Journal of Experimental Psychology:
Human Perception and Performance
1992, Vol. 18, No. 4, 1004-1014


0096-1523/92/$3.00

# The Body of the BOSS: Subsyllabic Units in the Lexical Processing of Polysyllabic Words

Marcus Taft
University of New South Wales
Kensington, New South Wales, Australia

The body of a monosyllabic word (i.e., its vowel plus terminal consonants) has been shown to be an important unit in lexical processing (e.g., the EAD of HEAD). This article attempts to define what the body of a polysyllabic word might be, suggesting that it is the body of the first orthographically defined syllable of the word (the body of its basic orthographic syllabic structure [BOSS], or BOB, e.g., the EAD of MEADOW). Three experiments, testing 60, 96, and 45 university students, respectively, demonstrated that the pronunciation of a nonword is influenced by the pronunciation of the BOB of a preceding word, but not by the pronunciation of its vowel alone or its first phonologically defined syllable. The results of the 3 studies are interpreted as supporting the idea that the BOB is an important unit of lexical processing.

The aim of this article is to draw together two areas of lexical processing that have been previously treated as separate areas of research. The first of these is the examination of the importance in visual lexical access of word "bodies" or "rimes" (e.g., Bowey, 1990; Kay & Bishop, 1987; Patterson & Morton, 1985; Treiman & Chafetz, 1987), and the second is the examination of the importance of the basic orthographic syllabic structure, or BOSS (e.g., Taft, 1979, 1986, 1987). In the former case, the research has focused on the internal (subsyllabic) structure of monosyllabic words, whereas in the latter case, the research has focused on the internal (syllabic) structure of polysyllabic words.

## The Word Body

The word body is defined as the grouping of letters in a monosyllabic word that comprises the terminal consonants (or "coda") plus the vowel. For example, the body of CAMP is AMP, the body of BREAD is EAD, and the body of STRIPE is IPE (because the vowel is taken to be I-E).[1] Support for the importance of the body in reading comes from a number of different lines of research.

First, Glushko (1979) and Andrews (1982) demonstrated that the consistency of pronunciation of a word's body influences the pronunciation latency for that word. For example, a word like BEAD will take longer to name than a word like BEAN, even though both words are pronounced regularly (the rule being EA →/i:/). The difference arises from the fact that there are other words in which the body EAD is not pronounced in the same way as in BEAD (e.g., BREAD and HEAD), and therefore its pronunciation is inconsistent, whereas the body EAN is always pronounced as in BEAN and is therefore consistent. It is seen, then, that pronunciation latencies are influenced by factors at the body level, when factors at the lower vowel level (e.g., the pronunciation of EA) are controlled.

Such a conclusion was also reached by Kay and Bishop (1987), who found that naming latencies were influenced by the commonness of the pronunciation of the word body rather than the commonness of the pronunciation of the vowel; by Brown (1987), who found that words with a unique body (e.g., SOAP) took longer to name than words that had a common Consistently pronounced body (e.g., PILL); and by Jared, McRae, and Seidenberg (1990), who demonstrated the importance in word naming of the degree of consistency of the word body. All of these results suggest a role for the body in visual lexical processing in that they demonstrate that latencies are affected by modulations in body characteristics.

Another paradigm that has produced results consistent with the idea that the body is an important unit in lexical processing involves the examination of pronunciations given to nonwords. For example, Kay and Marcel (1981) have demonstrated that the pronunciation of a nonword that has an ambiguously pronounced body can be biased by the pronunciation of a word that precedes it. For example, when JEAD

The research reported in this article was supported by a grant from the Australian Research Council.

I would like to thank Bruce Russell for conducting the three experiments, and also the anonymous reviewer of an earlier write-up of the first experiment whose suggestions led to the second experiment.

Correspondence concerning this article should be addressed to Marcus Taft, School of Psychology, University of New South Wales, P.O. Box 1, Kensington, New South Wales, 2033 Australia.

[1] Psychologists (e.g., Kay & Bishop, 1987; Patterson & Morton, 1985) have recently used the term *body* analogously to linguists' (e.g., Fudge, 1987; Kaye, 1989) use of the term *rime* or *rhyme*. The linguistic use of the term *rime*, however, refers to a phonological structure, whereas the term *body* in the psychological literature refers exclusively to an orthographic structure. I use *body* when referring to an orthographic vowel + coda because use of *rime* implies that two identical vowel + coda units should actually rhyme. The words BEAD and BREAD have the same orthographic vowel + coda but do not rhyme, whereas the words BEAD and BREED have different vowel + coda units but do rhyme. I say therefore that BEAD shares a "body" with BREAD and a "rime" with BREED.

is preceded by BEAD, it is more likely to be pronounced /ji:d/ and less likely to be pronounced /jɛd/ than when it is preceded by HEAD. This study, however, did not differentiate between bias arising specifically from the body pronunciation and bias arising from the vowel pronunciation. For example, a bias toward the /jɛd/ pronunciation of JEAD may also be generated by the prior presentation of SWEAT, DEATH, or BREAST, words that do not share their body with JEAD but whose vowel is the same. Research by Taraban and McClelland (1987), using the same paradigm, addressed this concern.

