊤ = CQ+WQ	♦ CT				1,33	23.92	*
			└→C⊤ = WQ+NQ	♦ CT				1,33	7.22	
			└→C⊤ = VQ+WQ	♦ CT				1,33	7.56	
		L _{ST} = DI	♦ CT					3,99	21.20	*
		└→C⊤ = CQ+NQ	♦ CT				1,33	39.61	*	
			L₀c⊤ = cq+vq	♦ CT				1,33	26.60	*
			└oct = VQ+NQ	♦ CT				1,33	6.82	
			└→C⊤ = CQ+WQ	♦ CT				1,33	16.84	*
			└→CT = WQ+NQ	♦ CT				1,33	11.80	,

... Table 7.7 continued

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 dativesubject 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 frontocentral 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 regions and the fronto-central midline regions. The comparison VQ + NQ was significant in the anterior lateral region. The comparison WQ + NQ was significant in the frontal midline region.

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 sentencetypes 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.

Factor			DF L	DF Lateral Regions				gions
◆ WO			1,33	13.55	***	1,33	12.12	***
◆ ROI × WO			3,99	20.93	***	5,165	24.17	***
└ROI = LA # FZ	◆ WO		1,33	25.03	***	1,33	21.87	***
L _{ROI} = LP ∥ FCZ	◆ WO		1,33	5.74	*	1,33	21.43	***
L _{ROI} = RA∥CZ	◆ WO		1,33	18.13	***	1,33	14.89	***
L _{ROI} = CPZ	◆ WO					1,33	8.01	**
♦ ST			1,33	3.39	☆			
♦ ROI X ST			3,99	8.02	***	5,165	10.14	***
LROI = LA∥FZ	♦ ST		1,33	7.39	**	1,33	7.01	**
L _{ROI} = FCZ	♦ ST					1,33	4.50	*
L _{ROI} = RA	♦ ST		1,33	9.10	**			
L _{ROI} = PZ	♦ ST					1,33	3.45	*
L _{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	***
	└₀ct = 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	***
L _{ROI} = LP ∥ FCZ	♦ CT		3,99	31.16	***	3,99	22.55	***
	└oct = 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	***
LROI = RA∥CZ	♦ CT		3,99	18.04	***	3,99	26.17	***
	$L_{CT} = CQ + NQ$	◆ CT	1,33	8.26	**	1,33	27.50	***
	L→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	***

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

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... Table 7.8 continued

Factor				DF La	teral Reg	gions	DF Midline Regions		
L _{ROI} = RP ∥ CPZ	◆ CT			3,99	25.77	***	3,99	28.48	***
	└→CT = CQ+NQ	♦ CT		1,33	33.47	***	1,33	41.47	***
	└→CT = VQ+NQ	◆ CT		1,33	43.22	***	1,33	45.92	***
	└→CT = WQ+NQ	◆ CT		1,33	54.90	***	1,33	50.77	***
L _{R0I} = PZ	◆ CT						3,99	28.48	***
	└→CT = CQ+NQ	◆ CT					1,33	46.14	***
	└→CT = VQ+NQ	♦ CT					1,33	40.72	***
	└→CT = WQ+NQ	♦ CT					1,33	53.58	***
L _{ROI} = POZ	♦ CT						3,99	23.43	***
	└oct = cQ+NQ	♦ CT					1,33	41.82	***
	└oct = VQ+NQ	◆ CT					1,33	32.56	***
	└→CT = WQ+NQ	♦ CT					1,33	45.90	***
◆ ROI x ST x CT				9,297	5.38	***	15,495	5.57	***
└ROI = LA # FZ	♦ ST X CT			3,99	3.86	**	3,99	4.09	**
	Lst = ds	♦ CT		3,99	12.30	***	3,99	14.91	***
		└→CT = CQ+VQ	♦ CT	1,33	7.82	*	1,33	8.47	**
		└→CT = VQ+NQ	♦ CT	1,33	11.33	**	1,33	11.59	**
		└→CT = CQ+WQ	♦ CT	1,33	20.58	***	1,33	21.76	***
		└→CT = WQ+NQ	♦ CT	1,33	24.14	***	1,33	31.12	***
		└→CT = VQ+WQ	♦ CT	1,33	9.24	**	1,33	11.77	**
	Lst = DI	♦ CT		3,99	14.83	***	3,99	12.04	***
		└→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	**
		└→CT = VQ+NQ	♦ CT	1,33	29.97	***	1,33	30.93	***
		└→CT = CQ+WQ	♦ CT	1,33	7.70	*	1,33	4.89	*
		└→CT = WQ+NQ	♦ CT	1,33	20.02	***	1,33	17.57	***
LROI = FCZ	♦ ST X CT						3,99	2.67	*
	Lst = ds	◆ CT					3,99	15.11	***
		└ct = cQ+VQ	♦ CT				1,33	12.98	**
		└→CT = VQ+NQ	♦ CT				1,33	19.25	***
		└→CT = CQ+WQ	+ CT				1,33	17.97	***
		└→CT = WQ+NQ	• CT				1,33	27.62	***
	L _{ST} = DI	◆ CT					3,99	16.84	***

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	Factor			DF La	ateral Reg	gions	DF M	idline Reg	gions
		L _{CT} = CQ+NQ	• CT				1,33	16.80	***
		L→CT = CQ+VQ	♦ CT				1,33	4.93	*
		└oct = VQ+NQ	♦ CT				1,33	48.95	***
		└→CT = WQ+NQ	♦ CT				1,33	36.78	***
LROI = RA∥CZ	♦ ST X CT			3,99	2.31	*	3,99	2.95	*
	L _{ST} = DS	◆ CT		3,99	14.24	***	3,99	18.17	***
		└oct = cQ+NQ	♦ CT				1,33	10.93	**
		L₀ct = cq+vq	♦ CT	1,33	11.62	**	1,33	11.03	**
		└oct = VQ+NQ	♦ CT	1,33	17.31	***	1,33	30.64	***
		└oct = cQ+WQ	♦ CT	1,33	17.88	***	1,33	9.53	**
		└→CT = WQ+NQ	♦ CT	1,33	25.95	***	1,33	31.05	***
	L _{ST} = DI	◆ CT		3,99	10.14	***	3,99	20.88	***
		└oct = cQ+NQ	♦ CT	1,33	11.37	**	1,33	31.45	***
		L₀ct = cq+vq	♦ CT	1,33	5.19	*			
		└oct = VQ+NQ	♦ CT	1,33	25.67	***	1,33	54.29	***
		└→CT = WQ+NQ	♦ CT	1,33	13.36	***	1,33	42.58	***
LROI = RP ∥ CPZ	♦ ST X CT			3,99	2.50	*	3,99	2.33	*
	L _{ST} = DS	◆ CT		3,99	20.93	***	3,99	19.47	***
		└oct = cQ+NQ	♦ CT	1,33	23.16	***	1,33	21.98	***
		L₀CT = CQ+VQ	♦ CT				1,33	5.52	*
		└oct = VQ+NQ	♦ CT	1,33	33.48	***	1,33	30.80	***
		└oct = WQ+NQ	♦ CT	1,33	36.93	***	1,33	32.11	***
	L _{ST} = DI	♦ 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	***
		└→CT = WQ+NQ	♦ CT	1,33	37.08	***	1,33	43.33	***

... Table 7.8 continued

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 > CO > NO. 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 dativesubject 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 sentencetype x context were significant in the lateral regions alone. The threeway 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 rightposterior 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 + NQand WQ + NQ showed a simple effect of context for both sentencetypes in both regions, whilst the comparisons CQ + VQ and CQ + WQwere significant for the ditransitive sentences in the left-posterior region alone.

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Factor		DF La	teral Reg	gions	DF Midline Regions			
♦ WO			1,33	17.34	***	1,33	14.71	***
♦ ROI × WO			3,99	31.65	***	5,165	34.60	***
L _{ROI} = LA ∥ FZ	♦ WO		1,33	33.61	***	1,33	33.24	***
L _{ROI} = LP ∥ FCZ	♦ WO		1,33	6.74	**	1,33	29.85	***
L _{ROI} = RA ∥ CZ	♦ WO		1,33	27.36	***	1,33	20.03	***
L _{ROI} = CPZ	♦ WO					1,33	8.26	**
♦ ST			1,33	16.14	***	1,33	26.97	***
♦ ROI X ST						5,165	4.61	*
L _{R0I} = FZ	♦ ST					1,33	5.28	*
L _{ROI} = FCZ	♦ ST					1,33	7.07	**
L _{R0I} = CZ	♦ ST					1,33	25.15	***
L _{R0I} = CPZ	♦ ST					1,33	44.04	***
L _{ROI} = PZ	♦ ST					1,33	32.01	***
L _{R0I} = POZ	♦ ST					1,33	18.09	***
♦ ROI × WO × 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	***
L _{ROI} = LA∥FZ	◆ CT		3,99	9.12	***	3,99	7.96	***
	└→C⊤ = 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	*
	└oct = WQ+NQ	♦ CT	1,33	18.30	***	1,33	16.55	***
└ROI = LP # FCZ	◆ CT		3,99	33.21	***	3,99	14.10	***
	└oct = cQ+NQ	♦ CT	1,33	39.67	***	1,33	11.64	**
	└ct = vq+nq	♦ CT	1,33	52.35	***	1,33	29.62	***
	└→C⊤ = CQ+WQ	♦ CT	1,33	4.68	*			
	└→CT = WQ+NQ	♦ CT	1,33	56.08	***	1,33	28.17	***
L _{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	***
L _{ROI} = RP ∥ CPZ	♦ CT		3,99	25.99	***	3,99	30.61	***

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

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 . '	Table	7	.9	continued	l

		Factor			DF La	iteral Reg	gions	DF M	idline Reg	gions
		L _{CT} = CQ+NQ	♦ CT		1,33	32.72	***	1,33	48.46	***
		└→CT = VQ+NQ	♦ CT		1,33	38.31	***	1,33	47.82	***
		└→CT = WQ+NQ	◆ CT		1,33	44.25	***	1,33	52.54	***
L _{ROI} =	ΡZ	◆ CT						3,99	32.13	***
		└oct = cQ+NQ	◆ CT					1,33	54.80	***
		└→CT = VQ+NQ	♦ CT					1,33	46.68	***
		└→CT = WQ+NQ	◆ CT					1,33	54.13	***
L _{R0I} =	P0Z	◆ CT						3,99	27.54	***
		└oct = cQ+NQ	◆ CT					1,33	49.82	***
		└oct = VQ+NQ	♦ CT					1,33	39.85	***
		└oct = WQ+NQ	♦ CT					1,33	43.63	***
♦ WO x CT								3,99	3.22	*
Lwo = da		◆ CT						3,99	16.73	***
		└oct = cQ+NQ	♦ CT					1,33	25.55	***
		└oct = VQ+NQ	♦ CT					1,33	30.94	***
		└→CT = WQ+NQ	◆ CT					1,33	28.07	***
Lwo = AD		◆ CT						3,99	20.22	***
		└oct = cQ+NQ	♦ CT					1,33	26.84	***
		└oct = VQ+NQ	♦ CT					1,33	30.61	***
		└oct = cQ+WQ	♦ CT					1,33	6.07	*
		└oct = WQ+NQ	◆ CT					1,33	42.82	***
♦ ST X CT					3,99	3.08	*			
♦ ROI X ST	х СТ				9,297	2.39	*			
L _{ROI} = LP		♦ ST X CT			3,99	5.14	**			
		L _{ST} = DS	♦ CT		3,99	27.81	***			
			L _{CT} = CQ+NQ	♦ CT	1,33	47.99	***			
			└ct = vq+nq	♦ CT	1,33	39.50	***			
			└oct = WQ+NQ	♦ CT	1,33	44.44	***			
		L _{ST} = DI	♦ CT		3,99	25.38	***			
			L _{CT} = CQ+NQ	♦ CT	1,33	17.12	***			
			$L_{CT} = CQ+VQ$	♦ CT	1,33	10.23	**			
			L _{CT} = VQ+NQ	• CT	1,33	51.43	***			
			L _{CT} = CQ+WQ		1,33	11.23	**			

7.5. RESULTS

	Facto	r		DF La	ateral Reg	gions	DF Midline Regions
		└→CT = WQ+NQ	♦ CT	1,33	48.56	***	
L _{ROI} = RP	♦ ST X CT			3,99	4.99	**	
	L _{ST} = DS	♦ CT		3,99	28.07	***	
		└ct = cQ+NQ	♦ CT	1,33	40.19	***	
		$L_{CT} = VQ + NQ$	♦ CT	1,33	35.51	***	
		└→CT = WQ+NQ	♦ CT	1,33	41.32	***	
	Lst = di	♦ CT		3,99	14.28	***	
		└ct = cQ+NQ	♦ CT	1,33	15.82	***	
		└ct = VQ+NQ	♦ CT	1,33	24.78	***	
		└→CT = WQ+NQ	♦ CT	1,33	28.65	***	

... Table 7.9 continued

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 positivites 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 positivegoing 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 contextinduced 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 positivies elicitied by the mismatch contexts VQ and WQ is along the lines of task-related stimulus categorisation that Roehm et al. (2007) and Kretzschmar (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 verbclass, these contexts necessitate a full lexical access in order to 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 nonneutral 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 sentencetypes 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; Kretzschmar, 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 timewindow 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 particular 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 postivity 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

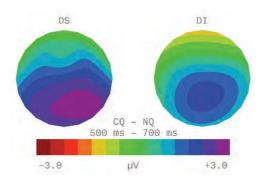


Figure 7.7: Topographic Map for the ERPs at the Verb: 500–700 ms.

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 verbtypes. 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 apperas 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 dativestative 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 ditransitve 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 postive 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 setence-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 contextinduced 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 sentencetype 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, defaultagreement 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 dativestative 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 relies 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 contextdependent accounts? At least two facts in our data speak againt 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 wordorder 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.

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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 questions 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 availabe 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 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 dativesubjects 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 sentenceinitial 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 nativespeaker 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 forthecoming 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 (sp > 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 mentod 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 nonneutral 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 nonneutral 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 sentencetype. 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 worldknowledge. 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 unvails in the same argumentorder 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 /E/ 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 becasue 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 taskrelated. 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 nonneutral contexts in Experiment 3 are almost identical. Therefore, could the late-positivities in Experiment 3 for the stative verbs well be taskrelated, 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 verbending. 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 dativesubjects, 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 taskbased 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 & Schlesewsky, 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 & Schlesewsky, 2006, p. 813) posits a phase that could accommodate these effects. The latest version of the eADM specifies that '[d]epending on the experimental environment 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 latepositivities 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-, intraand 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 dativenominative 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 crosslinguistic perspective from the outset (see Bornkessel & Schlesewsky, 2006, for instance), the bulk of the studies on online language comprehension 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 -

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 nativespeaker 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 hypothesis, 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 availble 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 sentencetypes 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 sentencetype, 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 dativestative 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 dativesubjects 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 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

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ERP Curves

- A -

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.

