Lexical access and inflectional morphology*

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Abstract

This study investigated the hypothesis that lexical representations are stored in morphologically decomposed form. Three lexical decision experiments in which the morphological structure of nonword stimuli was varied are reported. Systematic effects of morphological structure on reaction time and error performance were obtained. In particular, it was found that: (1) morphologically nondecomposable nonwords were easiest to process; (2) nonwords with partial morphological structure were processed with greater difficulty than this latter set of stimuli; and, (3) morphologically legal nonwords (i.e., nonwords that are exhaustively decomposable into morphemes) were processed with the greatest difficulty. Furthermore, it was found that within the class of morphologically legal nonwords performance was affected by the type of relationship that obtained between the morphemes that comprised a stimulus item. These results, which are interpreted as evidence in favor of the hypothesis that lexical representations are morphologically decomposed, are discussed in the context of the Augmented Addressed Morphology Model.

*The research reported here was supported by a grant from the Consiglio Nazionale delle Ricerche (Italy) and by NIH grant NS23836. We would like to thank Bill Badecker, Cristina Burani, and two anonymous reviewers for their helpful comments on an earlier version of this paper. We also thank Kathy Yantis for her assistance in the preparation of this manuscript. Requests for reprints may be addressed to Alfonso Caramazza, Cognitive Neuropsychology Laboratory, Cognitive Science Center, The Johns Hopkins University, Baltimore, MD 21218, U.S.A.
Introduction

After a period of relative neglect, morphology once again plays an important role in linguistic theory. Following the seminal work of Aronoff (1976; but see also Halle, 1973; Jackendoff, 1975) there has been a resurgence of interest in morphological theory. Of the many issues in morphology which have been addressed by linguists over the past decade two are of particular interest here. One issue concerns the relative burden carried by the syntactic and lexical components of grammar in representing morphological structure. A second, related issue concerns the relationship between word stems and inflectional and derivational morphology. Although these issues have not received a definitive solution, there is a growing consensus in favor of the Strong-Lexicalist thesis (Lapointe, 1979), namely, that all morphological information is represented in the lexicon. And, within this position, there is now a non-negligible set of arguments and data in favor of the view that inflectional and derivational morphology constitute distinct, autonomous processes (see Scalise, 1984, for review).

Over this same period psycholinguists have expressed an equally intense interest in the role of morphological structure in lexical processing. This issue has been investigated through a variety of experimental paradigms in studies on normal subjects (e.g., see Henderson, 1985, for review) and patients with acquired disorders of language (e.g., see Badecker & Caramazza, 1987; Job & Sartori, 1984). While the available experimental evidence unambiguously demonstrates that morphological structure plays a crucial role in lexical processing tasks (e.g., Butterworth, 1983; Cutler, 1983; Henderson, 1985), this evidence appears not to be equally unambiguous when it comes to choosing between alternative models of lexical organization and processing. Thus, there continues to be much uncertainty about whether or not words are represented in the lexicon in morphologically decomposed form and about whether or not lexical access requires morphological parsing of the stimulus word—the two theoretical issues that have animated most of the research in this area. This uncertainty may be fostered not so much by real incompatibilities in the experimental results as from the unfortunate conflation of results obtained with different experimental paradigms for different aspects of morphological structure in different components of the lexical system. To avoid this latter problem—at least for presenting our experimental results (we take up the larger issue of morphological processing in different components of the lexical system in the Discussion section)—we have chosen to focus on a particular juncture among experimental paradigms, components of the lexical system, and morphological features; namely, the processing of inflectional morphology for visually presented words in a lexical decision task.
To guide our experimental investigation we will make a number of assumptions about the architecture of the lexical system. (In this introductory section we discuss only those assumptions needed to develop the empirical predictions evaluated in this paper; other assumptions will be presented in the Discussion section.) We will assume that the lexical system is articulated into several independent but interconnected components. We distinguish between modality specific (orthographic or phonological) input and output lexical components. Within each component lexical entries are represented in morphologically decomposed form, with word stems and inflectional affixes represented independently (e.g., Caramazza, 1988; Miceli & Caramazza, in press). In the case of the orthographic input lexicon (and, presumably, of the phonological input lexicon), access to lexical representations may take place through a whole-word access procedure, for known words, or through a morpheme address procedure, for novel words. The mechanism of access is assumed to be a parallel activation system where the degree of activation of a stored orthographic representation is a function of the graphemic similarity between a letter string and the orthographic representation (e.g., Morton, 1970; Gordon, 1983).

The crucial assumption in our model (Caramazza, Miceli, Silveri, & Laudanna, 1985) is that a letter string activates both whole-word representations (where available—that is, for known words) as well as the morphemes that comprise a word. Thus, for example, the stimulus "walked" will activate the access representations WALKED, WALK- and -ED as well as orthographically similar representations such as WALKS, WALKING, TALKED, TALK-, WALKED, WINKED, etc. The orthographic representation that first reaches a preset threshold will activate its corresponding lexical entry. In this example it is assumed that the orthographic representation WALKED reaches this threshold first, making available, in turn, the morphologically decomposed lexical representation $^{1}$ "WALK-v + -ED"—the subscript V indicates that the activated morpheme is the verbal morpheme WALK-v and not the nominal morpheme WALK-n. Another important assumption of this model is that the activation of a whole-word orthographic representation proceeds more rapidly than the activation of the combined morphemes that comprise the word. Thus, although the orthographic representations WALKED, WALK-, and -ED could all reach threshold given the stimulus

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$^{1}$Actually the representation activated in the orthographic lexicon has a much more complex structure, both with respect to the information arrayed against the stem as well as that arrayed against affixes. Thus, at the very least the representation for walked should have the following structure: [walk]v, [ed]v, vI_. In this representation, both the stem and the affix are marked as specifying a verbal category (V) and, additionally, the affix is marked for context of attachment (VI_); i.e., the morpheme [-ed]v is only attached to verbal stems. Other features of lexical representations in the orthographic lexicon are discussed at a later point in the paper.
“walked”, we assume that if WALKED is represented in the access system (i.e., is a stimulus previously experienced by the subject\(^2\)), then it will reach threshold before the combined activation of the orthographic representations WALK- and -ED. If, on the other hand, a subject had never experienced the word “walked” but knew that walk was a verb, then the only orthographic representations to reach threshold would be WALK- and -ED, making available the lexical representation “WALK\(_{-v}\) + -ED” (other aspects of this model will be taken up in the Discussion section).

We have labeled the model of lexical access and representation briefly sketched above the Augmented Addressed Morphology (AAM) model (Caramazza et al., 1985). The “Addressed” part of the model’s name reflects the assumption that morphological representations for known (previously experienced) words are not accessed through an active, pre-lexical decomposition (or parsing) of the orthographic input string; the “Augmented” part of the model’s name indicates that the model has been extended to include a procedure for access of words not previously experienced (novel words).

The AAM model differs in interesting ways from the two major alternatives—the Word and the Morpheme Access Models—that have been discussed in the psycholinguistic and neurolinguistic literature. The Word Access (WA) model assumes that word representations are the *only* units of access in the lexicon (e.g., Rubin, Becker, & Freeman, 1979). The lexical information that is accessed through this procedure may or may not contain morphological structure. However, in light of the crucial role played by morphological structure, both inflectional and derivational, in language processing, it is not serious to adopt a model of lexical representation that does not explicitly include some means of recovering the morphological structure of a word. The Morpheme Access (MA) model assumes that the *only* units of access are morphemes, roots (or stems) and affixes. Models of this type further assume that there is a morphological “parsing” procedure that is applied to word stimuli in order to recover the relevant morphemic units for lexical access (Taft, 1979, 1985). These three models make contrasting predictions concerning the effects of morphological structure in (single word) lexical decision tasks for word and nonword stimuli. Whereas the MA model predicts effects of morphological structure in lexical decision tasks for both words and nonwords and the WA model predicts no effects of morphological structure for either type of stimulus, the AAM model predicts effects of morphological structure

\(^2\)Obviously much more need be said on this issue: How much experience is needed in order to store an access unit in the lexical system? Is one presentation of a stimulus sufficient? Or, do we need multiple presentations before an access unit is permanently stored in the system? In the absence of a theory of lexical acquisition there is not much more that can be said here.
only for nonwords. The predictions made by each of these models in lexical
decision tasks are developed in detail below.

Experiments on the effects of morphological structure with word stimuli
in lexical decision tasks have failed to reveal effects of such structure. Rubin,
Becker, & Freeman (1979; see also Henderson, Wallis, & Knight, 1984) com-
pared lexical decision performance for affixed (e.g., rejuvenate, sender) and
pseudo-affixed (e.g., religion, sister) words. If the lexical access procedure
proceeds through a process of affix stripping and then access of lexical rep-
resentations through the “stripped” lexical morpheme (e.g., Forster, 1976;
Taft, 1979), then there ought to be a difference in reaction times for affixed
and pseudo-affixed words. This prediction is based on the assumption that
there is a cost associated with the application of the stripping procedure to
the pseudo-affixed words. The application of the affix stripping procedure to
pseudo-affixed words results in letter strings that do not correspond to root-
morphemes (e.g., -ligion, sist-) and hence do not have entries in the lexicon. To
access the lexical representation for a pseudo-affixed word, a lexical
search has to be initiated for the “re-assembled” letter string (e.g., re-ligion)
after the search for the pseudo-root morpheme has failed (Forster, 1976;
Taft & Forster, 1975). Thus, if lexical access is always based on a procedure that
strips off the affixes of a word and then addresses the lexicon through the
remaining lexical morpheme, the expectation is that lexical decision times for
pseudo-affixed words should be longer than for truly affixed words. The
results reported by Rubin et al. (1979) (see also Henderson et al., 1984;
Manelis & Tharp, 1977) do not conform with this expectation: Reaction
times for affixed and pseudo-affixed words did not differ (but see Taft, 1981,
1985, for a critical analysis of these results).

