PROCESSING OF THE AFFIXES AND THE CLITICS IN TURKISH: AN ERP STUDY

The 20th Annual Meeting of the Organization for Human Brain Mapping
June 8-12, 2014, Hamburg, Germany

Mehmet Aygüneş[1], Özgür Aydın[2], Tamer Demiralp[3]

1. Department of Linguistics, Faculty of Arts, Istanbul University, Istanbul, Turkey
2. Department of Linguistics, Faculty of Languages, History and Geography, Ankara University, Ankara, Turkey
3. Department of Physiology, Istanbul Faculty of Medicine, Istanbul University, Istanbul, Turkey

Introduction

According to the Feature Hierarchy hypothesis, ϕ-features (i.e., gender, number and person) are organized hierarchically as follows: Person>Number>Gender. This hierarchy implies that person is more important than number and gender, as suggested by extensive evidence from language processing (Carminati, 2005; Mancini, et al., 2011) and language typology (Greenberg, 1963). Some Event-Related Brain Potentials (ERP) studies of Feature Hierarchy showed significant differences between person and number violations (Mancini, et al., 2011; Aygüneş, et al., 2012), while other studies revealed that there were no differences between the processing of person and number (Silva-Pereyra & Carreiras,2007). In the relevant literature, it has been debated as to whether clitics exhibit an independent morpho-syntactic category or whether they are incorporated in the category of affix. The aim of this presentation is to determine whether clitics are incorporated in the category of affix or not, and to show their effect on the Feature Hierarchy hypothesis.

Two verbal morphology in Turkish

Turkish exhibits two different verbal agreement paradigms which have different morphosyntactic properties from each other. One of the verbal agreement paradigms, called k-paradigm (Yu & Good, 2000) only attaches to verbal predicates that end with –DI and –sA affixes, as seen in Table 1. Another verbal agreement paradigm, called z-paradigm (Yu & Good, 2000) or clitic paradigm (Sezer, 2002), attaches to all other predicates as exemplified in Table 1.

		Affixes	Clitics			Affixes	Clitics
Ben 1sg	yemeğ-i food-acc	yap-tı-m cook-past-1sg	yap-ıyor-um cook-pres-1sg	Biz 1pl	yemeğ-i food-acc	yap-tı-k cook-past-1pl	yap-ıyor-uz cook-pres-1pl
Sen 2sg	yemeğ-i food-acc	yap-tı-n cook-past-2sg	yap-ıyor-sun cook- pres-2sg	Siz 2pl	yemeğ-i food-acc	yap-tı-nız cook-past-2pl	yap-ıyor-sunuz cook-pres-2pl
O 3sg	yemeğ-i food-acc	yap-tı-Ø cook-past-3sg	yap-ıyor-Ø cook-pres-3sg	Onlar 3pl	yemeğ-i food-acc	yap-tı-(lar) cook-past-(3pl)	yap-ıyor-(lar) cook-pres-3pl

Table 1. Affixes (k-paradigm) and Clitics (z-paradigm) in Turkish

Method

Participants

The data from the Experiment 1 (Exp.1) were collected by Aygüneş et al. (2012). from thirty-six native speakers of Turkish (19 women, mean age:26.18; 15 men, mean age: 27.02). On the other hand, thirty-four native speakers of Turkish (19 women, mean age: 25.16; 14 men, mean age: 27.18) participated in Experiment 2 (Exp.2). Two participants in Exp.1 and one participant in Exp.2 were excluded due to excessive movement artifacts during the EEG recording. All participants were right-handed, had normal or corrected-to-normal vision, and had good auditory acuity.

Materials

Examples of the materials are presented in Tables 2 and 3. The experimental material consisted of 400 sentences divided into four experimental conditions for Exp.1, while for Exp. 2, they consisted of 150 sentences divided into three experimental conditions.

