CAN VERB MORPHOLOGY BE PRIMED IN AGRAMMATIC APHASIA?

Introduction

Numerous studies have demonstrated that speakers' choice of words and sentences is influenced (*primed*) by the preceding linguistic context. For example, both normal and agrammatic aphasic participants are more likely to produce certain syntactic structures (such as passives and datives) after being primed with these types of sentences (Bock, 1986; Hartsuiker & Kolk, 1998; Hartsuiker et al., 1999; Marin & Schwartz, 1998). The mechanism underlying priming appears to be a boost in activation levels provided by the recent use of phonological, semantic, or syntactic elements, which in turn facilitates the likelihood of their re-use. Priming methodology is widely used as a window into the mental processes underlying language production in normal and aphasic individuals. A lack of a priming effect is also revealing about underlying impairments in aphasia.

Errors with verb inflections, especially tense marking, are a pervasive symptom of agrammatic speech. Although the exact impairment underlying these errors is debated, several recent perspectives are converging on the notion that the deficit is most severe when patients have to produce semantically relevant inflectional features such as tense marking, rather than syntactically specified inflections such as subject-verb agreement (Bastiannse, 2007; Burchert, et al., 2005; Faroqi-Shah & Thompson, 2007; Wenzlaff & Clahsen, 2004). Two sub-processes can be identified within the realm of producing semantically relevant inflectional features: conceptually encoding tense information and using tense information to retrieve relevant closed class elements (such as inflectional affixes) (Levelt et al., 1999; Roelofs, 1993) (see also Figure 1). It is not yet clear what role, if any, each of these sub-processes play in the verb inflection impairment seen in agrammatism.

The present study attempts to delineate these two potential sources of error (tense encoding versus inflectional retrieval) by using an inflectional priming paradigm. Tense information and inflectional structure can be separately primed in a language such as English because of the existence of irregular past tense verbs. Regular and irregularly inflected past tense verbs provide an interesting comparison because both convey the same tense while differing in morphological form. Hence an irregularly inflected past tense verb can putatively function as a tense prime for a regular past tense verb (e.g., *sang* [prime] » *jumped* [target]). In contrast, a regularly inflected past tense verb (e.g., *skipped* [prime] » *jumped* [target]) will prime both tense and morphological form for another regular past verb. And a present tense inflection (e.g., *skips* [prime] » *jumped* [target]) will prime neither tense nor morphological form. It is hypothesized that agrammatic aphasic individuals' production of past tense verbs will be facilitated by both regular and irregular past tense primes if the difficulty lies in tense encoding. That is, production of regular past tense will be facilitated by both regular and irregular past tense in the case of tense encoding difficulties. In contrast, if the difficulty is in verb form retrieval, then production will be facilitated only by affix overlap between the prime and target. Hence irregular past tense primes will not facilitate production of regular past tense.

Methods

Participants

Seven individuals with agrammatic Broca's aphasia (age range: 37 to 65 years, two female) participated in this study[1]. All individuals had sustained a single left hemisphere stroke in the region of the middle cerebral artery, were pre-morbidly right

[1] Two more participants (one male and one female) are currently being tested.

handed, had at least high school education (range: 12 to 20+ years), were native speakers of English, and had no significant prior psychiatric or neurological history. The diagnosis of Broca's aphasia with agrammatic speech profile was made on the basis of standardized test performance (Western Aphasia Battery; Kertesz, 1982) and spontaneous speech samples. Participants were also screened for apraxia, dysarthria, and cognitive deficits.

Stimuli and Procedure

Black and white line drawings of thirty two imageable verbs (16 regular and 16 irregular) were selected from the Object and Action naming battery (Druks & Masterson, 2000). Each of these verbs were elicited in the following prime-target conditions: *baseline* (without any preceding prime), *identical* (where target verb form and prime were identical), *congruent tense-congruent affix*, *congruent tense-incongruent affix*, and *incongruent tense-incongruent affix*. Both past and present tense were elicited in all conditions, except in the *congruent tense-incongruent affix* condition, where all stimuli were past tense (because there are no irregular third person present forms). These conditions are described in Table 1 with examples.

After verifying that participants could spontaneously name all 32 verbs[2], unprimed (baseline) accuracy was obtained. Next, target verb forms were elicited in a randomized sequence in a picture description task using temporal cues (*Yesterday* and *Nowadays*). Each picture description was preceded by the prime word, which was modeled by the experimenter and the participant had it repeat twice. Any errors in repetition were corrected. A filler trial, consisting of a noun and a description of a noun picture was interspersed between experimental trials in order to minimize any persistence

[2] Most participants had to be trained to name at least some of the verbs. Passing criterion was successfully naming each verb at least four times in five consecutive trials.

of priming from preceding primes or responses. The entire experiment was run on a desktop computer using Microsoft Powerpoint and is illustrated in Figure 1.