– B —

Glossing Conventions

Tamil is written in its own alphasyllabic script. Like in all other Brahmiderived 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 consonants 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/.

TAMIL	Ipa	Gloss	Tamil	Ipa	Gloss	TAMIL	Ipa	Gloss
அ	[A]	а	க்	[k],[g],[x],[h]	k, g	ம	[mʌ]	ma
ஆ	[aː]	a:	ាំ	[ŋ]	n(k,g)	மா	[maː]	ma:
	[i]	i	÷	[tʃ],[s],[dʒ],[ʃ]	ch, s	மி	[mi]	mi
नन	[iː]	i:	ஞ்	[ɲ]	ny	ഥ്	[miː]	mi:
ഉ	[u],[w] u,u'	ட்	[t],[d],[r]	t,d	ശ	[mu],[mu] mu,mu'
உள	[uː]	u:	ண்	[ŋ]	n.	ശ	[muː]	mu:
ഒ	[e]	е	த்	[t̪],[d̪],[ð]	th, dh	மெ	[me]	me
୶	[e:]	e:	ந்	[n]	n(dh)	மே	[me:]	me:
器	[AY]	ai	ப்	[p],[b],[ß]	p, b	மை	[mʌy]	mai
ନ୍ତ	[0]	0	ம்	[m]	m	மொ	[mo]	mo
ୢଢ଼	[0:]	0:	ய்	[j]	У	மோ	[moː]	mo:
	[AU]	au	ர்	[1]	r	மௌ	[mʌʊ]	mau
°.	[(?)]	(akh)	ல்	[1]	1	ம்	[m]	m
			ഖ്	[v]	V			
			ழ்	[J]	zh			
			ள்	[l]	1.			
			ற்	[r],[t],[d]	(t)r			
			ன்	[n]	n			
				[-]-]	:			
			ģ	[dʒ]	j - 1-			
			ର୍ଦ୍ଧ	[\$]	sh			
			സ്	[S]	S 1-			
			<u>ബ്</u>	[h]	h			
			ക്ഷ	[kş]	ksh			

Table B.1: Conventions used for phonetic glossing

- 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.

Morphological Gloss	Meaning
[] ^D	Determiner: Noun-modifiers, specifiers or quantifiers; not articles proper
[] ^s	Subject
[] ⁰	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

Table B.2: Conventions used for morphological glossing

— C —

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 versu குமாருக்கு Kuma:r~u'-kku' [Kumar] _{DAT-An.M} 'Kumar knows Ma	மாலாவைத் Ma:la:~v-ai~th [Mala] _{ACC-An.F}	தெரி theri	ியும். Ay-um w] _{Future-3singular.N}	euter
மலைஉச்சியிலிரு Malai-uchchi~y-il- [Hilltop] _{ABL-In} 'The town will be	irundhu' pa:r-th [see] _{Co}	th-a:l	ஊர் u:r [town] _{NOM-In}	தெரியும். theri~y-um [be visible] _{Future-3singular.Neuter}
	குமாரைப் Kuma:r-ai~p [Kumar] _{ACC-An.M} ar'.	pidi-	க்கும். kk-um Future-3singular.Neut	er

பழத்தைப்	போட்டால்	குரங்கு	அதைப்	பிடிக்கும்.			
Pazha~thth-ai~p	po:t.ta: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.

குரங்கு	பந்தைப்	பிடித்தது.	
Kurangu'	pandh-ai~p	pidi-thth-adhu'	
[Monkey] _{NOM-In}	[Ball] _{ACC-In}	[catch] _{Past-3singular.Neuter}	
'The monkey ca	ught 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	hall'	0	

*ரவி	பந்தைப்	பிடித்தது.
Ravi	pandh-ai~p	pidi-thth-adhu'
[Ravi] _{NOM-An.M}	[Ball] _{ACC-In}	[catch] _{Past-3singular.Neuter}
*'Ravi caught the b	all' . (Intended m	leaning)

*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'. (Intended meaning)							

— **D** —

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.

|--|

Example Table Entry		Meaning		
◆ WO		Effect of factor WO		
♦ WO x ST		Effect of the interaction of factors WO and ST		
L _{WO} = SO	♦ ST	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		
LROI = LA ∥ FZ	♦ WO	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; $p \le 0.085$		
*		Significant effect; p <= 0.055		
**		Very significant effect; p <= 0.015		
***		Highly significant effect; $p <= 0.0015$		

- E -

Experiment 1 : Supplement

E.1 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

Table E.1: Explanation of Condition Codes

E.2 Items Distribution Scheme

Table E.2 shows the distribution of the critical items in Experiment 1.

List			Senten	ce Sets		
LISU	01-12	13-24	25-36	37-48	49-60	61-72
	DAS	ADS	ADS	DAS	ADS	DAS
Х	NIA	NAA	NIA	SAI	NIA	NAA
	SAI	SAA	NAA	SAA	SAA	SAI
	ADS	DAS	DAS	ADS	DAS	ADS
Y	NAA	NIA	SAI	NIA	NAA	NIA
	SAA	SAI	SAA	NAA	SAI	SAA

Table E.2: Experiment 1: Distribution scheme for critical items

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.

01DAS முருகனுக்கு ரவியைப் பிடிக்கும். 01ADS ரவியை முருகனுக்குப் பிடிக்கும். 01NIA தண்ணீர் ரவியை நனைத்தது. முருகன் ரவியை நினைத்தான். 01NAA ரவியைத் தண்ணீர் நனைத்தது. 01SAI 01SAA ரவியை முருகன் நினைத்தான். 02DAS ராதாவுக்கு சோமுவைப் பிடிக்காது. 02ADS சோமுவை ராதாவுக்குப் பிடிக்காது. 02NTA உணவு சோமுவைத் தூங்கவைத்தது. 02NAA ராதா சோமுவைக் காதலித்தாள். 02SAI சோமுவை உணவு தூங்கவைத்தது. 02SAA சோமுவை ராதா காதலித்தாள். 03DAS டாக்டருக்கு குணாவைத் தெரியும். 03ADS குணாவை டாக்டருக்குத் தெரியும். மருந்து குணாவை குணமாக்கியது. 03NTA 03NAA டாக்டர் குணாவை குணமாக்கினார். 03SAI குணாவை மருந்து குணமாக்கியது. குணாவை டாக்டர் குணமாக்கினார். 03SAA 04DAS மருத்துவருக்கு செல்வியைத் தெரியாது. 04ADS செல்வியை மருத்துவருக்குத் தெரியாது. 04NTA மாத்திரை செல்வியை குணப்படுத்தியது. 04NAA மருத்துவர் செல்வியை குணப்படுத்தினார் செல்வியை மாத்திரை குணப்படுத்தியது. 04SAT 04SAA செல்வியை மருத்துவர் குணப்படுத்தினார். 05DAS சிவாவுக்கு மனோவைப் பிடிக்கும். மனோவை சிவாவுக்குப் பிடிக்கும். 05ADS 05NIA ஆட்டோ மனோவை மோதியது. சிவா மனோவை மிறட்டினான். 05NAA 05SAI மனோவை ஆட்டோ மோதியது 05SAA மனோவை சிவா மிறட்டினான். பையனுக்கு மோஹனைப் பிடிக்காது. 06DAS 06ADS மோஹனை பையனுக்குப் பிடிக்காது. 06NTA பந்து மோஹனைக் காயப்படுத்தியது. 06NAA பையன் மோஹனைத் திட்டினான். 06SAI மோஹனைப் பந்து காயப்படுத்தியது 06544 மோஹனைப் பையன் திட்டினான். 07DAS மீனாவுக்கு வள்ளியைத் தெரியும். 07ADS வள்ளியை மீனாவுக்குத் தெரியும். பத்தகம் வள்ளியை மகிழ்த்தியது. 07NIA 07NAA மீனா வள்ளியைக் காப்பாற்றினாள். 07SAT வள்ளியைப் புத்தகம் மகிழ்த்தியது. 07SAA வள்ளியை மீனா காப்பாற்றினாள். 08DAS குமாருக்கு ஷீலாவைத் தெரியாது. 08ADS ஷீலாவை குமாருக்குத் தெரியாது. 08NIA புடவை ஷீலாவை அழகுபடுத்தியது. 08NAA குமார் ஷீலாவை மணந்தான். 08SAI ஷீலாவைப் புடவை அழகுபடுத்தியது. 08SAA ஷீலாவைக் குமார் மணந்தான். 09DAS கீதாவுக்கு மாலாவைப் பிடிக்கும்.

Murugan likes Ravi. Murugan likes Ravi. Water drenched Ravi. Murugan thought about Ravi. Water drenched Ravi. Murugan thought about Ravi. Radha doesn't like Somu. Radha doesn't like Somu. Food made Somu feel sleepy. Radha loved Somu. Food made Somu feel sleepy. Radha loved Somu. The doctor knows Guna. The doctor knows Guna. The medicine cured Guna. The doctor cured Guna. The medicine cured Guna The doctor cured Guna. The doctor doesn't know Selvi. The doctor doesn't know Selvi. The tablet cured Selvi. The doctor cured Selvi. The tablet cured Selvi. The doctor cured Selvi. Siva likes Mano Siva likes Mano. The auto-rickshaw hit Mano. Siva threatened Mano. The auto-rickshaw hit Mano. Siva threatened Mano The boy doesn't like Mohan. The boy doesn't like Mohan. The ball hurt Mohan. The boy scolded Mohan. The ball hurt Mohan. The boy scolded Mohan. Meena knows Valli. Meena knows Valli The book made Valli happy. Meena saved Valli. The book made Valli happy. Meena saved Valli. Kumar doesn't know Sheela. Kumar doesn't know Sheela. The saree beautified Sheela. Kumar married Sheela. The saree beautified Sheela. Kumar married Sheela. Geetha likes Mala.

09ADS மாலாவை கீதாவுக்குப் பிடிக்கும். 09NIA அரிவாள் மாலாவைக் குத்தியது. 09NAA கீதா மாலாவைத் துன்புறுத்தினாள். 09SAI மாலாவை அறிவாள் குத்தியது. 09SAA மாலாவை கீதா துன்புறுத்தினாள். 10DAS லதாவுக்கு சூர்யாவைப் பிடிக்காது. சூர்யாவை லதாவுக்குப் பிடிக்காது. 10ADS 10NIA முள் சூர்யாவைக் குத்தியது 10NAA லதா சூர்யாவை உதைத்தாள். 10SAT சூர்யாவை முள் குத்தியது. சூர்யாவை லதா உதைத்தாள். 10SAA 11DAS விஜய்க்கு சிறுமியைத் தெரியும். 11ADS சிறுமியை விஜய்க்குத் தெரியும். 11NIA புயல் சிறுமியை பயமுறுத்தியது. 11NAA விஜய் சிறுமியைக் கொஞ்சினான். 11SAI சிறுமியைப் புயல் பயமுறுத்தியது. 11SAA சிறுமியை விஜய் கொஞ்சினான். 12DAS சுரேஷுக்கு சிறுவனைத் தெரியாது. 12ADS சிறுவனை சுரேஷுக்குத் தெரியாது. 12NIA அம்பு சிறுவனைத் தாக்கியது. 12NAA சுரேஷ் சிறுவனை முறைத்தான். 12SAI சிறுவனை அம்பு தாக்கியது. சிறுவனை சுரேஷ் முறைத்தான். 12SAA 13DAS மோஹனாவுக்கு சேகரைப் பிடிக்கும். 13ADS சேகரை மோனனாவுக்குப் பிடிக்கும். விவேகம் சேகரைக் காப்பாற்றியது. 13NTA 13NAA மோஹனா சேகரைக் காப்பாற்றினாள். சேகரை விவேகம் காப்பாற்றியது. 13SAT 13SAA சேகரை மோனனா காப்பாற்றினாள். 14DAS ரமேஷுக்கு உமாவைப் பிடிக்காது. 14ADS உமாவை ரமேஷுக்குப் பிடிக்காது. 14NIA தேங்காய் உமாவைக் காயப்படுத்தியது. 14NAA ரமேஷ் உமாவைக் கைப்பிடித்தான். உமாவைத் தேங்காய் காயப்படுத்தியது. 14SAI 14SAA உமாவை ரமேஷ் கைப்பிடித்தான். ரஞ்சித்துக்கு உஷாவைத் தெரியும். 15DAS 15ADS உஷாவை ரஞ்சித்துக்குத் தெரியும். 15NIA தோணி உஷாவைக் காப்பாற்றியது. 15NAA ரஞ்சித் உஷாவைக் காப்பாற்றினான். 15SAI உஷாவைத் தோணி காப்பாற்றியது. 15SAA உஷாவை ரஞ்சித் காப்பாற்றினான். 16DAS வாசுவுக்கு கமலாவைத் தெரியாது. 16ADS கமலாவை வாசுவுக்குத் தெரியாது. மழை கமலாவை நனைத்தது. 16NTA 16NAA வாசு கமலாவை மணந்தான். 16SAI கமலாவை மழை நனைத்தது. 16SAA கமலாவை வாசு மணந்தான். 17DAS வினித்துக்கு ரமாவைப் பிடிக்கும். 17ADS ரமாவை வினித்துக்குப் பிடிக்கும்.

Geetha likes Mala. The sickle stabbed Mala. Geetha hurt Mala. The sickle stabbed Mala. Geetha hurt Mala. Latha doesn't like Surya. Latha doesn't like Surya. The thorn pricked Surva. Latha kicked Surya. The thorn pricked Surya. Latha kicked Surya. Vijay knows the little girl. Vijay knows the little girl. The storm frightened the girl. Vijay cuddled the little girl. The storm frightened the girl. Vijay cuddled the little girl. Suresh doesn't know the little boy. Suresh doesn't know the little boy. The arrow hurt the little boy. Suresh frowned at the little boy. The arrow hurt the little boy. Suresh frowned at the little boy. Mohana likes Sekar. Mohana likes Sekar. Prudence saved Sekar. Mohana saved Sekar. Prudence saved Sekar. Mohana saved Sekar. Ramesh doesn't like Uma. Ramesh doesn't like Uma. The coconut nurt Uma. Ramesh married Uma. The coconut nurt Uma. Ramesh married Uma. Ranjith knows Usha. Ranjith knows Usha. The boat saved Usha. Raniith saved Usha. The boat saved Usha. Raniith saved Usha. Vasu doesn't know Kamala. Vasu doesn't know Kamala. The rain drenched Kamala. Vasu married Kamala. The rain drenched Kamala Vasu married Kamala. Vinith likes Ramaa. Vinith likes Ramaa.