Taraban and McClelland (1987) observed no bias in the pronunciation of nonwords arising from the vowel alone. For example, they demonstrated that a nonword such as YEAM is pronounced the same whether it is preceded by HEAD or by BEAD. The argument that EA would never be pronounced /ɛ/ when followed by an M is countered by the fact that biasing of pronunciation was observed with nonwords when the priming word and the nonword shared their onset as well as their vowel (e.g., HEAD biasing the pronunciation of HEAM toward /hɛm/).

This latter result might seem to compromise the conclusion that there is something special about the onset/body structure of a word because the priming of pronunciation was observed between two letter strings that did not share a body. However, the size of the onset + vowel priming (e.g., HEAD/HEAM) was far weaker than the priming that Taraban and McClelland (1987) observed between letter strings that shared a body (e.g., HEAD/JEAD); therefore, there appears to be something different about the status of the body and the status of the onset + vowel in the lexicon. Indeed, Treiman and Zukowski (1988) failed to find any evidence that the onset + vowel has status in the lexicon at all. They observed that nonwords are sometimes pronounced by analogy to a word that has the same body but are never specifically pronounced by analogy to a word that has the same onset + vowel. For example, the letter combination IE is pronounced /ɛ/ when contained in CHIEND more often than when it is contained in FRIETH, and, furthermore, it is no more likely to be pronounced /ɛ/ in FRIETH than in CHIETH. In other words, CHIEND is sometimes pronounced by analogy to FRIEND, with which it shares a body, whereas such analogical pronunciation does not occur with FRIETH, even though it shares an onset + vowel with FRIEND.

In another study, Treiman, Goswami, and Bruck (1990) found that the accuracy of nonword pronunciation was correlated with the frequency in English of the body of the nonword (where, for example, GOACH has the same body as COACH and ROACH, whereas TAICH has a body that does not occur in English) but not correlated with the frequency of the onset + vowel unit of the nonword (where, for example, SOAG has the same onset + vowel as SOAP, SOAK, and SOAR, whereas YOAL has an onset + vowel that does not occur in English).

Treiman and Chafetz (1987) also reported several experiments that directly compared the importance in the lexical representation of an onset/body structure (e.g., H/EAD) with that of an onset + vowel/coda structure (e.g., HEA/D) by visually splitting words in accordance with this structure. For example, when subjects were asked to judge whether a letter string formed a word or not (i.e., lexical decision), they were faster when the word was split on the screen after its onset than after its vowel (e.g., responses to CR//ISP were faster than responses to CRI//SP). Such a result again suggests that there is something special about the onset/body structure of a word.

Another paradigm was used by Bowey (1990) to point again to the importance of onset/body structure. When a word was preceded by a brief masked presentation of its final letters, naming responses to that word were facilitated only when those letters corresponded to its body. For example, although CLIP was primed by IP, DUSK was not primed by SK, and although WOKE was primed by OKE, GRIN was not primed by RIN.

## What Is the Body of a Polysyllabic Word?

It seems undeniable, then, that the body of a word is an important unit involved in lexical processing; what happens, however, when a word has more than one syllable (e.g., MEADOW, CAMOUFLAGE, or THUNDER)? All the research into word bodies has been restricted to monosyllabic words, and, indeed, when one considers extending the research to polysyllabic words, one immediately confronts the problem of determining what the body of a polysyllabic word might be. A definition in terms of the body being composed of a vowel plus coda is inadequate because a polysyllabic word invariably has more than one vowel. If one states it differently and proposes that the body is simply the word stripped of its initial consonant or consonant cluster, one confronts the extremely unappealing notion that, for example, the AMOUFLAGE of CAMOUFLAGE or the ETROPOLITAN of METROPOLITAN function as important units in lexical processing. There is little empirical evidence or intuitive support for such an idea, although the notion that there is a division between the onset and the rest of the word has been advocated in relation to phonological structure (e.g., Davis, 1989; but see Fudge, 1989).

