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Sentence Comprehension in Aphasia in Two Clear Case-Marking Languages

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Studies of aphasia in Indo-European languages point to a selective vulnerability of morphological case marking in sentence comprehension. However, in case-marking languages such as German and Serbo-Croatian, the use of case marking to express formal grammatical gender diminishes the clarity of grammatical role marking. In Hungarian and Turkish, there are simple and reliable markings for the direct object. These markings are not linked to grammatical gender. Compared to Hungarian, the Turkish accusative marking is somewhat lower in availability, but somewhat higher in detectability. The processing of these cues by aphasics was tested using the design of MacWhinney, Pléh, and Bates (1985. *Cognitive Psychology,* 17, 178–209). Simple sentences with two nouns and one transitive verb were read to Broca's and Wernicke's aphasics, anomics, and control subjects in both Turkey and Hungary. The main effect of case marking was extremely strong. However, this was not true for all groups. The aphasics used the case cue far less than the normals, with the Hungarian Wernicke's group showing the greatest loss. Word order variations were largely ignored in all groups whenever the case-marking cue was present. When case marking was absent, Turkish subjects had a clear SOV interpretation for NNV sentences and Hungarians had a clear SVO interpretation for NVN sentences, in accord with basic patterns in their

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languages. When there was a contrast between the animacy of the two nouns, subjects choose the animate nouns significantly more often. The effect of animacy was particularly strong in Turkish, in accord with basic facts of Turkish grammar. In Hungarian, VNN sentences without case marking were interpreted as VOS when the first noun was inanimate. In Turkish, VNN sentences without case marking were often interpreted as VSO. In general, the aphasic subjects showed a clear preservation of virtually all aspects of their native languages, albeit in a much noisier form. Despite the high reliability of the case-marking cue, it was damaged more than the word order cue in English subjects. The near-chance processing of the case cue by the Wernicke's aphasics in Hungarian can probably be attributed to the relatively greater difficulty involved in detecting the Hungarian accusative suffix.

One productive way of studying aphasia is to look at the selective vulnerability of particular linguistic abilities across patient types. For example, one can look at the differential loss of performance in particular skills such as comprehension, production, or grammaticality judgments. Studies such as the one by Goodglass and Geschwind (1976) have provided evidence for a selective disruption of language production. However, studies by Caramazza and Zurif (1976), Heilman and Scholes (1976), and Zurif and Caramazza (1976) have shown that, within a population of agrammatic aphasics, both production and comprehension can be equally disrupted. Other studies (Linebarger, Schwartz, & Saffran, 1983; Wulfeck, 1987, 1988) have shown that agrammatics can make reliable grammaticality judgments, despite problems with production.

In this paper we utilize a different way of looking at the selective vulnerability of particular linguistic abilities. Instead of focusing on overall psycholinguistic skills, such as comprehension or production, our study focuses on particular linguistic constructions, asking whether certain construction types are more vulnerable than others. In particular, we are interested in knowing whether morphological cues are more or less vulnerable to damage than are word order cues. Studies by Ansell and Flowers (1982), Goodglass (1968), and Saffran, Schwartz, and Marin (1980) have shown that many aspects of word order appear to be preserved in both comprehension and production. In comparison, morphological markings in English appear to be severely damaged in aphasia. However, attempts to argue for a selective vulnerability for morphology on the basis of data from English run up against the confounding fact that morphological cues in English are extremely low in cue validity (MacWhinney & Bates, 1989). This is not to say that these claims regarding the relative preservation of word order cues and the vulnerability of morphological cues are necessarily incorrect, only that data taken solely from English are not sufficient to establish these claims.

In order to compare the vulnerability of word order and morphology in aphasia, one needs to compare the data from English with data from languages of a quite different type—ones in which the primary reliable

cues are morphological markings and in which word order cues are of minimal importance. Two recent studies of sentence comprehension in German (Bates, Friederici, & Wulfeck, 1987) and Serbo-Croatian (Smith & Mimica, 1984) help to illuminate this issue. These studies show that morphology is indeed damaged in German and Serbo-Croatian, although the strength of morphological cues is much greater than in English aphasics. However, in both German and Serbo-Croatian, the marking of case is linked to the marking of gender and number. In both languages, case marking involves a number of inconsistencies and gaps that cut down on both its reliability and its availability (MacWhinney and Bates, 1989). For example, case marking for the accusative in German is only really available when at least one of the nouns in the sentence is in the masculine gender. If the nouns are in the feminine or neuter genders or if they are plural, the case cue is simply not available. Serbo-Croatian also shows case-marking neutralizations, even within the masculine gender.