Experimental results in which performance in responding to nonwords has
been used to investigate the structure of lexical access mechanisms paint a
different picture. Taft and Forster (1975, Exp. 1) found that lexical decision
times for bound stems of prefixed words (which result in nonwords) such as
“juvenate” (from “rejuvenate”) were longer than decision times for pseudo-
stem nonwords like “pertoire” (from “repertoire”). They also found (Exp.
3) that lexical decision times to reject nonwords such as “dejuvenate”, formed
by a prefix + real stem, were longer than decision times for nonwords such as
“depertoire”, formed by a prefix + pseudo-stem. These results support a
model of lexical access based on a lexical morpheme address procedure since,
presumably, the only difference between the two types of stimuli in each
experiment was whether or not a letter string contained a stem which corre-
sponded to an address in the lexicon. These results pose serious difficulties
for any model of lexical access based exclusively on a whole-word address
system.
Unfortunately, Taft and Forster's results have been challenged. Manelis and Tharp (1977) noted that although real stems in Taft and Forster's Experiments 1 and 3 were matched to control pseudo-stems for frequency, the frequency assigned to each stem (and pseudo-stem) was the frequency of only one word from which the stem was drawn. However, it has been established (Burani, Salmaso, & Caramazza, 1984; Taft, 1979) that lexical decision times are affected by the cumulative, stem-morpheme frequency of morphologically related words. When the frequencies for stems and pseudo-stems were recomputed on the basis of stem-morpheme, cumulative frequency, Manelis & Tharp (1977) noted that the mean frequency (per million) for real stems was 84 and for pseudo-stems 14 in Experiment 1, and 76 and 13, respectively, in Experiment 3. It is possible, therefore, that the difference in reaction times between stem-morpheme and pseudo-stem nonwords may simply reflect a difference in stem frequency (but see Taft, 1979, for a response to this objection).

Another potential difficulty with Taft and Forster's experiments is that the similarity of nonwords to words was not controlled. The similarity of nonwords to words is an important determinant of lexical decision latencies for nonwords: The more similar a nonword is to a word, the longer the time required to decide that it is not a word (Martin, 1982). The lack of this control in Taft & Forster's experiments raises the possibility that the pseudo-stems were less orthographically similar to words (and not just the one word from which a nonword stimulus was created) than were the real stems. It is important, therefore, to replicate the results reported by Taft and Forster since they are crucial for distinguishing between models of lexical access.

The experiments we undertook had a dual objective: first, to replicate the results reported by Taft & Forster concerning the effects of morphological structure in nonwords in a lexical decision task and, second, to address several questions concerning the representation and processing of inflectional morphology in the lexicon. The first objective was met through two experiments (Experiments 1 and 2) which replicated and extended the original Taft and Forster's results. The second objective was met through the investigation of the effects of various features of verbal inflections in lexical decision tasks (Experiments 2 and 3).

**Experiment 1**

The principal objective of Experiment 1 was to determine whether or not the presence of morphological structure in a nonword affects RT in a lexical decision task. If it were possible to demonstrate that nonwords with mor-
phological structure are more difficult to reject as words than nonwords comparable in all respects except that they do not contain morphological structure. In effect replicating the challenged result reported by Taft and Forster, we would have evidence against lexical access models which only postulate access procedures for whole-word representations.

This issue was addressed by comparing lexical decision times for nonwords composed of a stem plus affix (e.g., CANTEVI which may be parsed into the stem CANT-, the root-morpheme of the verb to sing, and the verbal affix-EVI, the 2nd person, singular, past tense affix for verbs of the 2nd conjugation) versus nonwords which do not permit such morphological decomposition (e.g., CANZOVI which contains neither a legal root-morpheme nor a verbal affix). The MA model and the AAM model predict that it should be more difficult to decide that CANTEVI-type stimuli are not words than the comparable decision for CANZOVI-type stimuli; the WA model predicts that there should be no difference in decision times for these two types of stimuli.

A further objective of this study was to provide experimental evidence to help us choose between the MA and the AAM models. This issue was addressed by considering lexical decision performance for nonwords which varied in the type of morphological structure they contained. The MA and the AAM models make different predictions about the effects of “partial” morphological structure in a nonword on lexical decision times. Consider in this regard the following types of nonwords: CANTEVI, CANTOVI, CANZEVI, and CANZOVI. As already noted, stimuli such as CANTEVI have a stem plus affix structure (CANT- + -EVI), whereas stimuli such as CANZOVI are not decomposable into morphemes. We will refer to the former type of stimuli (CANTEVI) as morphologically legal (ML) and to the latter type of stimuli (CANZOVI) as morphologically illegal stimuli (MI). The other two types of stimuli each have some morphological structure but neither is decomposable into a stem+affix sequence—CANTOVI-type stimuli contain a legal stem (CANT-) but do not have a verbal affix (OVI); CANZEVI-type stimuli contain a verbal affix (-EVI) but do not have a legal stem (CANZ). These two latter types of stimuli will be referred to as stem only (SO) and affix only stimuli (AO), respectively. A comparison of RT performance for stimuli with partial morphological structure (i.e., CANTOVI- and CANZEVI-type stimuli) versus morphologically decomposable (CANTEVI) and morphologically nondecomposable (CANZOVI) nonwords provides the opportunity to evaluate the relative merits of the MA and the AAM models.

The MA model (or more precisely the Affix Stripping model proposed by Taft) assumes that lexical access takes place through a two-step procedure: first, an affix stripping procedure which strips a word of its affixes leaving as
the unit of lexical access a word stem and, second, a search procedure with the bare stem as the unit of access in modality-specific access lexicons. This model predicts that it should take longer to reject as a word a morphologically decomposable nonword stimulus (e.g., CANTEVI) than a similar decision for a morphologically nondecomposable nonword stimulus (e.g., CANZOVI). The basis for this prediction is that, in comparison to CANZOVI-type stimuli, the rejection of CANTEVI-type stimuli involves an extra, time-consuming step. The claim is that stimuli such as CANTEVI are first stripped of their affixes (-EVI in this case) and the remaining stem (CANT-) is used to search for a stem entry. If this search is successful, the master lexicon is then consulted to determine whether or not there is a lexical entry corresponding to the reassembled stem + affix—a negative outcome in this case. Thus, a stimulus such as CANTEVI can only be rejected as a nonword after lexical access has taken place and the lexicon is consulted to determine that the particular combination of stem + affix presented is not a word in the language. By contrast, stimuli such as CANZOVI which do not permit morphological decomposition may be rejected as nonwords at the lexical access stage.

The MA model also makes clear predictions concerning lexical decision performance for nonword stimuli with “partial” morphological structure. Stimuli of the CANTOVI-type (containing a lexical morpheme but no affixes) do not allow affix stripping and, therefore, such stimuli may be rejected at the lexical access stage just like CANZOVI-type stimuli. Stimuli of the CANZEVI-type (containing a verbal affix but no lexical stem) do allow affix stripping but the remaining letter string does not correspond to a lexical stem and, therefore, the lexical search procedure fails. However, a negative decision is not taken at this point but must await the outcome of a new search of the recombined pseudostem plus affix—a negative outcome also in this case. Thus, the MA model predicts longer RTs for rejecting CANZEVI- (AO) than for CANTOVI- (SO) or CANZOVI-type (MI) stimuli since rejection of the former stimulus type involves an extra processing step. The model also allows predictions for the contrast between CANTEVI- (ML) and CANZEVI-type (AO) stimuli. For both stimulus types the affix stripping procedure is successful but in only one case, for CANTEVI-type (SO) stimuli, is the resulting stem an entry in the access lexicon. Thus, rejection of this latter stimulus type as a nonword must await first the failure to find an entry in the master lexicon for the reassembled string CANT- + -EVI and the failure to find an access unit corresponding to the full string CANTEVI. In other words, this model predicts that there is an extra, time consuming step involved in rejecting CANTEVI-type (ML) than in rejecting CANZEVI-type (AO) stimuli. In short, then, the MA model makes the following predictions
concerning processing difficulty for the four types of stimuli being considered: 
CANTEVI (ML) > CANZEVI (AO) > CANTOVI (SO) = CANZOVI (MI).

The AAM model predicts a different pattern of results for the four types 
of nonword stimuli from that described for the MA model. The predicted 
pattern is: CANTEVI (ML) > CANTOVI (SO) = CANZEVI (AO) > CANZONI (MI). The basis for predicting this pattern of results is as follows.

As noted in the Introduction the AAM model assumes that the mechanism 
of lexical access consists of a parallel activation procedure in which both 
whole-word (for known words) and morphemic access units (stems or roots 
and affixes) are activated. Those access units that reach a prespecified thresh-
old will address morphologically decomposed lexical representations. For the 
experimental stimuli (nonwords) used in this experiment the access system 
does not contain corresponding whole-word access units—i.e., there are no 
access units that correspond to the full letter strings CANTEVI or CANZONI. Thus, the only access units to be activated are orthographically similar 
words and morphemes. In the case of the stimulus CANZONI, for example, 
the units that are activated may be orthographically similar words such as 
"canzoni", "calzoni", "cantavi", etc.; similarly, for the stimulus CANTEVI, 
the units that are activated may be the orthographically similar words such 
as "cantavi", "canterà", "contavi", etc., but in addition this type of stimulus 
will activate the morpheme access units CANT- and -EVI which will reach 
threshold and address their corresponding representations in the lexicon. 
However, since the morpheme pair CANT- and -EVI may not be combined 
to form a word in Italian—CANT- is a verb stem for a verb of the 1st conju-
gation and -EVI is a verbal affix for verbs of the 2nd conjugation—the stimulus 
will be classified as a nonword at this level of the lexical system (the ortho-
graphic input lexicon). Thus, the AAM model predicts slower RT perfor-
mance for CANTEVI-type (ML) than for CANZONI-type (MI) stimuli.