Responses were scored for accuracy of verb form. Thirty percent of the samples were re-scored by an independent reliability scorer. Agreement between scorers was 98%.

Results

A total of 1344 responses were analyzed across all conditions and participants. The mean group accuracy scores for each condition are given in Table 1. Participants were more accurate with past tense targets than with present tense targets (Wilcoxon signed ranks, $p<0.5$), although the same patterns of performance between conditions were found for both tenses.

The mean accuracy was highest for the *Identical* (*I*) prime condition and lowest for the *Incongruent prime-Incongruent affix* (*II*) condition, showing that participants' responses were indeed influenced by the nature of the preceding prime (Wilcoxon signed ranks, $p< 0.01$). This pattern held for both present and past tense targets. Three comparisons are especially relevant. First, the accuracy of the *Identical* condition was significantly higher than *Baseline* (Wilcoxon signed ranks, $p<0.05$), showing a facilitative priming effect. Second, accuracy of both congruent tense conditions (*CC* & *CI*) was greater than the accuracy of the *Incongruent tense-Incongruent affix* condition (for *CI*: Wilcoxon signed ranks, $p<0.05$; for *CC*:Wilcoxon signed ranks, $p=0.07$, approaching significance). This pattern suggests that tense overlap between the prime and target resulted in a facilitative priming effect. Third, there was no significant difference between accuracies of the two congruent tense conditions (*CI* and *CC*), although the

mean accuracy of *CI* was slightly higher than the mean accuracy of *CC*. Finally, the difference between accuracies of *II* and *baseline* failed to reach significance, showing that the disadvantage rendered by incongruent primes was not substantial.

To summarize, the data showed that the congruent or incongruent nature of the prime influenced production of verb inflections, and more importantly, tense congruent primes (both *CC* and *CI*) facilitated production of verb inflections, irrespective of morphological overlap.

Discussion

The findings of this study indicate that prior activation of tense information alone provides as much facilitation as prior access to morphological information. In fact, the group accuracy in Table 1 shows higher accuracy for *CI* than *CC* condition. Hence the most likely source of the verb inflection deficit in agrammatism is insufficient activation of the appropriate tense information, as illustrated in Figure 2. The slightly lower accuracy of the CC condition as compared to the CI condition is possibly due to the inhibitory effects of form overlap (Allen & Badecker, 2002).

The clinical application of this finding is that production of verb inflections can be easily facilitated in agrammatic individuals. Hence training agrammatic individuals self-cueing (priming) strategies for tense morphology may be beneficial. Further, conversational partners may be able to facilitate accurate production of verb inflections via modeling; a phenomenon that is known to occur between normal non-brain damaged conversational partners (Schenkein, 1980).

Table 1. The priming conditions, stimulus details, and group accuracy (in percent).

Prime condition	Example (Prime>>Target)	Verb types	Mean accuracy (SD)
Baseline	N/A >>jumped	All (32) verbs; past & present; N = 64	40 (32.5)
Identical (I)	jumped>>jumped; begs>>begs	16 past, 16 present; ½ regular, ½ irregular; N =32	51.5 (39.9)
Congruent tense-Congruent affix (CC)	skipped >>jumped; skips >>begs	16 past, 16 present; all regular, N =32	42.2 (31.1.)
Congruent tense-Incongruent affix (CI)	sang >> jumped; skipped >> drove	All past, 16 regular; 16 irregular; N = 32	45.4 (32.4)
Inongruent tense-Incongruent affix (II)	Skips >> jumped; Begged > jumps	16 past, 16 present; ½ regular, ½ irregular; N= 32	34.3 (30.4)

Figure 1. Illustration of one experimental (*Yesterday the man sang*) and one filler item (*The flower is beautiful*) (each preceded by a "prime").