A clearer estimate of the selective vulnerability of case-marking morphology can be derived from studies of languages in which case marking is simple, clear, and uniform. In this paper we look at sentence comprehension by aphasic speakers of two non-Indo-European agglutinating languages in which the basic grammatical relations are marked extremely clearly and simply. These two languages are Hungarian and Turkish. Hungarian is a Finno-Ugric language related to Finnish, Estonian, Samoyed, Vogul, and other languages spoken in the Soviet Union and Eastern Europe. Turkish is a Ural-Altaic language related to Korean, Mongolian, Uzbeki, and many other Turkic languages of Central Asia. Both languages use a suffix to mark the object of the verb. When that suffix is present, normal adult speakers take it as a fully reliable cue to the identity of the object. In a simple sentence with two nouns and a verb, the noun that is marked with the accusative suffix is the object and the other noun is the subject. Consider the following Hungarian sentence.

A	kutya	kergeti	a	macskát.
the	*dog*	*chases*	*the*	*cat-ACC.*

Here the accusative suffix *-t* on the noun *macska* "cat" indicates that "cat" is the object of the verb. This means that the other noun *kutya* "dog," which has no accusative suffix, must be the subject of the verb *kergeti* "chases." Thus, it is the dog who is chasing the cat and not the cat who is chasing the dog. The corresponding sentence in Turkish has much the same structure.

köpek	kediyi	kovahıyor.
dog	*cat-ACC*	*chases.*

MacWhinney, Pléh, and Bates (1985) examined the use of the accusative case-marking cue by Hungarian children and adults. They found that,

below the age of 3, children tend to rely on animacy as a cue in interpreting simple sentences. After that age, they come to rely increasingly on the presence of the accusative case marking. By the age of 5, reliance on case marking is virtually absolute. Studying similar sentences in Turkish, Slobin and Bever (1982) found that the reliance on case marking appears even before age 3 in Turkish. Thus, in both languages, the case-marking cue is acquired very early and constitutes the backbone of sentence interpretation throughout life.

There are several features of the Turkish and Hungarian systems that should be noted. Although some of these features limit the overall reliability and availability of the case-marking cue, it still remains the pivotal cue for sentence interpretation.

1. Basic word order. In Turkish (Erguvanli, 1984) the basic, canonical, or unmarked, word order for a transitive sentence is Subject–Object–Verb or SOV, as in this example.

Ali Ayşe-yi sev-iyor.
Ali Ayşe-ACC love-PROG.
"Ali loves Ayshe." (SOV)

In Hungarian there are two basic word orders for transitive sentences. If the object is an unmarked indefinite noun with no article, the basic order is SOV, as in Turkish. However, if the object has either definite article or a marked indefinite article, then the basic word order is Subject–Verb–Object or SVO. Both SOV and SVO word orders are extremely common. Examples of these two types are

János almá-t esz-ik
János apple-ACC eat-INDEF.
"John eats an apple." (SOV)

János esz-i az almá-t.
János eat-DEF the apple-ACC.
"John eats the apple." (SVO)

2. Verbal conjugations. Corresponding to the two basic word orders, Hungarian has two major conjugations of the verb. The definite conjugation is used with definite objects in SVO order as in

a kutya kergeti a macskát.
the dog chase-DEF the cat-ACC.

The indefinite conjugation is used with SOV order and an indefinite object, as in

a kutya macskát kerget.
the dog cat-ACC chase-INDEF.

Turkish has only one preferred word order (SOV) and only one verbal conjugation.

3. Possible omission of the accusative. Both languages allow for omission of the accusative under particular circumstances. In Hungarian, however, cases where the accusative can be omitted are extremely rare. Omission can occur only when the direct object is a noun that has either the first person possessive or the second possessive suffix attached. A sentence illustrating such optional omission of the accusative is

A kutyá-m kerget-i a macská-d-(at).
the dog-mine chase-DEF the cat-yours-(ACC).
"My dog chases your cat."

In this example, if the accusative is dropped from "cat," one could conceivably give the sentence an OVS interpretation, although this would go against the weak SVO word order cue in Hungarian. Such sentences with two nonconjoined "nominative" nouns each with first or second person personal suffixes are extremely rare in Hungarian. Thus, for practical purposes, the accusative marking is always available.

In Turkish, there is an obligatory pattern of case-marking omission that extends to a very important and frequent class of sentences. When the object is indefinite, there is no overt accusative marking, as in

Murat kitap ok-uyor.
Murat book read-PROG.
"Murat is reading a book."

This obligatory deletion contrasts strongly with the Hungarian situation where no obligatory deletion is possible. Some consequences of this deletion pattern are noted in points 4 and 5.

