

Patterns of inflectional errors with reference to the Italian adjectival system

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This study investigated the morphological organization of the phonological lexicon involved in the retrieval of spoken words, with particular reference to the Italian adjectival system. In two experiments, subjects performed an oral free-recall task on Italian adjectives that were inflected for both gender and number, for a total of four possible inflections: *-o* (masculine singular), *-i* (masculine plural), *-a* (feminine singular), *-e* (feminine plural). The pattern of correct recalls revealed that the citation form (masc. sing.) was better recalled than the others. Inflection substitution errors were frequently produced. Analysis of errors showed that the citation form was produced as an error more frequently than the other inflected forms; errors tended to differ from the target by one morphological feature; gender was better preserved in subjects' errors than number. Implications of these results for the morphological organization of the phonological lexicon are discussed with reference to current models of lexical processing and representation.*

1. Introduction.

The morphological organization of the phonological lexicon was investigated in two experiments on the Italian language that are reported below. Many studies have been concerned with the mechanisms that lead to access and activation of representations in the internal lexicon. Among these studies, a number have addressed the issue of the role played by the word's morphological structure. However, the research has focussed mainly on visually presented stimuli. Thus the role of a word's morphological structure has been studied mainly in lexical access to written stimuli and in reading (see Henderson 1985 for a review; see also Caramazza *et al.* 1985, Caramazza *et al.* 1988, Burani & Caramazza 1987, Burani, in press a).

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Far fewer studies have investigated the processing of auditorily presented, morphologically complex words. Although there has been some research on the role of morphological factors in spoken word recognition (Kempler & Morton 1982, Jarvella & Meijers 1983, Taft *et al.* 1986, Tyler, Marslen-Wilson, Rentoul & Hanney 1988, Emmorey 1989, Tyler *et al.* in press), the structure of the phonological input lexicon has received less attention than that of the orthographical input lexicon.

Some insights into the morphological organization of the phonological lexicon and the access mechanisms to it can be drawn from production tasks.¹ Evidence for sensitivity to a word's morphological structure in speech production comes from three main sources: (i) speech errors, (ii) experimentally induced morphological errors, and (iii) language disturbances.

In the collections of speech errors, some morphological errors have been documented—mainly stem exchanges and affix shifts (Garrett 1975, 1982, Stemberger 1985). However, these errors are rare, and not so informative coming mainly from English, which is very poor in morphology (but see, for Spanish, del Viso, Igoa & Garcia-Albea 1987; for Italian, see Magno Caldognetto *et al.* 1987, Chialant 1987-88, Magno Caldognetto & Tonelli 1989; see also, for further considerations, Burani in press b).

Very few studies have been concerned with the experimental elicitation of morphological errors. These studies took into account the English language, and focussed on the complex relation existing between phonological and morphological factors in the retrieval of past tense (MacKay 1976, Bybee & Slobin 1982, Stemberger & MacWhinney 1986a, 1986b), derivations (MacKay 1978), and on the elicitation of verb form substitutions (Lapointe & Dell 1988).

The third source of evidence concerning the influence of morphological structure on word production comes from patients with acquired disturbances of language. Morphological errors consisting in affix omissions or affix substitutions are frequent in the production of some aphasic patients, who have been characterized as "agrammatics" (Kean 1985). Other patients, conversely, inflect properly neologistic roots according to sentence context (Caplan *et al.* 1972, Buckingham & Kertesz 1976, Butterworth & Howard 1987). Furthermore, patients affected by acquired dyslexia may produce

¹ From now on, I shall not distinguish between input and output phonological lexicons, namely the lexicons which may be involved in recognition and production tasks, respectively. The two types of lexicons can in principle be separate. However, current evidence is not clear-cut in this regard. A few detailed descriptions of patients which show a dissociation between the functioning of the input and the output phonological lexicons do exist (see e.g. Miceli & Caramazza 1988, Badercker & Caramazza 1991). By contrast, evidence from normal subjects is ambiguous in this regard, in that it derives largely from experimental tasks involving both input and output lexicons (see MacKay 1976, Stemberger & McWhinney 1986a, and see also the experimental studies that will be cited hereafter, with the inclusion of the present research). Therefore I will consider all the studies concerned with the morphological structure of words in the spoken domain, in both input and output tasks, as relevant to the characterization of a (single) phonological lexicon.