Another alternative is that the body is a concept that is only pertinent to monosyllabic words. However, there appears to be no reason for the internal structure of a syllable to be relevant only when that syllable forms a word, rather than when it is part of a word. Furthermore, using polysyllabic words, Jared and Seidenberg (1990) have obtained a result similar to that of Glushko (1979), whereby there is a delay in naming words that have an inconsistently pronounced first (and, to a lesser extent, second) syllable. For example, the first syllable of RIGOR, namely RIG, is inconsistent in that it is pronounced differently in the word RIGID. If the inconsistency effect for monosyllabic words is explained in terms of the consistency of the body, then it is parsimonious to suppose that the equivalent consistency effect for polysyllabic words should be explained in the same way.

How, then, should the body be defined so that it is applicable to both the monosyllabic and polysyllabic cases? To do this, it would seem sensible to focus on the subsyllabic quality of the body; that is, the body should be seen as being a specific cohesive structure found within a syllable. Following this orientation, the notion of a body can be extended to words of more than one syllable. In particular, one can suggest that each syllable of a polysyllabic word has a body. The problem confronting this approach, then, is the question of how one defines where the syllable boundary is. For example, if the syllable boundary of THUNDER fell between the N and the D, then the body of the first syllable would be UN, whereas if the boundary fell between the D and the E, the body of the first syllable would be UND. Therefore, to determine the appropriate bodies for any polysyllabic word, one must be able to determine where the syllable boundary occurs.

When it comes to defining the syllable boundary in terms of the pronunciation of the word, linguists have failed to agree. It has been traditionally supposed (e.g., Hansen & Rodgers, 1968; Pulgram, 1970) that the first syllable includes the single consonant following a vowel when that vowel is short (e.g., LEM/ON), but not when it is long or unstressed (e.g., DE/MON or CE/MENT), and that it includes only the first consonant when there are two medial consonants (e.g., THUN/DER). Others, however (e.g., Anderson & Jones, 1974; Kahn, 1976), have proposed that the first syllable includes the single consonant even when the vowel is long, or that the second consonant of a medial pair might sometimes be included in the first syllable. Furthermore, the placement of the syllable boundary appears to be influenced by how fast the word is spoken (e.g., Kahn, 1976). This inconsistency in defining the location of the phonological syllable boundary may be immaterial, however, when one is considering visual lexical processing. As I have argued elsewhere (e.g., Taft, 1979, 1985), what is likely to be relevant in the reading situation is a syllabic structure that is orthographically defined rather than one that is phonologically defined. The BOSS is such a structure.

## The BOSS

The BOSS refers specifically to the first orthographically (and morphologically) defined syllable contained within a word. Although all of the orthographic syllables of a word (and their bodies) may turn out to be relevant to the lexical processing of a polysyllabic word, the focus here will be on the first orthographic syllable only. I have defined the BOSS (Taft, 1979, 1985, 1986, 1987) as being that part of the stem of a word that includes the first vowel plus as many consonants that precede the second vowel (if there is one) as patterns of word-final orthographic co-occurrence will allow (i.e., whether or not the consonants can co-occur at the end of a word). For example, the BOSS of THUNDER is THUND and the BOSS of EMBEZZLE is BEZZ (because the stem of this prefixed word is BEZZLE, and ZZL cannot occur at the end of a word). I (Taft, 1987) have questioned the adequacy of this definition but concluded that it seems to at least approximate what the orthographic syllabic structure of a word might be.

The psychological reality of the BOSS has been tested using several different experimental paradigms. In one type of experiment, subjects must discriminate words from nonwords (the lexical decision task). The wordlikeness of the nonwords is manipulated by varying the amount of structural information in the nonword that coincides with the structural information of a word. If there is sufficient similarity between the nonword and a real word, the lexical representation of that word will be accessed, and thus there will be some difficulty in saying that that nonword is not a word. Refining the design of an experiment of this type by Taft and Forster (1976), I (Taft, 1986) found that nonwords that were BOSSes of real words (e.g., the BLEM of BLEMISH) took longer to respond to than control nonwords that were not the first part of any word (e.g., BLET). Furthermore, when the nonword was the first part of a word but not its BOSS (e.g., the BLEN of BLEND), there was no delay at all compared with the control condition. This result suggests that the BOSS has some sort of status in the lexicon that other subword units do not have.

