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Sentence comprehension in Turkish Broca’s aphasia: An integration problem

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Background: Comprehension of semantically reversible sentences is often impaired in Broca’s aphasia. When the arguments in such sentences are in derived order, they are more difficult to comprehend than when they are not. Most studies on this topic are of English, a morphologically poor language; only a few experiments have examined sentence comprehension in case-marking languages. These studies tested sentences in which word order was varied while case was kept constant. Their results suggest that case does not improve comprehension of derived order sentences. The present study is on the comprehension of semantically reversible sentences in Turkish Broca’s aphasia. Turkish, with its flexible word order and rich case morphology, is well suited to this investigation because there is an interaction between word order and case, which is known to influence sentence production in this aphasia type (Yarbay Duman, Aygen, & Bastiaanse, 2008).

Aims: The purpose of this study was to investigate the influence of word order and case information on the auditory comprehension of semantically reversible sentences in Turkish Broca’s aphasia to find out whether an interaction between word order and case, similar to the one found in production, can be observed in sentence comprehension.

Methods & Procedures: A comprehension test with five reversible sentence types (base order active sentences, sentences with object scrambling, subject relatives, object relatives, and passives) was developed. Sentences in base and derived word order varied in their use of case. Sentences with base case (subject = nominative; object = accusative) and non-base case were included to evaluate the interplay between word order and case separately.

Outcomes & Results: The results showed that both word order and case influenced sentence comprehension. Clauses were comprehended best when there was both base (unambiguous) case and base word order information (base order active sentences). Performance dropped if there was base case information but derived word order (object scrambling and subject relatives). When there was neither base case information nor base word order (object relatives and passives), clauses were comprehended least well.

Conclusions: The sentence comprehension deficit in Turkish Broca’s aphasia is due to a problem in assigning thematic roles to the noun phrases by integrating syntactic word order.
order and case information. Such an integration problem is in line with previous findings on sentence production in Turkish and the Integration Problem Hypothesis (IPH: Yarbay Duman, 2009).

**Keywords:** Broca’s aphasia; Auditory sentence comprehension; Case, Word order; Integration

One defining feature of sentence production in agrammatic Broca’s aphasia is the omission and substitution of free and bound grammatical morphemes in simple and complex sentence structures (e.g., Caramazza & Berndt, 1985; Goodglass, 1968; Marshall, 1986). With regard to comprehension, deficits are prominent when reversible sentences with theme–agent arguments order are examined. In English, for example, individuals with Broca’s aphasia understand simple active sentences, subject relatives, and subject clefts but they fail to understand passives, object relatives, and object clefts (e.g., Caramazza & Zurif, 1976; Schwartz, Saffran, & Marin, 1980). Although this pattern has been explained by various theories at different levels (e.g., Bastiaanse & Van Zonneveld, 2005; Drai & Grodzinsky, 2006; Grodzinsky, 1995; Schwartz, Linebarger, Saffran, & Pate, 1987), researchers agree that word order may influence sentence comprehension in agrammatic Broca’s aphasia.

Despite the extensive work on the influence of word order on sentence comprehension, only a few studies have investigated sentence comprehension in case-marking languages (Serbo-Croatian: Smith & Mimica, 1984; Turkish: McWhinney, Osmán-Sági, & Slobin, 1991; Lukatela, Shankweiler, & Crain, 1995; German: Burchert, De Bleser, & Sontag, 2003; Hebrew: Friedmann & Shapiro, 2003; Russian: Friedmann, Reznick, Dolingski-Nuger, & Soboleva, 2010). Their results suggest that case does not improve comprehension of theme–agent sentences. What is common to these studies is that they tested sentences with various word orders in which case morphology was kept constant.

Turkish agrammatic speakers with Broca’s aphasia have more problems producing sentences in derived order—these are sentence structures that are different from subject (agent) – object (theme) – verb—than sentences in base order, such as in Turkish sentences with object scrambling (Yarbay Duman, Aygen, Özgirgin, & Bastiaanse, 2007). Word order and morphology are closely related in Turkish. When both word order and case are varied, an interaction between the two is observed in sentence production. For example, in Turkish object relative clauses, the word order changes as does the case of the subject: nominative becomes genitive. These sentences were used in the production study of Yarbay Duman, Aygen, and Bastiaanse (2008). Word order errors and morphological errors were produced by the agrammatic speakers in sentences in derived order. When agrammatic speakers fail to produce the right order, they adapt case to the order they produce. Apparently there is an interaction between word order and case that Turkish agrammatic speakers are aware of when producing sentences. On the basis of these data the Integration Problem Hypothesis (IPH) was formulated (Yarbay Duman, 2009). The IPH correctly describes the problems that agrammatic speakers have in combining syntactic and morphological information when producing sentences. On the basis of the production data in Turkish, the question arises of whether an interaction between word order and case, similar to the one found in production, can be observed in sentence comprehension. Thus the research question of the current study is how word order and case information in Turkish interact in the comprehension of semantically reversible sentences in Broca’s aphasia.
The answer to this question will shed light on how impaired and unimpaired speakers use syntactic information (word order) and morphology (case) to interpret sentences. Turkish, with its flexible word order and rich case morphology is a suitable language for this investigation. First, the aphasiological background will be outlined. Second, the relevant linguistic structures of the Turkish grammar will be sketched out, followed by a section on the hypotheses for the present study. Then the experiment itself and the results will be presented, followed by a discussion of the results in the light of the IPH.