morphological errors (see e.g. Patterson 1980; Job & Sartori 1984, Kay 1988, Badercker & Caramazza 1991; and many others). Although the apparently morphological errors produced by some dislexic patients may be caused by a visual or semantic impairment (Badercker & Caramazza 1987, Pilon *et al.* 1991), in other cases the morphological errors more clearly reflect a morphological impairment. In these latter cases, the patterns of morphological errors are extremely revealing for the mechanisms of morphological processing and representation.

Current models of language production have provided different accounts of morphological errors (Garrett 1975, 1982, Stemberger 1985, Dell 1986, Lapointe & Dell 1988). These models are mainly concerned with defining the level at which morphological errors arise in the production of speech, and propose general mechanisms that may give rise to these errors. Unfortunately, these models usually do not provide detailed hypotheses on the principles of morphological organization within the phonological lexicon. At the same time, current empirical evidence is rarely detailed enough to provide interesting insights in this regard.

An interesting step towards detailing some hypotheses on morphological organization through the analysis of a patient's disturbed performance has been made by Miceli & Caramazza (1988). I will now describe in some detail this patient's performance, since the study I present below was inspired by Miceli & Caramazza's study, and is an attempt to further extend their results by analyzing the performance of normal adult subjects in experimental tasks.

Miceli & Caramazza (1988) described the case of an Italian patient, F.S., who displayed an impairment of morphology that appeared to be located in the phonological output lexicon. The patient produced many morphological substitution errors both in spontaneous speech and in single-word processing tasks such as oral repetition of words, and these errors predominantly affected the inflectional specification of a word. In the repetition task, the patient's errors revealed a pattern which seems to reflect principles of morphological organization within the phonological lexicon.

F.S. showed a particularly interesting pattern of errors when repeating inflected adjectives which may take four inflectional endings. Italian adjectives can take either two inflections (-e for singular, both masculine and feminine, e.g. *grande*, 'big', sing.; and -i for plural, both masc. and sing., e.g. *grand-i*, 'big', plur.), or four inflections. In this last case, the adjective is inflected for both number and gender: -o, masculine singular; -a, feminine singular; -i, masculine plural; -e, feminine plural. No uninflected base form exists; a root must necessarily take an inflectional suffix.

When presented with lists of adjectives having one of four possible inflections marking gender and number, patient F.S. made many morphological errors in repetition, substituting one inflectional affix for another. Interestingly, his performance was not random but showed that

the masculine singular form ("citation form") was both better preserved (giving rise to fewer errors than each of the other forms) and more frequently produced than the other forms, as a substitution of the correct response. Performances to the other three forms did not differ from each other. The same pattern of results was obtained also with more accurate frequency controls (namely, the patient showed the same performance both when the masculine singular form was more frequent than the other inflected forms and when it was less frequent).

A basic assumption of cognitive neuropsychology is that a patient's disturbed performance does not occur randomly, but reveals principles of organization of the normal lexical system (Caramazza 1986). Thus analogous results should be expected in the production of normal subjects under appropriate experimental or natural conditions. Converging evidence from neuropsychological and experimental sources is particularly relevant in order to describe the functioning of the normal language processing system (Ellis 1985, Caramazza 1986; Caramazza *et al.* in press).

The aim of the present study was twofold. First, by using normal subjects, I intended to investigate further whether the citation form has a particular status in lexical representation. The second goal was to examine in detail the structure of the adjectival inflectional system in the phonological lexicon. Specifically, the present study addressed the question of whether lexical entries are organized along dimensions corresponding to the morphological features of "gender" and "number", the hypothesis being that the entries sharing one morphological feature (e.g. having the same gender or the same number in common) are more tightly linked in the lexicon than the entries that do not share any morphological feature (neither number nor gender).