The predicted performance for stimuli with "partial morphological" struc-
ture (e.g., CANZONI and CANTOVI) is intermediate between the two ex-
tremes just described. Both CANZONI and CANTOVI will activate mor-
pheme access units which reach threshold—EVI and CANT-, respectively—but the remaining letter sequences fail to activate to threshold other mor-
pheme access units and, therefore, these stimuli are rejected prior to the 
activation of a full lexical pattern in the lexicon (unlike the case for CAN-
TEVI) but after the possible rejection due to the failure to activate any access 
units (unlike the case for CANZONI). Thus, the full pattern of predicted RT 
performance (or error rates) for the four types of nonwords considered here 
is the following: CANTEVI (ML) > CANTOVI (SO) = CANZONI (AO) 
> CANZONI (MI).
Table 1.

<table>
<thead>
<tr>
<th>Model</th>
<th>Stimulus type</th>
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<tbody>
<tr>
<td>WA</td>
<td>CANTEVI = CANZEVI = CANTOVI = CANZOVI</td>
</tr>
<tr>
<td>MA</td>
<td>CANTEVI &gt; CANZEVI &gt; CANTOVI = CANZOVI</td>
</tr>
<tr>
<td>AAM</td>
<td>CANTEVI &gt; CANZEVI = CANTOVI &gt; CANZOVI</td>
</tr>
</tbody>
</table>

The performance predicted by the three models of lexical access and representation—the Word Access, the Morpheme Access, and the Augmented Addressed Morphology model—is shown in Table 1.

Method

Stimuli

Three hundred and twenty stimuli were presented to each subject in a single experimental session. The stimuli were composed of an equal number of words and nonwords. Of the 160 nonwords 80 were experimental items—20 for each of the experimental types. That is, there were 20 items for each of the stimulus types CANTEVI, CANZEVI, CANTOVI, and CANZOVI. The mean length and mean N-count for the stimuli in each experimental condition were identical, 7.2 and 1.2 respectively. The mean root frequency (and range) of the words from which the nonwords were derived were also equal for the four experimental conditions (mean frequency = 203; range = 38–330, from a 500,000 word count).

The 80 filler nonwords were obtained by changing one or two letters from a word in Italian. These stimuli closely matched the characteristics of the experimental stimuli in length and the frequency of the words from which they were derived. The 160 word stimuli were adjectives (10), nouns (60), and verbs (90). The mean length of words was 6.9 and the mean frequency was 220 (range = 30–400). No stem appeared more than once in the stimulus set.

Materials and equipment

The stimuli appeared on a video display unit controlled by an Apple II personal computer.

Procedure

A lexical decision task was employed in which subjects were required to classify items as word or nonword. Subjects were instructed to be as fast and
accurate as possible. They responded by pushing one button when they rec-
ognized the stimulus item as a word, and another when they considered a
stimulus to be a nonword. The interval between the disappearance of a
stimulus and the presentation of a successive one was 1 second. If a subject
responded slower than a preset limit (1500 ms) the stimulus item disappeared
and the words “più veloce” (faster) appeared on the screen. If the subject
gave a wrong response, the word “errore” (“error”) appeared on the screen.
In the case of correct responses the reaction time (in ms) appeared on the
screen. Reaction time was measured from the onset of a stimulus item to the
time the subject pressed the response button. The stimuli were organized into
5 blocks of 64 items. Each block was preceded by two short blocks of 15
practice items each. Two constraints were observed in list composition: No
more than four words or nonwords could occur consecutively, and an approx-
imately equal number of experimental items were to be placed in each of the
five blocks. No experimental stimulus was included among the first three
stimuli of a block. The total pool of 320 items, arranged in four different
random orders, was presented to all subjects.

Subjects
Twenty-four subjects, all native speakers of Italian, completed the experi-
ment. They each served for one session lasting about 40 minutes. They were
volunteer students between 18 and 30 years of age, and they were paid for
their participation in the experiment.

Results and discussion

Mean reaction times and errors for the four categories of experimental items
are shown in Table 2. Analyses of variance, by subjects and by items, to
evaluate mean RT differences and errors revealed highly significant mean
differences among experimental conditions; for RT: Min F(3,135) = 5.4,
$ p < .005$; for errors: Min F(3,169) = 5.28, $ p < .005$. Post-hoc comparisons
among means (Duncan’s test) revealed the following pattern of significant
contrasts: Performance for CANTEVI-type stimuli resulted in significantly

Table 2.  Mean RT and error performance

<table>
<thead>
<tr>
<th></th>
<th>CANTEVI</th>
<th>CANZEV</th>
<th>CANTOVI</th>
<th>CANZOVI</th>
</tr>
</thead>
<tbody>
<tr>
<td>RT (ms)</td>
<td>875</td>
<td>809</td>
<td>781</td>
<td>760</td>
</tr>
<tr>
<td>Errors (%)</td>
<td>21.0</td>
<td>7.7</td>
<td>11.8</td>
<td>5.8</td>
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slower RT and higher error rates than all other stimulus types ($p < .001$, in all cases); furthermore, CANZEV1-type stimuli were responded to significantly slower than to CANZOVI-type stimuli ($p < .02$) and CANTOVI-type stimuli produced significantly higher error rates than CANZOVI-type stimuli ($p < .01$).

The pattern of results reported here is inconsistent with the predictions derived from the WA model, which postulates that the only units of access are whole-word representations, and the MA model, which postulates an affix stripping procedure prior to lexical search. Thus, the prediction made by the WA model of no differences in RT among the four experimental conditions did not obtain, nor did the predictions made by the MA model of no difference in RT between morphologically non-decomposable and “partially decomposable” stimuli. By contrast, the reported results generally agree with the predictions derived from the AAM model even though this model’s predictions for stimuli with “partial morphological” structure only received weak support.

The results of Experiment 1 show that the presence of morphological structure in nonwords plays an important role in determining lexical decision latencies and error rates. If our assumption that the four types of stimuli used in the experiment do not differ in terms of orthographic similarity to words (and, hence, to whole-word units in the lexical access system) were correct, then the only structural factor that could contribute to variation in lexical decision times would be the morphological structure that characterizes each stimulus type. Thus, these results may be interpreted as reflecting the involvement of different levels of representation in processing morphologically-decomposable and morphologically-nondecomposable nonwords; that is, these results are incompatible with the hypothesis that the only units of access to the lexicon are whole-word representations. Instead, it appears that the lexical access system does allow the direct activation of morphologically defined units—stems or roots and affixes.

The results of Experiment 1 also allow us to choose between the two models of the lexicon which include procedures for lexical access through morphemic units: the MA and the AAM models. The pattern of results obtained for nonwords with partial morphological structure are clearly incompatible with the MA model. These same results follow the pattern predicted by the AAM model even though the statistical reliability of these results was less-than-compelling. For this reason one of the goals of Experiment 2 was to replicate the effects of partial morphological structure in nonwords in lexical decision tasks. A second objective of Experiment 2 was to evaluate more detailed claims concerning the representation and access of inflected words within the framework of the AAM model.
Experiment 2

An important characteristic of the AAM model is the central role played by "productivity" in determining the processing structure of the lexical system. A process is morphologically productive if it includes explicit criteria for determining the legal morpheme combinations in the language. Productivity is usually associated with the principle of economy—that is, with the principle that the only information represented in the lexical system is that which is sufficient to generate all the legal lexical forms of the language. In our model we make a much weaker assumption for productivity. All that is assumed is that each legal morpheme combination of a language should be recoverable from the information stored in the lexicon. Thus, for example, if a speaker of English were to know that NOLK (to walk in knock-kneed fashion) was a verb but had only experienced the forms NOLK and NOLKS, s/he still ought to be able to recognize NOLKED as an inflectional and NOLKER as a (possible) derivational form, respectively, of the verb NOLK. However, the model also assumes that the previously experienced form NOLKS may be recognized by activating a whole word access representation. Thus, the AAM model explicitly captures the principle of productivity without a commitment to the principle of economy—its access procedure includes not only whole-word representations but also morpheme access units which may be combined in the recognition of novel, legal words. To empirically evaluate the plausibility of this model we must specify the nature of (1) the information needed to determine that a particular morpheme combination is legal and (2) the process by which a decision about lexicality may be taken.

