14th International Language, Literature and Stylistics Symposium

Processing active / passive sentences in Turkish agrammatic aphasics

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Abstract

In this study, the comprehension of lexical processing in aphasia was evaluated. Five left brain damaged Turkish Broca’s aphasics performed a lexical decision task. At the very outset of the study, a Dichotic Listening Test was conducted so that the dominant hemisphere for word processing could be evaluated. In order to check the level of lexical processing, the visual lexical decision task and passive sentence comprehension task which contained twenty active and twenty passive sentences were conducted to examine whether the subjects could comprehend the selected expressions. The results showed that Turkish Broca’s aphasics have no difficulty in understanding active sentences which has an agent as the first element in a sentence unlike passive equivalents in a theme agent order. In other words, the potential problem of comprehension is closely related to the word order of the target language in Broca’s aphasics patients.

1. Introduction

Various types of injury may reveal how language is organized in the brain. Focal injuries to the cortex of the brain, which is called “stroke” may lead to a specific defect in the functions of the brain. The study of aphasia, or the loss of language functions due to the damage to the language areas of the brain has been an important source of evidence for the study of brain and language relationships.

New techniques have been developed for exploring the activity of the brain as it performs a specific linguistic task. These imaging techniques are positron emission tomography (PET) and functional magnetic resonance imaging (fMRI). Measurements can also be made on the scalp using electrophysiological potentials (Event-related potentials- ERPs) and small electromagnetic potentials (magnetoencephalography) to record neural activity that arises in relationship to language functions. They all provide images of the brain ‘at work’ (Kandel, 2000).
Agrammatic Broca’s aphasia is caused by a brain lesion in Broca’s area or Brodmann’s area 44 and 45 in the anterior portion of the left hemisphere. Impairments are primarily due to difficulty in production of speech and comprehension of complex linguistic structures (Ingram, 2007; Yule, 2010). Their speech production is hesitant and effortful. The speech production of agrammatic Broca’s patient is characterized by telegraphic speech, in which bound and free grammatical morphemes are frequently omitted or substituted (Yule, 2010).

Within the last decades, several hypotheses have been suggested to enlighten the deficit in the background of agrammatic aphasia. The previous studies suggested that their comprehension is better than their production. However, current research agrees that the comprehension depends on the syntactic structure of the sentence. Given every language has a base order, Turkish has Subject-Object-Verb (SOV) order different from the base order and is called ‘derived order’. In English, an individual’s with Broca’s aphasia understands simple active sentences but they fail to understand passives (Schwartz, Saffran, & Marin, 1980; Bastiaanse& Van Zonneveld, 2005). However, Turkish agramatic patients have more problems producing sentences in derived order in their language (Yarbay et. al. 2007).

Several hypotheses try to explain the underlying mechanisms. According to the Schwartz, Linebarger and Saffran’s (1987) “Mapping Deficit Hypothesis (MDH), patients with agrammatism cannot assign or map appropriate semantic or thematic roles onto noun phrases, therefore, they cannot even interpret even simple sentences. Also this hypothesis suggests that this situation affects both sentence comprehension and sentence production. Mapping Deficit Hypothesis (MDH) suggests that the patients assign the agent role to the first noun phrase in the sentence (Duman et al. 2011)

Grodzinsky’s (1995) Trace Deletion Hypothesis (TDH) claims that Broca’s aphasics know how to assign semantic roles to noun phrases when the noun phrases are in the right place, but when noun phrases are moved they leave a trace in their original positions. Therefore, they do not assign any thematic role to the moved constituent and they fail to understand the sentence. They apply an agent-first strategy to the moved constituents in other words they take the first noun phrase as an agent. Bastiaanse and Van Zonneveld’s (2006) Derived Order Problem Hypothesis (DOP-H) claims that the arguments in derived order or theme-agent order such as passives are harder to comprehend than sentences with base order arguments.

The purpose of this study is to assess the comprehension of the active and passive sentences in Turkish aphasic patients and to shed light on factors that influence comprehension of complex syntactical units and to determine the dominant hemisphere for syllable processing.

2. Material and Method

The data of the study were collected from five Broca’s Aphasics Left Brain Damaged, who were hospitalized in Atatürk University Faculty of Medicine Research Hospital Neurology Clinics, and five control subjects. The control data were collected from the relatives of the patients giving company to the patient during their hospital stay. The Broca’s aphasic patients were selected according to be left brain damaged, right handed, native speakers of Turkish and being at least literate. Beside to these criteria, all the subjects had sufficient cooperation and comprehension level to understand the instructions. Moreover, subjects who had any auditory and visual deficiency were excluded from the study. The implementation was performed at least 8 weeks after stroke.

Along with the brain damaged subjects, a control group of five subjects was recruited among the non-brain damaged subjects, who were age, sex and education matched with the study group. All control subjects were right handed.

2.1. Dichotic listening test

Dichotic Listening Test is an experimental technique which declares a left hemisphere dominance for syllable and word processing. The test relies on the knowledge that each hemisphere is primarily concerned with sensory and motor processes on the contralateral side of the body. The main goal of applying dichotic test in this study is to define the dominant hemisphere for syllable processing in aphasic patients and compare them with their counterparts.