		Control	Person Mismatch	Number Mismatch	Per.+Num. Mismatch	n
Ben 1sg	yemeğ-i food-acc	yap-tı-m cook-past-1sg	yap-tı-n cook-past-2sg	yap-tı-k cook-past-1pl	yap-tı-nız cook-past-2pl	100
Sen 2sg	kahve-yi coffee-acc	iç-ti-n drink-past-2sg	iç-ti-m drink-past-1sg	iç-ti-niz drink-past-2pl	iç-ti-k drink-past-1pl	100
Biz 1pl	tahta-yı board-acc	sil-di-k clean-past-1pl	sil-di-niz clean-past-2pl	sil-di-m clean-past-1sg	sil-di-n clean-past-2sg	100
Siz 2pl	müze-yi museum-acc	gez-di-niz visit-past-2pl	gez-di-k visit-past-1pl	gez-di-n visit-past-1sg	gez-di-m visit-past-1sg	100
					Total	400

Table 2. Sample of the experimental material for Exp.1.

			Control	Person Mismatch	Number Mismatch	n
Ben 1sg	şimdi now	yemek food	yap-ıyor-um cook-pres-1sg	yap-ıyor-sun cook-pres-2sg	yap-ıyor-uz cook-pres-1pl	150

Table 3. Sample of the experimental material for Exp.2.

While affixes (k-paradigm) contains first and second person singular and plural pronouns in Exp. 1, clitics (z-paradigm) contains only the first person singular pronoun in Exp. 2. Since a more accurate way to compare affixes and clitics is to create similar data sets, we compared affixes which is contain only the first person singular pronoun form with clitics. Examples of the compared data set are presented in Table 4. Person Mismatches and Number Mismatches were examined using a repeated measure with the paradigm (affixes and clitics) set as a between-subject factor.

		Person Mismatch	Number Mismatch	Paradigm
Ben 1sg	yemeğ-i food-acc	yap-tı-n cook-past-2sg	yap-tı-k cook-past-1pl	Affixes (k-paradigm)
Ben 1sg	yemek food	yap-ıyor-sun cook-pres-2sg	yap- ıyor-uz cook-pres-1pl	Clitics (z-paradigm)

Table 4. Sample of the compared data set

Procedure

The participants were seated in front of a computer monitor, where sentences were presented word by word. Each word was presented for 500 ms, followed by a 300 ms blank screen. Participants were asked to evaluate its acceptability by pressing the left or right button of a mouse.

EEG recording and analysis

EEG was recorded from 30 scalp locations according to the 10/20 system. Electrode impedances were kept less than 12 kΩ. Data were acquired at a sampling rate of 500 Hz. EEG signal was filtered off-line with a band-pass (0.01–15 Hz) filter. Grand average waveforms were inspected to define the specific time windows associated with the specific components: 270–450 ms for N400/LAN and 500–750 ms for P600 component. Statistical analyses were performed on mean amplitude values based on the region of interests.

A global three-way ANOVA was performed in both Exp. 1 and in Exp. 2. Also, we ran a four-way ANOVA with three within-subject factors and a between-subject factor compare affixes and clitics. The three within factors were Condition (Person Mismatch minus Control & Number Mismatch minus Control), Antero-Posterior (A/P) Distribution (frontal [F,FC] & parietal [CP,P]) and Hemisphere (Left & Right), while Paradigm (affixes & clitics) was the between subject factor.

Experiment 1 (Affixes)

270-450 ms time window

Condition: [$F_{(3,99)}$=12.186, p<0.001]
Condition×Laterization: [$F_{(3,99)}$=8.753, p<0.001]
Condition×Region×Laterization: [$F_{(3,99)}$=3.102, p=0.041]

500-750 ms time window

Condition: [$F_{(3,99)}$=4.621,p=0.006]
Condition×Region×Laterization: [$F_{(3,99)}$=3.138, p=0.038]

	Control vs. Person Mismatch		Control vs. Number Mismatch		Control vs. Pers.-Num. Mism.		Person Mism. vs. Number Mism.		Person Mism. vs. Pers.-Num. Mism.		Number Mism. vs. Pers.-Num. Mism.	
Interactions	*270-450 ms*	*500-750 ms*	*270-450 ms*	*500-750 ms*	*270-450 ms*	*500-750 ms*	*270-450 ms*	*500-750 ms*	*270-450 ms*	*500-750 ms*	*270-450 ms*	*500-750 ms*
Cond.	14.849***	n.s.	5.073*	n.s.	32.894***	n.s.	7.643**	n.s.	n.s.	17.619***	10.366**	4.560*
Cond.×Reg.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	4.779*	n.s.	n.s.
Cond.×Lat.	14.242***	n.s.	17.140***	n.s.	15.547***	5.147*	n.s.	n.s.	n.s.	n.s.	n.s.	5.394*
Cond.×Reg.×Lat.	n.s.	n.s.	n.s.	n.s.	5.071*	7.529*	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

* 0.05, ** 0.01, *** 0.001, n.s: non-significant

Table 5. Pair-wise comparisons in Exp1.