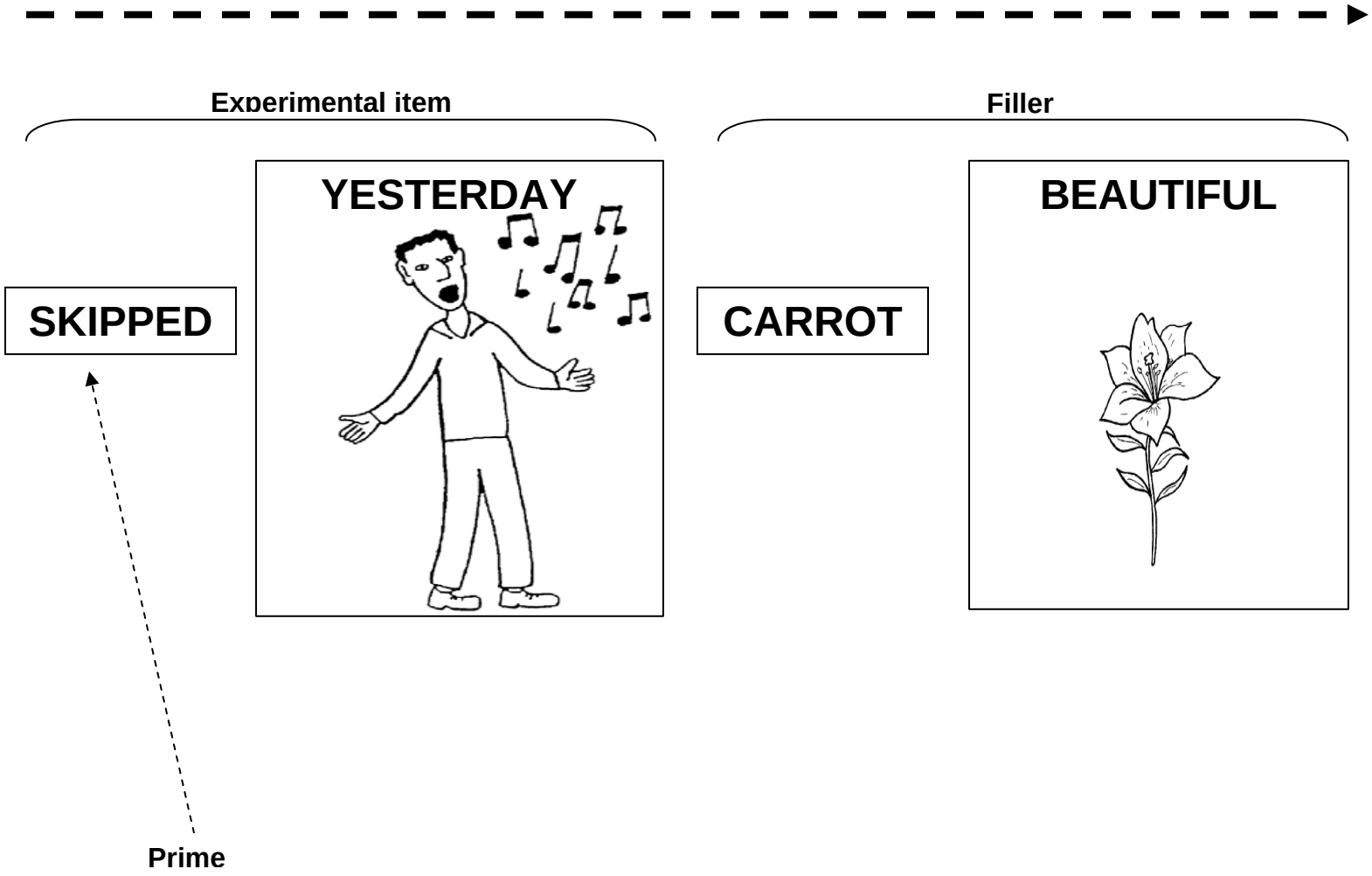
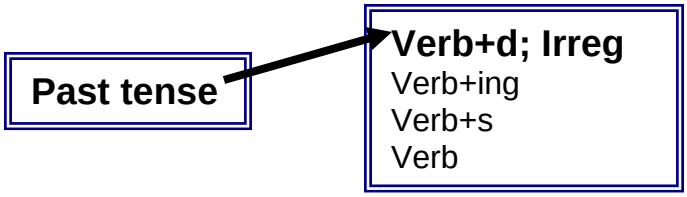
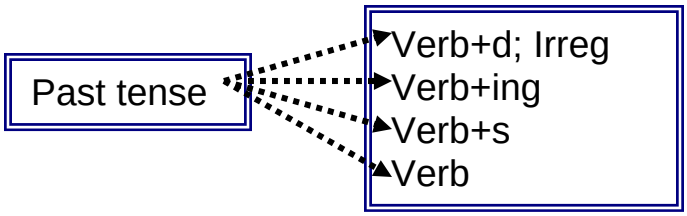


Figure 2. Representation of the two potential sources of verb inflection deficit in agrammatism, (a) normal, (b) agrammatism, (c) after priming in agrammatism.

(a)



(b)



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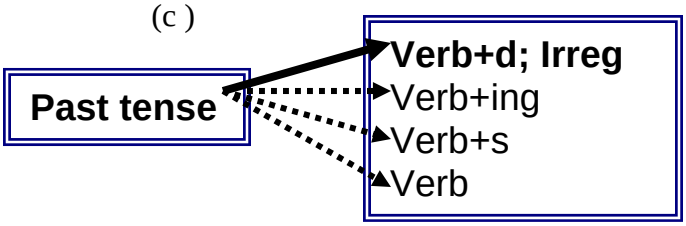

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