17NIA சாவி ரமாவைக் கீறியது. 17NAA வினித் ரமாவைத் திட்டினான். 17SAI ரமாவைச் சாவி கீறியது. ரமாவை வினித் திட்டினான். 17SAA தேவிகாவுக்கு சீதாவைப் பிடிக்காது. 18DAS சீதாவை தேவிகாவுக்குப் பிடிக்காது. 18ADS 18NIA ரோட்ரோலர் சீதாவை இடித்தது. 18NAA தேவிகா சீதாவைத் திட்டினாள். சீதாவை ரோட்ரோலர் இடித்தது. 18SAI 18SAA சீதாவை தேவிகா திட்டினாள். 19DAS உழவனுக்கு சுதாவைத் தெரியும். 19ADS சுதாவை உழவனுக்குத் தெரியும். டிராக்டர் சுதாவை இடித்தது. 19NIA 19NAA உழவன் சுதாவைப் பார்த்தான். சுதாவை டிராக்டர் இடித்தது. 19SAT 19SAA சுதாவை உழவன் பார்த்தான். 20DAS சரிதாவுக்கு அருணைத் தெரியாது. 20ADS அருணை சரிதாவுக்குத் தெரியாது. 20NIA கோபம் அருணை மடமாக்கியது. 20NAA சரிதா அருணை மணந்தாள். 20SAI அருணைக் கோபம் மடமாக்கியது. 20SAA அருணை சரிதா மணந்தாள். 21045 சுந்தருக்கு மஞ்சுவைப் பிடிக்கும். 21ADS மஞ்சுவை சுந்தருக்குப் பிடிக்கும். 21NIA கப்பல் மஞ்சுவைக் காப்பாற்றியது. சுந்தர் மஞ்சுவை அடித்தான். 21NAA மஞ்சுவைக் கப்பல் காப்பாற்றியது. 21SAI 21SAA மஞ்சுவை சுந்தர் அடித்தான். 22DAS ரகுவுக்கு ஆஷாவைப் பிடிக்காது. 22ADS ஆஷாவை ரகுவுக்குப் பிடிக்காது. 22NIA கடிதம் ஆஷாவைப் புகழ்ந்தது. 22NAA ரகு ஆஷாவை விரும்பினான். 22SAI ஆஷாவைக் கடிதம் புகழ்ந்தது. 22SAA ஆஷாவை ரகு விரும்பினான். 23DAS விக்ரமுக்கு பாலுவைத் தெரியும். பாலுவை விக்ரமுக்குத் தெரியும். 23ADS 23NTA பிரேக் பாலுவை உலுக்கியது. 23NAA விக்ரம் பாலுவைக் கிள்ளினான். 23SAI பாலுவை பிரேக் உலுக்கியது. 23SAA பாலுவை விக்ரம் கிள்ளினான் 24DAS பிரபுவுக்கு விசுவைத் தெரியாது. 24ADS விசுவை பிரபுவுக்குத் தெரியாது. 24NIA கத்தி விசுவைக் கீறியது. 24NAA பிரபு விசுவைக் கோபித்தான். 24SAI விசுவைக் கத்தி கீறியது. 24SAA விசுவைப் பிரபு கோபித்தான். 25DAS விஷாலுக்கு தீபாவைப் பிடிக்கும். 25ADS தீபாவை விஷாலுக்குப் பிடிக்கும். 25NIA காற்று தீபாவைத் தள்ளியது.

The key scratched Ramaa. Vinith scolded Ramaa. The key scratched Ramaa. Vinith scolded Ramaa. Devi doesn't like Geetha. Devi doesn't like Geetha. The road-roller hit Seetha. Devika scolded Seetha. The road-roller hit Seetha. Devika scolded Seetha. The farmer knows Sudha. The farmer knows Sudha. The tractor hit Sudha. The farmer looked at Sudha. The tractor hit Sudha. The farmed looked at Sudha. Saritha doesn't know Arun. Saritha doesn't know Arun. Anger made Arun stupid. Saritha married Arun. Anger made Arun stupid. Saritha married Arun. Sundar likes Manju. Sundar likes Manju. The ship saved Manju. Sundar hit Maniu. The ship saved Manju. Sundar hit Manju. Raghu doesn't like Asha. Raghu doesn't like Asha. The letter praised Asha. Ragu loved Asha. The letter praised Asha. Ragu loved Asha. Vikram knows Balu. Vikram knows Balu. The brakes shook Balu. Vikram pinched Balu. The brakes shook Balu. Vikram pinched Balu. Prabhu doesn't know Visu. Prabhu doesn't know Visu. The knife scratched/slit Visu. Prabhu told Visu off. The knife scratched/slit Visu. Prabhu told Visu off. Vishal likes Deepa. Vishal likes Deepa. The wind pushed Deepa over. 25NAA விஷால் தீபாவைக் கேலிசெய்தான். 25SAI தீபாவைக் காற்று தள்ளியது. 25SAA தீபாவை விஷால் கேலிசெய்தான். 26DAS சுஷிலுக்கு தேவியைப் பிடிக்காது. 26ADS தேவியை சுஷிலுக்குப் பிடிக்காது. 26NIA வெயில் தேவியை வாட்டியது சுஷில் தேவியைத் தடுத்தான். 26NAA தேவியை வெயில் வாட்டியது. 26SAI தேவியை சுஷில் தடுத்தான். 26SAA 27DAS ரம்யாவுக்கு ராஜுவைத் தெரியும். ராஜுவை ரம்யாவுக்குத் தெரியும். 27ADS தர்மம் ராஜுவைக் காத்தது. 27NTA 27NAA ரம்யா ராஜுவைத் தேடினாள். 27SAI ராஜுவை தர்மம் காத்தது. ராஜுவை ரம்யா தேடினாள். 27.SAA 28DAS ஹரிக்கு சுனிலைத் தெரியாது. 28ADS சுனிலை ஹரிக்குத் தெரியாது. 28NIA நெருப்பு சுனிலைக் காயப்படுத்தியது. 28NAA ஹரி சுனிலை அடித்தான். சுனிலை நெருப்பு காயப்படுத்தியது. 28SAI 28SAA சுனிலை ஹரி அடித்தான். 29DAS சௌம்யாவுக்கு சச்சினைப் பிடிக்கும். 29405 சச்சினை சௌம்யாவுக்குப் பிடிக்கும். 29NTA புல்டோஸர் சச்சினை இடித்தது. 29NAA சௌம்யா சச்சினைப் பார்த்தாள். சச்சினை புல்டோஸர் இடித்தது. 29SAT சச்சினை சௌம்யா பார்த்தாள். 29SAA முகேஷுக்கு நாஸைப் பிடிக்காது. 30DAS 30ADS நா்ஸை முகேஷுக்குப் பிடிக்காது. 30NIA ஊசி நாஸைக் குத்தியது 30NAA முகேஷ் நா்ஸை முறைத்தான். 30SAI நாஸை ஊசி குத்தியது 30SAA நா்ஸை முகேஷ் முறைத்தான். 31DAS ஷங்கருக்கு குருவைத் தெரியும். 31ADS குருவை ஷங்கருக்குத் தெரியும். 31NIA வெளிச்சம் குருவை எழுப்பியது. 31NAA ஷங்கர் குருவை வணங்கினான். குருவை வெளிச்சம் எழுப்பியது. 31SAI குருவை ஷங்கர் வணங்கினான். 31SAA 32DAS விஜயாவுக்கு பாரியைத் தெரியாது. பாரியை விஜயாவுக்குத் தெரியாது. 32ADS சோம்பல் பாரியைக் கெடுத்தது. 32NIA 32NAA விஜயா பாரியைத் தொட்டாள். 32SAT பாரியைச் சோம்பல் கெடுத்தது. 32SAA பாரியை விஜயா தொட்டாள். 33DAS பிரேமாவுக்கு ராமுவைப் பிடிக்கும். ராமுவை பிரேமாவுக்குப் பிடிக்கும். 33ADS 33NIA கனவு ராமுவை பயமுறுத்தியது. 33NAA பிரேமா ராமுவை நினைத்தாள்.

Vishal made fun of Deepa. The wind pushed Deepa over. Vishal made fun of Deepa. Sushil doesn't like Devi. Sushil doesn't like Devi. The sunshine made Devi tired. Sushil hindered Devi. The sunshine made Devi tired. Sushil hindered Devi. Ramva knows Raju. Ramya knows Raju. Charity saved Raju. Ramva looked for Raju. Charity saved Raju. Ramya looked for Raju. Hari doesn't know Sunil. Hari doesn't know Sunil. The fire hurt/wounded Sunil. Hari hit Sunil The fire hurt/wounded Sunil. Hari hit Sunil. Sowmya likes Sachin. Sowmya likes Sachin. The bulldozer hit Sachin. Sowmya looked at Sachin. The bulldozer hit Sachin. Sowmya looked at Sachin. Mukesh doesn't like the Nurse Mukesh doesn't like the Nurse. The needle pricked the nurse. Mukesh frowned at the nurse. The needle pricked the nurse. Mukesh frowned at the nurse. Shankar knows Guru. Shankar knows Guru. Brightness wooke Guru up. Shankar greeted Guru. Brightness wooke Guru up. Shankar greeted Guru. Vijaya doesn't know Paari. Vijaya doesn't know Paari. Laziness spoilt Pari. Vijaya touched Pari. Laziness spoilt Pari. Vijaya touched Pari. Prema likes Ramu. Prema likes Ramu. The dream frightened Ramu. Prema thought about Ramu.

33SAI ராமுவைக் கனவு பயமுறுத்தியது. 33SAA ராமுவைப் பிரேமா நினைத்தாள். 34DAS வருணுக்கு ரதியைப் பிடிக்காது. 34ADS ரதியை வருணுக்குப் பிடிக்காது. விமானம் ரதியை வியக்கவைத்தது. 34NIA 34NAA வருண் ரதியைப் பார்த்தான். ரதியை விமானம் வியக்கவைத்தது. 34SAI 34SAA ரதியை வருண் பார்த்தான். 35DAS ரம்பாவுக்கு தருணைத் தெரியும். தருணை ரம்பாவுக்குத் தெரியும். 35ADS 35NIA ரயில் தருணைக் கொண்டுசேர்த்தது. 35NAA ரம்பா தருணை காதலித்தாள். 35SAI தருணை ரயில் கொண்டுசோத்தது. 35SAA தருணை ரம்பா காதலித்தாள். உமேஷுக்கு சீனுவைத் தெரியாது. 36DAS 36ADS சீனுவை உமேஷுக்குத் தெரியாது. 36NIA சோப் சீனுவை மகிழ்த்தியது உமேஷ் சீனுவைக் கேலிசெய்தான். 36NAA 36SAI சீனுவை சோப் மகிழ்த்தியது சீனுவை உமேஷ் கேலிசெய்தான். 36SAA 37DAS சோமுவுக்கு கீதாவைப் பிடிக்கும். 37ADS கீதாவை சோமுவுக்குப் பிடிக்கும். தாகம் கீதாவை வாட்டியது. 37NTA 37NAA சோமு கீதாவை நினைத்தான். 37SAI கீதாவைத் தாகம் வாட்டியது. கீதாவை சோமு நினைத்தான். 37SAA 38DAS சுதாவுக்கு தேவிகாவைப் பிடிக்காது. 38ADS தேவிகாவை சுதாவுக்குப் பிடிக்காது. பசி தேவிகாவை வாட்டியது. 38NIA 38NAA சுதா தேவிகாவைக் கிள்ளினாள். 38SAI தேவிகாவைப் பசி வாட்டியது. 38SAA தேவிகாவை சுதா கிள்ளினாள். 39DAS மனோவுக்கு சுஷிலைத் தெரியும். 39ADS சுஷிலை மனோவுக்குத் தெரியும். 39NIA வலி சுஷிலைக் கொன்றது. மனோ சுஷிலை மிறட்டினான். 39NAA 39SAI சுஷிலை வலி கொன்றது. 39SAA சுஷிலை மனோ மிறட்டினான். 40DAS மஞ்சுவுக்கு குமாரைத் தெரியாது. 40ADS குமாரை மஞ்சுவுக்குத் தெரியாது. 40NIA நோய் குமாரைப் பயமுறுத்தியது. 40NAA மஞ்சு குமாரைத் திட்டினாள். 40SAI குமாரை நோய் பயமுறுத்தியது. 40SAA குமாரை மஞ்சு திட்டினாள். 41DAS சிறுமிக்கு விக்ரமைப் பிடிக்கும். 41ADS விக்ரமை சிறுமிக்குப் பிடிக்கும். 41NIA கல் விக்ரமைத் தாக்கியது. 41NAA சிறுமி விக்ரமைப் பார்த்தாள். 41SAI விக்ரமைக் கல் தாக்கியது.

The dream frightened Ramu. Prema thought about Ramu. Varun doesn't like Rathi. Varun doesn't like Rathi. The plane surprised Rathi. Varun saw Rathi. The plane surprised Rathi. Varun saw Rathi. Ramba likes Tarun. Ramba likes Tarun. The train made Tarun reach safely. Ramba loved Tarun. The train made Tarun reach safely. Ramba loved Tarun. Umesh doesn't know Seenu. Umesh doesn't know Seenu. The soap amused Seenu. Umesh made fun of Seenu. The soap amused Seenu. Umesh made fun of Seenu. Somu likes Geetha. Somu likes Geetha. The thirst made Geetha tired. Somu thought about Geetha. The thirst made Geetha tired. Somu thought about Geetha. Sudha doesn't like Devika. Sudha doesn't like Devika. The hunger made Devika tired. Sudha pinched Devika. The hunger made Devika tired. Sudha pinched Devika. Mano knows Sushil. Mano knows Sushil. The pain killed Sushil Mano threatened Sushil. The pain killed Sushil. Mano threatened Sushil. Maniu doesn't know Kumar. Manju doesn't know Kumar. Disease frightened Kumar. Maniu scolded Kumar. Disease frightened Kumar. Manju scolded Kumar. The little girl likes Vikram. The little girl likes Vikram. The stone hurt Vikram. The little girl looked at Vikram. The stone hurt Vikram.

