Universal and cross-linguistic influences on the processing of Word-order and Animacy: Neurophysiological evidence from Tamil

R. Muralikrishnan [1], Matthias Schlesewsky [2] & Ina Bornkessel-Schlesewsky [1]

[1] Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany
[2] Department of Germanic Linguistics, University of Marburg, Germany

muralir@cbs.mpg.de

Introduction

Background:

Previous examinations of languages as different as German and Chinese have revealed evidence for an argument interpretation strategy based on generalised role (GR) dependencies [1,2]. Thus, if an argument is unambiguously identified as the Undergoer of the event (e.g. on the basis of case marking), this leads to the prediction of an ideal Actor argument. When an inanimate, thus atypical, Actor is subsequently encountered, ERP measures show an increased N400 effect. It has been suggested that such a GR dependency-based processing strategy may constitute a universal of language comprehension [3].

To validate this hypothesis, a comparable strategy must be demonstrated for languages of other types, and its interaction with language-specific properties must be examined further. To this end, the present auditory ERP study examined incremental argument processing in Tamil.

Relevant Properties of Tamil:

Tamil is a consistently verb-final Dravidian language that allows flexible argument order. Inanimate (irrational) subjects appear to be generally dispreferred in Tamil. Crucially for present purposes, Tamil shows differential object-marking (DOM): animate (rational) Undergoer arguments in transitive constructions are always accusative-marked, whilst inanimate Undergoer arguments are case-marked depending upon whether:
- the Undergoer argument in question is specific / definite,
- the action (verb) causes adverse effects on its Undergoer, &
- both arguments are inanimate.

The Present Study:

The aim of our study was threefold. We examined whether:
1. Tamil shows a processing disadvantage for an inanimate Actor following an Undergoer,
2. the generally dispreferred status of inanimate subjects would lead to a qualitatively different ERP component to the N400 previously observed in German / Chinese, &
3. the inanimate-inanimate construction might show special processing behaviour in view of its exceptional triggering of DOM.

Methods & Materials

Participants:

Twenty-six Indian native speakers of Tamil participated in the experiment. Dominant right-handers alone were accepted as participants, determined by a Tamil version of the Edinburgh-Handedness questionnaire that they filled.

Procedure:

After a short practice phase, participants heard conditionally randomised trials of transitive SOV and OSV critical sentences, in which subjects and objects were either animate or inanimate. The eight critical conditions thus resulting (see Table 1) were interspersed with filler sentences of several types. At the end of each trial, participants performed a comprehension task.

EEG Recording:

The EEG was recorded by means of 25 AgAgCl-electrodes. Electrode impedances were kept below 7 kΩ. Recordings were referenced to the left mastoid, but re-referenced to linked mastoids offline. Trials with EEG artefacts were removed offline.

1 — Critical conditions and Examples

NII
வெளிச்சம் இருளை அகற்றியது.
Vel.ichcham irul.-ai agatr-i-y-adhu'
[Brightness]$_{NOM.In}$ [Darkness]$_{ACC.In}$ [remove]$_{Past-3singular-Neuter}$
'Brightness removed darkness'.

NIA
வெளிச்சம் குருவை எழுப்பியது.
Vel.ichcham Guru-v-ai ezhupp-i-y-adhu'
[Brightness]$_{NOM.In}$ [Guru]$_{ACC.An}$ [wake-up]$_{Past-3singular-Neuter}$
'Brightness woke Guru up'.

NAI
ஷங்கர் இருளை அகற்றினான்.
Shankar irul.-ai agatr-in-a:n
[Shankar]$_{NOM.An}$ [Darkness]$_{ACC.In}$ [remove]$_{Past-3singular-Masculine}$
'Shankar removed darkness'.

NAA
ஷங்கர் குருவை வணங்கினான்.
Shankar Guru-v-ai vanang-in-a:n
[Shankar]$_{NOM.An}$ [Guru]$_{ACC.An}$ [greet]$_{Past-3Singular-Masculine}$
'Shankar greeted Guru'.