APHASIOLOGICAL BACKGROUND

Several theories have been formulated to describe the word order problems individuals with Broca’s aphasia encounter in sentence comprehension. They aim to account for why patients have more difficulties comprehending sentences in theme–agent order than sentences in which the agent precedes the theme. First is Schwartz et al.’s (1987) Mapping Deficit Hypothesis (MDH), which suggests that the patients assign the agent role to the first NP in the sentence. Second is Grodzinsky’s (1995) linguistically motivated Trace Deletion Hypothesis (TDH), which claims that when arguments have been “moved”, they leave a trace in their original position. In sentence representations of individuals with Broca’s aphasia these traces are deleted, and therefore no thematic role can be assigned to the “moved” constituent and the patient fails to understand the sentence (see also Drai & Grodzinsky, 2006). Third is Bastiaanse and Van Zonneveld’s (2005, 2006) Derived Order Problem Hypothesis (DOP-H), according to which all sentences with the arguments in derived order (these are sentences in theme–agent order for the DOP-H) are harder to comprehend than sentences with base order arguments. There is quite some overlap between the predictions made by different hypotheses: they all predict more problems with the comprehension of sentences in theme–agent order such as passives and object relatives in English. Both the MDH and the DOP-H are overarching theories that make predictions for both production and comprehension. The TDH is only meant to cover comprehension data. Although these theories have initially been developed on the basis of the performance of Broca patients in morphologically simple languages, such as English, that do not mark case on the nouns, their predictions have been extended to case-marking languages.

The results of the studies of sentence comprehension in Broca’s aphasia in case-marking languages suggest that case and gender morphology does not improve sentence comprehension. Lukatela et al. (1995) examined the ability of Serbo-Croat-speaking patients to comprehend relative clauses. In Serbo-Croat case morphology can be used to detect the thematic roles and gender inflection to recognise the moved constituent if the two NPs in the sentence have different genders. Nevertheless, Serbo-Croat patients were unable to interpret the thematic roles in relative clauses. That is, the patients were unable to use morphological information, including information conveyed by case, while interpreting sentences. Similar findings were reported earlier by Smith and Mimica (1984) for Serbo-Croat and recently replicated for Russian, another Slavic language with a similar grammar (Friedmann et al., 2010). Russian patients’ comprehension of topicalised sentences and relative clauses was found to be impaired despite the availability of morphological cues on the topicalised object (case cue) and relative pronouns (case and gender cue). Similar findings have been reported for German and Hebrew. Burchert et al. (2003) tested case and number agreement in German. They found that the presence of case marking did not assist the comprehension of relative clauses and topicalised clauses. Friedmann and Shapiro...
YARBAY DUMAN ET AL. (2003) reported that Hebrew patients' comprehension of topicalised sentences was impaired, meaning that Hebrew patients did not use case information on the object. Comprehension of sentences with moved elements is also impaired in Italian-speaking Broca patients as well (Luzzatti et al., 2001). Italian has no cases on nouns, but sentences with pronouns carrying overt case in base and derived positions were also tested. Interestingly, the impairment was also observed in sentences with a clitic pronoun, which has overt case (Luzzatti et al., 2001). In sum, the findings in case-marking languages show that sentences in which the agent and theme roles are not in their base positions are hard to understand for individuals with Broca's aphasia, suggesting that these patients do not use case information (or gender and number) to understand sentences.

These findings contradict the Competition Model (MacWhinney & Bates, 1989) which assumes that case would make the correct interpretation of the clauses in case-marking languages. According to the model, it is cue validity (the information value of a particular source of information) and cue cost (the cost involved in processing that piece of information)—determined on the basis of frequency of a particular information structure, and not the morphosyntactic complexity (e.g., base versus derived word order)—that predict patient performance.

However, the performance of individuals with Broca's aphasia in case-marking languages is usually not as poor as the performance of patients from languages that do not have overt case marking. One of the explanations for this is that although case is intact, the individuals with Broca's aphasia cannot use case this information effectively for sentence interpretation (see also Smith & Mimica, 1984). Turkish production data (Yarbay Duman et al., 2007, 2008) show that sentences with simple word order are produced without case errors. If the patients produce complex sentences, then case is usually also correct. Case has been found to be preserved in several other languages, such as German and Dutch (Ruigendijk & Bastiaanse, 2002). This shows that case is usually correctly produced in production although the patients do not seem to take case into account in comprehension. It is unclear, however, why patients fail to understand semantically reversible sentences with derived order of the thematic roles in languages where case information unambiguously points to the subject and the object. In order to find out why, it is interesting to look at Turkish because it enables testing of sentences in which both word order and case are varied.

Aydın (2007) tested comprehension of Turkish subject and object relative clauses. As mentioned, there is both word order and case change in Turkish object relative clauses. The author reported poor comprehension performance overall. However, no information on the ability of Turkish patients to use specific case morphology in relative clauses was provided. Furthermore, no comparison with base order clauses was made, as a result of which it is unclear whether the comprehension difficulty the patients had was specific to sentences in derived order or an overall deficit in sentence comprehension. The next section is on the relevant grammatical characteristics of Turkish.