விக்ரமைச் சிறுமி பார்த்தாள். 41SAA 42DAS குணாவுக்கு பையனைப் பிடிக்காது. 42ADS பையனை குணாவுக்குப் பிடிக்காது. 42NIA கடல் பையனை மூழ்கடித்தது. 42NAA குணா பையனைக் காப்பாற்றினான். 42SAI பையனைக் கடல் மூழ்கடித்தது. பையனை குணா காப்பாற்றினான். 42SAA 43DAS மோஹனாவுக்கு லதாவைத் தெரியும். 43ADS லதாவை மோஹனாவுக்குத் தெரியும். 43NTA கண்ணாடி லதாவைக் கீறியது. மோஹன் லதாவை விரும்பினான். 43NAA லதாவைக் கண்ணாடி கீறியது. 43SAT 43SAA லதாவை மோஹன் விரும்பினான். 44DAS வள்ளிக்கு மருத்துவரைத் தெரியாது. 44ADS மருத்துவரை வள்ளிக்குத் தெரியாது. 44NIA அறிவு மருத்துவரை புகழடையச்செய்தது. 44NAA வள்ளி மருத்துவரை மணந்தாள். 44SAI மருத்துவரை அறிவு புகழடையச்செய்தது. 44SAA மருத்துவரை வள்ளி மணந்தாள். 45DAS உமாவுக்கு சுரேஷைப் பிடிக்கும். 45ADS சுரேஷை உமாவுக்குப் பிடிக்கும். 45NIA பழம் சுரேஷை மகிழவைத்தது. **45NAA** உமா சுரேஷை மணந்தாள். 45SAT சுரேஷைப் பழம் மகிழவைத்தது. 45SAA சுரேஷை உமா மணந்தாள். 46DAS பாலுவுக்கு ரஞ்சித்தைப் பிடிக்காது. ரஞ்சித்தை பாலுவுக்குப் பிடிக்காது. 46ADS 46NTA வயல் ரஞ்சித்தை வியக்கவைத்தது. 46NAA பாலு ரஞ்சித்தைக் கேலிசெய்தான். 46SAI ரஞ்சித்தை வயல் வியக்கவைத்தது. ரஞ்சித்தை பாலு கேலிசெய்தான். 46SAA 47DAS சச்சினுக்கு ரமேஷைத் தெரியும். 47ADS ரமேஷை சச்சினுக்குத் தெரியும். கவனம் ரமேஷைக் காப்பாற்றியது. 47NIA 47NAA சச்சின் ரமேஷைக் கோபித்தான். 475AT ரமேஷை கவனம் காப்பாற்றியது. ரமேஷை சச்சின் கோபித்தான். 47SAA 48DAS சிறுவனுக்கு மோஹனாவைத் தெரியாது. மோஹனாவை சிறுவனுக்குத் தெரியாது. 48ADS 48NIA பூட்டு மோஹனாவைக் காயப்படுத்தியது. 48NAA சிறுவன் மோஹனாவை அடித்தான். 48SAI மோனுனாவைப் பூட்டு காயப்படுத்தியது. 48SAA மோஹனாவைச் சிறுவன் அடித்தான். 49DAS சூர்யாவுக்கு ஹரியைப் பிடிக்கும். 49ADS ஹரியை சூர்யாவுக்குப் பிடிக்கும். **49NTA** காகிதம் ஹரியை எழுதத்தூண்டியது. 49NAA சூர்யா ஹரியை வெறுத்தான். 49SAI ஹரியைக் காகிதம் எழுதத்தூண்டியது. 49SAA ஹரியை சூர்யா வெறுத்தான்.

The little girl looked at Vikram. Guna doesn't like the little boy. Guna doesn't like the little boy. The sea made the boy drown. Guna saved the boy. The sea made the boy drown. Guna saved the boy. Mohana knows Latha. Mohana knows Latha. The glass scratched/slit Latha. Mohan loved Latha. The glass scratched/slit Latha. Mohan loved Latha. Valli doesn't know the doctor. Valli doesn't know the doctor. The intellect made the doctor famous. Valli married the doctor. The intellect made the doctor famous. Valli married the doctor. Uma likes Suresh. Uma likes Suresh. The fruit made Suresh happy. Uma married Suresh. The fruit made Suresh happy. Uma married Suresh. Balu doesn't like Raniith. Balu doesn't like Ranjith. The field surprised Ranjith. Balu made fun of Ranjith. The field surprised Ranjith. Balu made fun of Ranjith. Sachin knows Ramesh. Sachin knows Ramesh. Attention saved Ramesh. Sachin was angry at Ramesh. Attention saved Ramesh. Sachin was angry at Ramesh. The little boy doesn't know Mohana. The little boy doesn't know Mohana. The lock hurt Mohana. The little boy hit Mohana. The lock hurt Mohana. The little boy hit Mohana. Surva likes Hari. Surya likes Hari. The paper tempted Hari to write. Surva hated Hari. The paper tempted Hari to write. Surya hated Hari.

50DAS உஷாவுக்கு பிரேமாவைப் பிடிக்காது. 50ADS பிரேமாவை உஷாவுக்குப் பிடிக்காது. 50NIA கதை பிரேமாவை அழவைத்தது உஷா பிரேமாவைத் திட்டினாள். 50NAA பிரேமாவைக் கதை அழவைத்தது. 50SAI 50SAA பிரேமாவை உஷா திட்டினாள். சேகருக்கு மீனாவைத் தெரியும். 51DAS 51ADS மீனாவை சேகருக்குத் தெரியும். 51NIA சேலை மீனாவை அழகுபடுத்தியது. சேகர் மீனாவை விரும்பினான் 51NAA 51SAI மீனாவை சேலை அழகுபடுத்தியது. 51SAA மீனாவை சேகர் விரும்பினான். 52DAS ரமாவுக்கு பிரபுவைத் தெரியாது. 52ADS பிரபுவை ரமாவுக்குத் தெரியாது. மரம் பிரபுவை வியக்கவைத்தது. 52NTA 52NAA ரமா பிரபுவைத் தடுத்தாள். 52SAI பிரபுவை மரம் வியக்கவைத்தது 52SAA பிரபுவை ரமா தடுத்தாள். 53DAS ராஜுவுக்கு விஜயாவைப் பிடிக்கும். 53ADS விஜயாவை ராஜுவுக்குப் பிடிக்கும். 53NIA கயிறு விஜயாவைக் காப்பாற்றியது. 53NAA ராஜு விஜயாவைக் காப்பாற்றினான். விஜயாவைக் கயிறு காப்பாற்றியது. 53SAI 53SAA விஜயாவை ராஜு காப்பாற்றினான். 54DAS கமலாவுக்கு விஷாலைப் பிடிக்காது. 54ADS விஷாலை கமலாவுக்குப் பிடிக்காது. 54NIA விபத்து விஷாலைக் கொன்றது. 54NAA கமலா விஷாலைக் காதலித்தாள். 54SAI விஷாலை விபத்து கொன்றது 54SAA விஷாலை கமலா காதலித்தாள். 55DAS ராமுவுக்கு ரம்யாவைத் தெரியும். 55ADS ரம்யாவை ராமுவுக்குத் தெரியும். 55NTA ஆறு ரம்யாவை மூழ்கடித்தது. 55NAA ராமு ரம்யாவைக் கைப்பிடித்தான். 55SAI ரம்யாவை ஆறு மூழ்கடித்தது. 55544 ரம்யாவை ராமு கைப்பிடித்தான். சீதாவுக்கு டாக்டரைத் தெரியாது. 56DAS 56ADS டாக்டரை சீதாவுக்குத் தெரியாது. 56NIA தக்காளி டாக்டரைச் சிரிக்கவைத்தது. 56NAA சீதா டாக்டரைத் திட்டினாள். 56SAI டாக்டரைத் தக்காளி சிரிக்கவைத்தது. டாக்டரை சீதா திட்டினாள். 56SAA 57DAS மாலாவுக்கு சரிதாவைப் பிடிக்கும். 57ADS சரிதாவை மாலாவுக்குப் பிடிக்கும். 57NIA ஆட்டம் சரிதாவை மகிழ்த்தியது. 57NAA மாலா சரிதாவை நம்பினாள். 57SAI சரிதாவை ஆட்டம் மகிழ்த்தியது 57SAA சரிதாவை மாலா நம்பினாள். 58DAS பாரிக்கு ராதாவைப் பிடிக்காது.

Usha doesn't like Prema. Usha doesn't like Prema. The story made Prema cry. Usha scolded Prema. The story made Prema cry. Usha scolded Prema. Sekar knows Meena. Sekar knows Meena. The saree beautified Meena. Sekar loved Meena. The saree beautified Meena. Sekar loved Meena Ramaa doesn't know Prabhu. Ramaa doesn't know Prabhu. The tree surprised Prabhu. Ramaa hindered Prabhu. The tree surprised Prabhu. Ramaa hindered Prabhu. Raju likes Vijaya. Raju likes Vijaya. The rope saved Vijaya. Raju saved Vijaya. The rope saved Vijaya. Raju saved Vijaya. Kamala doesn't like Vishal. Kamala doesn't like Vishal. The accident killed Vishal. Kamala loved Vishal. The accident killed Vishal. Kamala loved Vishal. Ramu knows Ramya. Ramu knows Ramya. The river made Ramya drown. Ramu married Ramva. The river made Ramya drown. Ramu married Ramya. Seetha doesn't know the doctor. Seetha doesn't know the doctor. The tomate made the doctor laugh. Seetha scolded the doctor. The tomate made the doctor laugh. Seetha scolded the doctor. Mala likes Saritha. Mala likes Saritha. The match amused Saritha. Mala trusted Saritha. The match amused Saritha. Mala trusted Saritha. Paari doesn't like Radha.

ராதாவை பாரிக்குப் பிடிக்காது. 58ADS 58NIA சாலை ராதாவை வழுக்கிவிழவைத்தது. 58NAA பாரி ராதாவைக் காதலித்தான். ராதாவைச் சாலை வழுக்கிவிழவைத்தது. 58SAI 58SAA ராதாவைப் பாரி காதலித்தான். 59DAS ரதிக்கு சுந்தரைத் தெரியும். 59ADS சுந்தரை ரதிக்குத் தெரியும். 59NTA கார் சுந்தரை இடித்தது 59NAA ரதி சுந்தரை ஏமாற்றினாள். 59SAI சுந்தரை கார் மோதியது. 59SAA சுந்தரை ரதி ஏமாற்றினாள். 60DAS சுனிலுக்கு வருணைத் தெரியாது. 60ADS வருணை சுனிலுக்குத் தெரியாது. 60NIA நூல் வருணை வியக்கவைத்தது. 60NAA சுனில் வருணை எழுப்பினான். வருணை நூல் வியக்கவைத்தது. 60SAI 60SAA வருணை சுனில் எழுப்பினான். 61DAS தீபாவுக்கு முருகனைப் பிடிக்கும். 61ADS முருகனை தீபாவுக்குப் பிடிக்கும். 61NTA விளக்கு முருகனைச் சுட்டது. 61NAA தீபா முருகனைத் தொட்டாள். 61SAI முருகனை விளக்கு சுட்டது. முருகனை தீபா தொட்டாள். 61544 62DAS விசுவுக்கு உழவனைப் பிடிக்காது. 62ADS உழவனை விசுவுக்குப் பிடிக்காது. 62NTA செடி உழவனை மகிழ்த்தியது. 62NAA விசு உழவனை முறைத்தான். 62SAT உழவனைச் செடி மகிழ்த்தியது. 62SAA உழவனை விசு முறைத்தான். தேவிக்கு வினித்தைத் தெரியும். 63DAS வினித்தை தேவிக்குத் தெரியும். 63ADS 63NIA வீடு வினித்தைக் காப்பாற்றியது. தேவி வினித்தை அடித்தாள். 63NAA 63SAI வினித்தை வீடு காப்பாற்றியது. 63SAA வினித்தை தேவி அடித்தாள். ஆஷாவுக்கு வாசுவைத் தெரியாது. 64DAS 64ADS வாசுவை ஆஷாவுக்குத் தெரியாது. 64NIA குப்பை வாசுவை ஓடவைத்தது. . ஆஷா வாசுவை நினைத்தாள். 64NAA 64SAI வாசுவைக் குப்பை ஒடவைத்தது. வாசுவை ஆஷா நினைத்தாள். 64SAA தருணுக்கு ரம்பாவைப் பிடிக்கும். 65DAS 65ADS ரம்பாவை தருணுக்குப் பிடிக்கும். 65NTA சுவர் ரம்பாவைத் தடுத்தது. 65NAA தருண் ரம்பாவைக் கேலிசெய்தான். 65SAT ரம்பாவைச் சுவர் தடுத்தது. 65SAA ரம்பாவைத் தருண் கேலிசெய்தான். 66DAS சீனுவுக்கு விஜயைப் பிடிக்காது. 66ADS விஜயை சீனுவுக்குப் பிடிக்காது.

Paari doesn't like Radha. The road made Radha fall. Pari loved Radha. The road made Radha fall. Pari loved Radha. Rathi knows Sundar. Rathi knows Sundar. The car hit Sundar. Rathi cheated Sundar. The car hit Sundar. Rathi cheated Sundar. Sunil doesn't know Varun. Sunil doesn't know Varun. The thread surprised Varun. Sunil woke Varun up. The thread surprised Varun. Sunil woke Varun up. Deepa likes Murugan. Deepa likes Murugan. The lamp hurt Murugan. Deepa touched Murugan. The lamp hurt Murugan. Deepa touched Murugan. Visu doesn't like the farmer. Visu doesn't like the farmer. The plant amused the farmer. Visu frowned at the farmer. The plant amused the farmer. Visu frowned at the farmer. Devi knows Vinith Devi knows Vinith. The house saved Vinith. Devi hit Vinith. The house saved Vinith. Devi hit Vinith Asha doesn't know Vasu. Asha doesn't know Vasu. The litter made Vasu run (away). Asha thought about Vasu. The litter made Vasu run (away). Asha thought about Vasu. Tarun likes Ramba. Tarun likes Ramba. The wall hindered Ramba. Tarun made fun of Ramba. The wall hindered Ramba. Tarun made fun of Ramba. Seenu doesn't like Vijay. Seenu doesn't like Vijay.

பலூன் விஜயை மகிழ்த்தியது. 66NIA சீனு விஜயை நினைத்தான். 66NAA 66SAI விஜயை பலூன் மகிழ்த்தியது. விஜயை சீனு நினைத்தான். 66SAA 67DAS ரவிக்கு சௌம்யாவைத் தெரியும். 67ADS சௌம்யாவை ரவிக்குத் தெரியும். இருள் சௌம்யாவைப் பயமுறுத்தியது. 67NIA 67NAA ரவி சௌம்யாவைப் பார்த்தான். சௌம்யாவை இருள் பயமுறுத்தியது. 67SAI 67SAA சௌம்யாவை ரவி பார்த்தான். 68DAS ஷீலாவுக்கு உமேஷைத் தெரியாது. 68ADS உமேஷை ஷீலாவுக்குத் தெரியாது. 68NIA வேலை உமேஷை சோர்வடையச்செய்கது. 68NAA ஷீலா உமேஷை நம்பினாள். ். உமேஷை வேலை சோர்வடையச்செய்தது. 68SAT உமேஷை ஷீலா நம்பினாள். 68SAA செல்விக்கு முகேஷைப் பிடிக்கும். 69DAS முகேஷை செல்விக்குப் பிடிக்கும். 69ADS 69NIA தூக்கம் முகேஷைத் தெளிவுபடுத்தியது. செல்வி முகேஷை உதைத்தாள். 69NAA முகேஷைத் தூக்கம் தெளிவுபடுத்தியது. 69SAI முகேஷைச் செல்வி உதைத்தாள். 69SAA 70DAS குருவுக்கு ரகுவைப் பிடிக்காது. 70ADS ரகுவை குருவுக்குப் பிடிக்காது. தரை ரகுவை வழுக்கிவிழவைத்தது. 70NIA குரு ரகுவை கெஞ்சினான். 70NAA 70SAI ரகுவைத் தரை வழுக்கிவிழவைத்தது. ரகுவை குரு கெஞ்சினான். 70SAA 71DAS நாஸுக்கு சிவாவைத் தெரியும். . சிவாவை நா்ஸுக்குத் தெரியும். 71ADS மின்னல் சிவாவை பயமுறுத்தியது. 71NIA 71NAA நர்ஸ் சிவாவை குணப்படுத்தினாள். சிவாவை மின்னல் பயமுறுத்தியது. 71SAI 71SAA சிவாவை நாஸ் குணப்படுத்தினாள். 72DAS அருணுக்கு ஷங்கரைத் தெரியாது. 72ADS ஷங்கரை அருணுக்குத் தெரியாது. அழுக்கு ஷங்கரை அழவைத்தது. 72NIA 72NAA அருண் ஷங்கரை அடித்தான். 72SAI ஷங்கரை அழுக்கு அழவைத்தது. 72SAA ஷங்கரை அருண் அடித்தான்.