4. Variable word order. Because case is marked so clearly by the accusative suffix, both languages can use all of the nonbasic word orders (VSO, VOS, OSV, and OVS in both languages, as well as SVO in Turkish) to express variations in pragmatic structure and focus. However, in Turkish, when the direct object is indefinite and not case marked, order variation is restricted. For example, the NNV sentence with two indefinite nouns given above must be interpreted as having SOV order (Erguvanli, 1984). No such restriction holds in Hungarian.

5. Role of animacy. Although animacy plays an important role in both Hungarian and Turkish, its role in Turkish is more clearly syntactic. Indefinite inanimate subjects must occur preverbally. Thus, the first sentence below is possible, but the second is ungrammatical.

Ağaç-tan bir elma düs-tü
tree-ABL one apple fall-PAST
"From the tree, one apple fell."

*Bir elma ağaç-tan düs-tü.
One apple tree-ABL fall-PAST.
"One apple from the tree fell."

However, if it is a child and not an apple that is falling, both orders are possible. Note also that animacy can be useful in understanding sentences like the Turkish one given in point 3 above.

6. Clarity of marking. In Hungarian, the accusative marker is composed of a final /t/ preceded by a linking vowel. There are five possible linking vowels and the choice between them is determined by many complex factors. In addition, there are a dozen major stem modification patterns that occur when the accusative is added. After final nonstop coronals, the linking vowel is omitted and the final /t/ becomes part of a consonant cluster. Thus, the accusative of the noun *mokús* "squirrel" is *mokúst.* In Turkish, on the other hand, the accusative is marked by adding a vowel from the series /i/ı/ü/u according to the rules of vowel harmony. When the stem ends in a vowel, a /y/ is inserted before the case-marking vowel. Stem modifications are minimal in Turkish. Intuitively, the Turkish marking seems much clearer. It is much more consistent and the marking itself constitutes a full independent syllable, whereas the marking in Hungarian is sometimes just a part of a final cluster. MacWhinney et al. (1985) have shown that these detectability problems for the Hungarian suffix have important consequences for sentence interpretation.

Let us now summarize how these various factors should influence the vulnerability of case marking in aphasia. First, it is clear that Hungarian and Turkish express case relations far more consistently than German or Serbo-Croatian. As a result, we would expect that case should be better preserved in Turkish and Hungarian aphasics. However, there are still some gaps in the consistency of even these agglutinative languages. The major defect in the Hungarian system is the perceptual difficulty involved in detecting the accusative marking. Such difficulties could be particularly problematic for patients with auditory processing problems. The major defect in the Turkish system is the absence of marking on indefinite objects and the various word order limitations and uses of the animacy cue that result from that omission. In the terms of the Competition Model of MacWhinney and Bates (1989), this lowers the *availability* of the Turkish accusative marking, but not its *reliability.* The kinds of inconsistencies that we find in these systems are not nearly as extreme as those in German and Serbo-Croatian. In terms of regularity of marking, these languages use case marking much like English uses word order. Thus, the reasonable null hypothesis here is that case marking should be preserved in these

two languages at a level comparable to that of word order in English. If we find a greater loss of the case-marking cue in either of these languages, we have evidence for what Bates and Wulfeck (1989) have called "the selective vulnerability of morphology."

METHOD

The methodology used in this experiment was essentially identical to that used in Experiment 1 in MacWhinney et al. (1985). The experimenter read sentences to subjects and asked them to act out those sentences with small objects. From the way in which the sentences were acted out, the experimenter decided which object was being treated as the agent.

Subjects. Our Hungarian subjects included 11 Broca's aphasics, 11 Wernicke's aphasics, and 10 anomics who were tested at the Rehabilitation Institute in Budapest where they were recovering. All patients were studied at least 2 months after their initial insult at a point when their aphasic symptoms had stabilized. Our control subjects were 15 normals individually matched in age and educational level to the aphasic subjects. Our Turkish subjects included 6 Broca's aphasics, 7 Wernicke's aphasics, and 13 control subjects studied at the Çapa Medical School, Istanbul University. As in Hungarian, the control subjects were matched in age and educational level to the aphasic subjects. (See Slobin, 1991, for further details.)

Procedure. In both languages, native speakers conducted the experiment. The experimenters read the translation equivalent of the following set of instructions to the subjects:

> I am going to read a series of sentences to you. Before I read each sentence I will put some objects in front of you. After I read the sentence I would like you to show me the action between the two objects. For example, if I said "the bear is hitting the blocks" you would pick up the bear and hit the blocks like this.
>
> Now some sentences are not going to make any sense, but I would like you to try to show the action as best you can. Sometimes there are no right or wrong answers. Just make a choice and don't worry about the sentence not sounding right. Do the best you can. Here are a few more examples:
>
> 1. The cows are hitting the pencil.
> 2. The donkey is hitting the rock.