LINGUISTIC BACKGROUND

There are two characteristics of Turkish relevant to the present study. First, Turkish is a subject-object-verb (SOV) language (Erguvanlı, 1984)—see (1): nom = nominative; acc = accusative; pl = plural; 3s agr = third person singular—but word order is flexible, so alternations to this basic order are possible. Note that Turkish uses singular verb
forms with singular and plural animate subjects. There is no object–verb agreement in Turkish. In the examples below, the subject is inflected in the plural -loh and the verb is inflected for third person singular, a zero agreement morpheme in main clauses. Accordingly, it is not possible to identify the subject of the sentence on the basis of number in Turkish examples below.

(1) polis-ler_ler agent hırsız-ı_theme vur-uyor

policeman-nom-pl thief-acc shoot-aspect/3s agr

“the policemen shoot the thieves”

Word order alternations are given in (2).

(2) a. hırsızı polisler vur-uyor OSV
b. polisler vuruyor hırsızı SVO
c. hırsızı vuruyor polisler OVS
d. vuruyor polisler hırsızı VSO
e. vuruyor hırsızı polisler VOS

These sentences are syntactically derived from the base order by movement of noun phrases (NPs) for pragmatic purposes such as topicalisation, focusing, and back-grounding (Erguvanlı, 1984). Word order variation in Turkish is constrained for some constructions (Aygen, 2002). Definiteness is marked by the accusative case on objects and by sentence initial position in subjects. These definite objects may be topicalised. Indefinite objects are not overtly case marked and are obligatorily in the preverbal position. They cannot be moved to clause initial position: “hırsız polisler vuruyor is an unacceptable sentence for the interpretation of “the policemen shoots the thief”.

Second, Turkish is a case-marking language. In Turkish, grammatical case (here-after, case) is expressed inflectionally on the noun phrase. There are six cases in Turkish: nominative, accusative, genitive, dative, locative, and ablative. Each case has a specific inflection (zero morpheme for nominative, -i for accusative, -in for genitive, -e for dative, -de for locative, and -den for ablative).

Because of the flexible word order, the distinction between a subject and an object cannot be maintained solely on the basis of word order. Case inflection on the nouns marks the agent and the theme of the clause. Nominative case (zero inflected) marks the subject/agent and accusative case (-i) marks the definite object/theme.

For the present study sentences in which the object/theme is inflected in the accusative case and the subject/agent is inflected in the nominative case are called sentences with base case. Base order clauses (see 1 above) and some clauses with derived word orders (moved constituents are in italics)—i.e., of object scrambling (also called topicalisation: 2a, repeated below as 3) and subject relatives (see 4) are some examples. Note that, in the present study, derived word order refers to a sentence structure that is different from subject (agent) – object (theme) – verb. Theta-roles are assumed to be assigned to phrasal constituents, Determiner Phrases (DP), at their base positions (Chomsky, 1995).2

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1 In Turkish the use of a plural verb with inanimate subjects is ungrammatical (e.g., *kalem-ler düş-tüler, pencil-plural fall-past-plural, “the pencils fell down”). It is not ungrammatical to use plural verbs with animate subjects (e.g., çocuk-lar geldi-ler, children-plural come-past-plural, “the children came”). However, the plural inflection as such is used only for a stylistic purpose.

2 Alternatively, Hornstein (2001) assumes that theta-roles are features of the predicate and like all other features they license movement as a species of feature checking.
(3) Object Scrambling (OSV)

\[ \text{hırsız-ı theme} \quad \text{polis-ler agent} \quad \text{vur-uyor} \]

\[ \text{thief-acc} \quad \text{policeman-nom-pl} \quad \text{shoot-asp/3s agr} \]

“the thief, the policemen shoot”

(4) Subject relatives [NP OVS]

\[ [\text{hırsız-ı theme vur-an polis-ler agent}] \]

\[ \text{the thief-acc shoot-aspect the policeman-nom-pl} \]

“the policemen who have shot the thief”

The presence of base case makes word order a fairly reliable cue to thematic structure, even in derived order sentences. There are exceptions, however. Object relative clauses (see 5) and passives (Boeckx, 1998, see 6) have derived word order, but they do not have base case. In object relative clauses the agent is the subject and inflected with the genitive (gen) case and the theme is the object and inflected with the nominative case. The relative clauses in the present study are tested as NPs (i.e., in the absence of a higher main clause verb) in which the subject of the subject relative and the object of the object relative are unmarked for case. In this respect they appear nominative at the surface level (also see passives, below), since the nominative is also deprived of overt case morphology. In passives, both arguments carry zero marking characteristic of the nominative case. Thus these derived sentences are different from the abovementioned sentences with only derived word order, in that they lack base case assignment. Case assignment in these clauses is therefore called non-base case.

(5) Object relatives [NP SVO]

\[ [\text{polis-ler-in agent vur-duğ-u hırsız theme}] \]

\[ \text{the policeman-pl-gen shoot-aspect-agr the thief-nom} \]

“the thief whom the policemen have shot”

(6) Passives (S theme-byPhrase-V)

\[ hırsız theme \quad \text{polis-ler agent tarafından vur-ul-uyor} \]

\[ \text{thief-pl-nom policeman-nom-pl by phrase shoot-pass-3s agr} \]

“the thief is shot by the policemen”

In sum, it is not possible to interpret a Turkish sentence correctly solely on the basis of a single information source such as word order or morphology.