The balloon amused Vijay. Seenu thought about Vijay. The balloon amused Vijay. Seenu thought about Vijay. Ravi knows Sowmya. Ravi knows Sowmya. Darkness frightened Sowmya. Ravi looked at Sowmya. Darkness frightened Sowmya. Ravi saw Sowmva. Sheela doesn't know Umesh. Sheela doesn't know Umesh. Work made Umesh tired. Sheela trusted Umesh. Work made Umesh tired. Sheela trusted Umesh. Selvi likes Mukesh. Selvi likes Mukesh. Sleep made Mukesh feel better. Selvi kicked Mukesh. Sleep made Mukesh feel better. Selvi kicked Mukesh. Guru doesn't like Ragu. Guru doesn't like Ragu. The floor made Ragu slip and fall. Guru pleaded Ragu (for something). The floor made Ragu slip and fall. Guru pleaded Ragu (for something). The nurse knows Siva. The nurse knows Siva. The lightning frightened Siva. The nurse cured Siva. The lightning frightened Siva. The nurse cured Siva. Arun doesn't know Shankar. Arun doesn't know Shankar. The dirt made Shankar cry. Arun beat Shankar. The dirt made Shankar crv. Arun beat Shankar.

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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.

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.3: Mean Duration of Bare NPs

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 reveraled a simple effect of subjecttype in the comparisons NI + DS and NA + DS. For the pause intervening NP2 and the verb, there were main effects of word-order and subjecttype. 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 subjecttypes 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.

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.4: Mean Duration of the intervening pauses

Table E.5: Effects on the Duration of the intervening pauses

	Factor		DF	Pau	ise1	Paus	e2
♦ WO			1,71			5.39	*
♦ ST			2,142	8.71	***	4.97	**
♦WO x ST			2,142	2.56	☆	6.30	**
Lwo = 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	***
	L _{ST} = NA+DS	♦ ST	1,71	8.07	**	5.94	*

— * —

— F —

Experiment 2 : Supplement

F.1 Condition Codes

	1		
Condition Code	NP1	NP2	Verb
DAS	DAT-An Subject	ACC-An Object	Dative-Stative

Table F.1: Explanation of Condition Codes

	-	-	
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.

	Sentence Sets					
List	01-12	13-24	25-36	37-48	49-60	61-72
	ADS	DAS	DAI	DAS	DAI	DAS
	ADI	DAI	ADI	ADS	ADS	ADI
А	NIA	NAA	NIA	SAI	NIA	NAA
	SAI	SAA	NAA	SAA	SAA	SAI
	FII	FIA	FII	FPI	FII	FIA
	FPI	FPA	FIA	FPA	FPA	FPI
	DAS	ADS	DAS	DAI	DAS	DAI
	DAI	ADI	ADS	ADI	ADI	ADS
В	NAA	NIA	SAI	NIA	NAA	NIA
	SAA	SAI	SAA	NAA	SAI	SAA
	FIA	FII	FPI	FII	FIA	FII
	FPA	FPI	FPA	FIA	FPI	FPA

Table F.2: Experiment 1: Distribution scheme for critical items and Fillers

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.

01DAS முருகனுக்கு ரவியைப் பிடிக்கும். முருகனுக்கு ரவியைக் காட்டினேன். 01DAI 01ADS ரவியை முருகனுக்குப் பிடிக்கும். ரவியை முருகனுக்கு ஞாபகப்படுத்தினேன். 01ADI 02DAS ராதாவுக்கு சோமுவைப் பிடிக்காது. ராதாவுக்கு சோமுவை மணம்செய்துவைத்தேன். 02DAI சோமுவை ராதாவுக்குப் பிடிக்காது. 02ADS 02ADI சோமுவை ராதாவுக்கு அறிமுகப்படுத்தினேன். 03DAS டாக்டருக்கு குணாவைத் தெரியும். 03DAT டாக்டருக்கு குணாவை அறிமுகப்படுத்தினேன். குணாவை டாக்டருக்குத் தெரியும். 03ADS 03ADT கணாவை டாக்டருக்குக் காட்டினேன். 04DAS மருத்துவருக்கு செல்வியைத் தெரியாது. 04DAI மருத்துவருக்கு செல்வியை ஞாபகப்படுத்தினேன். செல்வியை மருத்துவருக்குத் தெரியாது. 04ADS செல்வியை மருத்துவருக்கு மணம்செய்துவைத்தேன். I married Selvi off to the doctor. 04ADI 05DAS சிவாவுக்கு மனோவைப் பிடிக்கும். சிவாவுக்கு மனோவைக் காட்டினேன். 05DAI 05ADS மனோவை சிவாவுக்குப் பிடிக்கும். மனோவை சிவாவுக்கு ஞாபகப்படுத்தினேன். 05ADT 06DAS பையனுக்கு மோஹனைப் பிடிக்காது. 06DAI பையனுக்கு மோஹனை ஞாபகப்படுத்தினேன். மோஹனை பையனுக்குப் பிடிக்காது. 06ADS 06ADT மோஹனை பையனுக்கு அறிமுகப்படுத்தினேன். 07DAS மீனாவுக்கு வள்ளியைத் தெரியும். மீனாவுக்கு வள்ளியை அறிமுகப்படுத்தினேன். 07DAT 07ADS வள்ளியை மீனாவுக்குத் தெரியும். 07ADT வள்ளியை மீனாவுக்குக் காட்டினேன். 08DAS குமாருக்கு ஷீலாவைத் தெரியாது. 08DAT குமாருக்கு ஷீலாவை மணம்செய்துவைத்தேன். 08ADS ஷீலாவை குமாருக்குத் தெரியாது. 08ADI ஷீலாவை குமாருக்குக் காட்டினேன். 09DAS கீதாவுக்கு மாலாவைப் பிடிக்கும். 09DAI கீதாவுக்கு மாலாவைக் காட்டினேன். 09ADS மாலாவை கீதாவுக்குப் பிடிக்கும். 09ADI மாலாவை கீதாவுக்கு அறிமுகப்படுத்தினேன். 10DAS லதாவுக்கு சூர்யாவைப் பிடிக்காது. லதாவுக்கு சூர்யாவை மணம்செய்துவைத்தேன். 10DAI 10ADS சூர்யாவை லதாவுக்குப் பிடிக்காது 10ADI சூர்யாவை லதாவுக்கு அறிமுகப்படுத்தினேன். விஜய்க்கு சிறுமியைத் தெரியும். 11DAS விஜய்க்கு சிறுமியை அறிமுகப்படுத்தினேன். 11DAI 11ADS சிறுமியை விஜய்க்குத் தெரியும். சிறுமியை விஜய்க்கு ஞாபகப்படுத்தினேன். 11ADT 12DAS சுரேஷுக்கு சிறுவனைத் தெரியாது. 12DAT சுரேஷுக்கு சிறுவனை ஞாபகப்படுத்தினேன். சிறுவனை சுரேஷுக்குத் தெரியாது. 12ADS சிறுவனை சுரேஷுக்குக் காட்டினேன். 12ADI 13DAS மோஹனாவுக்கு சேகரைப் பிடிக்கும்.

Murugan likes Ravi. I showed Ravi to Murugan. Murugan likes Ravi. I reminded Murugan about Ravi. Radha doesn't like Somu. I married Somu to Radha. Radha doesn't like Somu. I introduced Somu to Radha. The doctor knows Guna. I introduced Guna to the doctor. The doctor knows Guna. I showed Guna to the doctor. The doctor doesn't know Selvi. I reminded the doctor about Selvi. The doctor doesn't know Selvi. Siva likes Mano. I showed Mano to Siva. Siva likes Mano. I reminded Siva about Mano. The boy doesn't like Mohan. I reminded the boy about Mohan. The boy doesn't like Mohan. I introduced Mohan to the boy. Meena knows Valli. I introduced Valli to Meena. Meena knows Valli. I showed Valli to Meena. Kumar doesn't know Sheela. I married Sheela off to Kumar. Kumar doesn't know Sheela. I showed Sheela to Kumar. Geetha likes Mala. I showed Mala to Geetha. Geetha likes Mala. I introduced Mala to Geetha. Latha doesn't like Surya. I married Surya off to Latha. Latha doesn't like Surva. I introduced Surya to Latha. Vijay knows the little girl. I introduced the little girl to Vijay. Vijay knows the little girl. I reminded Vijay abt. the ltl. girl. Suresh doesn't know the little boy. I reminded Suresh abt. the ltl. boy. Suresh doesn't know the little boy. I showed the little boy to Suresh. Mohana likes Sekar.

13DAI மோஹனாவுக்கு சேகரைக் காட்டினேன். 13ADS சேகரை மோஹனாவுக்குப் பிடிக்கும். 13ADI சேகரை மோஹனாவுக்கு மணம்செய்துவைத்தேன். 14DAS ரமேஷுக்கு உமாவைப் பிடிக்காது. ரமேஷுக்கு உமாவை அறிமுகப்படுத்தினேன். 14DAI உமாவை ரமேஷுக்குப் பிடிக்காது. 14ADS உமாவை ரமேஷுக்கு மணம்செய்துவைத்தேன். 14ADI 15DAS ரஞ்சித்துக்கு உஷாவைத் தெரியும். 15DAI ரஞ்சித்துக்கு உஷாவை மணம்செய்துவைத்தேன். உஷாவை ரஞ்சித்துக்குத் தெரியும். 15ADS உஷாவை ரஞ்சித்துக்கு ஞாபகப்படுத்தினேன். 15ADI 16DAS வாசுவுக்கு கமலாவைத் தெரியாது. 16DAI வாசுவுக்கு கமலாவை ஞாபகப்படுத்தினேன். 16ADS கமலாவை வாசுவுக்குத் தெரியாது. 16ADT கமலாவை வாசுவுக்கு அறிமுகப்படுத்தினேன். 17DAS வினித்துக்கு ரமாவைப் பிடிக்கும். 17DAI வினித்துக்கு ரமாவை அறிமுகப்படுத்தினேன். 17ADS ரமாவை வினித்துக்குப் பிடிக்கும். 17ADI ரமாவை வினித்துக்கு மணம்செய்துவைத்தேன். 18DAS தேவிகாவுக்கு சீதாவைப் பிடிக்காது. 18DAT தேவிகாவுக்கு சீதாவைக் காட்டினேன். 18ADS சீதாவை தேவிகாவுக்குப் பிடிக்காது. சீதாவை தேவிகாவுக்கு ஞாபகப்படுத்தினேன். 18ADI 19DAS உழவனுக்கு சுதாவைத் தெரியும். 19DAI உழவனுக்கு சுதாவை ஞாபகப்படுத்தினேன். 19ADS சுதாவை உழவனுக்குத் தெரியும். சுதாவை உழவனுக்கு மணம்செய்துவைத்தேன். 19ADI 20DAS சரிதாவுக்கு அருணைத் தெரியாது. 20DAI சரிதாவுக்கு அருணை மணம்செய்துவைத்தேன். 20ADS அருணை சரிதாவுக்குத் தெரியாது 20ADI அருணை சரிதாவுக்குக் காட்டினேன். 21DAS சுந்தருக்கு மஞ்சுவைப் பிடிக்கும். 21DAI சுந்தருக்கு மஞ்சுவைக் காட்டினேன். 21ADS மஞ்சுவை சுந்தருக்குப் பிடிக்கும். 21ADI மஞ்சுவை சுந்தருக்கு அறிமுகப்படுத்தினேன். 22DAS ரகுவுக்கு ஆஷாவைப் பிடிக்காது. ரகுவுக்கு ஆஷாவை மணம்செய்துவைத்தேன். 22DAT 22ADS ஆஷாவை ரகுவுக்குப் பிடிக்காது. ஆஷாவை ரகுவுக்குக் காட்டினேன். 22ADT 23DAS விக்ரமுக்கு பாலுவைத் தெரியும் விக்ரமுக்கு பாலுவை அறிமுகப்படுத்தினேன். 23DAT 23ADS பாலுவை விக்ரமுக்குத் தெரியும். 23ADI பாலுவை விக்ரமுக்கு ஞாபகப்படுத்தினேன். 24DAS பிரபுவுக்கு விசுவைத் தெரியாது 24DAI பிரபுவுக்கு விசுவை ஞாபகப்படுத்தினேன். 24ADS விசுவை பிரபுவுக்குத் தெரியாது 24ADI விசுவை பிரபுவுக்கு மணம்செய்துவைத்தேன். விஷாலுக்கு தீபாவைப் பிடிக்கும். 25DAS 25DAI விஷாலுக்கு தீபாவைக் காட்டினேன்.

I showed Sekar to Mohana. Mohana likes Sekar. I married Sekar off to Mohana. Ramesh doesn't like Uma. I introduced Uma to Ramesh. Ramesh doesn't like Uma. I married Uma off to Ramesh. Ranjith knows Usha. I married Usha off to Ranjith. Raniith knows Usha. I reminded Ranjith about Usha. Vasu doesn't know Kamala. I reminded Vasu about Kamala. Vasu doesn't know Kamala. I introduced Kamala to Vasu. Vinith likes Ramaa. I introduced Vinith about Ramaa. Vinith likes Ramaa. I married Ramaa off to Vinith. Devi doesn't like Geetha. I showed Seetha to Devika. Devi doesn't like Geetha. I reminded Devika about Seetha. The farmer knows Sudha. I reminded the farmer about Sudha. The farmer knows Sudha. I married Sudha off to the farmer. Saritha doesn't know Arun I married Arun off to Saritha. Saritha doesn't know Arun. I showed Arun to Saritha. Sundar likes Manju. I showed Manju to Sundar. Sundar likes Manju. I introduced Manju to Sundar. Raghu doesn't like Asha. I married Asha off to Ragu. Raghu doesn't like Asha. I showed Asha to Ragu. Vikram knows Balu. I introduced Balu to Vikram. Vikram knows Balu. I reminded Vikram about Balu. Prabhu doesn't know Visu I reminded Prabhu about Visu. Prabhu doesn't know Visu. I married Visu off to Prabhu. Vishal likes Deepa. I showed Deepa to Vishal.