2.2. Visual lexical decision task
All the participants performed a ‘Visual Lexical Decision Task’ to investigate the comprehension of active sentences. Twenty syntactically simple affirmative sentences, in an active voice were prepared. For each of the sentences, a color picture illustrating the real meaning of the sentence and an irrelevant picture was selected. These pictures were prepared as flash cards to be presented to the subjects simultaneously. The researcher read sentences in a neutral voice; the patient was asked to choose the corresponding picture between the two options. For instance ‘Çocuk ata biniyor’ (The boy is riding a horse) vs ‘Çocuk bisiklete biniyor’ (The boy is riding a bicycle) were shown to the subjects. The patient’s performance on this task was compared with the performance of the healthy participants.

2.3. Visual lexical decision task

To determine the comprehension of passive sentences ‘Passive Sentence Comprehension Task’ was applied. Twenty passive sentences were read to the patient. She/he had to choose between two alternatives; while one picture represented the meaning of the passive sentence, the other, in active form, corresponded to the same meaning with an agent. For instance, the pictures representing the expressions ‘Kadın evi temizledi.’(The housewife cleaned the house.) vs ‘Ev temizlendi’ (The house was cleaned) were shown to the subjects.

3. Results

The Demographical information of Turkish Broca’s Aphasic Patients and their achievement scores in terms visual lexical decision task and passive sentence comprehension task of both active and passive sentences are shown in table 1

Table 1. Turkish Broca’s Aphasic’s demographic information and their achievement scores of active-passive sentence comprehension

<table>
<thead>
<tr>
<th>Participants</th>
<th>Age</th>
<th>Sex</th>
<th>Hemisphere</th>
<th>Education</th>
<th>Aphasia Type</th>
<th>Interval</th>
<th>Active Sentence (%)</th>
<th>Passive Sentence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>60</td>
<td>F</td>
<td>NA</td>
<td>Primary</td>
<td>NA</td>
<td>NA</td>
<td>100</td>
<td>95</td>
</tr>
<tr>
<td>2</td>
<td>57</td>
<td>M</td>
<td>NA</td>
<td>Literate</td>
<td>NA</td>
<td>NA</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>3</td>
<td>76</td>
<td>M</td>
<td>NA</td>
<td>Primary School</td>
<td>NA</td>
<td>NA</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>4</td>
<td>72</td>
<td>F</td>
<td>NA</td>
<td>Literate</td>
<td>NA</td>
<td>NA</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>5</td>
<td>83</td>
<td>F</td>
<td>NA</td>
<td>Primary</td>
<td>NA</td>
<td>NA</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Mean</td>
<td>69,6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>100</td>
<td>99</td>
</tr>
</tbody>
</table>

As seen in the table, all of the subjects are Broca’s aphasics with left brain damaged. Their lesion sites display certain characteristics such temporal (T), parietal (P), frontal (F). Their minimum educational level is being literate. Given the mean percentage of the correct answers in ‘Visual Lexical Decision Task’ for Turkish Broca’s Aphasic Group ( % 83) showed a significant achievement in comprehending the active sentence. On the other hand the same achievement is not seen for the passive counterparts.

Table 2. Turkish Broca’s Aphasic’s demographic information and their achievement scores of active-passive sentence comprehension in control group
Table 2 shows the demographical information and relevant achievement scores for active and passive comprehension in control group subjects. The average age of the control group is about 70 with 3 female and 2 male subjects with at least literate educational level. While their achievement rate in active sentences appears to be at ceiling (%100), there seems very little decline in the passive sentence comprehension (%99).

<table>
<thead>
<tr>
<th>Participants</th>
<th>Age</th>
<th>Sex</th>
<th>Lesion site</th>
<th>Education</th>
<th>Aphasia Type</th>
<th>Interval (weeks)</th>
<th>Active Sentences (%)</th>
<th>Passive Sentences (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>73</td>
<td>F</td>
<td>T+P</td>
<td>Primary</td>
<td>Broca</td>
<td>9</td>
<td>90</td>
<td>35</td>
</tr>
<tr>
<td>2</td>
<td>84</td>
<td>M</td>
<td>T+F</td>
<td>Literate</td>
<td>Broca</td>
<td>12</td>
<td>80</td>
<td>25</td>
</tr>
<tr>
<td>3</td>
<td>79</td>
<td>M</td>
<td>T+F</td>
<td>Primary</td>
<td>Broca</td>
<td>8</td>
<td>95</td>
<td>45</td>
</tr>
<tr>
<td>4</td>
<td>59</td>
<td>F</td>
<td>P</td>
<td>Literate</td>
<td>Broca</td>
<td>10</td>
<td>70</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td>70</td>
<td>F</td>
<td>T+P</td>
<td>Primary</td>
<td>Broca</td>
<td>11</td>
<td>80</td>
<td>30</td>
</tr>
<tr>
<td>Mean</td>
<td>73</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10</td>
<td>83</td>
<td>30</td>
</tr>
</tbody>
</table>

Figure 1. Dichotic Listening Test results in experimental and control group

Figure 1 illustrates the lateralization for syllable processing in both groups between Turkish Broca’s aphasics. LEA refers to left ear advantage, the persons who process syllables in the right hemisphere; on the other hand, REA refers to the people processing the syllables in the left hemisphere. BEA refers to both ear advantage among the aphasics. These patients are seen to process syllables in their both hemispheres. As seen in the figure four subjects had left ear advantage and one subject had both ear advantages. In control group all subjects had right ear advantage.

