

Experimentally induced morphological errors: Implications for the organization of the mental lexicon

Cristina Burani

A methodology for eliciting morphological errors in the laboratory is illustrated and discussed in comparison with other currently used methodologies (e.g. speech errors collections). Both advantages and limitations of this experimental methodology are considered. The implications of results drawn from experimentally elicited morphological errors are discussed with reference to the organization of the output lexicon involved in language production.

1. *Introduction.*

Errors produced by subjects in various linguistic tasks are a main source of evidence for assessing the principles governing organization and retrieval of lexical information during speech production. In the earliest investigations, collections of naturally occurring adults' speech errors (or slips of the tongue) constituted almost the unique source of data. In the long run, other types of errors were studied, namely errors produced by patients with acquired disturbances of language, and errors induced in normal subjects in experimentally controlled situations. These different sources of data have provided converging evidence on various aspects of lexical organization. The underlying assumption is that errors are not produced randomly; on the contrary, they are predictable, and exhibit regularities which originate from principles of lexical organization.

The preceding considerations suit the various dimensions of the mental lexicon (ranging from phonological to semantic dimensions), including morphological aspects. In discussing both theoretical and methodological issues concerning the study of the lexicon involved in speech production, I will deal mainly with its morphological organization. My discussion will focus on the evidence which can be drawn by exploiting more thoroughly the experimental investigation of word retrieval in controlled situations, thus far the most neglected source of data. After a brief sketch of some methodological approaches to the study of the morphological organization

of the production lexicon, I will discuss both advantages and limits of the experimental study of morphological errors, including a methodology for eliciting morphological errors which is proposed here and has been applied in other papers presented in this volume (Burani (1992), Burani *et al.* (1992), Chialant & Burani (1992 this issue)).

2. *Morphological errors produced by people in their spontaneous speech, and by patients with language disturbances.*

In the collections of naturally occurring speech errors, some errors have been considered to be morphological, in that the units involved in the error correspond to morphemes. The more usual morphological errors are stem exchanges with "stranding" of the affix (which is left in its intended sentence position, but now attached to the wrong stem), such as the following examples from Garrett (1980) (the displaced morphemes are capitalized; the intended targets are indicated by T):

- (1) You have to SQUARE it FACELY
T: to face it squarely
- (2) I've got a load of cooken chicked
T: of chicken cooked

Occasional affix shifts are also documented, like the following two examples, from Garrett (1980):

- (3) It certainly run outs fast
T: runs out
- (4) Even the best team losts
T: the best teams lost

Although these errors have been suspected to be execution errors rather than errors of access (Stemberger 1984), nevertheless the patterns they show seem to obey principles of lexical organization. For instance, affix shifts seem to be more common in inflectional than derivational formations (Garrett 1982); when derivational affix shifts occur, they are largely confined to highly productive affixes (e.g. English *-ly*, *-er*) (Garrett 1982). Furthermore, when morpheme reversals occur, the inflection usually adapts to the reversed root, and the appropriate allomorph is chosen for pronunciation (for a further discussion of morphological speech errors, with main reference to errors involving prefixes, see also Burani (in press), Burani *et al.* (1992 this issue)).

Converging evidence comes from studies of disturbed speech production. For instance, studies of neologistic jargonaphasia have shown that when an inflected word is distorted in a neologism, the inflection itself is preserved and accommodated to the neologised form of the root (Buckingham & Kertesz 1976). Moreover, some patients show a preserved knowledge of derivational

morphology (Panzeri *et al.* 1991). They occasionally produce neologisms formed by a neologistic root and a derivational affix which is appropriate to the sentence context; furthermore, the affixes involved in the neologism tend to be among the most productive (for further data and considerations, from both neologistic jargonaphasia and other types of disturbances, and from other tasks as reading and writing, see Panzeri & Job (in press); see also the other papers included in the monothematic section of this issue).

Errors of this type have been interpreted as revealing that morphemes act as units at some stage of lexical processing for speech. However, morphological errors need to be unequivocally distinguished from other types of errors, such as phonological errors. Some criteria for assigning an error to one category or to another have been developed (Cutler 1981, 1988). A methodological requirement is that an error should be assigned a given category only if the overall pattern of errors' distribution in the entire corpus has been considered. This constraint has been stressed in the study of errors produced by patients with acquired disturbances of language: an error produced by a patient is analyzable as originating from a disturbed cognitive component only if it is consistent with the overall pattern of errors produced by the patient on different occasions and in different tasks.

