Grammatical priming of nouns in connected speech

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Abstract

On-line processing of inflected spoken words was examined using phoneme-monitoring RT to following targets. Plural and singular nouns followed contexts that required plurals (e.g., A dozen <u>bagels</u>/<u>bagel</u> tumbled ...) or were neutral (e.g., The frozen <u>bagels</u>/<u>bagel</u> tumbled ...). Relative to the neutral contexts, recognition of congruent plural nouns was facilitated, and recognition of incongruent singular nouns was disrupted.

Introduction

The research reported in this paper investigates how inflected words are recognized and understood in spoken sentences. This line of investigation aims to make up for the relative neglect of two related topics in the study of spoken word recognition, the recognition of inflected and derived forms, and the processing of grammatical (syntactic) structure.

Recent research on spoken language processing has focussed on the contribution of preceding context, a focus which has proved to be a fruitful strategy, both theoretically and methodologically. Borrowing from this tradition, the present study examines the contribution of preceding context to the recognition of plural nouns.

The present research uses the on-line task of phoneme-monitoring in the same way that Blank and Foss (1978) used it to examine semantic constraints. They varied the constraints on a critical noun by preceding it with a related verb, adjective, or both. They compared sentences containing semantically related words with control sentences containing no related words. For example, recognition of the word "eye" was measured in the context "The drunk winked his bloodshot ..." and in the context "The drunk concealed his aching ...." Blank and Foss found faster recognition of the critical words when they were preceding by semantically related verbs or adjectives.

Blank and Foss measured recognition of the critical words indirectly, by measuring time to detect phoneme-targets at the beginning of the following words. In the sentences above, the target was /p/ in the word "probably." The reasoning behind this on-line measure is that a response to a word-initial target depends on recognizing that the target sound begins a word, which in turn implies that the end of the previous word has been recognized. Faster recognition of the preceding (critical) word would result in faster detection of the word-initial target phoneme. Delayed recognition of the critical word would delay detection of the target.

The present study examines a local and specific grammatical constraint: the dependency between the initial part of a noun phrase, and the form of

the noun. There are some common grammatical constructions in English that require the plural (inflected) form of a noun, and others that do not incorporate this constraint. We refer to this source of constraint as grammatical to emphasize that the constraint is on the form of the word, rather than on its semantic content. Whether it is a purely syntactic constraint is a problem which we will ignore for the present.

There are two possible ways of showing an effect of context on the processing of inflected words. One is to show that the violation of structural constraints causes disruption or slowing of recognition, relative to a condition which obeys the constraints. A second is to show that the availability of additional constraints speeds or facilitates recognition of the inflected forms. The present study looks for both disruptive and facilitative effects. It would not be surprising to find that grammatically incongruous words produced some disruption of sentence processing. It would be more unusual, and therefore interesting, to find that a more constraining grammatical context leads to faster recognition than a less constraining, but nonetheless appropriate context. To our knowledge, no one has demonstrated such a grammatical context effect.

In the present experiment, recognition of the nouns was assessed by measuring phoneme-monitoring RT to targets at the beginning of the words immediately after the critical nouns, as in Blank and Foss' (1978) study. This indirect measure was chosen because this paradigm is most likely to reveal effects on processing of the end of the critical word.

There were four conditions in the present study, which resulted from the combination of two contexts and two forms of the critical noun, plural and singular. In one context, the first part of the critical noun phrase contained a quantifier, number or other word that requires the following noun to be plural; for example, "many," "three," and "various." This context is called the Predicts-plural context. In the second context, the introductory words were ones that could be followed by either a plural or singular noun; for example, "the," "his." This context is referred to as the Neutral context. In each context, the critical noun was either plural or singular. Four versions of one sentence from the experiment are shown below, with the target phoneme underlined.

Neutral context, plural noun:
The frozen bagels tumbled out of the bag when she dropped it.

Predicts-plural context, plural noun:
A dozen bagels tumbled out of the bag when she dropped it.

Neutral context, singular noun:
The frozen bagel tumbled out of the bag when she dropped it.

Predicts-plural context, singular noun:
A dozen bagel tumbled out of the bag when she dropped it.

For plural nouns, a comparison between the Predicts-plural context and the Neutral context asks whether there is facilitation due to greater constraint on the inflected form. For singular nouns, a comparison between the Neutral context and the Predicts-plural context, where a singular noun

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is inappropriate, reveals whether a violation of this grammatical constraint disrupts on-line processing of the sentence. In this set of comparisons, phoneme-monitoring RTs in the same phonetic context are compared.

Method

Materials

There were 72 critical sentences. Each of the regular plural forms of English was represented. In one-third of the sentences, the critical noun took /s/ in its plural form; in another third, the plural ending was /z/; and in another third it was /Iz/. Within each third, there were equal numbers of one, two, and three syllable nouns. The target phonemes were the six stop (plosive) consonants: /b/, /d/, /g/, /p/, /t/, and /k/.

The critical sentences were randomly assigned to fixed serial positions on a list. Four lists were prepared for recording. Only one version of each sentence occurred on a list, so that each subject would hear only one version of each sentence. Each list contained an equal number of the four versions, as well as equal numbers of the three types of plurals, and of one, two, and three syllable nouns.