SII
இருளை வெளிச்சம் அகற்றியது.
Irul.-ai vel.ichcham agatr-i-y-adhu'
[Darkness]$_{ACC.In}$ [Brightness]$_{NOM.In}$ [remove]$_{Past-3singular-Neuter}$
'Brightness removed darkness'.

SIA
இருளை ஷங்கர் அகற்றினான்.
Irul.-ai Shankar agatr-in-a:n
[Darkness]$_{ACC.In}$ [Shankar]$_{NOM.An}$ [remove]$_{Past-3singular-Masculine}$
'Shankar removed darkness'.

SAI
குருவை வெளிச்சம் எழுப்பியது.
Guru-v-ai vel.ichcham ezhupp-i-y-adhu'
[Guru]$_{ACC.An}$ [Brightness]$_{NOM.In}$ [wake-up]$_{Past-3singular-Neuter}$
'Brightness woke Guru up'.

SAA
குருவை ஷங்கர் வணங்கினான்.
Guru-v-ai Shankar vanang-in-a:n
[Guru]$_{ACC.An}$ [Shankar]$_{NOM.An}$ [greet]$_{Past-3Singular-Masculine}$
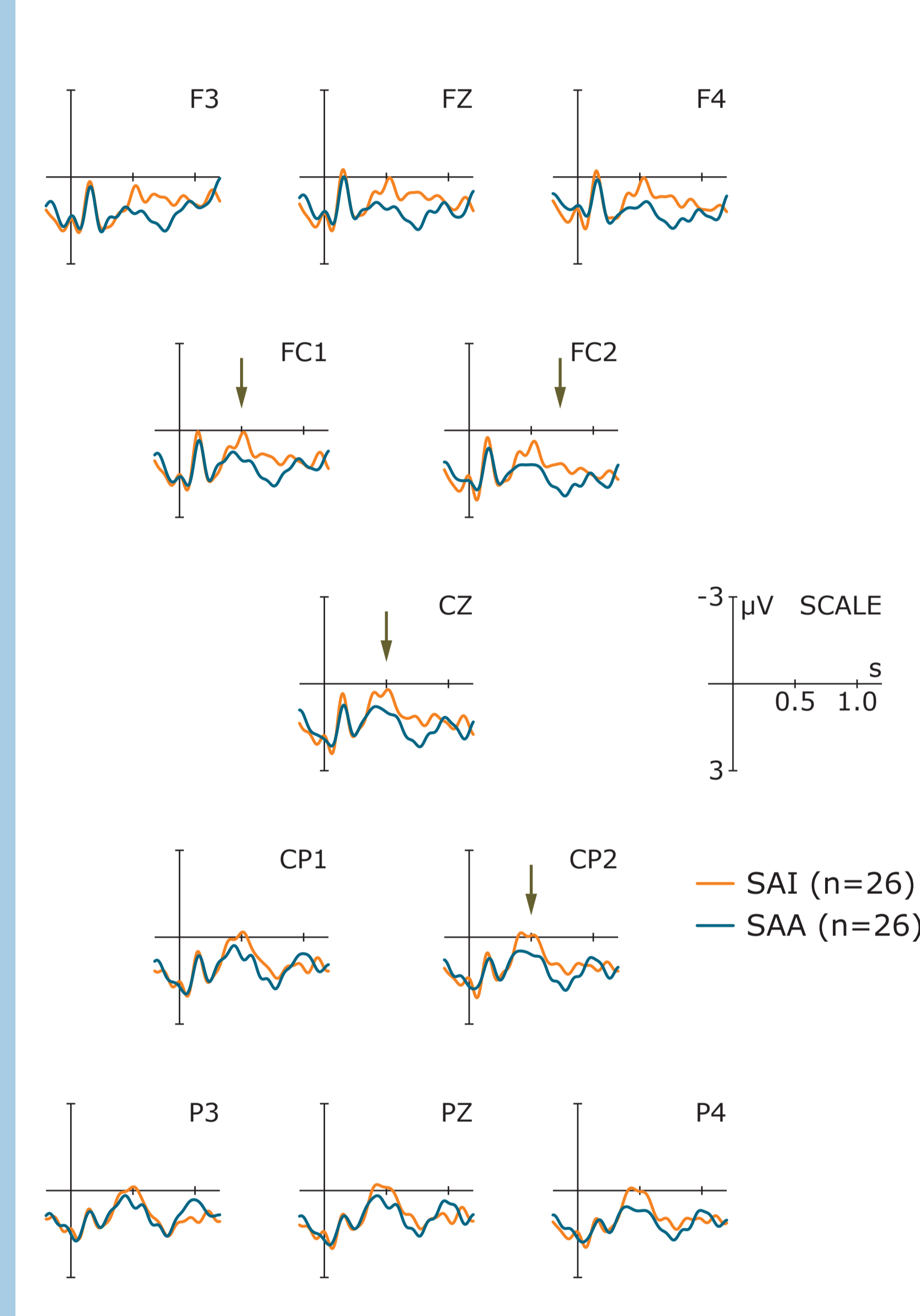'Shankar greeted Guru'.