Another methodological requirement of the systematic study of pathological linguistic behavior as conducted within cognitive neuropsychology, is that a patient's production should not be assessed only by analyzing her/his errors in spontaneous speech. The analysis of spontaneous speech is to be integrated with data derived from administering, in various output tasks, linguistic materials controlled for relevant variables. This methodology allows to investigate the role in lexical processing of a number of factors such as a word's frequency, length, grammatical category and so on.

Some of these factors have been investigated for their role in affecting the production of speech errors (see e.g., for the role of grammatical category, Dell (1990); for the role of frequency, Stemberger (1984), Stemberger & MacWhinney (1986), Dell (1990)). However, other aspects of lexical organization, which more recently have been shown to affect lexical activation and retrieval in recognition tasks, have not been taken into consideration in the analysis of spoken production. A relevant variable is, for instance, the frequency of the target word (the word which is to be uttered) in connection with the number and frequency of its morphological, phonological or orthographic "neighbours", that is of the words which are similar to the target for some aspects and may compete for its activation (see e.g., for printed word recognition, Grainger *et al.* (1988), Grainger (1990); for spoken word recognition, Goldinger *et al.* (1989), Luce *et al.* (1990)).

It can be supposed that the latter, as well as many other factors, may prove relevant in the course of word production too. However, the post-

hoc analysis of naturally occurring speech errors is not the best methodology to investigate systematically how the different variables interact in the process of lexical selection and production (Baars (1980), Burani (in press)). This limitation connected to speech errors' analysis has led researchers to find out experimental methodologies for artificially eliciting speech errors in controlled situations in which the role of various factors is systematically assessed.

3. Experimental techniques for eliciting slips of the tongue.

Methods for inducing errors in experimental settings include the use of tongue-twisters (e.g. *She sells sea shells*) based on controlled materials which permit to assess the role of factors as phoneme frequency, confusability, and position within the syllable in word production (Levitt & Healy (1985), Shattuck-Hufnagel (1992)).

Baars and colleagues (Baars *et al.* (1975), Baars (1980)) were the first to propose a technique for eliciting slips of the tongue, which has been very influential since. In their experiments, subjects are presented with series of word pairs they occasionally have to read aloud, when prompted by an auditory signal. The target word pairs are preceded by some biasing pairs designed to induce particular errors. Thus, if the target pair *dam bore* is preceded by a series of word pairs such as *ball dome*, in which the word-initial phonemes are the same as those of the target pair but in reversed order, speakers make occasional errors on the target pair, saying for instance *bam door* instead of *dam bore*. This paradigm has been widely used for various purposes: to test output biases, such as the tendency of sound errors to result in existing words or syntactically well-formed sequences of the language; to investigate the repeated phoneme effect and properties of onset cluster errors; to study the selective attention of speakers in monitoring for such errors (for a review, and discussion, see Levelt (1989); see also Levelt (1992)).

The methodological assumption underlying this technique is that the elicited errors are unintentional, and they are output errors. They are unintentional not in the sense of being unplanned. Rather, these errors are highly systematic and predictable, in that they should arise from competing plans in speech planning and production. The theoretical assumption is that the system which is studied is active and highly constrained. Thus, the resultant outcomes of internal competition are not arbitrary, but reflect the regularities inherent in its normal functioning, including the regularities which are found in the structure of the lexicon.

The procedure is quite effective at producing the desired behavior, namely slips. However, it has been objected that some of the normal planning processes might be omitted or altered and that the articulation might be

more difficult than in spontaneous speech, or it has been questioned that these errors are truly speech errors, that is errors of output. Consequently, some changes in the original procedure have been introduced, such as the inclusion of a deadline (Dell 1986). At the moment, it is clear that the advantages of experimental techniques, namely the possibility of systematically assessing the role of different variables which affect word production, must be integrated with the results of the analyses of naturally occurring speech errors.