Before reading each sentence, the experimenter placed the objects in front of the patient in random order and named each of them. Then the experimenter spoke the test sentence in a clear normal voice. The 54 sentences were administered one after another—usually in a single experimental session.

Materials and design. The 54 sentences were each composed of two common nouns and a transitive verb. The verbs used were "push away," "hit," "beat," "jump over," and "step over" in Hungarian and "hit," "eat," "pat," "lick," "smell," "kiss," "bite," and "push" in Turkish. In Hungarian, both nouns were presented with definite articles attached. Thus the English form of the sentences was "(The) dog pushes (the) pipe." It is important to note that, because the direct object is definite, the default word order in Hungarian for these sentences is SVO. However, in Turkish, the default order for these sentences is SOV.

Nouns were either animate (lizard, turkey, elephant, giraffe, wild pig, rabbit, camel, pig, crab, cow, cat, bird, and cowboy) or inanimate (pipe, boat, spoon, watch, shoe, button, mail, whistle, teacup, and chair). The factor of animacy was varied on three levels. In 18 sentences both nouns were animate (AA); in 18 sentences the first noun was animate and the second was inanimate (AI); and in 18 sentences the first noun was inanimate and the second was animate (IA).

Crossed with the factor of animacy was a word order factor with three levels: Noun–Verb–Noun (NVN), Verb–Noun–Noun (VNN), and Noun–Noun–Verb (NNV). All three of these word orders are grammatical in both Turkish and Hungarian and either interpretation is possible for each order (SVO or OVS, VSO or VOS, and SOV or OSV).

The third factor in the design was case marking which also had three levels. The accusative (direct object) case marker was placed on either (1) the first noun, (2) the second noun, or (3) neither noun. Sentences with no case marking on either noun are ungrammatical. In Hungarian, the reason they are ungrammatical is that the direct object must always have accusative case marking. In Turkish, the reason they are ungrammatical is that the object was definite and definite objects must have accusative case marking. For a justification of the use of ungrammatical stimuli in experiments of this type see MacWhinney et al. (1985), Smith and Mimica (1984), and Bates et al. (1987).

The complete within-subjects design was a 3 × 3 × 3 design with 27 cells. Within each of the 27 cells there were two replicates. The between-subjects factor had four levels in Hungarian: Broca's, Wernicke's, anomic, and normal. In Turkish, the between-subject's factor had only Broca's, Wernicke's, and normal. Comparisons between the two languages exclude the Hungarian anomic group.

RESULTS AND DISCUSSION

Hungarian. First let us take a look at the results of the analysis of variance for Hungarian. Most of the significant effects of the analysis hold across all four subject groups. Only one involves differences between the groups. The numbers we will report for cell means range between "0" and "1," where "0" represents consistent choice of the second noun and "1" represents consistent choice of the first noun.

The grand mean for the study was .56. If there were no overall bias toward selection of the first noun, the grand mean would have been closer to .50. Thus, there is an important overall tendency to select the first noun as the actor. This tendency is strongest for the NVN order (NNV = .55, NVN = .59, and VNN = .54), but the difference between the orders is only barely significant, $F(2, 86) = 2.96$, $p < .05$. This effect is due to the assimilation of NVN sentences to the canonical SVO order. The weakness of the effect of SVO order on these data contrasts markedly with the situation in English (MacWhinney, Bates, & Kliegl, 1984).

The main effect of case marking is massively significant, $F(2, 86) = 128.73$, $p < .0001$. The cell means are: first noun marked = .28, second noun marked = .80, neither noun marked = .61. Overall, subjects showed a clear tendency to obey the grammar by selecting the unmarked noun as the actor. This factor interacts significantly with word order, $F(4, 172) = 6.12$, $p < .0001$. As Fig. 1 indicates, when case is marked, word order has little effect, but in the 18 sentences with no case marking there is a tendency to use SVO for NVN sentences and a slightly weaker tendency to use SOV for NNV sentences. We see, then, that the barely significant main effect for word order is really concentrated in this particular interaction. In other words, when subjects have a case cue available, they largely ignore word order and only pay attention to it when the case cue is absent. Even then, only the canonical SVO order has a major impact.