2 — Acceptability Pre-Test Ratings

1 => Most Acceptable … 4 => Least Acceptable

Condition	Mean Rating	SD
NII	1.89	0.63
NIA	1.74	0.55
NAI	1.42	0.45
NAA	1.18	0.22
SII	2.12	0.46
SIA	1.75	0.51
SAI	2.00	0.61
SAA	1.31	0.32

3 — NP1: Subject-initial Conditions

NIX (n=26)
NAX (n=26)
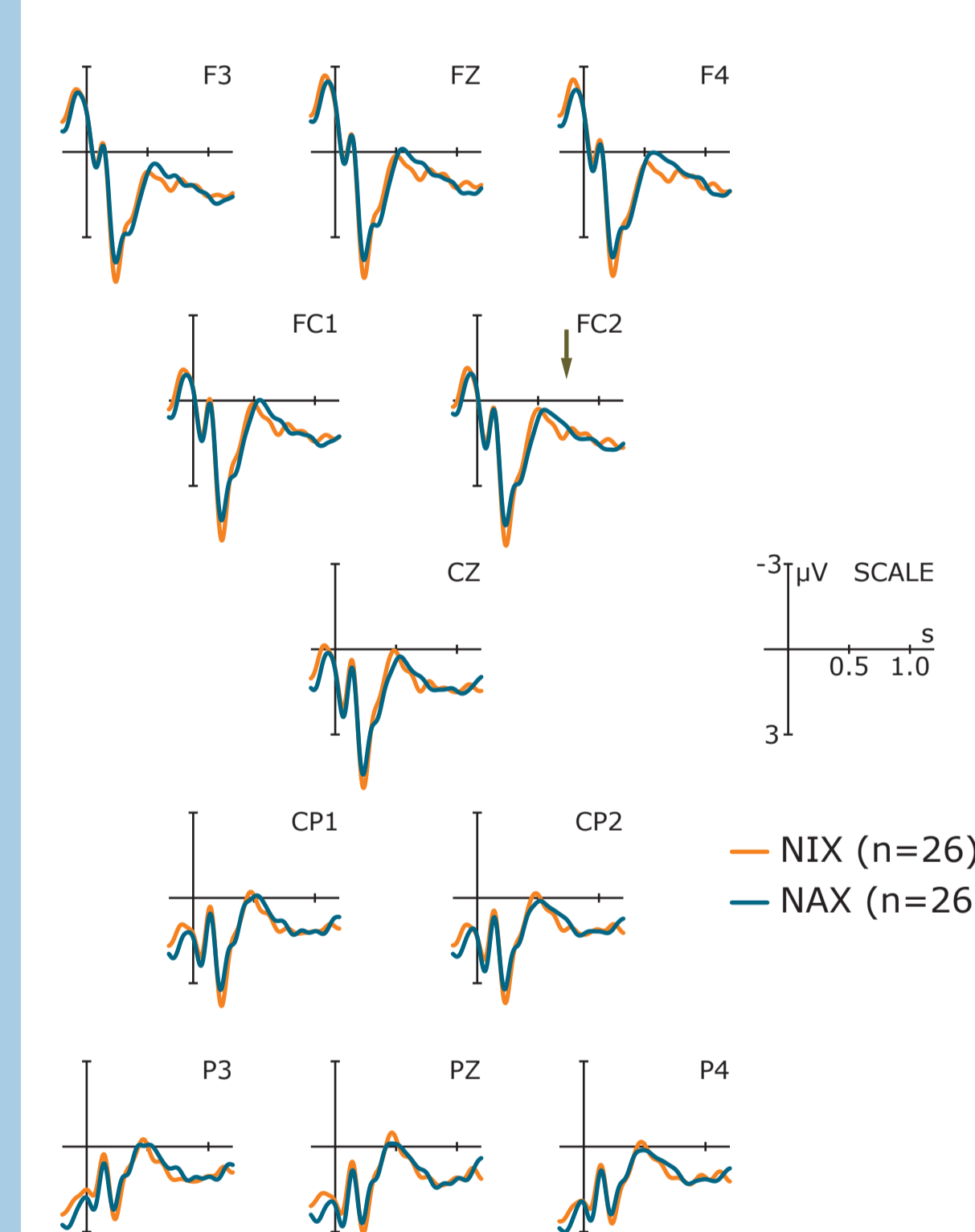
4 — NP2: Object-initial Conditions with Animate NP1