THE INTEGRATION PROBLEM HYPOTHESIS (IPH)

Studies of sentence production in Turkish show that agrammatic speakers are best at producing the grammatically most simple sentences: that is, sentences in base word order are easier to produce than sentences with derived word order (object scrambling:

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3The case on the extracted subject in subject relative clauses is dependent on the external syntax of the relative clause. Specifically, if the subject relative clause is the subject of a main clause, then it is in the nominative (e.g., polisi vuran hırsız burada “the thief who has shot the policeman is here”). If it is the object of a main clause, then it is in the accusative (i.e., polisi vuran hırsızı gördüm, “I saw the thief who has shot the policeman”). The case on the extracted object in object relative clauses is also dependent on the external syntax of the relative clause—the object is in the nominative case when it is the subject of a main clause (e.g., hırsızın vurduğu polisi burada, “the policeman who the thief has shot is here”). If it is the object of a main clause, then it is in the accusative case (e.g., hırsızın vurduğu polisi gördüm “I saw the policeman who the thief has shot”).
Yarbay Duman et al., 2007; relative clauses: Yarbay Duman et al., 2008). Second, in simple SOV sentences not only are the constituents in base order, but case is also used in its most basic way (subject / agent = nom; object / theme = acc). In Turkish object relatives, word order within the NP is derived and the subject is inflected in the genitive case. Agrammatic speakers have problems realising word order changes and the corresponding case changes are also difficult for them (Yarbay Duman et al. 2008). Finally, Turkish agrammatic speakers are relatively good in the production of non-remote verb forms (the present and future), whereas reference to the past through verb inflection (= remote verb forms) is impaired (Yarbay Duman & Bastiaanse, 2009). Accordingly, a sentence composed of (base order + base case + non-remote verb form) constitutes the simplest form of a sentence for Turkish agrammatic speakers (Yarbay Duman, 2009).

The Integration Problem Hypothesis (IPH) has been formulated to capture problems with derived word order, non-base case and remote time-reference. According to the IPH, when agrammatic speakers are required to use derived order, a case that is non-base or remote verb forms, their performance drops significantly. When variables add up, difficulties add up as well. For example, object relatives with derived word order and non-base case are more problematic to produce for individuals with Broca’s aphasia than subject relatives with derived word order and base case (Yarbay Duman et al., 2008). Furthermore, reference to the past through verb inflection is more difficult than reference to the future in sentences with a base order, however the ability to produce time reference morphology and object relatives leads to a decrease in performance in the future time frame (Yarbay Duman & Bastiaanse, 2009).

Accordingly, the IPH assumes that sentences with derived order and non-base case are more difficult to produce than sentences with only derived order, which are in turn more difficult to produce than sentences with base order. The IPH proposes that this is an integration problem: agrammatic speakers produce the correct case when they produce derived word order, regardless of whether this is base or non-base case. For example, Yarbay Duman et al. (2008) reported that the knowledge of the genitive case is intact, although the agrammatic speakers can only produce genitive case when they move the object to the clause final position to derive the object relative clause order. In other words, when patients fail to produce the right order, they produce a base order clause with the subject in nominative case. There was no instance in which the patient produced the derived order correctly but the case incorrectly. If the deficit is due to an integration problem, as proposed by the IPH, this predict that agrammatic patients cannot interpret a derived order sentence successfully solely on the basis of case.

THE PRESENT STUDY

Turkish speaking individuals with Broca’s aphasia were tested on a comprehension test where sentences with base and derived word order varied in their use of case. Both sentences with base case assignment (base order clauses, object scrambling, subject relatives: subject = nominative; object = accusative) and sentences with non-base...

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4According to the IPH, all orders that are different from the base order are derived, and therefore difficult to produce and to comprehend for Broca patients. The IPH takes only overt movement into account since this type of movement changes the base word order. Movement or merge operations that do not change the base word order are not assumed to be difficult for the patients.
case assignment (object relatives: subject = genitive; object = nominative and passives = both the subject and the object are in nominative) were included to evaluate the interplay between word order and case separately.

Only in sentences with base case assignment does the case information unambiguously signals the agent and theme roles of the noun phrase. In other words, the present study tests how patients comprehend sentences with variable case information (base versus non-base) in sentences with base and derived word order.

Before we proceed with the predictions for the present study, Table 1 provides a summary of the relevant grammatical characteristics of the clause types tested. It shows that (1) base order clauses have base case assignment; (2) object scrambled and subject relative clauses have derived word orders, but they have base case assignment; (3) object relatives and passives have derived word orders, and they do not have base case assignment.

Theories of sentence comprehension (MDH, TDH, and DOP-H) fall short in making relevant predictions on how Turkish speaking individuals with Broca’s aphasia can comprehend clauses in terms of word order and case because they do not take case into account. For word order, they predict that sentences in theme–agent order (object scrambling, subject relatives, passives) will be more difficult than sentences in agent-theme order. The IPH makes the following predictions:

1. Sentences in derived word order (object scrambling, subject relatives, object relatives, and passives) will be more difficult to comprehend than sentences in base order.
2. Comprehending sentences with derived word order and non-base case (object relatives and passives) will be more difficult than sentences with derived word order and base case (object scrambling and subject relatives), should an interaction between word order and case similar to production also exist in comprehension.