Other experiments testing the existence of the BOSS have used a similar paradigm to that used in the experiment by Treiman and Chafetz (1987) testing onset/body structure. For example, in one experiment I (Taft, 1979) presented words in a lexical decision task, visually segmented either with a gap (e.g., THUND ER) or with a change of case (e.g., THUNDer), and found that response times were faster when the division was made at the BOSS boundary rather than at the traditional phonologically defined syllable boundary. Experiments dividing words in this way have not proven to be a very reliable source of support for the BOSS (e.g., Lima & Pollatsek, 1983). However, when using other methods of splitting words into their constituents, I (Taft, 1987) have continued to find results favoring the existence of the BOSS, despite failures by others to do so (e.g., Seidenberg, 1987). For example, I (Taft, 1987) found that subjects were able to identify the word THUNDER more rapidly when THUND had been briefly presented beforehand than when THUN had been briefly presented beforehand (i.e., when the prime was the BOSS rather than the phonological syllable). The BOSS plus one letter (e.g., THUNDE) provided no greater priming than did the BOSS, demonstrating that the advantage of the BOSS over the syllable was not simply a matter of its extra letter.

## The Body of the BOSS

It can be seen, then, that the notion of the BOSS has found empirical support. However, because almost all of this support comes from the same person (i.e., Taft), its existence remains controversial. If one does accept, though, that there is experimental evidence that favors the BOSS notion, one is provided with a description of what the body of a polysyllabic word might be. In particular, the body of the first syllable of a polysyllabic word can be postulated to be the body of the BOSS. For example, the word THUNDER can be said to contain the body UND, just as the monosyllabic word FUND does. Similarly, the word MEADOW can be said to contain the body EAD, just as the words BEAD, BREAD, and THREAD do. Whether or not the other orthographic syllables of a polysyllabic word also contain (or constitute) bodies, such as the ER of THUNDER or the OW of MEADOW, will not be directly addressed in this article. The focus of the experiments to be reported here will be the reality of the notion of the body of the BOSS, which will be abbreviated as the BOB.

## Experiment 1

The studies to be reported here used the Kay and Marcel technique of examining the bias in pronunciation of a nonword arising from the prior presentation of a word. In particular, is the pronunciation of a nonword biased by the pronunciation of the BOB of the word that precedes it? For example, would JEAD be pronounced /jɛd/ more often when preceded by the word MEADOW than when preceded by an unrelated word (e.g., TUNNEL). Given that the BOB of MEADOW would be EAD, the bias that has been observed in the pronunciation of JEAD arising from the prior presentation of HEAD should also be observed when the previously presented word is MEADOW.

Of course, even if such a biasing of pronunciation were to be observed, it does not necessarily mean that the BOB produced the bias. As discussed earlier, the pronunciation of the vowel alone could produce bias, even though Taraban and McClelland's (1987) findings suggest otherwise. To test whether priming arises specifically from the BOB, and not from the vowel alone, a further condition was included in the study. In this condition, the prime word had the same number of letters in common with the nonword (including the vowel) as did the BOB prime, but the body of the word and the nonword was not the same. For example, JEALOUS has three letters in common with JEAD, just as MEADOW does, but the body of JEALOUS (namely EAL) is different from the body of JEAD.

Thus, there were three conditions in Experiment 1: (a) the control condition, in which the nonword was preceded by an unrelated word (e.g., TUNNEL JEAD and DANGER ROUL); (b) the BOB condition, in which the nonword was preceded by a word that had the same body (e.g., MEADOW JEAD and BOULEVARD ROUL); and (c) the vowel condition, in which the nonword was preceded by a word that shared the same vowel (e.g., JEALOUS JEAD and TROUBADOUR ROUL).

If the body of a polysyllabic word is actually the body of that word's BOSS, then it would be predicted that the BOB condition would lead to a greater biasing of pronunciation than would the vowel condition (with the control condition as the baseline). On the basis of Taraban and McClelland's (1987) finding that onset + vowel units can produce priming, one might expect at least some biasing of pronunciation in the vowel condition because some of the word–nonword pairs in this condition shared onset + vowel units.

### *Method*

*Subjects.* Sixty subjects participated in the experiment. All were native speakers of Australian English and were either undergraduate or graduate students at the University of New South Wales.

*Materials.* Eighteen monosyllabic nonwords were constructed that possessed bodies that had more than one possible pronunciation. For example, JEAD could be pronounced /ji:d/ (rhyming with BEAD) or /jɛd/ (rhyming with HEAD), and ROUL could be pronounced /raʊl/ (rhyming with FOUL), /ru:l/ (rhyming with GHOUL), or /roʊl/ (rhyming with SOUL). Each of these nonwords was designed so that there were three types of polysyllabic priming word that could be generated.

The first type of priming word had a BOSS whose body was the same as the body of the nonword (e.g., MEADOW JEAD and BOULEVARD ROUL). These word–nonword pairs constituted the BOB condition. The pronunciation of the BOB of the word was one that should only occasionally be given as the pronunciation of the body of the nonword. This judgment was based on various prior studies I have conducted that have examined nonword pronunciations (e.g., Taft & Cottrell, 1988). For example, the irregular pronunciation /jɛd/ should only occasionally be given to JEAD. If it were always the pronunciation produced (regardless of the priming word), then one could never detect any bias toward that pronunciation.