The information needed to determine whether a particular stem+affix combination is legal involves both information about stem- and affix-type. Consider the case of verbal inflection in Italian. Italian verbs are grouped in three conjugation types—the first, second, and third conjugation verbs. Each verb has four finite moods (indicative, subjunctive, conditional, and imperative) and three non-finite moods (infinitive, participle, and gerund). Within the finite moods, the infinitive has four tenses, the subjunctive has two, and the conditional and imperative have one each. Each tense for each finite mood has six voices—first, second, and third singular and first, second, and third plural. For the non-finite moods, the participle has two tenses and the infinitive and the gerund one each. These forms are invariable except for the participle which, in certain conditions, may take four forms. Each of the forms discussed here may be represented as: a stem + inflection. Thus, for example, the six voices (person and number) for the imperfect tense in the indicative mood are formed by adding to the verbal stem the suffixes -avo, -avi, -ava, -avamo, -avate, -avano, for first conjugation verbs, -evo, -evi, -eva, -evamo, -evate, and -evano, for second conjugation verbs, and -ivo, -ivi, -iva, -ivamo, -ivate, and -ivano, for third conjugation verbs.
For fully regular verbs, knowing the conjugation type (marked in the infinitive form by -are, -ere, and -ire for first, second, and third conjugation, respectively) of a verb would be sufficient to specify the inflectional affixes it will accept for each person, number, tense, aspect, and mood combination. For example, the first person, singular affixes for the imperfect and past definite tenses in the indicative mood of the first, second, and third conjugation verbs are -avo, -evi, and -ivi (parlavo, temevi, and finivi), and -ai, -ei, and -ii (parlai, temei, and finii), respectively. Thus, if a verb stem were marked for conjugation type it would automatically specify the set of inflectional affixes it could legally accept. The organization of lexical information that emerges from these considerations is the following: Verb stems must be marked for conjugation type and verbal affixes must be grouped by conjugation type. This organization of lexical information is sufficient for the productive recognition of novel, regular forms of verbs. A schematic representation which may serve as a visual summary of the proposed organization of the orthographic input lexicon is shown in Figure 1.

The proposed organization of the orthographic input lexicon generates all the legal verbal inflections for regular verbs. However, Italian, like other languages, is not fully regular. We may distinguish between two types of irregularity: predictable and unpredictable irregularity. Unpredictable irregularities (suppletive forms) constitute those cases where the verbal stem undergoes a major, idiosyncratic change in form. For example, the first person, singular, present, indicative form of the verb ANDARE is VADO. This specific type of stem change is particular to the verb ANDARE and, therefore, not generalizable to other verbs. By contrast, predictably irregular verbs are those verbs which undergo generalizable, local, stem changes. The verbal subparadigm for the irregular forms of these verbs is locally regular. Thus, for example, many second conjugation verbs (verbs ending in -ere, as in CORRERE (to run) and PERDERE (to lose)) have two productive stems (e.g., CORR- and CORS- for CORRERE; PERD- and PERS- for PERDERE) which enter in predictable inflectional affixation; that is, for each of the two stems there is a well-defined set of affixes it will accept. To continue with our example, for the verb CORRERE (but applicable to all other verbs of this subparadigm, such as PERDERE, STENDERE, CONTENDERE, etc.), the stem CORS- is used for the participle and the first and second person singular and third person plural of the past tense. Given the regularity of this subparadigm, the inflectional morphology of these verbs may be considered to be productive (within its two subparadigms) just like the fully regular verbs.

An important issue to be addressed by any model of the lexicon which purports to capture the productive nature of lexical knowledge, concerns the representation of irregular (and predictably irregular) verbal paradigms. Our assumption is that suppletive forms are fully listed in the orthographic input
Figure 1. Schematic representation of parts of verbal morphology and its organization. In this figure we capture the fact that a verb stem marked for a particular conjugation is linked to the set of suffixes for that conjugation. Only regular verbs are shown here. [The symbol V indicates that the morpheme is a verbal suffix; the symbol V[ indicates that the morpheme attaches to a verbal stem; and, the remaining descriptive features indicate person, number, tense, and mood, respectively (pers. = person; sing. = singular; pl. = plural; pres. = present; imperf. = imperfect; ind. = indicative; cond. = conditional; subj. = subjunctive).]

lexicon. By contrast, we hypothesize that predictably irregular verbs are represented just like fully regular verbs with the exception that there are distinct entries for each of their two stems. Each of the stems for this type of verbs is associated with a disjoint set of inflectional affixes. This latter hypothesis (and associated processing assumption) is empirically testable with the experimental paradigm used in Experiment 1 (suppletive forms will not be considered further in this paper; henceforth irregular verb will refer to predictably irregular verb). A test of this hypothesis also allows a more general evaluation of the three models of lexical processing discussed in the Introduction.

In the Introduction we presented the general processing assumptions of the AAM model. However, those assumptions are not sufficiently articulated to cover the specific details concerning the structure of the orthographic input lexicon proposed in this section of the paper. We assumed that since novel words (operationally represented by morphologically legal nonwords in this
research) do not have whole-word access representations, the only units to reach threshold at the access level are the morphemes that comprise the novel word. We further assumed that the morpheme access units that reach threshold will address their corresponding representations in the lexicon and that if the addressed morphemes constitute a legal combination a positive lexical decision is taken, otherwise the combination is considered to be a nonword. This description of the decision process is sufficient to account for the results of Experiment 1; it is inadequate, however, as a more general characterization of the lexicality decision process. A more detailed proposal follows.

We have assumed that lexical entries are represented in the orthographic input lexicon in morphologically decomposed form. Each stem is marked with the relevant grammatical features (e.g., [+verb], [1st conj.], [+transitive], etc.) which serve to specify the set of affixes it will accept. Thus, for example, the stem of the verb AMARE (to love; a fully regular verb) will be linked to the set of inflectional verbal affixes of the first conjugation (as well as appropriate derivational affixes; e.g., [-abile]Adj.). This same stem will have no links (or inhibitory links) to the sets of affixes for the other conjugation types (and inappropriate derivational affixes; e.g., [-zione]N).

The representational scheme proposed for regular verbs also applies, with appropriate modification, for predictably irregular verbs. The assumption here is that the "minor" stem form of these verbs (e.g., CORS- for the verb CORRERE) will only be linked to the set of irregular affixes for their conjugation type. The situation is more complex for the "major" stem-form of irregular verbs. These stems will be linked to their conjugation-appropriate affix set but in addition they will have inhibitory links with the affixes of those verb forms that are irregular. Thus, for example, the stem CORR- will be linked to the affix set for second conjugation verbs but will have inhibitory links to the participle affix -uto and the past tense affixes -ci, è, and -crono. These latter affixes cannot be combined with the stem CORR- (CORRUTO, CORREI, CORRE; and CORRERONO) to form legal words in Italian; the participle and the first and third person, singular and the third person, plural, past tense forms for the verb CORRERE are the irregular forms CORSO (-I), CORSI, CORSE, and CORSERO, respectively. Figure 2 may serve as a visual aid for a better appreciation of the complex arrangement proposed for the organization of verbal morphology.

The principal difference between the current and the earlier proposal for the organization of the orthographic input lexicon concerns the postulation of inhibitory links between some word stems and some affixes. The function of these inhibitory links is to block the incorrect acceptance of over-regularized forms of irregular verbs (e.g., CORRUTO in our example, and taked, goed, etc. in English) as words of the language. At the same time, however, the link between the "major" stem of these verbs (e.g., CORR-)
Figure 2. Schematic representation of parts of verbal morphology and its organization. In this figure we represent the difference in representation between regular (temere) and irregular (correre) verbs. Regular verbs are linked only to the set of conjugation-appropriate suffixes. Irregular verbs have two (or more) stem forms. The major stem is linked positively (solid line) to its set of conjugation appropriate suffixes and negatively (inhibitory links – broken lines) to the suffixes of the irregular forms for a particular verb. The minor stem is linked only to the conjugation appropriate, irregular suffix set. [The symbols and descriptive features are as in Figure 1. The asterisk indicates that the conjugation set concerns only the irregular forms.]

\[
\begin{align*}
\text{[TEM-}v, \text{2nd conj.]} & \quad \begin{cases}
-O_v v_{L}, 1st \text{ pers., sing., pres., ind., } \ldots \\
-E_{V}^{-}o V_{v_{L}}, 3rd \text{ pers., pl., imper., ind., } \ldots \\
-E_{I} v_{v_{L}}, 1st \text{ pers., sing., past., ind., } \ldots \\
-U_{v} v_{v_{L}}, \text{ past, part., } \ldots 
\end{cases} \\
\text{[CORR-}v, \text{2nd conj.]} & \quad \begin{cases}
-O_v v_{L}, \text{ past, part., } \ldots \\
-I_{v} v_{L}, 1st \text{ pers., sing., past., ind., } \ldots 
\end{cases} \\
\text{[CORS-}v, \text{2nd conj. *]} & \quad \begin{cases}
-O_v v_{L}, \text{ past, part., } \ldots \\
-I_{v} v_{L}, 1st \text{ pers., sing., past., ind., } \ldots 
\end{cases} 
\end{align*}
\]

and the conjugation-appropriate affix set allows us to recognize the over-regularized stimuli as legal but incorrect forms. We assume that the recognition of over-regularized forms as legal but incorrect results from the conflict between the positive activation of a verb stem and the correct affix set, on the one hand, and the inhibitory activation between a verb stem and a specific, inappropriate affix, on the other. We are now in a position to submit the AAM model, as elaborated here, to a strict empirical test. This was done by attempting to replicate the results of Experiment 1 and by testing specific predictions concerning decision times and error rates for over-regularized, morphologically-legal nonwords.