It will be shown that case influences performance both at the group and at the individual level, but that it is less decisive than word order, even in a language where word order is flexible.

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5The detailed syntactically represented predictions of the TDH and DOP-H (as well as the validity of those predictions) regarding thematic role assignment for each sentence type tested in this study can be found in Yarbay Duman (2009).
METHOD

Participants

A total of 17 monolingual Turkish-speaking individuals with Broca’s aphasia (7 female, 10 male) with a mean age of 49.8 years ($SD$: 14.3) participated in the study.

The patients were recruited from the Ankara Physical Medicine and Rehabilitation Centre (Ankara, Turkey). They were first assessed and diagnosed by neurologists as suffering from aphasia. Then, the patients were directed to the speech therapy unit, where the aphasia type was established with the Gülhane Aphasia Test (Tanrıdağ, 1993) and confirmed by the speech therapists’ clinical judgements. The testing took place at this centre. Individuals who were diagnosed as suffering from Broca’s aphasia and fulfilled the following criteria were included in the study: (1) a left frontal damage due to a lesion and being right-handed; (2) at least 3 months post-onset; (3) having non-fluent agrammatic speech; (4) having good comprehension of single words; and (5) having normal/corrected to normal auditory and visual acuity.

Based on spontaneous speech production, the speech therapist confirmed that all the patients had non-fluent (i.e., slower than normal) speech. They were able to produce simple and short utterances but had difficulty with the production of complex utterances. It was also confirmed that the patients’ comprehension was relatively good compared to their production. All the patients were right-handed and had normal or corrected to normal auditory and visual acuity. All patients but one (B12) were at least 4 months post-onset and had single lesion in the left hemisphere; except for B4 and B7 who had two strokes in their left hemispheres. Of the 17 patients, 15 suffered from left CVAs, and the others from brain trauma due to a gunshot (B15) and a brain tumour (B16). All but one (B7) suffered from right hemiplegia at the time of the testing, matching their left frontal damage. All the patients were treated for aphasia and social consequences at the time of testing. The treatment did not focus on comprehension. Relevant patient data are provided in Appendix 1. Ten native non-brain-damaged speakers of Turkish without language or speech impairment history served as the control group. All were right-handed. This group was matched for age and education with the Broca’s aphasia group. They performed at ceiling. Therefore their data will be ignored further.

Materials

A spoken-sentence-to-picture-matching task was developed with the five semantically reversible sentence types. There were 20 items in each condition. A total of 100 reversible sentences were tested for each participant.

For each item the patient had to choose one out of four pictures: (1) target picture; (2) picture with role reversals; (3) picture in which roles are correct, but the number of agents/themes was wrong (hereafter, number); and (4) picture in which both the roles and the number of agents/themes were incorrect (hereafter, role reversal + number). The sentence was read aloud by the experimenter and the participants were asked to point to the picture that matched the spoken sentence. Figure 1 shows an example of the test stimuli. For the sentence “the policeman shoots the thieves” the target is at the

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6The authors initially planned to use the test in Turkish–Dutch bilingual agrammatic speakers and the singular/plural distinction is needed to disambiguate Dutch relative clauses.
left upper corner and next to it is the role reversal. The number distractor is at the left bottom corner and next to it is the role reversal + number.

Half of the sentences in each condition were presented with singular agent/plural theme and the other half of the sentences were presented with singular theme/plural agent to manipulate number. The plural morpheme on the NP was always the same (-lEr). However, as mentioned earlier, Turkish uses third person singular verbs inflected with a zero agreement morpheme with plural subjects. Therefore verb inflection had no effect on identifying the subject of the Turkish sentence in this study. The order of the pictures was pseudo-randomised. Test sentences for base order condition are given in Appendix 2.

The task was administered individually. It started with two practice trials, each consisting of five items. The practice trials were repeated until it was clear that the patient understood the task. Once the test started, the experimenter only repeated the target sentence on request, not more than once. No time limit was imposed.

RESULTS

Quantitative analysis

The mean numbers (proportions in brackets) of the correctly interpreted sentences are given in Table 2 (individual scores are given in Appendix 3).

<table>
<thead>
<tr>
<th></th>
<th>Base Order</th>
<th>Object Scrambling</th>
<th>Subject Relative</th>
<th>Object Relative</th>
<th>Passive</th>
</tr>
</thead>
<tbody>
<tr>
<td>mean (Sdv)</td>
<td>15.06 (2.48)</td>
<td>12.00 (2.17)</td>
<td>12.06 (2.72)</td>
<td>10.23 (1.78)</td>
<td>9.29 (1.89)</td>
</tr>
<tr>
<td>proportion</td>
<td>0.75</td>
<td>0.60</td>
<td>0.60</td>
<td>0.51</td>
<td>0.46</td>
</tr>
</tbody>
</table>
A repeated measures analysis of variance was performed to investigate whether and how order (base and derived order) affected sentence comprehension in Broca’s aphasia in sentences with base case assignment (agent = nominative case, theme = accusative case) or non-base case assignment. Both order and case were treated as within-participants factors. For base order with base case assignment, we used Base Order (BO); for derived order with base case assignment, we used the average of Scrambling and Subject Relative (SCR-SR); for derived order without base case assignment, we used Object Relative (OR) and we used the Passive (PASS).