The second type of priming word was one that shared the same number of letters with the nonword target as did the BOB condition priming word and whose vowel was pronounced in the same way as that of the BOB condition priming word, but one that did not share its body with the nonword target (e.g., JEALOUS JEAD and TROUBADOUR ROUL).[2] These word–nonword pairs constituted the vowel condition. In 7 of the 18 items, the onset of the word and the nonword were the same (e.g., JEALOUS JEAD).

The third type of priming word was simply a word that bore no systematic resemblance to the nonword (e.g., TUNNEL JEAD and DANGER ROUL). These word–nonword pairs constituted the control condition.

All of the items are presented in the Appendix.

Three lists were constructed such that they contained six item pairings from each condition, without the same nonword occurring more than once in each list. The control condition in each list made use of the same six priming words, but paired with different nonwords. The word prime was always the item that immediately preceded the nonword target. In addition to the 36 items arising from the 18 word–nonword pairings, there were 28 single filler items, 14 words and 14 nonwords. Half of these were monosyllabic (e.g., TENSE, BRICK, BORF, and WHAMP) and half were polysyllabic (e.g., BUTTON, WELCOME, HELSAK, and ERVULL), and they were interspersed in a random fashion among the experimental items, which were also randomized. There were two orders for each list.

*Procedure.* There were three groups of 20 subjects, with each group receiving one of the two orders of one of the three lists. The items were presented in uppercase to subjects via a computer screen, 1,500 ms per item with an interstimulus interval of 1,500 ms. Subjects were requested to read aloud each letter string into the microphone in front of them. It was pointed out that many of the letter strings would be nonwords and that the pronunciation they gave to the nonword should simply be the first pronunciation they thought was appropriate. Responses were monitored through headphones by an individual who was naive to the aims of the experiment, and a phonemic transcription of each nonword pronunciation was recorded.

### *Results and Discussion*

The dependent variable was the number of occasions that the nonword was pronounced in a way that would be expected if the BOB and vowel conditions produced bias (e.g., /jɛd/

---

[2] In fact, the matching of shared letters was not exactly achieved. In 3 of the 18 cases, the nonword had one less letter in common with this second type of priming word than it had with the matched BOB condition priming word, whereas in 1 case it had one more letter in common.

for JEAD and /ru:l/ for ROUL).[3] The results are presented in Table 1.

It can be seen from Table 1 that more biased pronunciations were given in the BOB condition than in the other two conditions. The difference between the BOB and control conditions proved to be significant, $F_1(1, 57) = 7.085$, $p < .02$, and $F_2(1, 17) = 7.112$, $p < .02$, as did the difference between the BOB and vowel conditions, $F_1(1, 57) = 15.125$, $p < .001$, and $F_2(1, 17) = 10.194$, $p < .01$. The vowel and control conditions did not differ (both $F$s $< 1$).

The results of this experiment appear to support the idea that the BOB of a polysyllabic word is an important unit in lexical processing. It was only when the body of the nonword and the BOB of the polysyllabic priming word coincided (e.g., MEADOW JEAD) that a bias in pronunciations was observed relative to the baseline (e.g., TUNNEL JEAD). When the nonword and the polysyllabic priming word shared a vowel and some preceding consonant(s) (e.g., JEALOUS JEAD), there was no biasing at all.

Such a result adds force to the psychological reality of dividing a word in accordance with its BOSS. It raises the possibility, however, that the BOB is the unit of representation in the lexicon, and not the BOSS itself. That is, perhaps MEADOW is represented with the structure M/EAD/OW rather than MEAD/OW. The experiments that have previously demonstrated support for the BOSS (e.g., Taft, 1979, 1986, 1987) could equally be seen as being consistent with support for the BOB. Those studies examined the importance of the BOSS boundary as opposed to the phonological syllable boundary; they said nothing about the involvement of the word's onset. For example, priming THUNDER with THUND may have been better than priming with THUN because of the importance of UND rather than the importance of THUND. In other words, instead of there being a special unit THUND that is used in the accessing of THUNDER, the unit UND may be used, the same unit that is involved in the accessing of FUND, REFUND, PLUNDER, BUNDLE, REDUNDANT, and so forth.

Taraban and McClelland (1987) found a weak but significant biasing in pronunciation with monosyllabic items in which the priming word and the nonword target shared a vowel plus an onset (e.g., HEAD HEAM). From this result, one might have expected JEALOUS to have biased the pronunciation of JEAD, yet there was no evidence of any bias in the vowel condition. Two possible explanations for the difference between the present results and those of Taraban and McClelland suggest themselves.