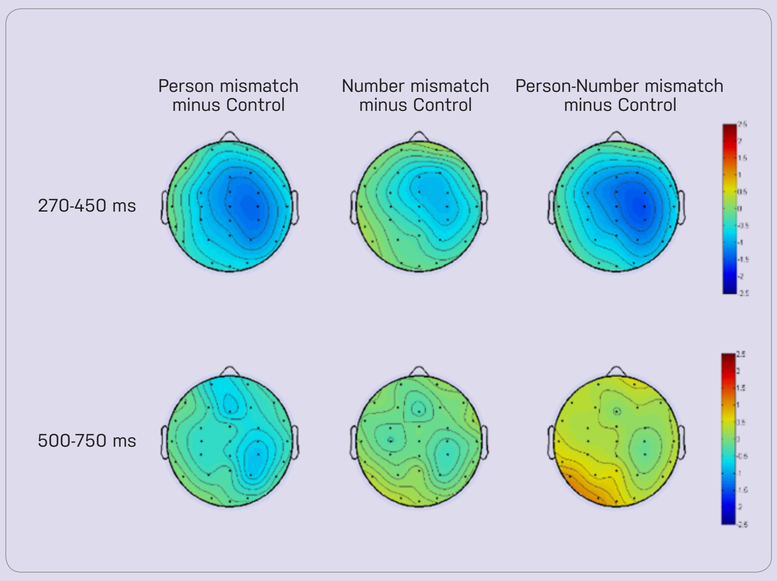


Figure 1. Isovoltage maps for the affixes (k-paradigm)

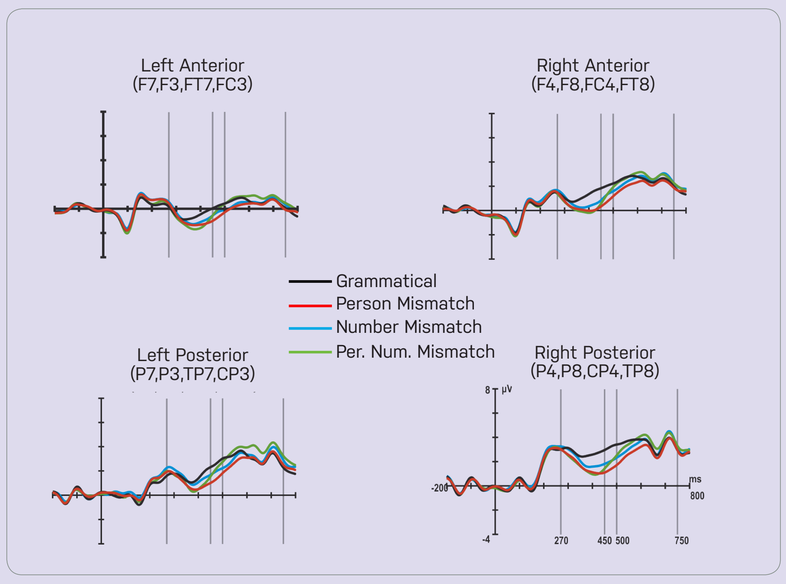


Figure 2. Grand-averaged ERPs time-locked to the verb presentation for the k-paradigm

Experiment 2 (Clitics)

270-450 ms time window

Condition: [$F_{(2,64)}$=5.943, p=0.005]
Condition×Region: [$F_{(2,64)}$=4.495, p=0.022]
Condition×Region×Laterization: [$F_{(2,64)}$=4.346, p=0.018]