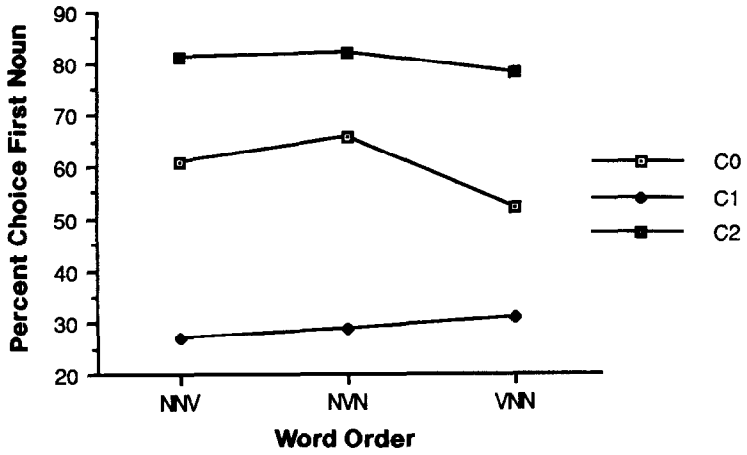

FIG. 1. The effect of the interaction of word order and case marking in Hungarian.

As expected, the overall effect of animacy is significant, $F(2, 86) = 3.97$, $p < .02$. When only the first noun is animate (AI), first noun choice is highest (.60). When only the second noun is animate (IA), first noun choice is lowest (.52). When both nouns are animate, the animacy cue is missing and choice is intermediate (.57). There is an interesting interaction of word order with animacy, $F(4, 172) = 3.48$, $p < .009$. In VNN order, there is a stronger use of a VSO interpretation when both nouns are animate than when only the first is animate. In these sentences there is a stronger tendency to maintain the VO unit when the noun following the verb is inanimate. As Corrigan (1988) has shown, the kinds of verbs used in this study tend to take inanimate objects, thereby favoring a VO interpretation of the VN pattern. The remaining final noun is then assumed to be the right-dislocated subject. When the noun following the verb is animate, either of the two postverbal nouns could be assumed to be the subject and both VSO and VOS interpretations are plausible.

There was no significant overall effect of the group factor. However, there was a strong interaction between case marking and group, $F(6, 86) = 19.78$, $p < .00001$. As shown in Fig. 2, the aphasics used the case cue far less than the normals, with the Wernicke's aphasics showing the greatest loss. Indeed, the Wernicke's group shows virtually no evidence of having preserved the use of case marking.

Turkish. Next we take a look at the results for the Turkish subjects. Let us begin by looking at the results for word order and case. As for Hungarian, our graphs track the percentage choice of the first noun. The grand mean for Turkish was .63, indicating an even stronger tendency than in Hungarian to pick the first noun as the actor across all stimulus types. The main effect of word order was significant, $F(2, 42) = 5.12$, p

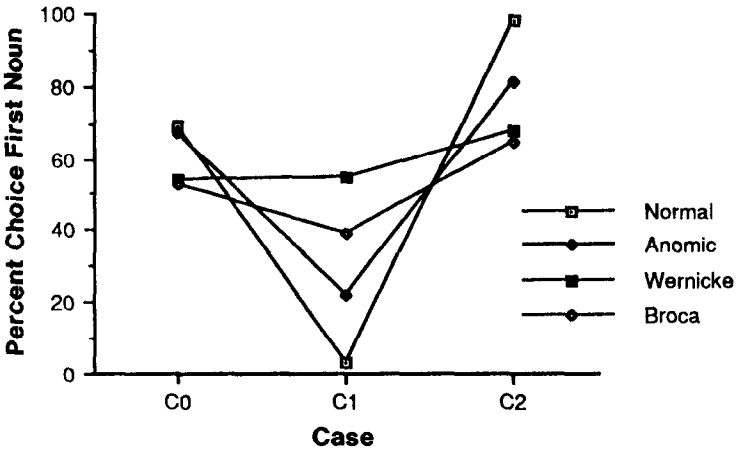

FIG. 2. The effect of the interaction of group and case marking in Hungarian.

$< .01$. However, the main effect of case was even more strongly significant, $F(2, 42) = 57.97$, $p < .0001$. The word order effect was largely due to a stronger choice of first noun as agent in NNV and VNN sentences. The case effect was due to a strong tendency to pick the first noun as the agent both when the second noun was in the accusative (C2) and when neither noun was in the accusative. Figure 3 indicates the shape of this effect. The interaction of case with word order was only barely significant, $F(4, 84) = 2.78$, $p < .03$. In the VNN order, there was a slight tendency for sentences with no case marking (C0) to have even more first noun choice than those with case on the second noun (C2).

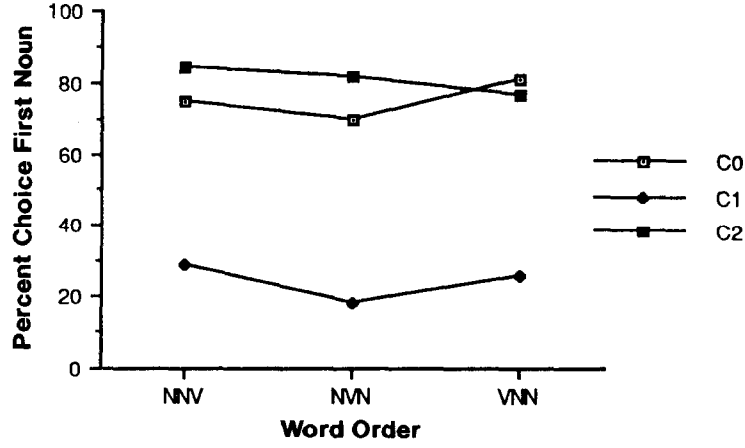

FIG. 3. The effect of the interaction of word order and case in Turkish.