4. Experiments eliciting morphological errors.

The methodology discussed in the preceding section has been developed for the induction of phonological errors (or spoonerisms) and malapropisms, but has not been applied to the study of morphological dimensions. The experimental studies in which morphological errors are induced, show a main methodological difference with respect to the preceding studies, in that they require the subjects to produce intentionally a word which is morphologically related to a given target. Thus the occasional morphological errors which are produced are not in a sense unintentional slips, in that they are not produced incidentally while attending to another task, such as reading aloud or repeating a word, but are produced while intentionally trying to retrieve a given morphological form. In other words, the studies which will be briefly reviewed below rely on evidence drawn from tasks which have a metalinguistic character, and do not seem to arise from "on-line" processing of language.

In many of these studies subjects are asked to produce, in some controlled situation, a particular word form which is morphologically related to some target word, usually the base form. For instance, MacKay (1976, 1978) presented subjects auditorily with present tense verbs (e.g., *teach*), and they had to produce the past tense form (*taught*), or presented them with verbs (e.g., *decide*), and they had to produce a related derived noun (*decision*). The subjects had to utter the forms as quickly as possible, and reaction times and errors in word retrieval were analyzed.

In other studies (e.g. Stemberger & MacWhinney 1986, study 4), the verbs were presented one at a time in the frame *was ...-ING* in the center of a screen, and the subject had to speak aloud the past tense form of the verb as quickly as possible. Then reaction times and errors were analyzed.

A procedural variant which seems to require less metalinguistic awareness consists in inserting the target word in a sentence context preceded by another sentence, and in asking the subject to repeat one of the two sentences (Lapointe & Dell 1988). The subject sees two sentences, each of which has a different verbal form. Then the subject is cued with the subject noun

phrase of one of the sentences, and s/he must produce the remainder of the sentence as quickly as possible. For example, the sentences given in (5) are presented to the subject.

- (5) Sheila has mowed the lawn
Tom is wrapping the meat

Then the cue *Tom* is presented to the subject who must say *is wrapping the meat* as quickly as s/he can. The idea is that the procedure generates some substitutions of verb forms like *has wrapped the meat*, which permit to evaluate their relative retrievability.

Through the analysis of subjects' speed and accuracy on the different morphological processes, and particularly through the analysis of subjects' error patterns, these studies may evidence various phenomena, among which: the effects on word retrieval of morpho-phonological principles, such as the complexity of a derivational rule (MacKay 1976, 1978); the role of some organizational principle as the properties of the system that stores and determines the retrieval of verbal forms (Lapointe & Dell 1988); the role of some empirical factors, such as frequency, in determining no-marking errors on regular verbal forms (that is the dropping of the *-ed* suffix on regular past and perfect verb forms) (Stemberger & MacWhinney 1986, study 4). However, these studies may suffer from the limitation of tapping the lexical morphological organization in too a direct and intentional, rather than incidental, way.

5. *The experimental induction of morphological errors through a free-recall task.*

A methodology which seems to circumvent some of the problems connected to the techniques discussed in the preceding paragraph, was adopted in the studies which are presented in the remainder of this volume's section, and will be discussed now. Incidentally, this methodology is useful when one wants to avoid transcoding from the visual to the spoken modality, in order to assess the functioning of the phonological lexical component without involving orthographic processes.

The task is not in itself a new one, being it typical of the study of short-term memory, but if combined with particular cues it can be usefully applied to the study of some factors affecting single-word retrieval. The task used for inducing morphological errors is free-recall of lists of words. Words are presented auditorily and subjects have to recall them orally (for similar uses of serial recall in studying the morphological representation of inflected English nouns, and American Sign Language inflected signs, see van der Molen & Morton (1979), Poizner *et al.* (1981), respectively). This task is combined with a set-induction technique, in which subjects are presented with lists of words which are homogeneous for one or more relevant variables

(for application of a set-induction technique to recognition of printed derived words, see e.g. Colé *et al.* 1989). For instance, the lists of words which are presented to the subjects may include only prefixed words. Thus subjects will tend to retrieve only prefixed words. If an error occurs during recall, it ought to consist in the production of a different prefixed word. In other terms, subjects' errors should consist for the most part in the substitution of the prefix or the root of a target word.