Consider the two nonword stimuli CORRUTO and COPRUTO. As already discussed the nonword CORRUTO is composed of the stem CORR- (second conjugation) and the second conjugation past participle -UTO. If the verb CORRERE were regular, CORRUTO would have been the past participle form of this verb. However, CORRERE is an irregular verb and the correct form of the past participle is CORSO (composed of the irregular stem CORS- and the irregular affix -O). A superficially similar situation obtains
for the nonword COPRUTO. This nonword is composed of the stem COPR- (from the verb COPRIRE (to cover), third conjugation) and the second conjugation past participle affix -UTO. If the verb COPRIRE were regular, its past participle form would have been COPRITO; but, it is irregular and its past participle form is COPERTO. Notice, however, that CORRUTO and COPRUTO differ in one important respect: while CORRUTO has a conjugation-appropriate (C-A) affix (second conjugation stem and second conjugation affix), COPRUTO does not have a conjugation-appropriate (C-I; for conjugation-inappropriate) affix (third conjugation stem and second conjugation affix). Thus, on our account, although both CORRUTO and COPRUTO address appropriate morphemic representations (CORR- and -UTO and COPR- and -UTO) in the orthographic input lexicon, in the case of CORRUTO there is a conjugation-appropriate link between stem and affix set which must be counteracted by the inhibitory link between the stem and the specific affix before the stimulus could be rejected as a nonword, whereas in the case of COPRUTO there is no conjugation-appropriate link between stem and affix and, therefore, could be readily rejected as a nonword. The prediction of the AAM model for lexical decision performance with the two types of nonwords considered here is straightforward: Decision times should be longer and error rates higher for CORRUTO-type (C-A) than COPRUTO-type (C-I) stimuli. The predictions made by the three models of lexical access and representation considered here—the WA, MA, and AAM model—for the five types of nonword stimuli discussed (the four types of stimuli used in Experiment 1 and the over-regularized nonwords discussed in this section) are summarized in Table 3. As previously discussed (see Experiment 1), the WA model predicts equal performance across all five types of stimuli. The MA model predicts that performance for CORRUTO should be equal to COPRUTO since in both cases lexical access takes place through a legal, affix-stripped stem and, then, in both cases the reassembled stem + affix combinations fail to find corresponding lexical entries in the master lexicon. This model’s predictions for the remaining three contrasts are as previously described (see Experiment 1). The predictions for the AAM model are as discussed in this section and in Experiment 1.

Table 3.

<table>
<thead>
<tr>
<th>Model</th>
<th>Stimulus type</th>
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<tbody>
<tr>
<td>WA</td>
<td>CORRUTO = COPRUTO = CANZEVI = CANTOVI = CANZOVI</td>
</tr>
<tr>
<td>MA</td>
<td>CORRUTO = COPRUTO &gt; CANZEVI &gt; CANTOVI = CANZOVI</td>
</tr>
<tr>
<td>AAM</td>
<td>CORRUTO &gt; COPRUTO &gt; CANZEVI = CANTOVI &gt; CANZOVI</td>
</tr>
</tbody>
</table>
Method

Stimuli

Three hundred and twenty stimuli were presented to each subject in a single experimental session. The stimuli were composed of an equal number of words and nonwords—160 words and 160 nonwords. Of the 160 nonwords, 50 were experimental stimuli—10 each for the five experimental conditions. Four of the experimental conditions were identical to those of Experiment 1 except that new stimulus items were created using exactly the same criteria as in Experiment 1. The fifth condition consisted of nonword stimuli created by combining the “major” stem of an irregular verb with a conjugation-appropriate affix. This combination, however, resulted in an incorrect over-regularization (e.g., CORRUTO) of an irregular verb form (e.g., CORSO). Mean length (6.4 letters) and mean N-count (1.05) were identical and the distribution of length and N-count values were similar across the five experimental conditions. In addition, the stems of the legal-stem nonwords (CORRUTO, COPRUTO, and CANTOVI) were matched for frequency as were the irregular forms (CORSO and COPERTO) of the over-regularized nonwords. Finally, the distribution of affix types was similar across stimulus conditions which contained a legal affix.

The 110 filler nonwords were obtained by changing one or two letters approximately equally in the initial, medial or final part of 30 adjectives, 20 function words, and 60 nouns. The 160 word stimuli were adjectives, function words, nouns, and verbs matched one to one for length, frequency, and form class with the words from which the nonword stimuli were derived. Additional constraints in the construction of the stimulus list were that no stem was used more than once and that the mean length of the experimental stimuli, the filler nonwords and the word stimuli was the same (6.4 letters for each type of stimulus).

Materials and equipment

These were as in Experiment 1.

Procedure

The only difference between this and Experiment 1 was that in this experiment the practice session consisted of 50 items—25 words and 25 nonwords—randomly presented in two blocks of 25 items each.
Subjects

Twenty-one university students between 18 and 28 years of age volunteered and completed the experiment. They each served for one single session and were paid for their participation.

Results and discussion

Mean reaction times and percentage errors for each of the five experimental conditions are shown in Table 4. As is apparent on inspection of these data the general pattern of results is as predicted by the AAM model. Analyses of variance, by subjects and by items, performed for the reaction time and error data revealed significant differences among stimulus conditions (RT: Min $F(4,145) = 4.43$, $p < .001$; Errors: Min $F(4,134) = 8.1$, $p < .001$). Further statistical analyses using Duncan's test were carried out in order to detail the pattern of reliable differences among stimulus types.

The first issue considered was whether or not the pattern of results obtained in Experiment 1 could be replicated with a different set of stimuli; that is, whether or not morphological decomposability affects lexical decision performance. The results relevant to this issue were clear cut: CORRUTO- (C-A) and COPRUTO-type (C-I) stimuli—the morphologically legal non-words—each differed significantly ($p$ at least < 0.05) from all other stimulus types, both in RT and errors (CORRUTO vs. CANZEVI, vs. CANTOVI, and vs. CANZOVI, $t(k=4) = 9.01$, $t(k=3) = 8.24$, and $t(k=5) = 12.51$, respectively for RT and $t(k=3) = 11.31$, $t(k=4) = 11.71$, and $t(k=5) = 13.71$, respectively for errors; COPRUTO vs. CANZEVI, vs. CANTOVI, and vs. CANZOVI, $t(k=3) = 4.78$, $t(k=2) = 4.02$, and $t(k=4) = 8.73$, respectively for RT and $t(k=2) = 2.8$, $t(k=3) = 3.18$, and $t(k=4) = 5.18$, respectively for errors). Furthermore, while the stimuli with partial morphological structure (CANZEVI- (AO) and CANTOVI-type (SO) stimuli) did not differ from each other, neither in RT nor in error rates, both types of stimuli were responded to significantly slower than stimuli without morphological structure (CANZEVI vs. CANZOVI, $t(k=2) = 3.95$, $p < .005$; CANTOVI vs.

Table 4. Mean RT and error rates

<table>
<thead>
<tr>
<th></th>
<th>CORRUTO</th>
<th>COPRUTO</th>
<th>CANZEVI</th>
<th>CANTOVI</th>
<th>CANZOVI</th>
</tr>
</thead>
<tbody>
<tr>
<td>RT (ms)</td>
<td>850</td>
<td>788</td>
<td>718</td>
<td>729</td>
<td>666</td>
</tr>
<tr>
<td>Errors (%)</td>
<td>38.1</td>
<td>17.6</td>
<td>11.0</td>
<td>10.0</td>
<td>5.2</td>
</tr>
</tbody>
</table>
Canzovi, $t(k=3) = 4.71, p < .005$; error rates while in the same direction as RT did not differ significantly for these stimulus contrasts). These results replicate the statistically reliable results reported in Experiment 1 and confirm the trends reported in that experiment.

The second issue addressed in this experiment concerns the contrast between morphologically legal nonwords composed of stems with conjugation-appropriate affixes and those composed of stems with conjugation-inappropriate affixes. The results, here, are no less clear cut: Responses were slower and error rates much larger for Corruto- (C-A) than for Copruto-type (C-I) stimuli (RT: $t(k=2) = 4.24, p < .005$; Errors: $t(k=2) = 8.53, p < .001$).

The results of this experiment confirm and extend those reported in Experiment 1; that is, we have once again obtained orderings of RTs and error rates that parallel the degree of "morphological structure" in nonwords. The RT ordering among stimulus types was as follows: Corruto (C-A) > Copruto (C-I) > Canzovi (AO) = Cantovi (SO) > Canzovi (MI)—the RT pattern predicted by the AAM model. These results provide further evidence in favor of the AAM model and against the WA and the MA models. The fact that the "morphological structure" of nonwords—apparently the only factor that varied among experimental conditions—determined in an important way lexical decision times and error probabilities, provides a strong disconfirmation of the WA model. The results are clearly incompatible with any model of lexical access that does not include in some way or other a means of representing morphological information at the level of the orthographic input lexicon. Furthermore, the RT results (as well as errors) show an articulation relative to the type of morphological structure represented in different stimuli that is incompatible with expectations derived from the MA model (see Table 3).

An important result obtained in this experiment concerns the difference in performance for the Corruto- (C-A) and the Copruto-type (C-I) stimuli. Both types of nonwords are morphologically legal—that is, both are exhaustively decomposable into morphemes of the language—but they differ in the type of interaction that exists between the two morphemes that comprise each of the two nonword types: Whereas for Corruto-type (C-A) stimuli the affix is appropriate for the conjugation feature of the stems in these nonwords (-UTO is a second conjugation affix and Corr- is a second conjugation verb stem), for Copruto-type (C-I) stimuli the affix is not appropriate for the stems of these nonwords (-UTO is a second conjugation affix and Copr- is a third conjugation stem). RT and error performance was considerably worse for the conjugation-consistent than for the conjugation-inconsistent nonwords, indeed, error performance for Corruto-type (C-A) stimuli was 20 percentage points worse than for Copruto-type (C-I)
stimuli. These results not only confirm the important role of morphological structure in lexical access and representation but, in addition, support the hypothesis that stem representations are linked to the set of conjugation-appropriate affixes, as predicted by the productivity assumption of lexical organization (see discussion in the introduction to Experiment 2).

Experiment 3

In the two experiments we have reported (and, in particular, in Experiment 2), we have focused on the organization of regular verb stems and their suffixes in the orthographic input lexicon. To be sure, we have exploited certain properties of predictably irregular verbs in our experimental investigation but the relevant generalization we sought to arrive at in this research concerned regular verbs. In this experiment we shift the focus directly to the issue of lexical access and representation of irregular verb forms.