First, in only 7 of the 18 vowel condition items in the present experiment was the onset of the priming word also the onset of the nonword, whereas this was true for all the Taraban and McClelland (1987) items. It may be that priming of nonword pronunciations is observed with non–body-related words only when both the onset and the vowel are intact. However, there is little support for this idea in the present data because of those 7 items that shared their onset + vowel, only 2 gave a higher score than the control condition, 1 gave a lower score, and the remaining 4 gave equal scores. Thus, there was no noticeable trend toward a biasing of pronunciations in the vowel condition when the onset + vowel was contained in both the word and the nonword. However, it could be argued that there were too few items on which to base such a conclusion.

There is a second possibility, however. About half of the nonwords used by Taraban and McClelland (1987) in the onset + vowel condition possessed a body that did not occur in English (e.g., DEAD DEAB and SAID SAIP). It may be that there is a biasing of pronunciation from the onset + vowel only when the pronunciation of the nonword cannot be generated from its body. In other words, when there is no representation of the body in the lexicon, other less important units might be brought into play.

Table 1
*Percentage of Times the Pronunciation of the Vowel of the Nonword Was Biased Toward the Pronunciation of the First Vowel of the BOB and Vowel Condition Words: Experiment 1*

| Condition | Example | Bias (%) | *SD* |
|---|---|---|---|
| BOB | MEADOW JEAD | 40.0 | 27.9 |
| Vowel | JEALOUS JEAD | 29.4 | 23.9 |
| Control | TUNNEL JEAD | 31.4 | 22.5 |

*Note.* BOB = body of the basic orthographic syllabic structure.

## Experiment 2

Although Experiment 1 was interpreted in terms of the BOB, in the majority of the BOB condition items the BOSS of the prime word coincided with the traditionally defined first syllable of that word (e.g., the MEAD of MEADOW). As such, Experiment 1 was not designed to discriminate between the BOSS boundary and the syllable boundary. The reason was that my recent research, which directly compared the BOSS and the syllable (Taft, 1987), had already come out in favor of the BOSS being a unit of processing rather than the syllable. However, the argument that the BOB has a special status in the lexical system would be more strongly made if the BOSS could be distinguished from the syllable using the nonword priming paradigm. In Experiment 1, those six items in which the body of the nonword coincided with the BOSS boundary and not the syllable boundary (i.e., TRAUMA LAUM, ALTITUDE CHALT, BOULEVARD ROUL, ALMOND THALM, ROUTINE COUT, and ALKALINE HALK) did demonstrate a bias in pronunciation (a 21% difference between BOB and control, which is even greater than the effect for the remaining 12 items), and this is consistent with the BOSS interpretation.

However, not only does the small number of items weaken such a post hoc analysis, but it could be argued that the wrong definition of the phonological syllable has been used, not just

[3] Response times were measured as well but could not be used because the biased pronunciations were not given often enough to be meaningful. Furthermore, some items produced no biased pronunciations at all.

here, but in all studies that contrast the BOSS and the syllable. As mentioned earlier, there are some phonological theories of syllable structure that propose that the consonant following the first vowel is included in the first syllable even when the vowel is long, and that both members of many consonant clusters may also be included (e.g., Anderson & Jones, 1974). Because this is very similar to the BOSS definition, one could say that the results that appear to favor the BOSS could alternatively be explained in terms of a phonological syllable, but one that does not follow the traditional definition.

If, however, the BOSS is in isomorphic correspondence with the phonological syllable, then the issue of whether the orthographic or the phonological structure of a word is important is no longer of concern, because they amount to the same thing. However, there is one type of word in which the BOSS and the phonological syllable appear to differ. There are no phonological theories of the syllable that include a single medial consonant in an initial unstressed syllable (e.g., by syllabifying CEMENT as CEM/ENT). The BOSS, on the other hand, includes this consonant (i.e., the BOSS of CEMENT is CEM), and therefore such words would provide the ideal test of whether the syllable structure that is important in lexical access is orthographic rather than phonological.

If one is going to study words with an unstressed first syllable using the nonword priming paradigm, one cannot use monosyllabic nonwords as in Experiment 1. The reason is that the BOB of the nonword will necessarily have a stressed vowel, whereas the BOB of the prime word will have an unstressed vowel, and therefore they cannot be pronounced in the same way.[4] However, another design suggests itself using bisyllabic nonwords.