The repeated measures ANOVA showed a statistically significant effect for order: $F(1, 16) = 19.3, p = .000$. The easiest sentence type to comprehend was sentences with BO. In addition, an inspection of the mean scores indicated that sentences with agent–theme order (BO + OR) ($M = 0.63, SD = 0.02$) were comprehended better than sentences with theme–agent order (SCR-SR + PASS) ($M = 0.53, SD = 0.02$). There was a statistically significant main effect of case as well, $F(1, 16) = 192, p = .000$. That is, sentences with base case information (BO + SCR-SR) ($M = 0.67, SD = 0.02$) were comprehended better than sentences from which this type of information was absent (OR + PASS) ($M = 0.48, SD = 0.01$). There was a statistically significant main effect of case when only derived order clauses was considered as well, $F(1, 16) = 22.30, p = .000$. That is, sentences with base case and derived order (SCR + SR) ($M = 0.60, SD = 0.11$) were comprehended better than sentences with non–base case and derived order (OR + PASS) ($M = 0.48, SD = 0.01$).

These main effects were qualified by a significant interaction between order and case: $F(1, 16) = 5.75, p = .029$. Although there was an effect of order when two clauses had normal case information, $F(1, 16) = 18.1, p < .046$, this effect was lost when the normal case information was absent, $F(1, 16) = 3.13, p = .096$. In other words, according to the mean scores, the order of agent with respect to its theme in the sentence was not a good predictor of the patients performance: a sentence in agent–theme order (BO; $M = 0.752, SD = 0.12$) is easier to comprehend than a sentence in theme–agent order (SCR-SR; $M = 0.60, SD = 0.11$) only when both have base case information. However, when base case information is lacking, the sentences in agent–theme order (BO; $M = 0.752, SD = 0.12$) is easier to comprehend than a sentence in theme–agent order (SCR-SR; $M = 0.60, SD = 0.11$) only when both have base case information. Hence base order clauses were significantly easier to comprehend than all other sentence types. Sentences with object scrambling were as difficult as subject relatives. Both of these clauses were easier to comprehend than object relatives and passives. Object relatives were as difficult as passives. When performance on sentences with (object scrambling + subject relatives) was taken together and compared to (object relatives + passives), sentences with (object scrambling + subject relatives) were found to be easier to comprehend than sentences with (object relatives + passives).

Qualitative analysis

Table 3 presents the mean numbers (proportions in round brackets) of the error types per condition. Individual scores are given in Appendix 4. There were three types of
distractors: role reversal (RR), number (N) and [role reversal + number] (RR + N). The patients made significantly more errors with distractors with role reversals (i.e., role reversal and role reversal + number) compared to (single) number errors in all conditions (for base order, \( t = 4.06, \text{df} = 16, \ p = .001 \); object scrambling, \( t = 12.2, \text{df} = 16, \ p = .000 \); subject relatives, \( t = 7.5, \text{df} = 16, \ p = .000 \); object relatives, \( t = 16.9, \text{df} = 16, \ p = .000 \)).

A one-way analysis of variance (ANOVA) revealed that there was a statistically significant difference in the test conditions, \( F(4, 80) = 25.4, \ p = .000 \). According to the post-hoc comparisons with Bonferroni corrections (corrected \( p \) value is < .005 since there are overall 10 comparisons between groups), role reversals were the least frequent for the base order (\( M = 3.5, \ SD = 1.90 \)) compared to object scrambling (\( M = 7.2, \ SD = 1.98, \ p = .000 \)), subject relatives (\( M = 6.8, \ SD = 2.7, \ p = .000 \)), object relatives (\( M = 9.1, \ SD = 1.81, \ p = .000 \)), and passives (\( M = 10.17, \ SD = 1.84, \ p = .000 \)). No significant difference however was found between role reversals for object scrambling (\( M = 7.2, \ SD = 1.98 \)) and subject relatives (\( M = 6.8, \ SD = 2.7, \ p = 1.000 \)) and object relatives (\( M = 9.1, \ SD = 1.81 \)) and passives (\( M = 10.17, \ SD = 1.84, \ p = 1.000 \)).

Summary of the results

Quantitatively: Base order clauses were the easiest to comprehend. The performance of the individuals with Broca’s aphasia dropped significantly for sentences with object scrambling and subject relatives. Object relatives and passives were the most difficult to comprehend.

Qualitatively: The patients predominantly made role reversal errors but this type of error was less frequent for base order clauses than for the others. They made role reversal errors regardless of whether a clause followed the theme–agent order or not. In other words, these errors were made not only when the clause had theme–agent order (object scrambling, subject relatives) but also when it has agent–theme order (base order, object relatives).7

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7The number of role reversal errors made in sentences with singular subjects did not differ statistically from the number of role reversal errors made in sentences with plural subjects (\( \chi^2 = 1.2, \text{df} = 2, \ p = .282 \)). If the patients were matching singular subjects with singular verbs, they would make more role reversal errors when the subject was plural than when the subject was singular.
DISCUSSION

The structure of the discussion will be as follows. First, the interaction between word order and case will be examined. Second, the present findings on comprehension will be compared to our earlier findings on production in Turkish agrammatic speakers with Broca’s aphasia, with respect to the Integration Problem Hypothesis (IPH).