SAI (n=26)
SAA (n=26)

5 — NP2: Subject-initial Conditions with Inanimate NP1

NII (n=26)
NIA (n=26)
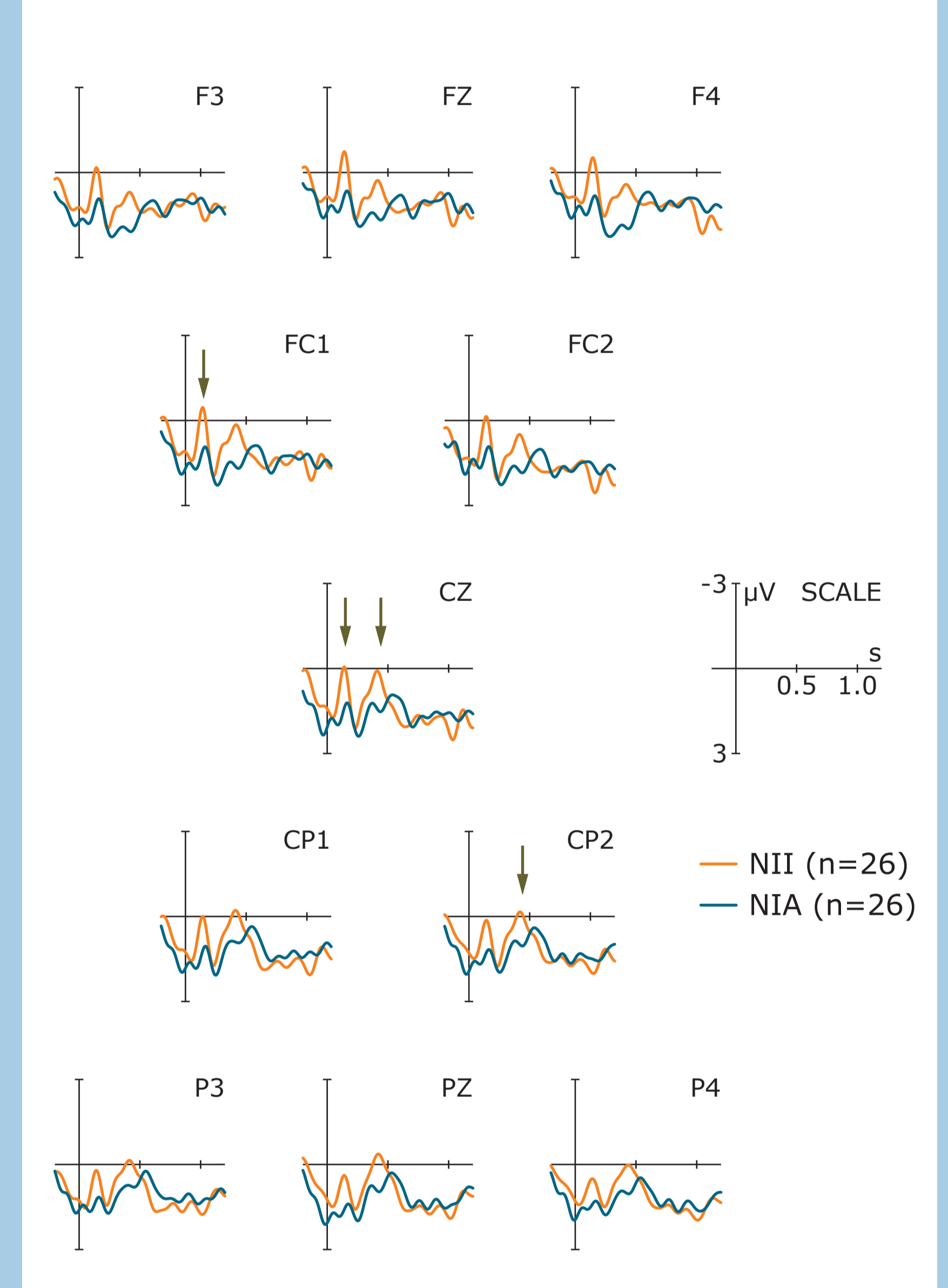
Results & Discussion