A morphological organization like this should be revealed by the pattern of inflectional errors produced by subjects: an inflectional error should more frequently consist in an inflected word sharing with the target word one morphological feature (either number or gender), than a word differing from the target for two morphological features (i.e., having neither gender nor number in common).

In order to investigate these issues experimentally, an experimental task was adopted which was likely to induce morphological errors in normal subjects, in a condition that resembled oral repetition by the patient (see Burani 1992 this issue, for further discussion of the methodology). A free-recall task was chosen in which subjects were presented with lists of inflected adjectives that they had to recall in the correct form. The lists were presented auditorily and subjects recalled the items orally.

2. Experiment 1.

2.1. Method.

2.1.1. *Materials and design.* 72 adjectives that take four inflections were selected. One fourth of the adjectives were presented in the masculine singular form, one fourth in the feminine singular, one fourth in the masculine plural and one fourth in the feminine plural. Adjectives were chosen from the medium-low frequency range in the frequency count of Bortolini *et al.* (1971). Experimental words in the four morphological classes had the same mean frequency, for both root frequency and form frequency (mean root frequency was about 15 and mean form frequency was 8 out of 500.000 occurrences). For each inflected adjective that was presented, its three morphologically alternative forms all had the same mean frequency, which was slightly lower than that of the presented form. These controls were made to ensure (a) that all the presented morphological forms had the same probability of being correctly recalled; (b) that there was no frequency bias towards producing one particular type of morphological error.

Adjectives in the four classes were also balanced for the factors that can affect recall performance (length, abstractness/concreteness, presence of a derivational affix).

The 72 adjectives were presented in three lists of 24 each. The first list was composed by 24 "short" adjectives, the second by 24 "medium length" adjectives, and the third by 24 "long" adjectives. In each list each inflection was included in one fourth of the adjectives. Lists were submitted to subjects in different orders and with different orders of stimuli randomization.

2.1.2. *Procedure.* An experimental session proceeded as follows. The experimenter asked the subject to pay attention to the words s/he was going to hear, in order to recall them. Then the experimenter read the first list of 24 words at the rate of about one word every 3 seconds. Each list was read four times to a subject in four different randomization orders, to avoid effects related to items' position in the list. After hearing the list for the fourth time, the subject was given an interfering task (some simple written arithmetic operations) lasting at least 10 seconds, then s/he was asked to recall orally as many words as possible. The subject was not given any deadline, and s/he stopped when s/he could not recall any more words. After recalling the first list, the subject heard the second list four times, then performed the interfering task before recalling the items, and so on for all three lists. Subjects' recalls were taped. Each experimental session lasted about 30 minutes.

2.1.3. *Subjects.* 30 students from the University of Rome participated in the experiment and were paid for their participation.

2.2. *Results and discussion.*

Each subject's performance was scored for omissions (i.e. items not recalled), and items recalled. For recalled items, a distinction was made between (a) correct "root" recalls, that is all the cases in which the adjective's root was recalled, either in the form in which it had been presented or with the substitution of the inflection; and (b) correct "form" recalls, that is recalls of the target-form without changing its inflection.

Subjects' performance included also some perseverations across lists, some errors that were related to the target by meaning (e.g. *splendente* instead of *luminosa*, both adjectives meaning 'bright, shining'), some errors related by sound (e.g. *onorati* for *moderati*, the first adjective meaning 'honored' and the second 'moderate'), some related by both meaning and sound (e.g. *pregiati* for *preziosi*, both meaning 'precious, valuable'), as well as unrelated errors (that is words for which no apparent sources were found in the list). These errors (always adjectives) accounted for a small proportion of total words produced (about 8%), and will thus be neglected hereafter.