The interaction between case and order

The results showed a hierarchy in the difficulty of the sentences. Each level seems to be shaped by an interaction between case and word order. This hierarchy is:

1. Base order clauses were the easiest to comprehend. In these clauses, there is base case assignment (the agent = nominative; theme = accusative). Also, the agent and the theme are in their base positions: the participants received unambiguous information both from case and order.

2. Object scrambling sentences and subject relatives were more difficult to comprehend. In object scrambling and subject relatives, there is base case assignment (agent = nominative; theme = accusative). However, the theme is not in its base position. Thus, the participants received information only from case, since the word order is derived.

3. Object relatives and passives were the most difficult to comprehend. In object relatives and passives, there is non-base case assignment (agent = genitive; theme = accusative in object relatives: agent = nominative; theme = nominative in passives). Moreover, the theme is not in its base position. Consequently, there is neither base case information nor base word order.

In sum, a clause is comprehended best when there is both base (unambiguous) case and base word order information (base order clauses). The performance of the patients drops if there is base case information but derived word order (object scrambling and subject relatives). A clause is comprehended the poorest when there is neither base case information nor base word order (object relatives and passives).

At the individual level, however, three patients (B12, B15, and B17; see Appendix 3) scored better on sentences with derived order and base case information compared to sentences with derived order with non-base case information. They seemed to profit from the case information in sentences with object scrambling and subject relatives. A clause is comprehended the poorest when there is neither base case information nor base word order (object relatives and passives).

According to the theories of sentence comprehension on thematic role assignment (e.g., MDH, TDH, DOP-H), it is the theme–agent order of arguments that influences comprehension in agrammatic aphasia. However, first, the present study showed that two sentence types with theme–agent order elicited statistically different performance levels (e.g., passives are more difficult to comprehend than object scrambling). Second,
two sentence types in *agent–theme* order yielded statistically different performance levels as well (e.g., object relatives are more difficult to comprehend than simple sentences with a base order). Finally, sentences in agent–theme order and theme–agent order were found to be equally impaired (e.g., object relatives are as difficult to comprehend as passives). Accordingly, theories that take thematic role assignment as the decisive factor to predict patient performance and expect difficulties only with the theme–agent argument order cannot account for agrammatic performance on sentence comprehension in Turkish. However the present findings, as proposed in the IPH, show that case and derived word order—influence sentence comprehension, as evidenced by the complexity hierarchy: (a) sentences with object scrambling were as difficult as subject relatives; (b) object relatives were as difficult as passives, and (c) (object relatives + passives) were more difficult to comprehend than sentences with (object scrambling + subject relatives).

Apparently there is an interaction between case and word order information. When one of these is not in base form, comprehension diminishes. This is also shown in studies of comprehension in languages that have overt unambiguous case, such as Serbo-Croat (Lukatela et al., 1995), German (Burchert et al., 2003), Russian (Friedmann et al., 2010). Comprehension of non-base order sentences is poor, even though case is transparent. When neither word order nor case is in base form, performance drops even further. The IPH shows that the interaction between case and word order found in this study is paired with the earlier reported Turkish production data.

In understanding agrammatism, caution is needed not only to examine how a grammatical phenomenon surfaces in a specific grammar (here, Turkish) but also how the grammatical deficit is reflected in different modalities in that language. An example is that Turkish agrammatic speakers produce case quite well but they cannot comprehend a sentence on the basis of case. This is because the deficit (*integration of derived word order and case*) surfaces differently in both modalities. We explain this as follows. In production (see Yarbay Duman et al., 2007, 2008), when the patients were prompted with base order and base case, they produced sentences that pertain to these characteristics correctly. When the patients were prompted with derived order and base case (nominative + accusative: subject relative) or non-base case (e.g., genitive + nominative: object relative), they either (a) produced the required derived order and the required case correctly or (b) produced a base order clause with base case. Note that (a) is a moment when integration is already complete and (b) is a moment when the patient rules out the negative effect of derived word order. There was no instance where the patient produced the derived order correctly but the case incorrectly or vice versa. Consequently, case was found to be intact in production, although the patients produced fewer instances of non-base case (genitive) than of base case (nominative) by avoiding object relative clause order. The data then permitted the evaluation of how the patients produced base/non-base case when they produced a base/derived order.

Accordingly, Turkish speaking agrammatic Broca patients are aware of the correct combination of word order and case, but they are unable to integrate both sources to interpret sentences correctly. When it is not clear to them who is the agent and who is the theme in a comprehension test like the current one, they had no opportunity to rule out the negative effect of derived word order, as they did not have a chance to adapt the clause to base order, as they did in the production test by avoiding syntactic derivation. Since the deficit is an integration problem (e.g., integration of derived word order information and case), then the patients could not understand
the sentences solely on the basis of case information. That is, they did not eliminate
the effect of derived word order that blocks information coming from order and
case. Consequently, the patients seem to be impaired in comprehending case while
being able to produce it well, which is indeed the result of how the integration deficit
surfaces in comprehension. Indeed, if the deficit were not due to an integration
problem, case would make the correct interpretation of the clauses regardless of
whether their word order was derived or not. Note the discrepancy is observed only
for case and not word order, because derived order was found to be difficult both in
production (see above) and comprehension (this study).