A central assumption of the AAM model is that morphological representations in the orthographic input lexicon reflect a word's surface orthographic structure. This assumption captures the deeper principle that the orthographic input lexicon is the repository of our knowledge of the orthographic structure of words. The most obvious implication of this assumption is that all orthographic variants of a morpheme have independent entries in the orthographic input lexicon. Thus, for example, for the verb CORRERE there are separate representations for the stems CORR- and CORS-. These latter morpheme representations are addressed by distinct sets of words—words that contain in their surface form the letter sequences “corr” or “cors”, respectively (as in, e.g., CORREVA or CORRESTITI and CORSE or CORSERO). Thus, at the level of the orthographic input lexicon orthographic variants of a verb stem constitute, for all intents and purposes, distinct lexical entries. The fact that CORR- and CORS- are orthographic variants of the same verb stem is only captured at the lexical-semantic level.

On the account of lexical organization in the orthographic input lexicon proposed here there is an asymmetry in the links that are assumed to exist between the “major” and “minor” orthographic stems and their verbal suffixes. We have assumed that the “major” stem (e.g., CORR-) is linked to the (full) conjugation set appropriate for a stem (the second conjugation set in our example), including, of course, inhibitory links to the affixes of the verbal voices that are irregular for that verb (-UTO, -EI, -E`, and -ERONO, in our example). By contrast, the “minor” stem (e.g., CORS-) is only linked to the set of irregular affixes appropriate for that stem (-O, -I, -E, and -ERO, in our example). This proposal is empirically testable.
Consider the following three nonwords: CORRUTO, COPRUTO, and CORSUTO. We have already seen that CORRUTO is morphologically decomposable into the stem CORR- and the suffix -UTO and that these morphemes are conjugation appropriate. We have also noted the fact that COPRUTO is decomposable into the stem COPR- and the suffix -UTO but that these morphemes are not conjugation appropriate. On our account, CORSUTO has the same structure as COPRUTO—the two morphemes that comprise this nonword, the stem irregular CORS- and the suffix UTO, are not linked to each other. Thus, since the addressed stem/suffix pairs for COPRUTO- (C-I) and CORSUTO-type ("C-I") stimuli are not linked—that is, neither pair constitutes an actual or a possible word of the language—these stimuli may (relatively) readily be rejected as nonwords. As already discussed, stimuli of the CORRUTO-type (C-A) present a more difficult decision because the morpheme pairs addressed for this type of stimuli do constitute possible words of the language in virtue of the direct link assumed to exist between conjugation-appropriate representations. Thus, the AAM model predicts the following pattern of lexical decision performance for the three types of stimuli: CORRUTO (C-A) > COPRUTO (C-I) = CORSUTO ("C-I"). The WA and the MA models predict equal performance across all three stimulus types.

Method

Stimuli

The experimental stimuli consisted of three sets of 10 morphologically legal nonwords. The three sets of stimuli—CORRUTO- (C-A), COPRUTO- (C-I), and CORSUTO-type ("C-I")—were structured as discussed above; that is, the stem/affix relationship for each type of stimulus was as discussed in the introduction to Experiment 3: The CORRUTO-type (C-A) nonwords were derived by combining the “major” (regular) stem of a verb with a regular, conjugation-appropriate affix; the COPRUTO-type (C-I) nonwords were derived by combining a regular stem with a conjugation-inappropriate affix; and, the CORSUTO-type ("C-I") nonwords were derived by combining the “minor” (irregular) stem of a verb with a conjugation-appropriate affix. The CORRUTO- (C-A) and the COPRUTO-type (C-I) stimuli were constructed using the same procedure as that used in Experiment 2, except that a new set of stimuli was generated. The stimuli in the three experimental conditions were matched for length (mean length = 7), N-count (mean N-count = 0.85), and frequency of the stems of the verbs from which the nonwords were derived.

In addition to the 30 experimental stimuli, each session also contained 120
filler nonwords and 150 words (60 nouns, 50 verbs, 25 adjectives, and 15 function words). The words and the filler nonwords had the same mean length as the experimental nonwords. In addition, words were matched one to one in length, frequency, and form class with the words from which the nonwords were derived. No stem was used more than once in the whole stimulus list. The 300 stimuli in each session were arranged in four different random orders with the constraints discussed in Experiment 1.

Materials and equipment
These were the same as in the previous two experiments.

Procedure
The general procedure in this experiment was the same as that in the preceding experiments except for the following: The practice session was slightly expanded to 60 items—30 words and 30 nonwords—randomly presented in two blocks of 30 stimuli each; the time allocated for a response was reduced from 1500 ms to 1200 ms to encourage faster responses and reduce RT variance.

Subjects
Twenty-four subjects, all native speakers of Italian and between the ages of 18 and 28 took part in the experiment. They were paid for their participation in the experiment.

Results and discussion
Mean RTs and mean percent errors for the three experimental conditions are shown in Table 5. An analysis of variance, by items and by subjects, for error rates shows a strong effect of experimental condition: Min $F(2.88) = 7.4, p < .005$. The effect of stimulus type was not nearly as clear for RT data—a significant effect was only obtained in the item analysis: $F(2.27) = 7.82, p < .001$. However, it is clear that the pattern of RTs closely parallels the pattern of errors for the three experimental conditions.

It is immediately apparent that performance for the CORSUTO-type stimuli is like the COPRUTO-type (C-I) and not the CORRUTO-type (C-A) stimuli. This effect is most evident for error rates. Comparisons between pairs of experimental conditions (Duncan’s test) revealed highly statistically
Table 5. *Mean RTs by subjects*\(^1\) and percent errors

<table>
<thead>
<tr>
<th></th>
<th>CORRUTO</th>
<th>COPRUTO</th>
<th>CORSUTO</th>
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</thead>
<tbody>
<tr>
<td>RT (ms)</td>
<td>740</td>
<td>712</td>
<td>724</td>
</tr>
<tr>
<td>Errors (%)</td>
<td>41.7</td>
<td>15.8</td>
<td>17.9</td>
</tr>
</tbody>
</table>

reliable effects—CORRUTO vs. COPRUTO: \(t(k=3) = 9.78, p < .001\); CORRUTO vs. CORSUTO: \(t(k=2) = 9.24, p < .001\); COPRUTO vs. CORSUTO: \(t(k=2) = 0.54, \text{n.s.}\). These results allow us to reject the hypothesis that the irregular stem of a verb is linked to the regular, conjugation-appropriate suffix set. Instead, it appears that these stems are only linked to a set of irregular suffixes that are appropriate for them. In other words, these results “confirm” the hypothesis that irregular stems constitute autonomous lexical entries in the orthographic input lexicon. And, finally, the results obtained in this experiment constitute additional support for the AAM model and further undermine the alternative models of lexical access and representation considered in this paper—the WA and the MA models.

**General discussion and conclusion**

The results of the three experiments reported in this paper present a remarkably consistent pattern: Lexical decision performance for nonwords is strongly and consistently affected by the “morphological” structure of these stimuli. In other words, the variation in performance obtained for a relatively wide range of nonword types appears to be explicable only by appeal to morphological principles. These results constitute strong evidence in favor of a model of the lexicon which explicitly includes morphological structure in the representation of lexical items and in the procedures for lexical access.

The relevant aspects of the reported results that may be taken as evidence in support of the strong conclusion reached here, may be divided in three parts: (1) those results that strictly concern the difference between morphologically decomposable (CORRUTO, CORSUTO, COPRUTO (or CANTEVI), CANZEVI, and CANTOVI) and morphologically nondecomposable (CANZOVI) nonwords; (2) those results that concern the difference

\(^1\)The corresponding mean RTs by items are: CORRUTO = 728 ms; COPRUTO = 723 ms; and CORSUTO = 729 ms.
between morphologically legal (CORRUTO, CORSUTO, and COPRUTO) and morphologically illegal (CANZEVI, CANTOVI, and CANZOVI) nonwords; and (3) those results that concern variation among morphologically legal nonwords (CORRUTO vs. CORSUTO vs. COPRUTO).

In Experiments 1 and 2 we found an effect of morphological decomposability of nonwords in lexical decision performance. The presence of a morpheme—a stem or a suffix—in a nonword was found to be sufficient to affect decision time (and error) performance in a lexical decision task. These results replicate, albeit for a different aspect of morphological structure, those of Taft and Forster (1975). These latter authors focused on prefixes and derivational morphology, whereas in the present research we have focused on suffixes and inflectional morphology. Thus, the two sets of results, ours and those of Taft and Forster, allow a more general conclusion about the role of morphological structure in lexical processing than either set of experiments allows on its own. That is, the available evidence about the role of morphological structure in lexical processing concerns both derivational and inflectional morphology. Furthermore, since our results were obtained in an experimental context where the frequency (both surface and cumulative) of the words from which experimental nonwords were derived and the N-count of the experimental stimuli were strictly controlled, they are not subject to the criticisms that were directed to the Taft and Forster's experiments. We may conclude, therefore, that inflectional and, possibly, derivational morphology play an important role in lexical access.