Table 1. *Total number and percentages of correct "root recalls" and "form recalls" for each type of inflected form. Exp. 1*

Target inflection	Root recalls	Form recalls
-o (masc. sing.)	187/540 (34.6)	156/187 (83.4)
-i (masc. plur.)	191/540 (35.4)	121/191 (63.4)
-a (fem. sing.)	195/540 (36.1)	113/195 (61)
-e (fem. plur.)	200/540 (37)	131/200 (65.5)

Table 1 shows the total number and percentages of correct root recalls and correct form recalls for each type of inflected form. Subjects recalled about one third of the items in the experimental list, and the number of roots correctly recalled did not differ according to the type of inflection. As to the percentages of correct form recalls out of the total number of root recalls, analyses of variance, by subjects and by items, revealed significant differences among types of inflected forms: $\min F'(3, 152) = 2.76$, $p < .05$. Post-hoc comparisons (Duncan's test based on the analysis by items) revealed that target-forms with masculine singular inflection -o were more frequently recalled in the correct form than each other type of inflected forms (-o vs -i: $t(k=3) = 4.8$, $p < .005$; -o vs -a: $t(k=4) = 4.87$, $p < .005$; -o vs -e: $t(k=2) = 3.76$, $p < .01$). The percentages of correct form recalls to the forms inflected by a, e and i, did not differ each to the other.

The absence of a difference in the number of correct root recalls according to inflection type confirms that the items in the four classes were appropriately selected, and there were no semantic or frequency biases in the roots included in the four classes. The data concerning the percentages of correct form recalls are in accordance with those obtained with patient F.S.: the masculine singular form is more error-resistant than all the other forms.

When the pattern of morphological errors was analyzed, further analogies with patient F.S.' performance were found.

Table 2. *Total number and percentages of inflectional errors per target form, subdivided for the possible morphological alternatives (percentages are relative to the total number of inflectional errors per target).*

Target	Error				Total
	-o (m. sg.)	-i (m. pl.)	-a (f. sg.)	-e (f. pl.)	
-o (m. sg.)	—	(+G) 7 (22.6)	(+N) 12 (38.7)	(-) 12 (38.7)	31
-i (m. pl.)	(+G) 36 (51.4)	—	(-) 13 (18.6)	(+N) 21 (30)	70
-a (f. sg.)	(+N) 36 (47.4)	(-) 8 (10.5)	—	(+G) 32 (42.1)	76
-e (f. pl.)	(-) 35 (50.1)	(+N) 10 (14.5)	(+G) 24 (34.8)	—	69
Total	107	25	49	65	65

Table 2 shows, for each target inflected form, the number of inflection substitutions produced by subjects, subdivided for the three possible morphological alternatives given that target. The percentage is relative to the number of inflectional errors of each type out of the total of inflectional errors produced for each target.

Analyses of variance, by subjects and by items, revealed significant differences among the numbers of errors of the four types: $\min F'(3, 196) = 4.2$, $p < .01$. Post-hoc comparisons, based on the Duncan's test on the analysis by items, revealed significant differences between the number of errors inflected for masc. sing. and the number of errors inflected for each of the other inflections (masc. sing. vs masc. plur.: $t(k=4) = 8.0$, $p < .001$; masc. sing. vs fem. sing.: $t(k=3) = 5.68$, $p < .001$; masc. sing. vs fem. plur.: $t(k=2) = 4.1$, $p < .005$). This means that a morphological error was more likely to result in a masc. sing. form. To say it differently, the masc. sing. was produced more frequently as an error than the other forms. Again, this result shows analogies with patient F.S.' performance, who tended to produce more frequently masculine singulars as morphological substitution errors.

Furthermore, in subjects' results was found a tendency to produce overall fewer errors inflected for masc. plur. This tendency resulted in a significant difference between the number of errors inflected for masc. plur. and errors

inflected for fem. plur. ($t(k=3) = 3.89, p < .01$). This finding will be discussed after the presentation of further results of both Exp. 1 and Exp. 2.

Inflectional errors were then analyzed according to the number and type of morphological features shared with the target. For example, if the target has the inflection *-i* (masculine plural), the error with inflection *-o* (masculine singular) maintains the feature "gender" (+G); the error with inflection *-e* (feminine plural) preserves the feature "plural" (+N), whereas if the error takes inflection *-a* (feminine singular), neither number nor gender are preserved (-). In this last case we say that the inflectional error differs from the target by two morphological features, while in the first two examples it differs by only one morphological feature.