Consequently the results are not compatible with the Competition Model
(MacWhinney & Bates, 1989) since the model cannot account for why Turkish
individuals with Broca’s aphasia are unable to interpret a sentence solely on the basis
of case, including sentences with accusative case marking (e.g., object scrambling,
subject relatives in this study), which is the most salient case in Turkish. The IPH,
however, defines how word order and case interact in sentence comprehension and
proposes that the patients cannot process a sentence solely on the basis of case, since
the deficit relates to an integration problem. Only when derived word order informa-
tion is integrated into case information can a sentence be interpreted correctly,
meaning that the interpretation of case is not an immediate process.

Moreover, it is the linguistic complexity of morphosyntactic operations (base ver-
sus derived order) and their interaction with case that make sentences more difficult
to produce (Yarbay Duman et al., 2007, 2008) and to comprehend. This excludes the
claim that the frequency of SOV order (SOV is more frequent than other orders in
Turkish) can explain the ease with which this sentence type is produced and com-
prehended. Indeed, it is already known from previous studies that frequency of word
order does not play a decisive role in agrammatism (Bastiaanse, Bouma, & Post, 2009):
completing a matrix clause (i.e., derived SVO order) is significantly more difficult than
completing an embedded clause (i.e., base SOV order) for Dutch agrammatic speak-
ers, even though the Dutch matrix clause is twice as frequent as the embedded clause.
Furthermore, Taylan and Koç (1998) show that native speakers of Turkish produce
more object relative clauses in their narratives than subject relative clauses. However,
object relatives were found to be more difficult to comprehend than subject relatives
for Turkish individuals with Broca’s aphasia.

In summary, the present study shows that when the derivational variables add up,
the sentence becomes more difficult to produce and comprehend for Broca’s patients:
if both word order and case are non-base, sentences are more difficult than when only
word order is derived.

REFERENCES

Aydın, Ö. (2007). The comprehension of Turkish relative clauses in second language acquisition and

the ICTL 2000 International Conference in Turkish Linguistics*. Istanbul: Boğaziçi University.


Bastiaanse, R., & van Zonneveld, R. (2005). Sentence production with verbs of alternating transitivity in

Language*, 96, 135–142.


APPENDIX 1

Patient data

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<th>Gender</th>
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</table>

Mean 49.8 (sdv) 17.9 (27.7)

APPENDIX 2

Test items for base order condition (nom = nominative; acc = accusative; plr = plural; asp/agr = aspect/agreement):

1. Kadın adamları itiyor
   the woman-nom the man-plr-acc push-asp/agr
2. Polis adamları selamlıyor
   the police-nom the man-plr-acc greet-asp/agr
3. Adamlar kadını çiziyor
   the man-plr-nom the woman-acc draw-asp/agr
4. Kadın adamları kurtarıyor
   the woman-nom the man-plr-acc save-asp/agr
5. Kedi köpekeri takip ediyor
   the cat-nom the dog-plr-acc follow-asp/agr
6. Çocuklar adami gidikleyor
   the children-nom the man-acc tickle-asp/agr
7. Hırsızlar polisi vuruyor
   the thief-plr-nom the police-acc shoot-asp/agr
8. Çocuk adamları tekmeleyor
   the child-nom the man-plr-acc kick-asp/agr
9. Kadın çocukları taşıyor
   the woman-nom the children-plr-acc carry-asp/agr
10. Çocuklar doktoru çekiyor
    the child-plr-nom the doctor-acc pull-asp/agr
11. Kadın adamları boğuyor
the woman-nom the man-plr-acc strangle-asp/agr

12. Çocuklar kadını sallıyor
the child-plr-nom the woman-acc swing-asp/agr

13. Çocuklar adamı çimdiriyor
the child-plr-nom the man-acc pinch-asp/agr

14. Kadın adamları tokatlıyor
the woman-nom the man-plr-acc smack-asp/agr

15. Adamlar çocuğun durduruyor
the man-plr-nom the child-acc stop-asp/agr

16. Hırsız adamları bağılıyor
the thief-nom the man-plr-acc tie-asp/agr

17. Adamlar kadını azarlıyor
the man-plr-nom the woman-acc scold-asp/agr

18. Kadın çocukları öpüyor
the woman-nom the child-plr-acc kiss-asp/agr

19. Çocuklar kadımı yıkıyor
the children-plr-nom the woman-acc wash-asp/agr

20. Köpekler kediyi tırmalıyor
the dog-plr-nom the cat-acc scratch-asp/agr

**APPENDIX 3**

Individual scores for the correctly interpreted sentences (maximum score in each condition is 20) (sdv = standard deviation).

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APPENDIX 4

Individual error patterns ($RR = \text{role reversal}; N = \text{number}; RR + N = \text{role reversal + number}; \text{max. per patient} = 20$).

<table>
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