The results we have reported show a more richly articulated pattern than merely a processing difference between morphologically decomposable and nondecomposable nonwords. We also found differences between nonwords with "partial" morphological structure (CANZEVI and CANTOVI) and those that are not morphologically decomposable, and between morphologically legal (e.g., CANTEVI) and illegal (e.g., CANZEVI) nonwords. As already noted in the discussion sections of Experiments 1 and 2, these results not only serve to undermine a specific instantiation (i.e., Taft's Affix Stripping model; see Taft, 1979, 1985) of the class of MA models, but also allow us to defend a distinction between two levels of processing in lexical access—a level at which access representations are specified (roughly corresponding to the notion of logogen in Morton's (1979, 1981) more recent discussions of this concept) and a level at which lexical/linguistic information (orthographic or phonological, morphological, and syntactic) is represented—as hypothesized by the AAM model proposed by Caramazza et al. (1985; see also Burani & Caramazza, in press; Laudanna & Burani, 1985) and more fully developed here. Briefly, the basis for considering the cited results as evidence in support of the AAM model is as follows.
By hypothesis, the only type of information captured at the level of the lexical access procedures in the AAM model is that contained in the surface representation of words—orthographic structure in the present case. In the case of known words, this information is sufficient to activate whole-word access procedures as well as morpheme access procedures; in the case of novel words, the orthographic structure of the stimulus is sufficient to activate the morphemic access units that comprise the stimulus. Also, by hypothesis, in the AAM model lexical/linguistic information is represented at the level of the orthographic input lexicon. It is at this level that information about the combinability of morphemes is specified. The information needed to determine the legal combinability of morphemes is quite complex and abstract, involving such features as grammatical class, subcategorization features, and selectional restrictions (see Scalise, 1984, for review). It thus appears that quite distinct sorts of information—"prelinguistic" and linguistic—are needed for the efficient and accurate determination of the lexicality of a string of letters. These two types of information are best captured at distinct levels of representation and processing. The results we have obtained for morphologically legal and illegal nonwords are consistent with this hypothesis—that is, morphologically illegal nonwords may be rejected at the "prelinguistic" level of processing whereas morphologically legal nonwords engage linguistic-level processing mechanisms and are rejected on the basis of information activated by these mechanisms.

It will be recalled that we found that morphologically legal nonwords—that is, nonwords that are exhaustively decomposable into morphemes—are more difficult to reject as nonwords than stimuli that are only partially morphologically decomposable or are not morphologically decomposable at all. Our assumption is that this distinction obtains because the latter type of stimuli (morphologically illegal nonwords) can be rejected as nonwords at an earlier stage of processing than morphologically legal nonwords. Our assumption is that morphologically illegal nonwords can be rejected as soon as the system fails to activate access representations that correspond to the presented stimulus, whereas morphologically legal nonwords can only be rejected as nonwords at the level of the orthographic input lexicon where it is determined that the activated morpheme combination does not constitute a word of the language. This hypothesized difference about the locus of the lexicality decision for the two classes of stimuli allows us to account for the results obtained in Experiments 1 and 2 of this research.

Further evidence in support of the AAM model accrues from the results obtained for the different types of morphologically legal nonwords. In Experiments 2 and 3 we found that lexical decision performance is a function of the kind of relationship that obtains between the morphemes that comprise
a stimulus item. Specifically, it was found that nonwords consisting of conjugation-appropriate, stem/suffix pairs are considerably more difficult to reject as nonwords than those stimuli consisting of conjugation-inappropriate, stem/suffix pairs. Since information about conjugation type is an abstract feature of linguistically defined units (verbs), the “lowest” level at which this information may be represented is the orthographic input lexicon. That is, this information cannot be represented at the level of the access procedures to the lexicon where the only information used concerns superficial properties of the orthographic structure of words. We are justified, therefore, in concluding that the reported processing difference between morphologically legal and illegal nonwords constitutes evidence in favor of the hypothesized distinction between access procedures and lexical representations as proposed by the AAM model.

The results obtained for morphologically legal nonwords are important for another reason: They help constrain hypotheses about the organization and processing structure of the orthographic input lexicon. As discussed in some detail in the introduction section of Experiments 2 and 3, a possible organizing principle for verb stems and verbal inflections is that the stem of regular verbs and the “major” stem of (predictably) irregular verbs are linked to their conjugation-appropriate suffix set while the “minor” stem of irregular verbs is only linked to the relevant set of irregular suffixes (see Figure 2). In addition to these positive links between stems and suffix sets, inhibitory links are assumed to exist between the “major” stem of irregular verbs and the specific suffixes for verbal forms that are irregular for a particular verb. Thus, the proposed organization of the orthographic input lexicon envisions a competitive processing structure in which facilitatory and inhibitory activations summate to determine whether or not a particular stem/suffix pair will be accepted as a word. The results we have reported for the different types of morphologically legal nonwords are generally consistent with this hypothesized structure of the orthographic input lexicon. Specifically, it was found that those nonwords consisting of stem/suffix pairs that do not have positive links to each other (i.e., COPRUTO- (C-I) and CORSUTO-type (“C-I”) stimuli) are easier to reject than those nonwords consisting of stem/suffix pairs that involve the activation of both facilitatory and inhibitory links (i.e., CORRUTO-type (C-A) stimuli).

One may challenge the usefulness of data obtained from the processing of nonwords to draw inferences about word processing. Thus, for example, Henderson (1986) has noted that if the issue of interest concerns processing of familiar words then it is inappropriate to investigate this issue through research with nonword stimuli. But, why this injunction against the use of nonword stimuli? To be sure, Henderson’s injunction against the use of non-
words is not total—he concedes, albeit grudgingly, that nonword stimuli may be used to draw inferences about the processing of unfamiliar words. Presumably the justification for this partial injunction against the use of nonword stimuli is that familiar and unfamiliar words are processed in fundamentally different ways and that our principal concern should be with the processing of familiar words.

We find the injunction, even in its partial form, to be arbitrary. On what grounds should we grant the distinction drawn by Henderson? That is, how do we know that familiar and unfamiliar words are processed in fundamentally different ways? One major source of evidence for the putative distinction is precisely the contrasting pattern of results of morphological structure on lexical decision times for words and nonwords. Experimental results with nonword stimuli provide one of the principal sources of empirical support for the putative distinction. But, this is clearly an empirical matter; things did not have to be as they would now appear to be to us. The fact that we may have grounds for believing that familiar and unfamiliar or novel words may be processed in different ways does not justify an a priori injunction on the use of experimental observations with nonwords to constrain claims about lexical processing in general, including processing of familiar words.

A stronger injunction (e.g., Henderson, 1985) against the use of nonwords to inform theories of lexical processing is even less defensible. The injunction here is based on the assumption that special processes are engaged in processing nonwords—processes that do not play a role in processing words. Even if we grant the plausibility of this assumption, it does not follow that experimental results obtained with nonword stimuli cannot be used to draw conclusions about lexical processing. The total injunction against the use of nonwords is only defensible on the arbitrary and implausible assumption that the cognitive mechanisms engaged in processing words and nonwords, respectively, are completely disjunctive, at least with respect to the domain of interest—namely, lexical processes. To our knowledge no one has taken this implausible position. And, in any case, there remains the empirical fact that “morphological” structure in nonwords plays a significant and highly reliable role in lexical decision tasks. Indeed, the results we have reported (as well as the many others on morphological processing in the literature) reveal a reliable and highly articulated pattern that appears to be explicable only by appeal to strong claims about the structure of the lexical system. These claims could be wrong and the models based on them equally inadequate, but they are not unprincipled—unprincipled would be the a priori refusal to consider the experimental results that form the empirical basis for the proposed models of lexical processing. And, in any case, it remains to be seen whether the proponents of the injunction against the use of nonword stimuli to inform the
The structure of lexical processing can offer motivated, alternative explanations for the results obtained with nonword stimuli.

The results of experiments in which nonword stimuli have been used to address questions about the structure of lexical access mechanisms (the results reported here, those of Caramazza et al., 1985, and those of Taft & Forster, 1975) support the hypothesis of morphological decomposition in lexical representation and access. It would be somewhat troubling, but not necessarily less valid, if the only results in support of the hypothesis of morphological decomposition were to be obtained for nonword stimuli. Indeed, experiments in which word stimuli were used to test the hypothesis of morphological decomposition in lexical access have produced negative results (Andrews, 1986; Henderson et al., 1984; Manelis & Tharp, 1977; Rubin et al., 1979). But this dissociation in processing morphological structure in lexical access is precisely what is predicted by the AAM model which assumes that the access system contains both whole-word and morpheme access units. Thus, the failure to find that pseudoaffixed words (e.g., remote, detonate, sister, etc.) are processed differently from truly affixed words (e.g., rework, demystify, hunter, etc.) is compatible with predictions made by the AAM model of lexical access. Still, there should be experimental conditions where the effects of morphological decomposition in word processing could be revealed. And, indeed, there are.

One set of results that could be interpreted as revealing an effect of morphological structure in lexical processing concerns those experiments that have evaluated the effects of surface word frequency (e.g., the frequency of occurrence in the language of the specific form “walked”) and cumulative (root or stem) word frequency (the summed frequency of morphologically related words; e.g., the summed frequency of “walked”, “walk”, “walking”, etc.). It has been shown that both surface and stem frequency, the latter defined as the summed frequency over the inflectional paradigm of a word stem, affect RTs in lexical decision tasks (Burani et al., 1984; Taft, 1979). Similar effects have been obtained for surface and root frequency, the latter defined as the summed frequency over all (derivational and inflectional) morphologically related forms (Bradley, 1979; Burani & Caramazza, in press). The fact that surface and cumulative word frequencies have independent effects on lexical decision performance is consistent with predictions derived from the AAM model. Since this model assumes that for known words the access procedure is specified over the whole word, we expect to find a surface word frequency effect in lexical decision performance; furthermore, since the addressed lexical representations are morphologically decomposed, we also expect to find an effect of cumulative word frequency in lexical decision
Another set of results that is explicable only by appeal to specifically morphological principles, concerns the repetition priming effect for morphologically related words. In a now extensive literature it has been demonstrated that the prior presentation of a morphologically related word, and not merely an equally visually similar word, affects the lexical decision performance of a target word (Fowler, Napps, & Feldman, 1985; Murrell & Morton, 1974; Stanners, Neiser, Hemon, & Hall, 1979; Stanners, Neiser, & Painton, 1979). However, this repetition priming effect for morphologically related words is only reliably obtained for regularly inflected forms; thus, for example, “burned” will prime “burn” but “shook” will not be as effective a prime for “shake” (Stanners et al., 1979; Kempley & Morton, 1982; Fowler et al., 1985). The difference between repetition priming for regularly and irregularly inflected words has been considered to be problematic for the hypothesis of morphological decomposition in the lexicon. This critical position is only tenable, however, for a view of lexical organization which assumes that only one stem (or root) representation is stored in the orthographic input lexicon for a lexical paradigm, independently of the orthographic variations that characterize the lexical paradigm. On this latter account, the only stem representation stored in the orthographic input lexicon for the verb “correre” would be the regular form CORR-. We have already argued that such a position makes little sense theoretically, and is not supported by the empirical results reported in this paper.