Errors of the type (+G) were 99; those of the type (+N) were 79; errors of the type (-) were 68. Analysis of variance showed significant differences among categories only by subjects ($F(2,58) = 3.33, p < .05$), but not by items. Post-hoc comparisons (Duncan's test) revealed a significant difference only between the number of errors preserving the feature "gender" (+G) and the number of errors sharing no morphological feature with the target (-) ($t(k=3) = 3.71, p < .05$). Errors preserving the feature "number" (+N) did not differ either from errors preserving the feature "gender" or from errors having no morphological feature in common with the target (-).

The results revealed a tendency for errors differing by only one morphological feature to be more frequently produced than errors differing from the target by two morphological features. Moreover, the feature "gender" seemed more frequently preserved in subjects' errors than the feature "number".

Since the tendency described did not result in a clear pattern of differences, it seemed worthwhile to investigate the issue further in an experimental context where the citation form was not included among the target forms. The presence in the first experiment of masculine singular forms, whose retrieval seems to obey specific principles, might have obscured other possible principles of morphological organization.

3. Experiment 2.

3.1. Method.

3.1.1. *Materials and design.* In the second experiment, the experimental list was composed of the same adjectives as in the first experiment, with the exclusion of the masculine singular forms, for a total of 54 stimuli, one third in *-a* (feminine singular), one third in *-e* (feminine plural) and one third in *-i* (masculine plural).

The 54 adjectives were presented in three groups of 18 each, according to stimulus length. In each of the three lists there was one third of adjectives for each inflection. Lists were submitted to subjects in different orders of presentation and with different orders of stimuli randomization.

3.1.2. *Procedure.* The procedure was the same as in the first experiment, with one small difference: since sublists contained a smaller number of items, they were presented only three times each to subjects. Each experimental session lasted about 25 minutes.

3.1.3. *Subjects.* 30 students from the University of Rome participated in the experiment and were paid for their participation. No subject had participated in the preceding experiment.

3.2. Results and discussion.

Subjects' performance was scored for omissions and items correctly recalled, either of the kind "correct root recalls" and "correct form recalls". The mean percentage of non-morphological errors and intrusions was again low (about 12% out of the total number of words produced). A very small number of errors resulting in the citation form were also produced (2.7% out of the total number of words produced).

Table 3. Total number and percentages of correct "root recalls" for each type of inflected form. Exp. 2

Target inflection	Root recalls	Form recalls
-i (masc. plur.)	229/540 (42.4)	162/229 (70.7)
-a (fem. sing.)	218/540 (40.4)	151/218 (69.3)
-e (fem. plur.)	216/540 (40)	150/216 (69.4)

In Table 3 results relative to roots and forms correctly recalled are presented. The number of root recalls and form recalls is almost identical for the three kinds of inflected forms, thus exactly replicating the results of the first experiment. (In the present experiment the overall number of correct recalls is greater because lists are shorter).

The analysis of morphological errors showed the pattern reported in Table 4. Analyses of variance revealed significant differences among numbers of errors in the different inflectional types (by subjects: $F(2,58) = 4.2, p < .025$; by items: $F(2,105) = 5.25, p < .01$). Post-hoc comparisons (Duncan's test on the analysis by items) showed that, as in the first experiment, errors inflected with *-i* (masc. plur.) were produced less frequently than errors inflected with *-e* (fem. plur.) ($t(k=3) = 4.07, p < .01$).

Table 4. Total number and percentages of inflectional errors per target form, subdivided for the possible morphological alternatives (percentages are relative to the total number of inflectional errors per target). Exp. 1

Target	Error			Total
	-i (m. sg.)	-a (f. sg.)	-e (f. pl.)	
-i (m. pl.)	—	(-) 25 (43.1)	(+N) 34 (56.9)	59
-a (f. sg.)	(-) 20 (32.8)	—	(+G) 41 (68.3)	61
-e (f. pl.)	(+N) 12 (20)	(+G) 48 (80)	—	60
Total	32	73	75	

Furthermore, errors inflected with *-i* were also significantly less frequent than errors inflected with *-a* (fem. sing.) ($t(k=2) = 3.9, p < .01$). The number of errors inflected with *-e* was not different from that of errors inflected with *-a*.