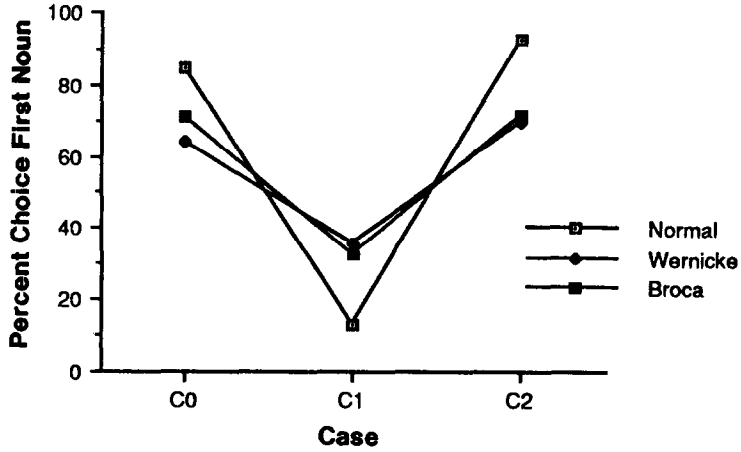

FIG. 4. The effect of the interaction of group and case in Turkish.

It is interesting to note that, in Turkish, sentences without case marking (C0) behave just like sentences in which the case marking is on the second noun. Figure 3 shows that this is true across all three word orders. In effect, when the case marker is not there, the listener simply treats the sentence as if the case marker were in its normal position. This makes sense in Turkish, since the case marker is missing whenever the object is indefinite. Figure 1 shows that, in Hungarian, sentences without case marking behaved in a different way. They were between the C1 and C2 patterns in each of the three word orders. In the absence of the case cue, Hungarians were more likely to fall back on other cues. It seems that Hungarians are counting on the presence of the marking more than are the Turks. This makes sense when we remember that the case marking can be absent in Turkish when the object is indefinite. In Hungarian, the case marking is almost always obligatory.

The main effect of group was just barely significant, $F(2, 21) = 3.57$, $p < .04$. However, the interaction of group with case was significant, $F(4, 42) = 4.55$, $p < .004$. As Fig. 4 indicates, the normals showed a much clearer use of the grammatical cue than did the two aphasic groups. Although the two aphasic groups show a strongly damaged use of case marking, their results still preserve the directionality of the normal pattern. Compared to the Hungarian Broca's and Wernicke's groups, we see somewhat more preservation of the case-marking cue in Turkish. In the Hungarian results, the Wernicke's aphasics showed particularly acute vulnerability of the case-marking cue. The Turkish Wernicke's group, on the other hand, performed almost exactly like the Broca's group. This pattern makes sense, if we assume that Wernicke's aphasics include at least some subjects with auditory processing difficulties. Such subjects should en-

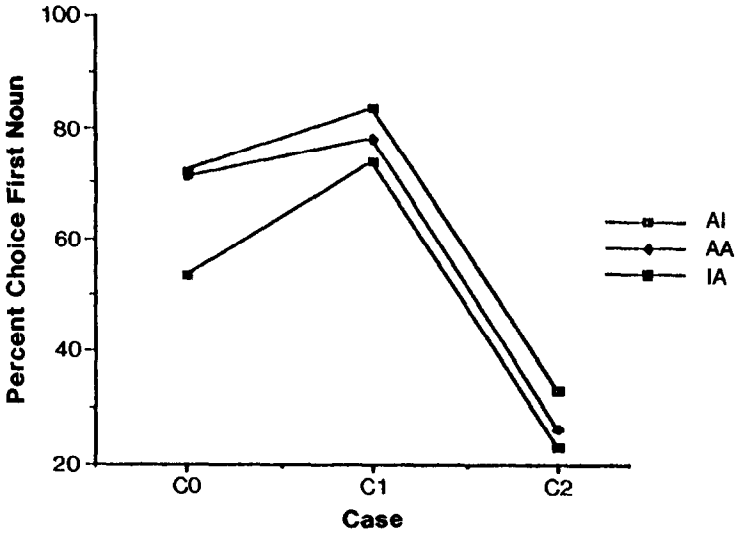

FIG. 5. The effect of the interaction of animacy and case in both languages combined.

counter more difficulties with the low-detectability Hungarian suffix than with the highly detectable Turkish suffix.