25ADS தீபாவை விஷாலுக்குப் பிடிக்கும். 25ADI தீபாவை விஷாலுக்கு மணம்செய்துவைத்தேன். 26DAS சுஷிலுக்கு தேவியைப் பிடிக்காது. 26DAI சுஷிலுக்கு தேவியை ஞாபகப்படுத்தினேன். தேவியை சுஷிலுக்குப் பிடிக்காது. 26ADS தேவியை சுஷிலுக்கு அறிமுகப்படுத்தினேன். 26ADI 27DAS ரம்யாவுக்கு ராஜுவைத் தெரியும். 27DAI ரம்யாவுக்கு ராஜுவை மணம்செய்துவைத்தேன். 27ADS ராஜுவை ரம்யாவுக்குத் தெரியும். 27ADT ராஜுவை ரம்யாவுக்கு ஞாபகப்படுத்தினேன். ஹரிக்கு சுனிலைத் தெரியாது. 28DAS 28DAT ஹரிக்கு சுனிலை அறிமுகப்படுத்தினேன். 28ADS சுனிலை ஹரிக்குத் தெரியாது. 28ADI சுனிலை ஹரிக்குக் காட்டினேன். 29DAS சௌம்யாவுக்கு சச்சினைப் பிடிக்கும். 29DAI சௌம்யாவுக்கு சச்சினை மணம்செய்துவைத்தேன். 29ADS சச்சினை சௌம்யாவுக்குப் பிடிக்கும். 29ADI சச்சினை சௌம்யாவுக்குக் காட்டினேன். 30DAS முகேஷுக்கு நா்ஸைப் பிடிக்காது 30DAI முகேஷுக்கு நாஸை அறிமுகப்படுத்தினேன். 30ADS நாஸை முகேஷுக்குப் பிடிக்காது. 30ADI நாஸை முகேஷுக்கு ஞாபகப்படுத்தினேன். 31DAS ஷங்கருக்கு குருவைத் தெரியும். 31DAT ஷங்கருக்கு குருவை ஞாபகப்படுத்தினேன். 31ADS குருவை ஷங்கருக்குத் தெரியும். குருவை ஷங்கருக்கு அறிமுகப்படுத்தினேன். 31ADT விஜயாவுக்கு பாரியைத் தெரியாது. 32DAS 32DAI விஜயாவுக்கு பாரியைக் காட்டினேன். 32ADS பாரியை விஜயாவுக்குத் தெரியாது. 32ADI பாரியை விஜயாவுக்கு மணம்செய்துவைத்தேன். 33DAS பிரேமாவுக்கு ராமுவைப் பிடிக்கும். 33DAI பிரேமாவுக்கு ராமுவை மணம்செய்துவைத்தேன். 33ADS ராமுவை பிரேமாவுக்குப் பிடிக்கும். 33ADI ராமுவை பிரேமாவுக்குக் காட்டினேன். 34DAS வருணுக்கு ரதியைப் பிடிக்காது. வருணுக்கு ரதியை அறிமுகப்படுத்தினேன். 34DAI 34ADS ரதியை வருணுக்குப் பிடிக்காது. 34ADI ரதியை வருணுக்கு ஞாபகப்படுத்தினேன். 35DAS ரம்பாவுக்கு தருணைத் தெரியும். 35DAI ரம்பாவுக்கு தருணை ஞாபகப்படுத்தினேன். 35ADS தருணை ரம்பாவுக்குத் தெரியும். 35ADI தருணை ரம்பாவுக்கு மணம்செய்துவைத்தேன். 36DAS உமேஷுக்கு சீனுவைத் தெரியாது. 36DAI உமேஷுக்கு சீனுவைக் காட்டினேன். 36ADS சீனுவை உமேஷுக்குத் தெரியாது. 36ADI சீனுவை உமேஷுக்கு அறிமுகப்படுத்தினேன். சோமுவுக்கு கீதாவைப் பிடிக்கும். 37DAS சோமுவுக்கு கீதாவை மணம்செய்துவைத்தேன். 37DAI 37ADS கீதாவை சோமுவுக்குப் பிடிக்கும்.

Vishal likes Deepa. I married Deepa off to Vishal. Sushil doesn't like Devi. I reminded Sushil about Devi. Sushil doesn't like Devi. I introduced Devi to Sushil. Ramya knows Raju. I married Raju off to Ramya. Ramya knows Raju. I reminded Ramya about Raju. Hari doesn't know Sunil. I introduced Sunil to Hari. Hari doesn't know Sunil. I showed Sunil to Hari. Sowmya likes Sachin. I married Sachin off to Sowmya. Sowmya likes Sachin. I showed Sachin to Sowmya. Mukesh doesn't like the Nurse. I introduced the nurse to Mukesh. Mukesh doesn't like the Nurse. I reminded Mukesh about the nurse. Shankar knows Guru. I reminded Shankar about Guru. Shankar knows Guru. I introduced Guru to Shankar. Vijaya doesn't know Paari. I showed Oaari to Vijaya. Vijaya doesn't know Paari. I married Paari off to Vijaya. Prema likes Ramu. I married Ramu off to Prema. Prema likes Ramu I showed Ramu to Prema. Varun doesn't like Rathi. I introduced Rathi to Varun. Varun doesn't like Rathi. I reminded Varun about Rathi. Ramba likes Tarun. I reminded Ramba about Tarun. Ramba likes Tarun I married Tarun off to Ramba. Umesh doesn't know Seenu. I showed Seenu to Umesh Umesh doesn't know Seenu. I introduced Seenu to Umesh. Somu likes Geetha. I married Geetha off to Somu. Somu likes Geetha.

37ADI கீதாவை சோமுவுக்குக் காட்டினேன். 38DAS சுதாவுக்கு தேவிகாவைப் பிடிக்காது. 38DAI சுதாவுக்கு தேவிகாவைக் காட்டினேன். 38ADS தேவிகாவை சுதாவுக்குப் பிடிக்காது. 38ADI தேவிகாவை சுதாவுக்கு ஞாபகப்படுத்தினேன். மனோவுக்கு சுஷிலைத் தெரியும். 39DAS மனோவுக்கு சுஷிலை ஞாபகப்படுத்தினேன். 39DAI 39ADS சுஷிலை மனோவுக்குத் தெரியும். 39ADI சுஷிலை மனோவுக்கு அறிமுகப்படுத்தினேன். மஞ்சுவுக்கு குமாரைத் தெரியாது. 40DAS மஞ்சுவுக்கு குமாரை அறிமுகப்படுத்தினேன். 40DAI குமாரை மஞ்சுவுக்குத் தெரியாது. 40ADS 40ADI குமாரை மஞ்சுவுக்கு மணம்செய்துவைத்தேன். 41DAS சிறுமிக்கு விக்ரமைப் பிடிக்கும். சிறுமிக்கு விக்ரமை ஞாபகப்படுத்தினேன். 41DAT 41ADS விக்ரமை சிறுமிக்குப் பிடிக்கும். 41ADI விக்ரமை சிறுமிக்குக் காட்டினேன் 42DAS குணாவுக்கு பையனைப் பிடிக்காது. குணாவுக்கு பையனைக் காட்டினேன். 42DAI பையனை குணாவுக்குப் பிடிக்காது. 42ADS 42ADI பையனை குணாவுக்கு அறிமுகப்படுத்தினேன். 43DAS மோஹனாவுக்கு லதாவைத் தெரியும். 43DAT மோஹனாவுக்கு லதாவை அறிமுகப்படுத்தினேன். 43ADS லதாவை மோஹனாவுக்குத் தெரியும். 43ADI லதாவை மோஹனாவுக்கு ஞாபகப்படுத்தினேன். 44DAS வள்ளிக்கு மருத்துவரைத் தெரியாது. வள்ளிக்கு மருத்துவரை மணம்செய்துவைத்தேன். 44DAI 44ADS மருத்துவரை வள்ளிக்குத் தெரியாது. மருத்துவரை வள்ளிக்குக் காட்டினேன். 44ADI 45DAS உமாவுக்கு சுரேஷைப் பிடிக்கும். 45DAI உமாவுக்கு சுரேஷை மணம்செய்துவைத்தேன். 45ADS சுரேஷை உமாவுக்குப் பிடிக்கும். சுரேஷை உமாவுக்கு அறிமுகப்படுத்தினேன். 45ADI 46DAS பாலுவுக்கு ரஞ்சித்தைப் பிடிக்காது. 46DAI பாலுவுக்கு ரஞ்சித்தைக் காட்டினேன். ரஞ்சித்தை பாலுவுக்குப் பிடிக்காது. 46ADS 46ADT ரஞ்சித்தை பாலுவுக்கு அறிமுகப்படுத்தினேன். 47DAS சச்சினுக்கு ரமேஷைத் தெரியும். சச்சினுக்கு ரமேஷை அறிமுகப்படுத்தினேன். 47DAT 47ADS ரமேஷை சச்சினுக்குத் தெரியும். 47ADT ரமேஷை சச்சினுக்கு ஞாபகப்படுத்தினேன். 48DAS சிறுவனுக்கு மோஹனாவைத் தெரியாது. 48DAI சிறுவனுக்கு மோஹனாவை ஞாபகப்படுத்தினேன் 48ADS மோஹனாவை சிறுவனுக்குத் தெரியாது. 48ADI மோஹனாவை சிறுவனுக்குக் காட்டினேன். 49DAS சூர்யாவுக்கு ஹரியைப் பிடிக்கும். 49DAI சூர்யாவுக்கு ஹரியை அறிமுகப்படுத்தினேன். ஹரியை சூர்யாவுக்குப் பிடிக்கும். 49ADS ஹரியை சூர்யாவுக்கு ஞாபகப்படுத்தினேன். 49ADI

I showed Geetha to Somu. Sudha doesn't like Devika. I showed Devika to Sudha. Sudha doesn't like Devika. I reminded Sudha about Devika. Mano knows Sushil. I reminded Mano about Sushil. Mano knows Sushil. I introduced Sudhil to Mano. Maniu doesn't know Kumar. I introduced Kumar to Manju. Manju doesn't know Kumar. I married Kumar off to Manju. The little girl likes Vikram. I reminded the ltl. girl abt. Vikram. The little girl likes Vikram. I showed Vikram to the little girl. Guna doesn't like the little boy. I showed the boy to Guna. Guna doesn't like the little boy. I introduced the boy to Guna. Mohana knows Latha. Lintroduced Latha to Mohana Mohana knows Latha. I reminded Mohana about Latha. Valli doesn't know the doctor. I married the doctor off to Valli. Valli doesn't know the doctor I showed the doctor to Valli. Uma likes Suresh. I married Suresh off to Uma. Uma likes Suresh. I introduced Suresh to Uma. Balu doesn't like Ranjith. I showed Ranjith to Balu. Balu doesn't like Ranjith. I introduced Ranjith to Balu. Sachin knows Ramesh. I introduced Ramesh to Sachin. Sachin knows Ramesh. I reminded Sachin to Ramesh. The little boy doesn't know Mohana. I reminded the ltl. boy abt. Mohana. The little boy doesn't know Mohana. I showed Mohana to the little boy. Surya likes Hari. I introduced Hari to Surya. Surya likes Hari. I reminded Surya about Hari.

50DAS உஷாவுக்கு பிரேமாவைப் பிடிக்காது. உஷாவுக்கு பிரேமாவை ஞாபகப்படுத்தினேன். 50DAI 50ADS பிரேமாவை உஷாவுக்குப் பிடிக்காது. பிரேமாவை உஷாவுக்கு மணம்செய்துவைத்தேன். 50ADI சேகருக்கு மீனாவைத் தெரியும். 51DAS சேகருக்கு மீனாவை மணம்செய்துவைத்தேன். 51DAI மீனாவை சேகருக்குத் தெரியும். 51ADS 51ADI மீனாவை சேகருக்கு அறிமுகப்படுத்தினேன். 52DAS ரமாவுக்கு பிரபுவைத் தெரியாது. ரமாவுக்கு பிரபுவைக் காட்டினேன். 52DAT பிரபுவை ரமாவுக்குத் தெரியாது. 52ADS 52ADT பிரபுவை ரமாவுக்கு மணம்செய்துவைத்தேன். 53DAS ராஜுவுக்கு விஜயாவைப் பிடிக்கும். 53DAI ராஜுவுக்கு விஜயாவைக் காட்டினேன். விஜ்யாவை ராஜுவுக்குப் பிடிக்கும். 53ADS 53ADI விஜயாவை ராஜுவுக்கு மணம்செய்துவைத்தேன். 54DAS கமலாவுக்கு விஷாலைப் பிடிக்காது. கமலாவுக்கு விஷாலை மணம்செய்துவைத்தேன். 54DAI 54ADS விஷாலை கமலாவுக்குப் பிடிக்காது 54ADI விஷாலை கமலாவுக்கு ஞாபகப்படுத்தினேன். 55DAS ராமுவுக்கு ரம்யாவைத் தெரியும். 55DAI ராமுவுக்கு ரம்யாவை ஞாபகப்படுத்தினேன். 55ADS ரம்யாவை ராமுவுக்குத் தெரியும். 55ADT ரம்யாவை ராமுவுக்குக் காட்டினேன். 56DAS சீதாவுக்கு டாக்டரைத் தெரியாது. சீதாவுக்கு டாக்டரை அறிமுகப்படுத்தினேன். 56DAT டாக்டரை சீதாவுக்குத் தெரியாது. 56ADS டாக்டரை சீதாவுக்கு மணம்செய்துவைத்தேன். 56ADT 57DAS மாலாவுக்கு சரிதாவைப் பிடிக்கும். 57DAI மாலாவுக்கு சரிதாவை ஞாபகப்படுத்தினேன். சரிதாவை மாலாவுக்குப் பிடிக்கும். 57ADS 57ADI சரிதாவை மாலாவுக்கு அறிமுகப்படுத்தினேன். 58DAS பாரிக்கு ராதாவைப் பிடிக்காது. 58DAI பாரிக்கு ராதாவைக் காட்டினேன். 58ADS ராதாவை பாரிக்குப் பிடிக்காது. ராதாவை பாரிக்கு மணம்செய்துவைத்தேன். 58ADI 59DAS ரதிக்கு சுந்தரைத் தெரியும். 59DAI ரதிக்கு சுந்தரை மணம்செய்துவைத்தேன். 59ADS சுந்தரை ரதிக்குத் தெரியும். 59ADI சுந்தரை ரதிக்கு அறிமுகப்படுத்தினேன். 60DAS சுனிலுக்கு வருணைத் தெரியாது. 60DAI சுனிலுக்கு வருணை ஞாபகப்படுத்தினேன். 60ADS வருணை சுனிலுக்குத் தெரியாது. 60ADT வருணை சுனிலுக்குக் காட்டினேன். 61DAS தீபாவுக்கு முருகனைப் பிடிக்கும். 61DAT தீபாவுக்கு முருகனை அறிமுகப்படுத்தினேன். 61ADS முருகனை தீபாவுக்குப் பிடிக்கும். முருகனை தீபாவுக்குக் காட்டினேன். 61ADI 62DAS விசுவுக்கு உழவனைப் பிடிக்காது.