The model of lexical processing we have proposed—the AAM model—makes explicit provision for distinguishing between morphologically regular

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*Cumulative frequency effects may receive an account in the proposed model by making either of the following two assumptions. We may assume that the activation of a stem representation in the lexicon primes all its word-access representations (e.g., the activation of SENT- (stem for the verb to hear) primes the full set of word access units for this verb—SENTIRE, SENTO, SENTIAMO, SENTONO, etc.) thus locating the observed effect at the word-access level. Alternatively, we may assume that the stem frequency effect is located at the level of lexical representations. On this latter account lexical decisions for known words are not always taken at the level of activation of word-access units but sometimes at the level of lexical representations. The repeated activation of the stem of a word through access of the various surface forms of the verb has presumably lowered the stem access threshold which, in turn, leads to a lowering of access time. Thus, the relatively lower threshold settings for the higher stem frequency words is assumed to be responsible for the lower response times associated with this latter set of words.

*The results on cumulative stem frequency may alternatively be considered to merely reflect an orthographic frequency effect. To distinguish between the alternative accounts we would have to compare performance between true stem and pseudo-stem words such as SENTIAMO (we hear) and SENTIERO (path). The former type of word has the stem SENT-; the latter type of word has the pseudo-stem *SENT-. If the morphological explanation of the stem frequency effect is the correct one then we expect responses to be faster for SENTIAMO than for SENTIERO even though the two words have the same surface frequency. We have not yet carried out this control experiment.
and irregular words. This model correctly predicts the obtained difference in repetition priming effects for regularly and irregularly inflected words. That is, the AAM model predicts that if the locus of the repetition priming effect is at the level of the orthographic input lexicon, then, a previously presented stimulus will only prime those morphologically related words that share the same stem. This prediction is dictated by the fact that the AAM model assumes that the orthographic stem variants of a word are represented independently in the orthographic input lexicon. Thus, for example, presentation of the stimulus word “corsero” (they ran), composed of the stem CORS- and the suffix -ERO, should not prime the word “correranno” (they will run), composed of the stem CORR- and the suffix -ERANNO, because the representations of the stems CORS- and CORR- in the orthographic input lexicon are no less independent than any pair of stems of morphologically unrelated words. Thus, the repetition priming effect for morphologically related words may be considered to constitute evidence in favor of the particular type of morphological organization we have proposed for the AAM model of lexical representation and access.

Finally, we have recently obtained results in an experiment with word stimuli that are transparently interpretable as support for the hypothesis of morphological decomposition of lexical representation (Laudanna, Badecker, & Caramazza, in preparation). In this experiment we compared the performance in a double-word, lexical decision task for word pairs with homographic stems (e.g., “busta” (envelope) and “busto” (corset), have the homographic stem BUST-) and word pairs that had only visually similar stems (e.g., “collo” (neck) and “colpo” (blow), have the stems COLL- and COLP-, respectively). The AAM model predicts that lexical decision performance for the homographic stem pairs should be poorer than for control stimuli pairs. The basis for this prediction is as follows. Even though the model assumes that there are whole-word access representations for each of the stimuli used in the experiment (the words used were all common words in Italian), these access units address morphologically decomposed lexical representations. In the case of visually similar words this latter aspect of the process does not present particular problems—the activated representations in the orthographic input lexicon (e.g., COLL- + -O and COLP- + -O) constitute words of the language and a positive response can be produced. The situation is more complicated for the homographic stem stimuli. For these stimuli we assume that the lexical representation that first reaches a threshold value of activation partially inhibits the activation of its homographic mate making the double word decision more difficult for these stimuli. Thus, for example, if the lexical representation of “busta” (BUST-[N,fem.] + -A) were to reach threshold first, the activation of BUST-[N,fem.] would partially inhibit the
activation of BUST-[N,mas.], the stem of "busto". Alternatively we could assume that the activation of the homographic stems are mutually inhibitory. In either case the effect is the same: Lexical decisions for homographic stem pairs should be relatively more difficult for these stimuli than for control stimuli. The important point here is that the prediction of relatively "impaired" performance for homographic stem pairs goes through only if we assume that stem representations, and not just whole word representations, are activated in the course of lexical access; that is, if we assume that lexical representations are morphologically decomposed.\(^6\)

The results reported in this paper as well as those of Taft and Forster (1975) with nonword stimuli and the results of experiments with word stimuli that we have reviewed here are consistent with the AAM model—a not insignificant achievement given the extent and complexity of the available evidence in this area of lexical processing. There remain, however, a number of important issues that must be considered in a fuller account of lexical processing and morphology. Here we can do little more than raise these issues.

One central issue concerns the extent and form of morphological decomposition in the lexicon. In this paper we sidestepped this issue by restricting the focus of our analysis to inflectional, verbal morphology. We avoided discussion of the question of whether the basic unit of lexical representation is the root (the unanalyzable part of a word; e.g., touch in untouchables) or the stem (the part of a word that remains once all inflectional affixes have been removed; e.g., untouchable in untouchables) of a word (see Bauer, 1983, for a clear discussion of the difference between these two linguistic concepts). This choice is not unjustified given the paucity of experimental evidence on this and the related issue of the relationship between derivational and inflectional morphology. Although for our immediate purposes a resolution of these issues is not imperative, it is quite evident that further progress in elaborating a detailed model of lexical processing cannot be achieved without such a resolution.

Another important issue to be considered is whether or not the output lexicons (the phonological and orthographic output lexicons) also represent lexical information in morphologically decomposed form. Fortunately the experimental evidence on this issue is extensive if not completely unambiguous (e.g., Butterworth, 1983; Cutler, 1983; Henderson, 1985). The pattern of speech errors (slips of the tongue) in normal speakers (Garrett, 1980, although some aspects of the processing structure in our model have a family resemblance to McClelland and Rumelhart's (1981) model of lexical access where they propose facilitatory and inhibitory links among lexical representations, one dissimilarity in particular is crucial. We, unlike McClelland and Rumelhart, propose a morphologically decomposed lexicon.)
1982; Stemberger, 1985) and the pattern of omissions and substitutions of inflectional affixes in aphasic patients (see Caramazza, 1988, for review) has been used to support the contention that the phonological output lexicon represents lexical entries in morphologically decomposed form. A particularly compelling result in this regard is the report of a patient with a highly selective deficit in processing inflectional morphology (Miceli & Caramazza, in press). This patient presented with severe difficulties in the repetition of single words. Interestingly, however, the great majority of this patient’s repetition errors consisted of morphological variants of the target response. And, in turn, these consisted almost entirely (97%) of inflectional substitutions. It would appear, therefore, that the phonological output lexicon represents lexical items in morphologically decomposed form.

Finally, an issue that we have not considered is whether or not the adoption of a radically different functional architecture (e.g., massively parallel network models; McClelland & Rumelhart, 1986) might not render moot all this discussion of morphologically decomposed versus morphologically non-decomposed lexical representation, as has been suggested by Fowler et al. (1985). We cannot answer this question. But, as always the proof of the pudding is in the eating—should a model of lexical processing based on a radically different functional architecture from that of the AAM model be able to account for the richly articulated results now available on lexical processing and morphology, we would then have to find ways to help us choose between concrete alternative accounts.

To conclude, we have reported the results of a set of lexical decision experiments which, as a group, serve to set precise constraints for a model of lexical representation and access. The results show that lexical decision performance depends critically on the morphological structure of the stimuli. We have interpreted these results as evidence for the hypothesis that lexical representations are stored in the orthographic input lexicon in morphologically decomposed form. More specifically, we have argued that the reported results are incompatible with exclusively Whole-Word Access models and the Affix Stripping model proposed by Taft (1979), but that they are compatible with the Augmented Addressed Morphology model as developed here.

References


**Résumé**

Cette étude explore l'hypothèse selon laquelle les représentations lexicales sont stoquées sous une forme morphologiquement décomposée. Trois expériences de décision lexicale sont décrites; la structure morphologique des stimuli non-mots y est manipulée. Des effets systématiques de la structure morphologique sur les temps de réaction et le taux d'erreur ont été obtenus. En particulier, il est apparu que: (1) les non-mots indécomposables morphologiquement étaient les plus faciles à traiter; (2) les non-mots comportant une structure morphologique partielle étaient traités avec plus de difficulté; (3) les non-mots légaux sur le plan morphologique (c.a.d. entièrement décomposables en morphèmes) étaient les plus difficiles à traiter. De plus, il a été trouvé qu'à l'intérieur des non-mots morphologiquement légaux, la performance était affectée par le type de relation existant entre les différents morphèmes qui composent les stimuli. Ces résultats, qui sont interprétés en faveur de l'hypothèse que les représentations lexicales sont décomposées morphologiquement, sont discutés dans le cadre du “Modèle Morphologique Augmenté et Adressé”.