A nonword such as CAMULK could be pronounced with stress either on its first or its second syllable. Presumably, a bias toward stressing the second syllable can be induced if the nonword is preceded by a word stressed on its second syllable as opposed to a word stressed on its first syllable (e.g., DIVERT CAMULK vs. SILENT CAMULK). The question of interest, however, is whether there is an increased bias toward second-syllable stress when the nonword and the second-syllable stressed word have the same BOB (e.g., LAMENT CAMULK) and, furthermore, whether the bias arising from a shared BOB is greater than when it is the first syllable that is shared (e.g., CAVORT CAMULK). The answer to both these questions should be in the affirmative if it is true that the first syllable of a word is a less important lexical unit than is its BOB. Experiment 2 was set up to test this prediction.

## *Method*

*Subjects.* Ninety-six undergraduates at the University of New South Wales served as subjects. All were native speakers of Australian English.

*Materials.* Twenty-eight bisyllabic nonwords were constructed such that it was possible they might be pronounced with stress on their second syllable (e.g., CAMULK, TYRETTE, GABINTH, and BAZATE). Each nonword was designed so that there existed a word with second-syllable stress that had the same BOB, and another that had the same first syllable (e.g., CAMULK with LAMENT and CAVORT, TYRETTE with SYRINGE and TYPHOON, and GABINTH with CABOOSE and GAZETTE). These words were used as primes for the nonwords, along with two other sets of words that did not share a BOB or syllable and either had second-syllable stress (e.g., DIVERT CAMULK, MUNDANE TYRETTE, and SINCERE GABINTH) or first-syllable stress (e.g., SILENT, CAMULK, JASMINE TYRETTE, and LOZENGE GABINTH).

Thus, there were four conditions in the experiment: (a) the BOB condition, in which the word had second-syllable stress and shared its BOB with the nonword (e.g., LAMENT CAMULK); (b) the syllable condition, in which the word had second-syllable stress and shared its first syllable with the nonword (e.g., CAVORT CAMULK); (c) the 2nd stress control condition, in which the word had second-syllable stress but did not share a BOB or syllable with the nonword (e.g., DIVERT CAMULK); and (d) the 1st stress control condition, in which the word had first-syllable stress and no shared BOB or syllable with the nonword (e.g., SILENT CAMULK).

The items, which are presented in the Appendix, were organized into four lists such that each list contained seven word–nonword pairings from each condition, and no list repeated any nonword. There were three different orders for each list. Although a target nonword was always the item immediately following its priming word, there were filler words and nonwords interspersed among the experimental items. These were included to prevent subjects from being overwhelmingly biased toward giving second-syllable stress to all of the nonwords. The filler words were 20 first-syllable stressed words (e.g., IGLOO, HYGIENE, and VOLUME) that were included to counteract the fact that three quarters of the priming words had stress on their second syllable, whereas the filler nonwords were 20 nonwords that would be very unlikely to be pronounced with stress on their second syllable (e.g., DONGLE, JINER, and QUEEVIL).

*Procedure.* The experiment was conducted in the same way as in Experiment 1, except that responses were recorded on tape so that the subjects' stress assignment to the nonwords could be double checked by a second person. There were four groups of 24 subjects, each subject being assigned to one of the four lists presented in one of the three orders.

Unlike Experiment 1, there were quite a few errors recorded in the pronunciations made by subjects (11.3% errors). Such errors were not included in the analysis because the dependent variable was taken to be the percentage of times a second-syllable stress was given among the correct responses. Errors took several forms. Either subjects gave the wrong stress to the priming word (e.g., giving first-syllable stress to LAPEL or second-syllable stress to STIPEND) or they misread a letter (e.g., saying CRENDY instead of CRENOY), assigned three syllables to the nonword (e.g., pronouncing CHAPOQUE like CHAPOCUE), or gave the nonword an idiosyncratic pronunciation (e.g., saying CARE-ME for CAREME or CRENVOY for CRENOY).

## *Results and Discussion*

The mean percentage of occasions that subjects gave second-syllable stress to the four conditions of nonwords is presented in Table 2.

It seems that the stress pattern of a word can influence the stress pattern assigned to a following nonword, even when that word and nonword bear no orthographic relationship to each other. This is seen in the difference between the two control conditions, a difference that was significant on the item analysis, $F_2(1, 27) = 8.847$, $p < .01$, but not on the

[4] There is an occasional exception to this, namely when the word is stressed on its second syllable and yet the first syllable has a full vowel, as in ROUTINE COUT.

Table 2
*Percentage of Times the Nonword Was Assigned Stress to Its Second Syllable: Experiment 2*

| Condition | Example | Bias (%) | *SD* |
|---|---|---|---|
| BOB | LAMENT CAMULK | 70.7 | 17.4 |
| Syllable | CAVORT CAMULK | 63.6 | 18.3 |
| 2nd stress control | DIVERT CAMULK | 62.2 | 17.4 |
| 1st stress control | SILENT CAMULK | 57.0 | 15.9 |

*Note.* BOB = body of the basic orthographic syllabic structure.

subject analysis, $F_1(1, 92) = 2.677, p > .1$. Why this result did not generalize across all subjects is unclear. However, what is more important is whether additional bias could be engendered by the congruence of the BOB of the word and the nonword or by the congruence of the first syllable of the word and the nonword.