4. Discussion and Conclusion

Most studies investigating lateralization for syllable processing agree that aphasics patients have a tendency to show left ear advantage relative to non-brain damaged listeners (Niccum & Speaks, 1991). Crosson and Warren applied dichotic listening task to subjects with Broca’s and Wernicke’s aphasia, and normal subjects. They found that normal subjects demonstrated the usual right ear advantage, both the Broca’s and Wernicke’s aphasia groups demonstrated left ear advantage. (Crosson & Warren, 1981). The results of this study are consistent with the current literature stating that Turkish Broca’s aphasics demonstrated left ear advantage for syllables.

In this study, however, there was significant difference in ‘Visual Lexical Decision Task’ and ‘Passive Sentence Comprehension Task’ in both groups. In many studies it is stated that individuals with agrammatic aphasia have difficulty in producing and comprehending syntactically complex sentences such as passives (Gavarro, 2013; Meyer et al, 2012; Cho & Thompson, 2010; Berndt et al.1997; Lukatela et al. 1995). It is stated that Broca’s aphasics have no difficulty in understanding active sentences but perform with less achievement level in passive
constructions (Caramazza et al. 2001). Agrammatic speakers have more problems in comprehending and producing sentences in derived order than sentences in base order (Bastiaanse & van Zonneveld, 2005). The results of Gavarró’s study (2013) indicates that the comprehension deficit of Broca’s aphasics is selective, not general. Yarbay Duman et al., in 2007 investigated the affect of word order in comprehension. The results of their study showed that the patients had significantly more problems in producing sentences in Object Subject Verb word order. Most of them left the object in its base position so it was concluded that derived order is difficult for Turkish agrammatic speakers. Yarbay Duman et al. in 2011 stated that comprehension of semantically reversible sentences is often impaired in Broca’s aphasia. They indicated that clauses were comprehended better when there was base word order information. They stated that the sentence comprehension deficit in Turkish Broca’s aphasia is due to a problem in assigning thematic roles to the noun phrase by integrating syntactic word order. The findings of our study shows that aphasic patients have no difficulty in understanding active sentences which has an agent as a first element in the sentence whereas they have difficulty in understanding passive sentences which has a theme-agent order. Therefore, the results indicate that Turkish aphasic patients’ comprehension deficit is selective depending on the word order of the sentence. These results are consistent with the hypothesis that aphasic patients understand the sentences containing agent. Consequently, since most studies into sentence comprehension and lateralization among aphasics often focus on European languages, and given little research examining another language such as Turkish have been conducted, this study may contribute to the researchers in neurolinguistics to better understand the language processing within diverse utterances in both healthy and damaged brains.

APPENDIX A.

The correct active sentences illustrated on the flash card

1. Çocuk bisiklete biniyor. 1) Çocuk ata biniyor.
2. Kadın çamaşır yıkıyor. 2) Kadın üstü yapıyor.
4. Çocuklar top oynuyor. 4) Çocuklar müzik dinliyor.
7. Çocuklar kızak yapıyor. 7) Çocuklar ağaça türmannıyor.
9. Adam araba süriyor. 9) Adam oturuyor.
10. Dede uyuyor. 10) Dede koşuyor.
11. Çocuklar ders çalışiyor. 11) Çocuklar oyun oynuyor.
17. Adam badana yapıyor. 17) Adam televizyon izliyor.
20. Çocuk ağlıyor. 20) Çocuk ders çalışıyor.

APPENDIX A (Continuing)

The irrelevant active sentences illustrated on the flash card

Active forms of passive sentences

Passive Sentences

1) Çocuk atasını biniyor.
2) Kadın üstünü yapıyor.
3) Kız uyuyor.
4) Çocuklar müziği dinliyor.
5) Nine televizyon izliyor.
6) Kadın bulaşığını yıkıyor.
7) Çocuklar ağaça türmanınıyor.
8) Kız temizliği yapıyor.
9) Adam oturuyor.
10) Dede koşuyor.
11) Çocuklar oyun oynuyor.
12) Kadın evini süpüryor.
13) Oğlan kitap okuyor.
14) Kadın oturuyor.
15) Kız yemek pişiriyor.
16) Kadın örtüleri yıkıyor.
17) Adam televizyon izliyor.
18) Kadın yerleri siliyor.
19) Kız ders çalışıyor.
20) Çocuk ders çalışıyor.
References


Cho S. and Thompson C.K. (2010), What goes wrong during passive sentence production in agrammatic aphasia: An eyetracking study, APHASIOLOGY, 2010, iFirst, 1–17