The main effect of animacy was significant, $F(2, 42) = 4.71$, $p < .01$, and the interaction of animacy with case was significant, $F(4, 84) = 4.76$, $p < .004$. The nature of these interactions will be discussed in the next section for both Hungarian and Turkish in combination.

Combined analysis for Turkish and Hungarian. For the combined analysis, only normal, Broca's, and Wernicke's groups were used, since there was no Turkish anomic group. In regard to the animacy cue, Turkish and Hungarian have similar patterns across subject groups. For the combined data set, there was a significant overall main effect for animacy, $F(2, 134) = 10.90$, $p > .001$, in the expected direction. There was also a massive overall effect for case, $F(2, 134) = 154.04$, $p < .0001$, also in the predicted direction. And there was a significant overall interaction between animacy and case, $F(4, 268) = 4.296$, $p < .001$ which is graphed in Fig. 5.

Although animacy has relatively little effect when case marking is present, in the C0 order there is tendency to choose the second noun in IA orders as the actor. Animacy effects were somewhat more marked overall in Turkish, which led to a small but significant interaction of language with animacy, $F(2, 134) = 3.43$, $p < .03$. This effect clearly matches the analysis of Erguvanli (1984) regarding the relatively greater syntactic role of animacy in Turkish sentences with indefinite inanimate subjects. The three-way interaction of patient group with case and animacy was significant, $F(12, 268) = 2.31$, $p < .008$. In both Turkish and Hungarian, the

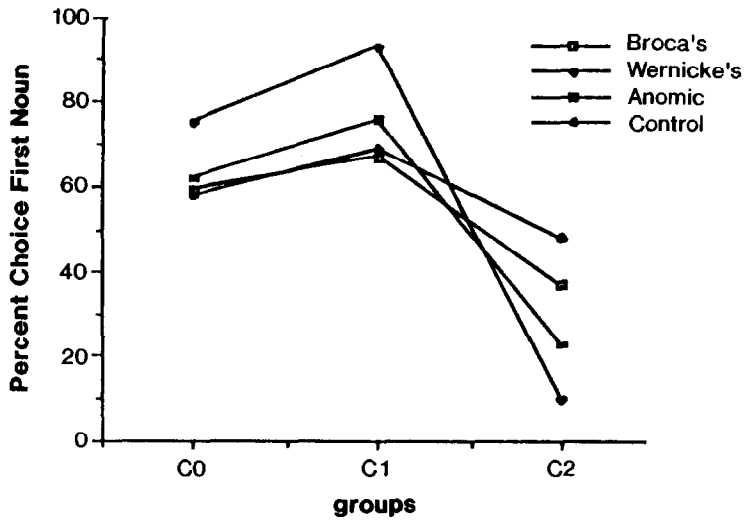

FIG. 6. The effect of the interaction of groups and case in both languages combined.

normal subjects tended to make more use of the animacy cue when the case cue was absent than did the Broca's and Wernicke's.

Across the two languages, there is a significant interaction of patient group with case marking, $F(6, 134) = 14.49$, $p < .0001$. The case cue was strongest in the normals in both languages. As can be seen by comparing Figs. 2 and 4, the Wernicke's group performed particularly poorly in Hungarian, possibly because of problems they encountered with the detectability of the Hungarian case-marking suffix. Interestingly, there was no overall significant interaction of language with case. Across groups, the case marking was preserved at roughly similar levels in the two languages (Fig. 6). However, when compared with the high level of preservation of word order marking in English (Bates and Wulfeck, 1989), it appears that case marking is relatively more vulnerable in both of these languages.

So far, our comparison of the Turkish and Hungarian results has focused on the similarities between the two languages in regard to the processing of animacy and case marking. However, we also found marked differences in the way the two languages handled word order. These tendencies are fully in accord with the grammatical description of the languages. As Fig. 7 indicates, there is a strong tendency to interpret NVN order in Hungarian as SVO. As we noted earlier, in sentences such as the ones we used with definite objects, the unmarked word order is SVO in Hungarian. For NNV sentences, Hungarian also has a tendency to assume an SOV interpretation. However, since such an interpretation usually assumes that the object has no article, the tendency in Hungarian toward clear recognition