500-750 ms time window

Condition: [$F_{(2,64)}$=3.501, p=0.044]
Condition×Region×Laterization: [$F_{(2,64)}$=8.883, p=0.001]

	Grammatical vs Person Mistmach		Grammatical vs Number Mistmach		Person Mistmach vs Number Mistmach	
Interactions	*270-450 ms*	*500-750 ms*	*270-450 ms*	*500-750 ms*	*270-450 ms*	*500-750 ms*
Cond.	11.356**	4.635*	n.s.	n.s.	7.002*	5.304*
Cond.×Reg.	12.439***	n.s.	4.587*	n.s.	n.s.	n.s.
Cond.×Reg.×Lat.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
	10.930**	23.327***	n.s.	n.s.	n.s.	6.651*

* 0.05, ** 0.01, *** 0.001, n.s: non-significant

Table 6. Pair-wise comparisons in Exp2.

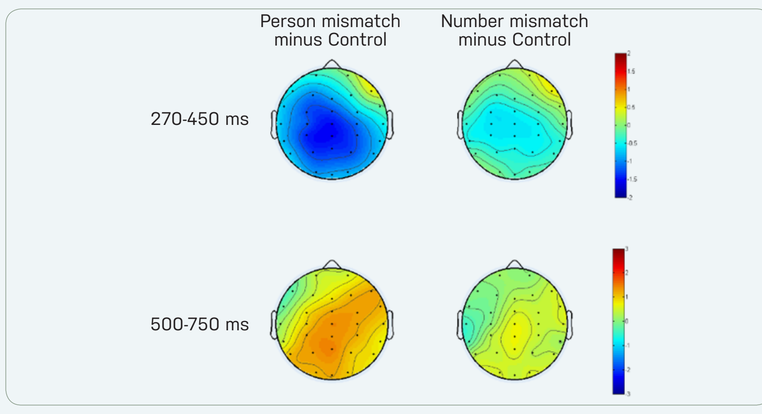


Figure 3. Isovoltage maps for the clitics (z-paradigm)

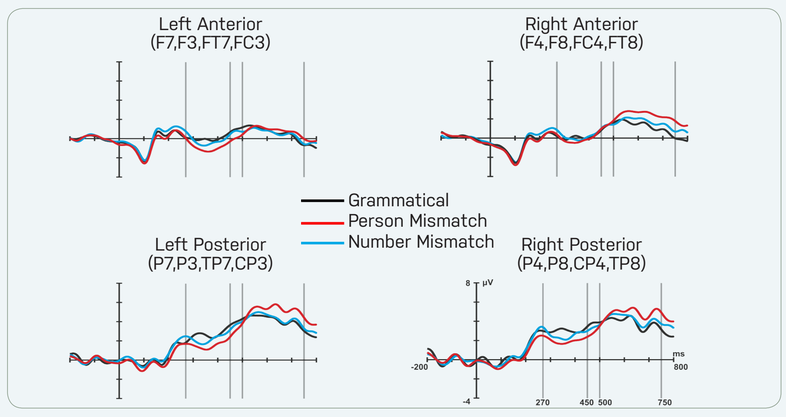


Figure 4. Grand-averaged ERPs time-locked to the verb presentation for the z-paradigm

A Comprehension:Affixes vs. Clitics

Statistical analyses in the N400/LAN time window showed an interaction between A/P and Paradigm factors [$F_{(1,65)}$=4.462, p=.039] and between Hemisphere and Paradigm factors [$F_{(1,65)}$=6,438, p=.014] for the person condition. In the number mismatch condition, the effect elicited in the k-paradigm was left lateralized compared with the z-paradigm [HemispherexParadigm: $F_{(1,65)}$=5,272, p=.025].

In the P600 time window, ERPs showed positivity for only the person mismatch in the z-paradigm. This is borne out by the main effect of Paradigm [$F_{(1,65)}$=4,342, p=.041] in the ANOVA. However, k-paradigm vs z-paradigm comparison in the P600 window showed no significant differences in the number mismatch condition.