Errors were then analyzed for number and type of morphological features they had in common with the target inflection. Summing across target-types, results were the following. Errors in which the feature gender was preserved ($n = 89$) were almost twice the number of errors differing by the two morphological features (gender and number) ($n = 45$) and of errors preserving number alone ($n = 46$). This difference among types of errors was highly significant in the analyses of variance (min $F(2,163) = 3.52, p < .05$). Post-hoc comparisons (Duncan's test on the analysis by items) showed that errors in which the feature gender is maintained (+G) were produced more frequently than errors that did not share any morphological feature with the target (-) ($t(k=3) = 4.2, p < .005$), and errors that maintained only the feature number (+N) ($t(k=2) = 4.14, p < .005$). On the contrary, errors of the types (+N) and (-) did not differ.

Analyses of variance among error categories ((+G); (+N); (-)) within each targets type showed analogous results. For targets inflected with *-a*, the form that differs by only one morphological feature (+G) was produced more frequently as an error than the form differing by two features (by subjects: $F(1,29) = 5.18, p < .05$; by items: $F(1,58) = 4.65, p < .05$), while for targets inflected with *-i*, for which the form differing by one morphological feature is the one that preserves the feature number (+N), the difference between the two categories of errors was not significant. As for targets with *-e* inflection, where both morphological alternatives differ by one morphological feature, errors preserving the feature gender (+G) were more frequently produced than errors preserving the feature number (+N): min $F(1,77) = 6.76, p < .005$.

In other words, what seems to be relevant to the probability of producing a morphological error is not the sharing of any kind of morphological feature with the target, but the presence in the error of a particular morphological feature, namely gender.

4. General discussion.

The results of the two experiments can be summarized as follows. When trying to recall inflected adjectives in an oral free-recall task, subjects made many morphological errors consisting in inflection substitutions. Forms inflected for masc. sing. (citation form) were better recalled than the other inflected forms (masc. plur; fem. sing.; fem. plur), and were also more frequently substituted to other forms when an error occurred (Exp. 1). The other three inflected forms did not differ from each other in number of correct recalls. However, forms inflected for masc. plur. were less frequently produced as errors than the other forms (Exp. 1 and 2).

When inflection substitutions were analyzed according to the number and type of morphological features (gender or number) shared with the target form, it was found that subjects produced significantly more incorrect inflections that had the same gender (masc. or fem.) of the target-form, than inflections having the same number (sing. or plur.) or having neither gender or number in common with the target (Exp. 2).

The first result is in accordance with patient F.S.'s performance (Miceli & Caramazza 1988). In an oral free-recall task, subjects' performance is strikingly similar to that shown by the patient in a single-word repetition task: masc. sing. adjectival forms (citation forms) are more resistant to loss/forgetting than the other inflected forms, and are more available for retrieval (see the high number of masc. sing. substitutions).

The results of the second experiment constitute a new finding that sheds further light on principles governing organization of units in the lexicon: units sharing the same gender seem more closely connected in the lexicon than units sharing number or having no morphological features in common.

The last result to be discussed (i.e., forms inflected for masc. plur. were less frequently produced as substitution errors than the other forms) can be explained as a by-product of the principle that assigns a special status to gender in the retrieval of morphological information. The explanation is particularly simple in the case of the second experiment. In this experiment it is possible to produce an error consisting in the substitution of masc. plur. inflection in two cases: when the target is *-a* (fem. sing.), and when the target is *-e* (fem. plur.). In the first case, the substitution differs from the target by two morphological features, while in the second case the substitution has only the feature "number" in common with the target. Consequently, being these the two cases that give rise to fewer substitutions overall, the probability of having an error inflected by *-i* is highly reduced.