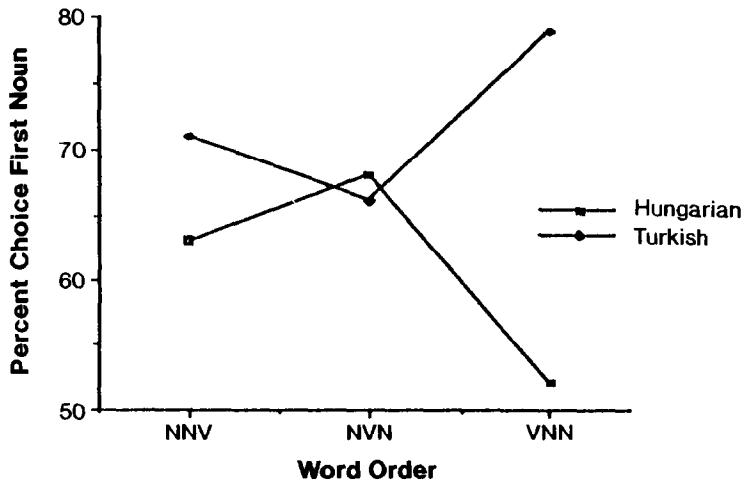

FIG. 7. The effect of the interaction of language and word order in sentences without case marking.

of NNV order is somewhat less in Fig. 7 than the tendency toward clear recognition of NVN order. In Turkish, on the other hand, the only strong unmarked pattern is SOV. This means that, in Turkish, NNV sentences should be uniformly interpreted as SOV. In Hungarian VNN can be interpreted as either VSO or VOS, but in Turkish VNN strongly predicts VSO. These differences in word order preferences are basic facts about the languages involved. The preferences for certain basic word orders are quite significant, $F(2, 134) = 7.06$, $p < .001$. However, there is an even stronger three-way interaction of language with case and word order, $F(4, 268) = 7.08$, $p < .0001$. This interaction arises because the language-specific effect of word order is clearest in those cells where there is no case marking. Figure 7 graphs the pattern for sentences with no case marking. The pattern of results displayed in Fig. 7 held across each of the subject groups and there was no significant interaction of subject group with language and word order.

CONCLUSIONS

This study examined the use of accusative case marking by aphasic speakers of Hungarian and Turkish—two languages that make clear and consistent use of accusative case marking. Earlier studies of German and Serbo-Croatian, as reviewed by Bates and Wulfeck (1989), had indicated that case marking may be particularly vulnerable to loss in aphasia. However, the grammars of German and Serbo-Croatian are inconsistent in their use of case-marking cues. In contrast, the use of case marking in Turkish and Hungarian is extremely consistent. Despite its high reliability,

Hungarian case marking suffers from problems with detectability. On the other hand, Turkish case marking is not available when the object is indefinite. These limitations on availability and detectability are not very extreme, and one would expect these morphological cues to be as well preserved in aphasics as the word order cue is in English.

In fact, we found, as did Bates and Wulfeck (1989), that these cues are indeed more vulnerable than the English word order cue. Broca's aphasics in both languages and Wernicke's aphasics in Turkish showed a pattern that resembled the normal pattern, but with a significantly reduced cue strength. Hungarian Wernicke's aphasics showed a complete loss of the case-marking cue. The fact that use of the case cue by Hungarian Wernicke's aphasics was actually worse than in Hungarian Broca's aphasia and roughly equal to that of Broca's aphasics in Turkish indicates that any simple identification of Broca's area as a "grammar box" (Kean, 1985) is not tenable for Hungarian or Turkish speakers. If grammatical cues are indeed stored in Broca's area, we would have expected the opposite pattern of results. The complete loss of the cue in Hungarian Wernicke's aphasics may reflect the difficulties these subjects have processing certain types of auditory material. However, this hypothesis would have to be tested by further experimentation. For example, it would be possible in Hungarian and Turkish to look at processing of simple sentences such as "the chair sat on the dog" in which the marking of the nonsubject is given by an easily detected and highly available case suffix.

For normal subjects, these findings replicate the results of MacWhinney, Pléh, and Bates (1985) for Hungarian adults. As in other studies conducted within the framework of the Competition Model (MacWhinney et al., 1989), the cues in this study worked together in a integrative fashion. For normal subjects, the more cues favoring a particular interpretation, the more likely subjects were to select that interpretation. Also, in accord with the claims of the Competition Model, cues that are the strongest in the language tend to be the best preserved. However, for the aphasics, this general tendency was limited by the special vulnerability of the case-marking cue. Despite its high reliability and availability, the use of the case cue in Hungarian and Turkish aphasics declined to a level that was close to the level of use for the much less reliable word order cues.

The crucial finding of this study is that, despite the high cue validity of case marking in Turkish and Hungarian, this morphological cue is clearly damaged in aphasia. The fact that both the detectability problems found in Hungarian and the consistency problems found in Turkish may explain this vulnerability underscores the ways in which the various properties characteristic of morphological markings (Bates & Wulfeck, 1989) make them particularly vulnerable to damage in aphasia.

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