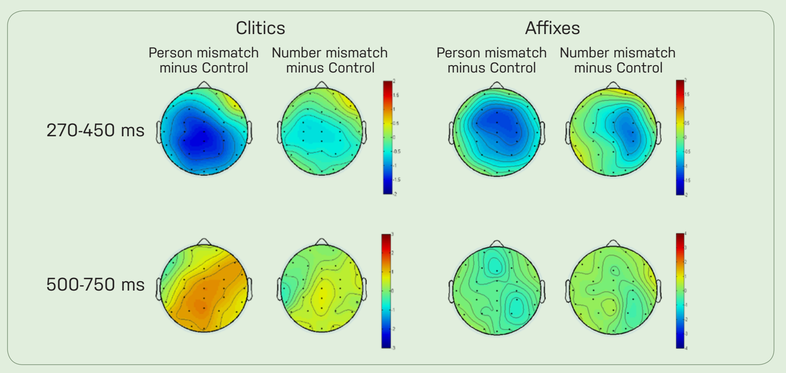


Figure 5. Isovoltage maps for clitics and affixes for first person

Conclusion

Affix paradigm (k-paradigm)

Contrary to Silva-Pereyra and Carreiras (2007), who found a similar LAN+P600 pattern for number and person mismatches, Aygüneş et al. (2012) found differences between person and number in the same experiment paradigm (Exp. 1).

Clitic paradigm (z-paradigm)

Similar to the k-paradigm, the results show that person and number are distinct features in the z-paradigm (Exp. 2). Contrary to the k-paradigm, person mismatch gives rise to a P600 effect but number mismatch does not in the 500-750 ms time window.

Affixes v.s. Clitics

Taken together, the results of Exp. 1 and Exp. 2 suggest that affixes and clitics are processed in different ways. This can be seen clearly in the second time window result for the person feature. By virtue of the morpho-syntactic properties of pronominal enclitics, such as the position of the clitic or the nature of the ϕ-features (i.e., interpretable features), person violations resulted in a large P600 effect. Contrary to the affix paradigm, and because of a large P600 effect in clitic paradigm, the effect could not have been masked by the sentence-final closure negativity.

These results also supported the finding of N400 effects to manipulations that are not straightforwardly lexical-semantic in nature. (Choudhary et al., 2009; Haupt et al., 2008; Bornkessel et al., 2004, Mancini, et al., 2011).

References

Aygüneş, M., Kaşıkçı, I., Aydın, Ö., Demiralp, T. (2012). Türkçede uyum özelliklerinin işlemlenmesi: *Olaya-ilişkin beyin potansiyelleri incelemesi*, 16th International Conference on Turkish Linguistics, 18-20 September 2012, METU, Ankara.

Bornkessel, I., McElree, B., Schlesewsky, M., & Friederici, A.D. (2004). Multi-dimensional contributions to garden path strength: Dissociating phrase structure from case marking. *Journal of Memory and Language, 51*, 495–522.

Choudhary, K. K., Schlesewsky, M., Roehm, D., & Bornkessel-Schlesewsky, I. (2009). TheN400 as a correlate of interpretively-relevant linguistic rules: Evidence from Hindi. *Neuropsychologia, 47*, 3012–3022.

Haupt, F. S., Schlesewsky, M., Roehm, D., Friederici, A. D.,&Bornkessel-Schlesewsky, I. (2008). Thestatus of subject–object reanalyses in the language comprehension architecture. *Journal of Memory and Language, 59*, 54–96.

Mancini,S, Molinaro, N., Rizzi, L, & Carreiras, M. (2011). A person is not a number: Discourse involvement in subject–verb agreement computation, *Brain Research, 1410*, 64-76.

Silva-Pereyra, J., Carreiras, M. (2007). An ERP study of agreement features in Spanish. *Brain Research. 1185*, 201–211.

Sezer, E. (2002). Finite inflection in Turkish. In E. Taylan (eds.) *The Verb in Turkish* (pp. 1-45). Amsterdam: John Benjamins.

Yu, A.C. & Good, J.C. (2000). *Morphosyntax of two Turkish subject pronominal paradigms*, NELS 30.

Please scan to download

This research was supported by TÜBİTAK (Project ID: 111K230) and this presentation was supported by Istanbul University (Project ID: 43242)