In addition to the critical sentences, there were filler sentences of two types. Some contained target phonemes, placed on nouns and adjectives for variety. Other fillers had no targets. There were twenty-eight fillers, for a total of 100 sentences per list. The sentences were divided into 5 blocks of 20 sentences. Each list began with four fillers, and each block began with a filler.

A female speaker recorded the sentences on one channel of a tape. Each sentence trial consisted of the word "Ready" followed by a specification of the target phoneme for that sentence, for example "/b/ as in Bob," then the sentence. Clicks were placed on the second channel, coincident with the stop bursts of the targets. The clicks, which were inaudible to subjects, started the recording of RT by an Apple microcomputer. After 2500 msec, the trial was terminated.

Procedure

Subjects were tested individually. They were given four practice sentences. Subjects were warned to pay close attention to the meaning of the sentences, since they would receive a comprehension test afterwards. The test was a recognition memory test for the fillers.

Subjects

Subjects were students at the University of Wisconsin-Madison. They participated for pay, or for extra course credit. Fifty six subjects were tested.

Results

Only data from subjects who scored 75% or better on the comprehension test were included in the analysis of phoneme-monitoring RTs. This

criterion exluded 4 subjects, leaving 13 subjects who heard each tape.

For each subject, a mean RT for each of the four conditions was calculated. For each version of the critical sentences, a mean reaction time was calculated. The subject and item means were analysed in two separate analyses of variance, whose factors were the nature of the preceding context, and the nature of the noun preceding the phoneme target. The table below presents the overall means for the four conditions, averaged over the 72 sentences.

Table 1

Mean Phoneme-monitoring RTs (in msec) to targets after critical nouns.

	Preceding Context	
	Predicts Plural	Neutral
Critical Noun		
Plural	514	558
Singular	552	534

The first row in the table shows that the monitoring time to targets following plural nouns is faster in contexts that predict plurals than in contexts that allow singular and plural nouns. *This result indicates that recognition of the inflected form is facilitated in a constraining context, relative to a less constraining context. The second row of the table shows* that average monitoring time after singular nouns is slower in contexts that require plural nouns than in neutral contexts. *This results indicates that recognition of the nouns is delayed when they violate grammatical constraints.*

The main result of the analyses of variance was a significant interaction between the two factors: F_1 (1,51) = 15.31, p < .001; F_2 (1,72) = 17.77, p < .001; min F' (1,115) = 8.22, p < .01. Separate one-way analyses of variance were performed to compare the Neutral contexts and the Predicts-plural contexts. When the critical nouns were plural, the subjects analysis showed a marginally significant effect (F_1 (1,51) = 3.48, p < .07) and the items analysis showed a significant effect (F_2 (1,71) = 12.93, p < .001. When the critical nouns were singular, the subjects analysis showed a significant effect (F_1 (1,51) = 11.76, p < .001) and the items analysis showed a marginal effect (F_2 (1,71) = 3.18, p < .08.

Discussion

The results of the present experiment show two effects of grammatical context on the on-line processing of spoken words, one harmful, the other beneficial. When the preceding context leads the listener to expect the plural form of a noun, and the expectation is violated, processing at that point in the sentence is disrupted, compared either to processing of the singular noun in a neutral context, or to processing of the appropriate plural form in the same constraining context. The latter comparison is between a context-word combination that violates a set of constraints, and a combination that satisfies the same set of constraints. It is analogous to the comparison made in Gurjanov, Lukatela, Lukatela, Savic, and Turvey's (1985) study of inflected forms. Gurjanov et al. compared grammatically correct pairings of possessive adjectives and nouns with incongruous

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pairings, and found slower recognition of the nouns in incongruous contexts.

In the present study the disruptive effect of violating grammatical constraints can also be seen relative to a neutral context, a comparison that Gurjanov et al., as well as Goodman, McClelland, and Gibbs (1981), were unable to make. This effect might have been stronger except for a problem with the experiment. Whenever there was a grammatical violation, a phoneme target followed. Subjects may have been able to anticipate the occurrence of a target in this condition, counteracting the disruptive effect somewhat.

The second effect of grammatical context was facilitated recognition of inflected words in contexts that predicted plural forms. This conclusion is possible because of the inclusion of an appropriate neutral context. If the contexts are not really neutral, then this novel finding is discredited. An alternative account of the difference between Predicts-plural and Neutral contexts assumes that the neutral contexts actually favor singular noun continuations. Thus, when a plural form follows, it is unexpected. On this account, recognition of plural nouns is slower in the Neutral contexts than in the Predicts-plural contexts, in which no expectation are violated.

The resolution of this problem remains for another experiment. If the neutral contexts are truly neutral, then it should be possible to compare them to different constraining contexts, and also find facilitation. Just as there are demonstratives and quantifiers that require plurals, there are determiners ("a", "an") and demonstratives ("this", "that") that require singulars. An experiment testing this prediction is in progress.

The present experiment provides an interesting demonstration of the effects of grammatical context on word recognition. Its broader implications concern the purpose of various linguistic devices and properties. Agreement phenomena, such as agreement in number and gender between an adjective and noun, are common, and probably serve some purpose other than to frustrate foreign language students. Agreement provides redundancy, and so aids in successful communication. The present results suggest that such grammatical constraints also confer a processing advantage. Ironically, such a processing advantage cannot be measured in a language with full agreement, because there is no neutral baseline.

References

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