Further considerations are required to explain the same result in the context of the first experiment. In the first experiment the strongest determinant of subjects' errors is the citation form, and in fact subjects retrieve a high proportion of masculine singular forms. Let us assume that after exposure to the experimental lists, subjects are aware that the lists

include the same proportion of masculines and feminines, and of singulars and plurals. If gender is more available than number for form retrieval, subjects would be expected to retain gender in memory more easily than number. Consequently, they should respect list composition more closely for gender than for number. This is in fact the case. If we sum errors inflected for masc. gender ($107 + 25 = 132$) and compare them to errors inflected for fem. gender ($49 + 65 = 114$), we find that the proportion of masculines to feminines in the experimental list is respected in subjects' errors. However, given the high proportion of masc. sing. form productions, this same ability of subjects to retain gender is prejudicial to the production of masc. plur. forms. The same does not occur in the case of number. Subjects seem much less able to respect the relative proportion of singulars vs plurals in the list, producing fewer plurals ($25 + 65 = 90$) than singulars ($107 + 49 = 156$). But again this happens to the detriment of the production of masc. plur. forms.

In synthesis, results from the two experiments can be summarized in the following way. First, the masc. sing. (citation) form of adjectives seems to have a special status in lexical representation. Second, gender seems to provide a principle around which Italian lexical entries are organized. These results have various implications. First of all, the massive production of inflectional errors in a single-word task by normal subjects and the patterned performance they show, can be taken as evidence that, as most recent linguistic theories assume, inflection is part of the lexical component (Lieber 1980; Selkirk 1982; Scalise 1984). In other words, as similarly argued by Miceli & Caramazza (1988) for patient F.S.'s morphological deficit, normal subjects' performance in single-word processing can be interpretable by appealing to morphological principles that are located within the lexicon and do not necessarily involve a syntactic component.

I will now consider the first result. Present data, as well as data from patient F.S., show that the primary determinant of the probability of retrieving an adjective in its correct form is the fact that the stimulus is given in the citation form (masc. sing.). Moreover, masc. sing. forms, for both the patient and the subjects, and independently of word frequency (which in the two experiments is the same for all the experimental inflected forms), are also more available for retrieval than the other forms.

What determines the peculiarity of citation forms? In linguistics, this notion is grounded on a number of considerations. The citation form (of a lexeme) is "...the word-form from the inflectional paradigm of the lexeme which is used when a lexeme is entered in a standard dictionary...[and it]...may be conventionally determined..." (Bauer 1983: 12). In English, citation forms serve as the base for productive derivational processes (Aronoff 1978), although there exist also base forms which are not free forms (or "stems"). It is simply language-specific whether citation forms are free or bound forms (Wolff 1984).

In some theories (Greenberg 1967, Matthews 1974, Mayerthaler 1988), the citation form constituted by the masculine singular (of adjectives and nouns) is considered as maximally unmarked, less complex, more "natural" and more frequent than the other, more marked members of the inflectional paradigm. It is therefore hypothesized that it should be acquired earlier than the other forms, and should also be more resistant to change and loss/affectation.

I will now consider the second result of present experiments: gender, but not number, seems to constitute a principle of lexical organization. Some lexicalist theories consider both gender and number as properties of inflectional affixes which should be accounted for in the lexical component without making reference to syntactic principles. Selkirk (1982), for example, proposes to treat number for inflectional affixes as a diacritic feature, that is as a descriptive and distinctive feature of morphemes that does not pertain directly to the syntactic category of these morphemes.

However, locating inflectional processes inside the lexicon is not a processing account of lexical phenomena. So how can the present results be accounted for in current processing models of the internal lexicon? Different theoretical solutions are available.

One candidate is the *satellite hypothesis* developed for recognition of inflected words in Serbo-Croatian (Lukatela *et al.* 1980, Lukatela *et al.* 1987). According to this hypothesis, inflected cases of a noun are represented fully but not independently in the lexicon, and the nominative singular of the noun (the base form) has a special status in that it provides a nucleus around which the oblique cases cluster. Nominative forms are most accessible in the internal lexicon; once a satellite entry is accessed, the nominative nucleus of the noun is also activated.