Usha doesn't like Prema. I reminded Usha about Prema. Usha doesn't like Prema. I married Prema off to Usha. Sekar knows Meena. I married Meena off to Sekar. Sekar knows Meena. I introduced Meena to Sekar. Ramaa doesn't know Prabhu. I showed Prabhu to Ramaa. Ramaa doesn't know Prabhu. I married Prabhu off to Ramaa. Raju likes Vijava. I showed Vijaya to Raju. Raju likes Vijaya. I married Vijaya off to Raju. Kamala doesn't like Vishal. I married Vishal off to Kamala. Kamala doesn't like Vishal. I reminded Kamala about Vishal. Ramu knows Ramya. I reminded Ramu about Ramya. Ramu knows Ramva. I showed Ramya to Ramu. Seetha doesn't know the doctor. I introduced the doctor to Seetha. Seetha doesn't know the doctor. I married the doctor off to Seetha. Mala likes Saritha. I reminded Mala about Saritha. Mala likes Saritha. I introduced Sarigtha to Mala. Paari doesn't like Radha. I showed Radha to Paari. Paari doesn't like Radha. I married Radha off to Paari. Rathi knows Sundar. I married Sundar off to Rathi. Rathi knows Sundar. I introduced Sundar to Rathi. Sunil doesn't know Varun. I reminded Sunil about Varun. Sunil doesn't know Varun. I showed Varun to Sunil. Deepa likes Murugan. I introduced Murugan to Deepa. Deepa likes Murugan. I showed Murugan to Deepa. Visu doesn't like the farmer.

62DAI விசுவுக்கு உழவனைக் காட்டினேன். 62ADS உழவனை விசுவுக்குப் பிடிக்காது. 62ADI உழவனை விசுவுக்கு அறிமுகப்படுத்தினேன். தேவிக்கு வினித்தைத் தெரியும். 63DAS தேவிக்கு வினித்தை மணம்செய்துவைத்தேன். 63DAI 63ADS வினித்தை தேவிக்குத் தெரியும். 63ADI வினித்தை தேவிக்கு ஞாபகப்படுத்தினேன். 64DAS ஆஷாவுக்கு வாசுவைத் தெரியாது. ஆஷாவுக்கு வாசுவை ஞாபகப்படுத்தினேன். 64DAI வாசுவை ஆஷாவுக்குத் தெரியாது. 64ADS 64ADI வாசுவை ஆஷாவுக்கு மணம்செய்துவைத்தேன். தருணுக்கு ரம்பாவைப் பிடிக்கும். 65DAS 65DAI தருணுக்கு ரம்பாவை மணம்செய்துவைத்தேன். 65ADS ரம்பாவை தருணுக்குப் பிடிக்கும். 65ADT ரம்பாவை தருணுக்குக் காட்டினேன். சீனுவுக்கு விஜயைப் பிடிக்காது. 66DAS 66DAI சீனுவுக்கு விஜீயை அறிமுகப்படுத்தினேன். 66ADS விஜயை சீனுவுக்குப் பிடிக்காது. 66ADI விஜயை சீனுவுக்கு ஞாபகப்படுத்தினேன். 67DAS ரவிக்கு சௌம்யாவைத் தெரியும். 67DAI ரவிக்கு சௌம்யாவை ஞாபகப்படுத்தினேன். 67ADS சௌம்யாவை ரவிக்குத் தெரியும். சௌம்யாவை ரவிக்கு மணம்செய்துவைத்தேன். 67ADT 68DAS ஷீலாவுக்கு உமேஷைத் தெரியாது. 68DAI ஷீலாவுக்கு உமேஷைக் காட்டினேன். உமேஷை ஷீலாவுக்குத் தெரியாது. 68ADS 68ADI உமேஷை ஷீலாவுக்கு அறிமுகப்படுத்தினேன். செல்விக்கு முகேஷைப் பிடிக்கும். 69DAS செல்விக்கு முகேஷை மணம்செய்துவைத்தேன். 69DAI முகேஷை செல்விக்குப் பிடிக்கும். 69ADS 69ADI முகேஷை செல்விக்குக் காட்டினேன். 70DAS குருவுக்கு ரகுவைப் பிடிக்காது. குருவுக்கு ரகுவை அறிமுகப்படுத்தினேன். 70DAT 70ADS ரகுவை குருவுக்குப் பிடிக்காது. 70ADI ரகுவை குருவுக்கு ஞாபகப்படுத்தினேன். நாஸுக்கு சிவாவைத் தெரியும். 71DAS நாஸுக்கு சிவாவைக் காட்டினேன். 71DAI 71ADS சிவாவை நர்ஸுக்குத் தெரியும். 71ADI சிவாவை நாஸுக்கு மணம்செய்துவைத்தேன். 72DAS அருணுக்கு ஷங்கரைத் தெரியாது. 72DAT அருணுக்கு ஷங்கரை ஞாபகப்படுத்தினேன். 72ADS ஷங்கரை அருணுக்குத் தெரியாது. ஷங்கரை அருணுக்கு அறிமுகப்படுத்தினேன். 72ADI

I showed the farmer to Visu. Visu doesn't like the farmer. I introduced the farmer to Visu. Devi knows Vinith. I married Vinith off to Devi. Devi knows Vinith. I reminded Devi about Vinith. Asha doesn't know Vasu. I reminded Asha about Vasu. Asha doesn't know Vasu. I married Vasu off to Asha. Tarun likes Ramba I married Ramba off to Tarun. Tarun likes Ramba. I showed Ramba to Tarun. Seenu doesn't like Vijay. I introduced Vijay to Seenu. Seenu doesn't like Vijay. I reminded Seenu about Vijay. Ravi knows Sowmya. I reminded Ravi about Sowmya. Ravi knows Sowmya. I married Sowmya off to Ravi. Sheela doesn't know Umesh. I showed Umesh to Sheela. Sheela doesn't know Umesh. I introduced Umesh to Sheela. Selvi likes Mukesh I married Mukesh off to Selvi. Selvi likes Mukesh. I showed Mukesh to Selvi. Guru doesn't like Ragu. I introduced Ragu to Guru. Guru doesn't like Ragu. I reminded Guru about Ragu. The nurse knows Siva. I showed Siva to the nurse. The nurse knows Siva. I married Siva off to the nurse. Arun doesn't know Shankar. I reminded Arun about Shankar. Arun doesn't know Shankar. I introduced Shankar to Arun.

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.

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.3: Mean Duration of Bare NPs

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			
♦ WO	1,71		10.28 **			
♦ ST	1,71	6.65 *				

F.5 Supplementary ERP Plots

F.5.1 ERPs at NP1

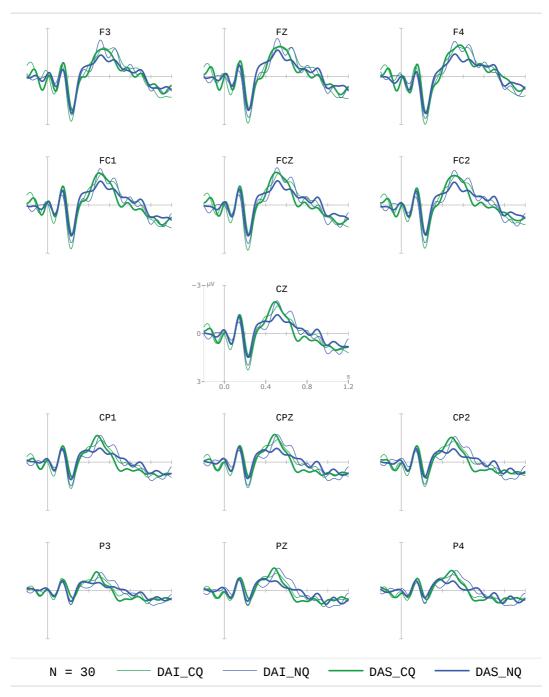


Figure F.1: ERPs at NP1: DA Conditions.

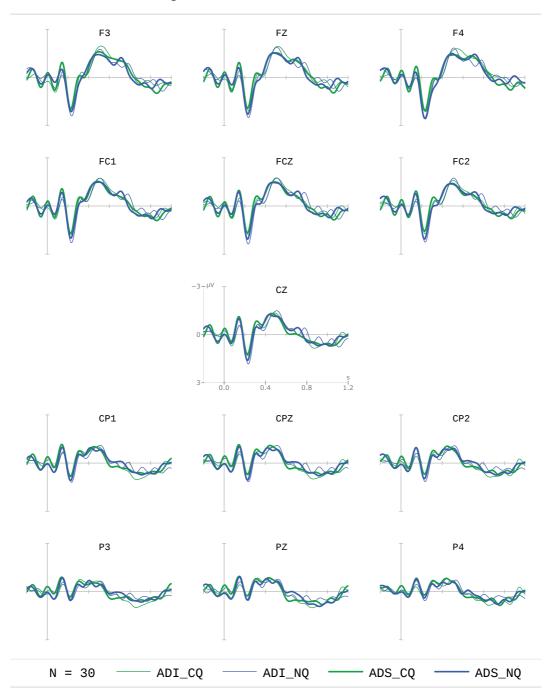


Figure F.2: ERPs at NP1: AD Conditions.

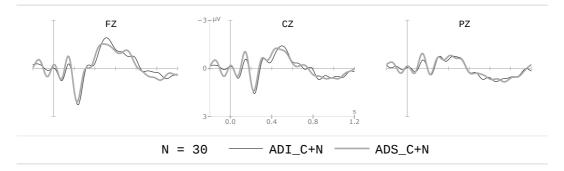


Figure F.3: ERPs at NP1 - Collapsed over CT: AD Conditions.

Figure F.4: ERPs at NP1 - Onset of the case-marker: DAS Conditions.

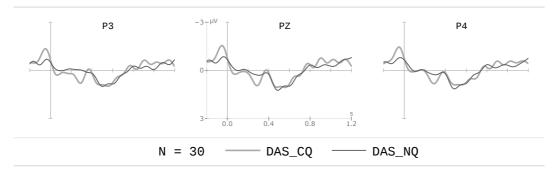
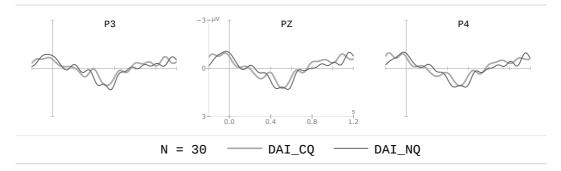


Figure F.5: ERPs at NP1 - Onset of the case-marker: DAI Conditions.



F.5.2 ERPs at NP2

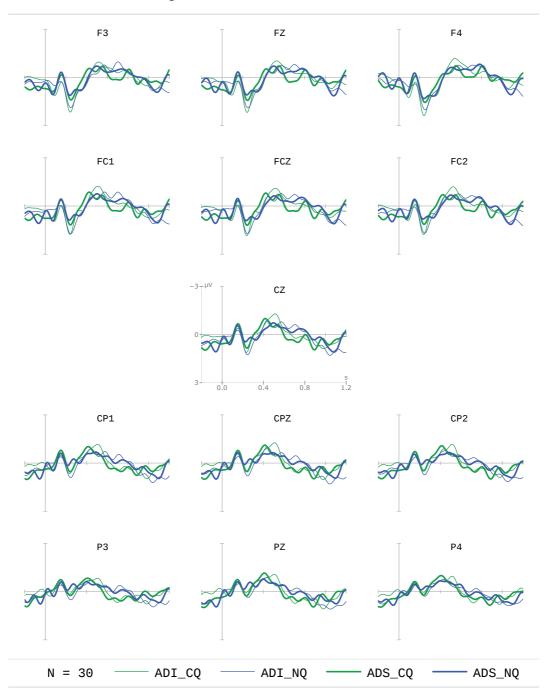


Figure F.6: ERPs at NP2: AD Conditions.

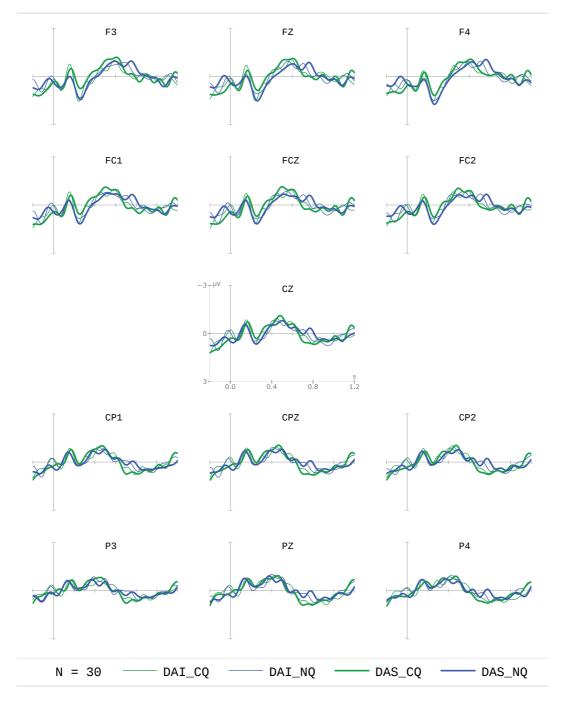


Figure F.7: ERPs at NP2: DA Conditions.

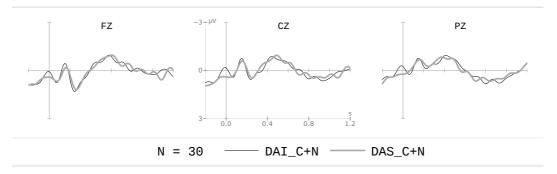


Figure F.8: ERPs at NP2 - Collapsed over CT: DA Conditions.

Figure F.9: ERPs at NP2 - Onset of the case-marker: ADS Conditions.