Acceptability Pre-test:

In order to examine the possible acceptability differences between the critical conditions, a separate questionnaire pre-test was done prior to the experiment on a sample of more than half of the critical sentences. The acceptability ratings (see Table 2) showed that Tamil indeed appears to have a dispreference for inanimate subjects regardless of their linear position in a sentence.

Further, the special status that we hypothetically accorded to transitive constructions in Tamil with an inanimate subject and an inanimate object seems to hold good. That the acceptability ratings for the conditions NII and SII are the lowest amongst the nominative-initial and accusative-initial conditions respectively appears to corroborate this.

Processing of Inanimate Subjects:

Although sentence-initial inanimate subjects did not show a general disadvantage (see Figure 3), we observed that the inanimate subject NPs (Actors) following animate object NPs (Undergoers) elicited a central negativity in the N400 time-window (see Figure 4). This fits into the general pattern observed in languages such as German [1] and Chinese [2]. This finding provides further converging support for the fact that this phenomenon might well be universal cross-linguistically, irrespective of the availability of DOM in a language.

Inanimate-Inanimate Constructions:

We observed two negativities at the processing of the object NP in inanimate-inanimate SOV sentences, that is condition NII (see Figure 5).

- First, a very early negativity seen only in this condition, perhaps hinting that the processing system had recognised the noun to be inanimate as early as 100-150 ms post-onset.
- Second, a negativity that could be plausibly classified as an N400.

The latter effect stands in stark contrast to results from Chinese, which revealed late positivities in similar constructions [2]. This qualitative ERP difference might be due to the fact that Tamil generally requires morphological distinctness of two inanimate arguments, whilst in Chinese, structures with two inanimates are pragmatically suboptimal.

Conclusion

Our findings support the cross-linguistic processing disadvantage for inanimate Actors following Undergoers. They further suggest that GR dependency processing between arguments is generally reflected in N400 effects, independently of language-specific properties. By contrast, the effects for inanimate-inanimate SOV constructions appear to result from language-specific aspects of argument interpretation.

References:

[1] Roehm, D., Schlesewsky, M., Bornkessel, I., Frisch, S., & Haider, H.(2004). Fractioning language comprehension via frequency characteristics of the human EEG. Neuroreport, 15, 409-412.

[2] Philipp, M., Bornkessel-Schlesewsky, I., Bisang, W., & Schlesewsky, M. (in press). The role of animacy in the real time comprehension of Mandarin Chinese: Evidence from auditory event-related brain potentials. Brain and Language.

[3] Bornkessel, I., & Schlesewsky, M. (2006). The extended argument dependency model: A neurocognitive approach to sentence comprehension across languages. Psychological Review, 113, 787-821.

[4] Muralikrishnan, R. (2007). The influence of word order and animacy in processing transitive sentences: Neurophysiological evidence from Tamil. Unpublished Master's thesis, Saarland University.