This permits to design lists which are controlled for the variables under investigation, and to extract from the subjects' patterns of errors the indication that different types of morphologically complex words, or words which are affected in different degrees by different variables, are processed and represented in different ways. The assumption, as it is usual in the field, is that if prefix substitution errors (or, more generally, morpheme substitution errors) do not occur randomly but they are distributed in significantly different ways according to different variables, this should indicate that different types of morphologically complex words are differentially subject to be processed and represented in terms of morphemic constituency. Along with the analysis of morphological errors, a second dependent variable which can be usefully analyzed in order to shed light on lexical retrieval processes is the pattern of correct recalls of the words as whole-forms (see the others papers in this section).

In order to assume that the effects on recall have a lexical source and do not arise at lower, more peripheral levels such as phonological or phonetic encoding which is at work in determining the phonological memory trace, a number of constraints typically used in the study of short-term memory can be applied. For instance, subjects are required to recall the words that have been presented after a delay during which an interfering task (usually the execution of some arithmetic operations) is administered. The intervening delay and the execution of the interfering task should guarantee that subjects cannot rely for recall on a phonological memory trace which on the contrary should be decayed at the moment of recall. Analogously, in order to avoid semantic effects in recall, by which words which are related for meaning might be recalled better, the list composition can be manipulated: semantic relations among words in the list may be avoided, or words with a more "abstract" meaning can be employed (instead of words with a more "concrete" or imageable meaning, for which it can be easier to develop semantic or imageable relations with other words).

The occasional production of morphological (namely morpheme substitution) errors during word retrieval seems to have an incidental and unintentional character (although "oriented" and shaped by the set induction technique), in that errors arise during the execution of a task (free-recall of words) in which it is not required to perform explicitly morphological operations. An obvious "caveat" to be applied when interpreting results obtained through this technique is to control for the possibility that

presumed morphological errors may have instead a phonological source, that is that errors which apparently arise within a morphological component derive from formal similarity among words which only casually results in preservation of the morphological constituents. In other words, the possibility must be controlled for that errors are not genuinely morpheme substitutions, rather they are phoneme substitutions which casually result in substitution of a morpheme. This is a methodological constraint which has been widely discussed and applied in both the study of pathological linguistic behavior and the study of normal speech errors (for further discussion of this issue, see Burani *et al.* (1992 this issue) and Chialant & Burani (1992 this issue)).

If all these methodological cares are correctly applied, this task can provide useful insights into the process of word retrieval from the lexicon, thus contributing to show that the organization of the lexical component can be studied in its autonomy, that is not only in its interaction with the syntactic component as it is the case while studying speech errors. At the same time, it has the obvious specular limitation that it cannot be applied to the investigation of the role of bound morphemes, mainly inflections, in the process of syntactic planning (for further discussion of this issue, see Burani 1992 this issue).

The main limitation of this methodology may consist in the fact that it does not allow to identify with enough confidence the lexical component which is responsible for subjects' performance. In other words, results from this task do not seem to be directly relevant to one component of the production process, although presumably these results originate in between the process of selecting from the lexicon an appropriate lexical entry (or lexical entries, if a view of morphologically decomposed lexicon is adopted), and phonologically encoding it (or them). It is well known that failures to produce a target word may have many underlying causes. Thus many potential loci of specifically linguistic failure may be singled out. In a view in which sequential stages in speech production are assumed (Garrett 1992), morphological errors which arise in our task may originate from a failure of lexical selection, and reasonably in the stage that can be characterized as proceeding from lemma to word-form representations. However, a more interactive view can also be developed, in which some degree of local interaction in the course of lemma and phonological access is assumed, as a product of lexical retrieval processes. In such a view, it can be questioned whether phonological encoding can in turn affect lexical selection (Dell & O'Seaghdha (1992); for a more general discussion, see also Levelt (1992)).

In the current framework of research on speech production, it must be acknowledged that, while data are increasing, theoretical models are not yet much developed in detail. Thus empirical findings seem often to be compatible with a number of theoretical interpretations. A goal of research in lexical access for production is therefore to develop more detailed models.

At the same time, data coming from different sources are needed. At present, the use of a pluralistic methodology is encouraged. However, experimental data need to be further extended. To this aim, the proposal of a number of tasks as well as the discussion of their potential advantages and limitations does not seem to be irrelevant. The research proposed here is a contribution towards this more general goal.

Address of the Author:

Cristina Burani
Istituto di Psicologia del C.N.R.
Viale Marx, 15
00137 Roma
Italy
e-mail: BURANI@IRMKANT.bitnet

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