This interpretation might be applied to the case of masculine singular forms of Italian adjectives. The masculine singular form would constitute the nucleus around which the other members of the inflectional paradigm may cluster. This would explain the greater availability of citation forms in the present experiments. The results showing the peculiar role of the feature "gender" in determining the probability of an inflectional error might also be accounted for by the satellite hypothesis. Feldman & Fowler (1987) have shown some asymmetries in the organization of satellite entries from which they have argued that connections among satellites are not uniformly represented in the lexicon but may vary in strength. By the same logic, it is conceivable that entries sharing the feature gender are more tightly linked to each other than entries sharing the feature number or having no morphological feature in common.

The present results are also compatible with an interpretation (e.g. Stemberger & MacWhinney 1986, 1988) according to which only some forms (e.g. base forms or high-frequency regularly inflected forms) are stored in the lexicon, while other regularly inflected forms are produced by

application of an inflectional *rule* to the base form. If citation forms are considered base forms, their greater availability for production might be due to the fact that they do not have to be retrieved by rule like the other inflected forms.

An hypothesis of this type is advanced by Miceli & Caramazza (1988), who assume that a lexical item is stored in the phonological lexicon in its citation form. The latter would be transformed by application of appropriate inflectional processes driven by the inflectional semantic features. According to this hypothesis, citation forms should be more directly accessible in the lexicon. Thus the high probability of producing an inflected form related by gender to the target might result from the high activation level of semantic information concerning gender in the lexical semantic component.

Finally, our results can be accounted for also in a framework in which it is assumed that lexical units are decomposed into morphemes corresponding to roots and affixes. The decomposition hypothesis has been mainly developed with reference to visual lexical access (Burani *et al.* 1984; Caramazza *et al.* 1985, Laudanna & Burani 1985, Burani & Caramazza 1987, Caramazza *et al.* 1988, Burani & Laudanna 1992). For speech production, "connectionist" models have been proposed (Stemberger 1985, Dell 1986, 1990), in which morphemes are represented in a network as units (nodes) interconnected by intra-level connections. The units corresponding to morphemes are also connected with units (nodes) of the other levels where phonemes and words are represented. In this framework, the unit corresponding to the inflectional affix for masculine singular could be conceived as more closely linked to the root-unit than the other inflectional units. These in turn could be more or less tightly interconnected along lines corresponding to different morphological-semantic information such as gender or number.

Each of these theoretical solutions seems to provide a reasonable account of present data. At the same time, none of the proposed models can be ruled out on the base of current evidence. Besides, each of the proposed accounts relies on partially different kinds of data. On the one hand, the morphological decomposition hypothesis has been developed with main reference to speech error data, that is to phenomena that are found in spontaneous sentence production: mainly root morpheme exchange errors and affix shifts, but also morphological accommodations in which the appropriate allomorph is chosen for pronunciation when inflected roots are exchanged and the inflection adapts to the reversed root. On the other hand, other hypotheses like the satellite hypothesis or that proposed by Miceli & Caramazza (1988), rely on evidence from single-word tasks.

However, as Miceli & Caramazza (1988) point out, in the case of single-word retrieval inflectional affixes may be activated from the semantic component of the lexicon, while in sentence production they may be accessed directly from information specified in a syntactic frame. Analogous

considerations are developed by Garcia-Albea *et al.* (1988) with special reference to the distinction between number and gender information. Relying on speech error data from Spanish and particularly from patterns of stranding involving suffixes bearing information on number or gender, these authors argue that the marking of number is embedded in the process of phrasal construction whereas the marking of gender might be more associated with the process of word retrieval.

In conclusion, various distinctions should be taken into account in developing models of speech production. Results from the present experiments have indicated some principles of lexical organization which suggest a role of morphological factors in the retrieval of spoken words. However, present data, considered either in isolation or in the context of the scarce evidence currently available, do not allow to opt for one particular solution. Further data are required to constrain theoretical interpretations.

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