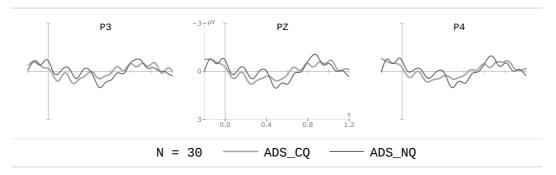
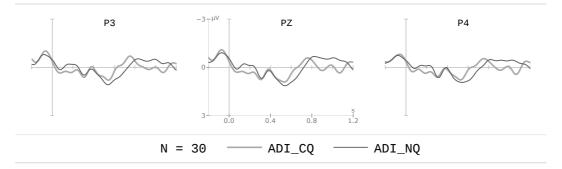
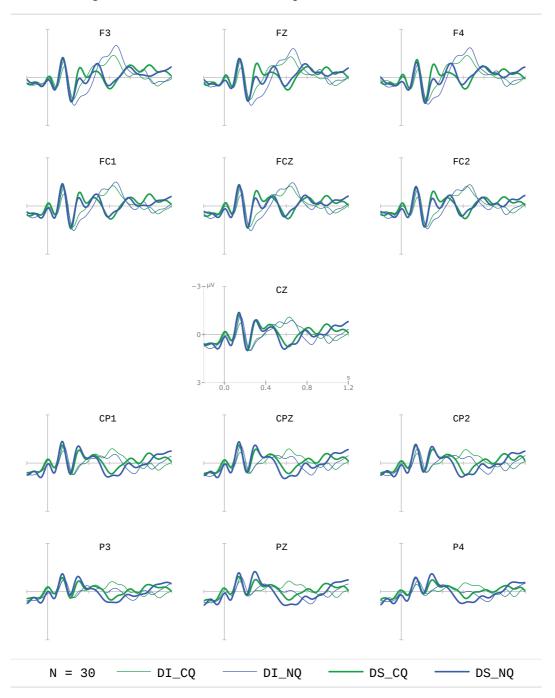


Figure F.10: ERPs at NP2 - Onset of the case-marker: ADI Conditions.



F.5.3 ERPs at the Verb





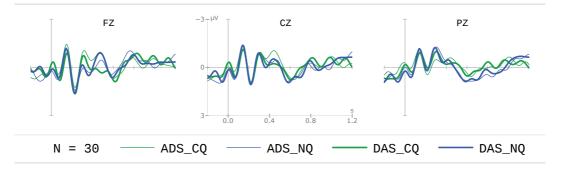
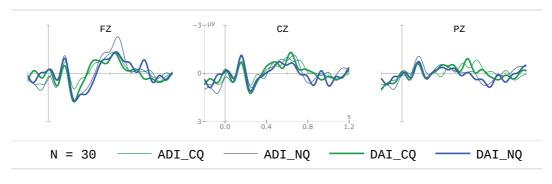


Figure F.12: ERPs at the Verb - Not Collapsed over WO: DS Conditions.

Figure F.13: ERPs at the Verb - Not Collapsed over WO: DI Conditions.



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-G-

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.

NQ	A COMPANY OF CALL OF CALL	l contex			c inform				5			
VQ	a loss of the second				match,				1.2			
WQ	Wrong	-verb co	ntext: \	erbs mis	smatch,	and verl	o-classe	s misma	tch			
Set	18 5	entences	s per co	ntext			9 se	entences	per cor	text		
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	10 10	V		N		C	0112
DAI	N	V	W	C		С	1	W		V	1	N
ADS	V	W	C	N	N		С	100	W		V	-
ADI	W	C	N	V		V		N	1	С	-	W
NII					C	N	C	N	C	N		
NIA					100		N	С	N	С	N	C
FII						N		N			-	-
FPA										N		N
	10 -			-			0				_	
Set 02		entence	and the second second	and a start of the	01.00	10.10	and the second se	entences	and the second second	and the second		CA
DAS	01-18	19-36 V	37-54	55-72	01-09	10-18 W	19-27	28-36	37-45	46-54 N	55-63	64-72
DAS	N	W	W	C N	С	W	N	C	V	N.	W	V
ADS	W	C	N	V	C.	N	Ŋ	V	V	Ŵ	W	C
ADI	C	N	V	W	V	15	W	v	C	W	N	6
NII	6	(A	V	W	V	C	N	C	N	C	N	
NIA					С	6	N.	N	C	N	C	N
FII					N		N	(N	6	10	6	1N
FPA					LAT.		14		N		N	
1.1.2.1	-								in .			
Set	18 s	entence	s per co	ntext			9 se	entences	per cor	ntext		-
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	and an	W	-	V	-
DAI	W	C	N	V		V	All and a second	N		C		W
ADS	С	N	V	W	W		V		N	-	C	Sec.
ADI	N	V	W	C		C	-	W	1	V		N
NII					-	-	С	N	C	N	C	N
NIA					N	C			N	C	N	C.
FII						_				N		N
FPA			_		_	N	-	N	-			-
Set	18 s	entences	s per co	ntext			9 se	ntences	per cor	text		_
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	55	W	50.00	C
DAI	C	N	V	W	V		W		C	1	N	
ADS	N	V	W.	C		W	-	C		N	54	V
ADI	V	W	C	N	C	-	N		V	1.	W	1
NII					N			C	N	Ċ.	N	C
NIA					С	N	C	1.1		N	C	N
									N	1.	N	
FII												

Figure G.1: Items Distribution Scheme

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G.2 Supplementary ERP Plots

G.2.1 ERPs at NP1

Figure G.2: ERPs at NP1: DAS Conditions.

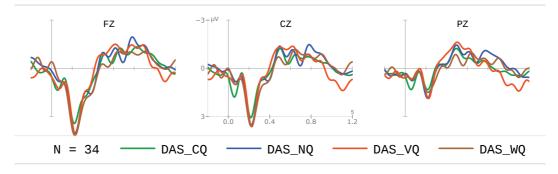


Figure G.3: ERPs at NP1: DAI Conditions.

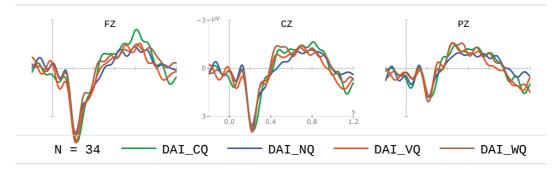
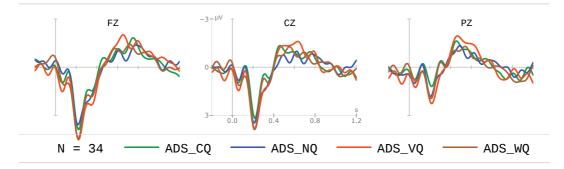


Figure G.4: ERPs at NP1: ADS Conditions.



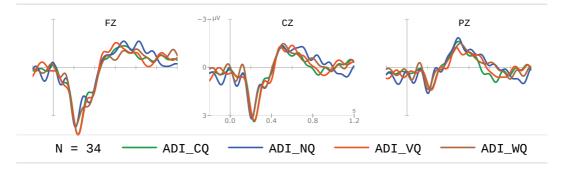


Figure G.5: ERPs at NP1: ADI Conditions.

G.2.2 ERPs at NP2

Figure G.6: ERPs at NP2: ADS Conditions.

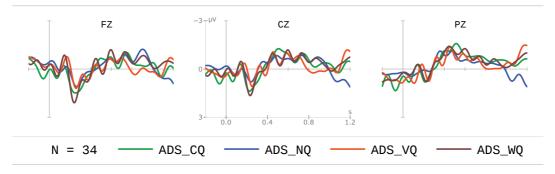
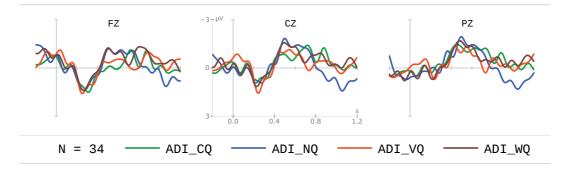


Figure G.7: ERPs at NP2: ADI Conditions.



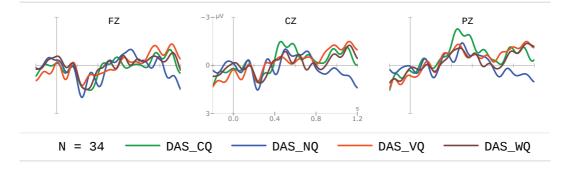
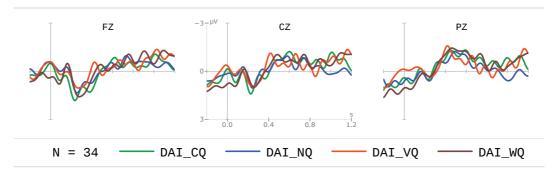
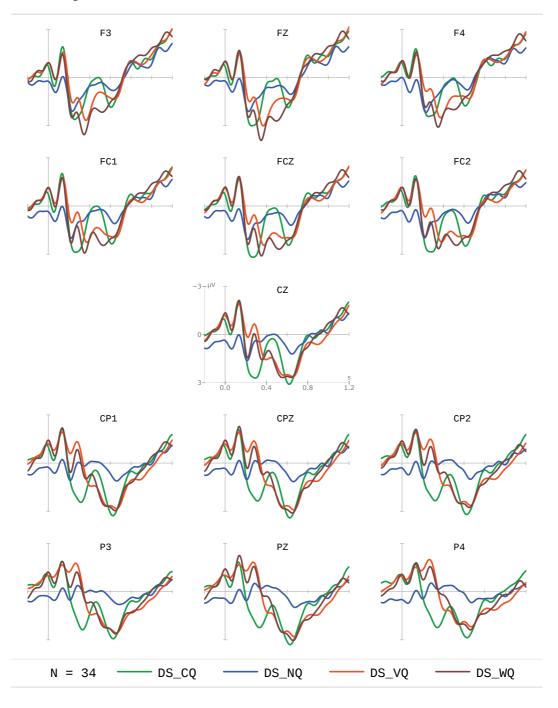


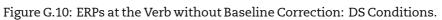
Figure G.8: ERPs at NP2: DAS Conditions.

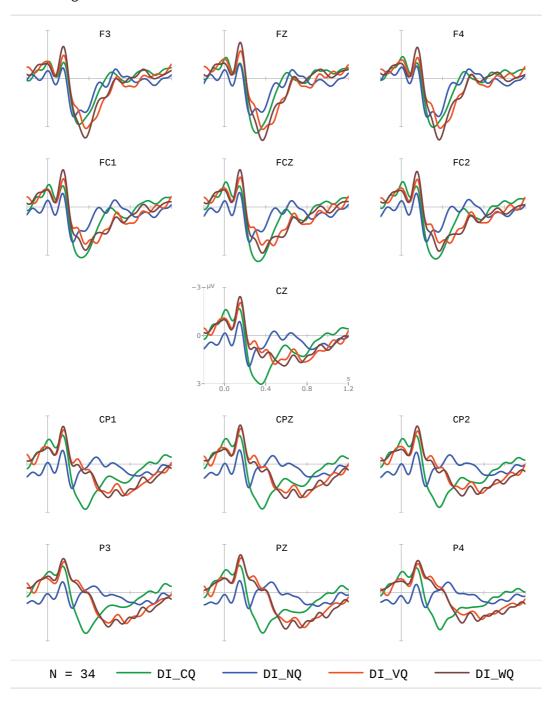
Figure G.9: ERPs at NP2: DAI Conditions.



G.2.3 ERPs at the Verb









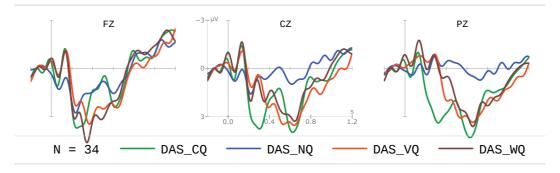


Figure G.12: Baseline Corrected ERPs at the Verb: DAS Conditions.

Figure G.13: Baseline Corrected ERPs at the Verb: DAI Conditions.

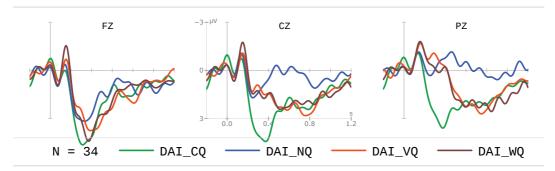
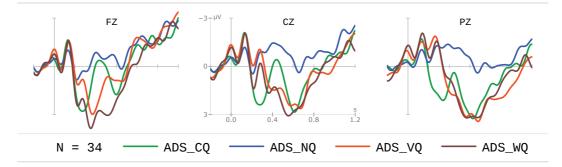


Figure G.14: Baseline Corrected ERPs at the Verb: ADS Conditions.



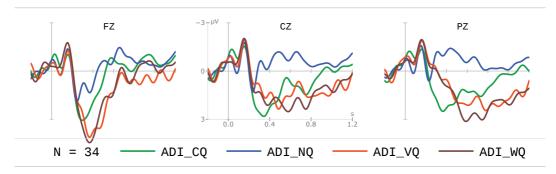
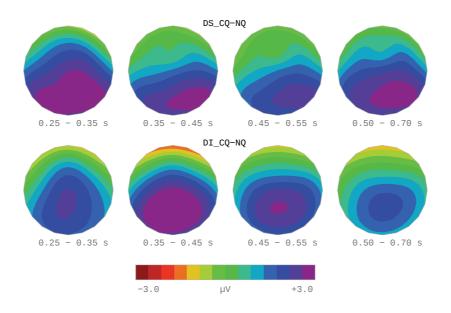


Figure G.15: Baseline Corrected ERPs at the Verb: ADI Conditions.

Figure G.16: Topographic Map for the ERPs at the Verb: CQ–NQ



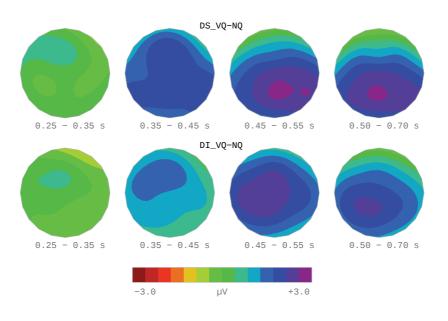
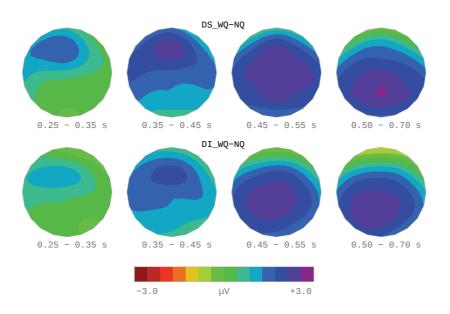


Figure G.17: Topographic Map for the ERPs at the Verb: VQ–NQ

Figure G.18: Topographic Map for the ERPs at the Verb: WQ–NQ



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G.2. SUPPLEMENTARY ERP PLOTS

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Zusammenfassung

Die vorliegende Dissertation beschäftigt sich mit der Echtzeitverarbeitung der Dativsubjekt Konstruktionen im Tamil, einer der 23 offiziellen Sprachen Indiens. Dir 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 Verarbeitungsmerkmaleähnlich oder underschiedlich 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 Stimulisätze 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 Stimulisätze 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 stative 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 enabled 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 dativestative 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 nonneutral 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 dativesubjects 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 Date of Birth Place of Birth	R.Muralikrishnan 17.04.1979 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.

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