Congruence of the first syllable provided no additional bias toward second-syllable stress on the nonword, as can be seen in the lack of difference between the syllable condition and the 2nd stress control condition (both $F$s $< .1$). Thus, for example, CAMULK was just as likely to be stressed on its second syllable when preceded by CAVORT as when preceded by DIVERT.

On the other hand, congruence of the BOB of the word with the BOB of the nonword did lead to an additional bias in the pronunciation of the nonword. The BOB condition produced significantly more second-syllable stressed pronunciations than both the 2nd stress control condition, $F_1(1, 92) = 14.080, p < .001$, and $F_2(1, 27) = 19.879, p < .001$, and the syllable condition, $F_1(1, 92) = 10.589, p < .01$, and $F_2(1, 27) = 6.069, p < .025$. Thus, CAMULK was more likely to be stressed on its second syllable when preceded by LAMENT than when preceded by either CAVORT or DIVERT.

Thus, the results obtained in this experiment follow from the view that the body of the BOSS is an important subword unit in reading. Furthermore, as has been claimed elsewhere (e.g., Taft, 1979, 1987), the syllable does not appear to constitute a functional subword unit in reading. This experiment perhaps provides the strongest evidence to date for this view in that it uses materials that allow the clearest separation of BOSS boundary and syllable boundary, namely, words whose first syllable is not stressed. It also provides a counterintuitive result in that the initial letters of a word would appear to be more prominent than the medial letters, yet it is a medial unit that has the most influence here.

As in Experiment 1, the results suggest that the BOSS provides a way of breaking up a polysyllabic word into monosyllabic parts and that these monosyllables are lexically represented in terms of their bodies, just as are monosyllabic words. That is, LAMENT is represented with the structure L/AM/ENT, and CAVORT with the structure C/AV/ORT. The syllabic structure LA/MENT and CA/VORT does not seem to be lexically represented. The phonetic syllable boundary that occurs after the first vowel in the pronunciation of these words is presumably generated from the lexical representation of the word, which is an underlying phonological representation that corresponds in some way to the BOB structure. The bias in nonword pronunciation observed in the present experiment apparently arises from priming within a lexical representation rather than on the basis of the phonetic representation of the word.

What needs to be explained still is the bias that appears to occur purely on the basis of the stress pattern of the priming word (i.e., the difference between the 2nd stress and the 1st stress control conditions). This bias can also be explained in terms of priming within the lexicon rather than priming at the phonetic level. The underlying phonological representation of a word must contain information that will allow the appropriate stress assignment to be made in the phonetic manifestation of that word (e.g., Chomsky & Halle, 1968). For example, if the vowel has the feature <+tense> it typically will be assigned main stress. Thus, the difference in the underlying representation between the first-syllable stressed word MOMENT and the second-syllable stressed word LAMENT would be that the first vowel of the former is tense and the first vowel of the latter is lax (i.e., has the feature <−tense>). It is possible, then, that the bias in pronunciation of the nonword could arise from a bias in the assignment of phonological features. For example, if the first vowel of the priming word is associated with the phonological feature <−tense>, then the first vowel of the following nonword might also be assigned this feature, which in turn could lead to a stressed second syllable (depending on the structure of the rest of the item).

## Experiment 3

Experiment 2 has been taken to show that the BOB is an important unit in the orthographic processing of a word, whereas the first syllable is not. However, it is still possible to salvage the position that the experiment actually reflects an effect of phonological syllabic structure. What one could say is that it is the first letter of the stressed second syllable of the priming word that produces the bias in the pronunciation of the nonword. That is, the prior presentation of LAMENT biases the pronunciation of CAMULK toward having stress on its second syllable not because they share the unit AM, but because they share the letter M. This letter marks the beginning of the stressed syllable in the word LAMENT and thus triggers an analogous pronunciation in CAMULK. Such an explanation would obviate the need for the concept of the BOB.

Experiment 3 was set up to test whether the priming effect that was observed in Experiment 2, when the BOB of the nonword and preceding word matched, could have arisen simply from the fact that their medial consonants matched. This was achieved by examining the pronunciation given to a nonword when it was preceded by a word with stress on its second syllable that shared a BOB (e.g., CIGAR MIGUME), a medial consonant alone (e.g., LAGOON MIGUME), or no matching letters within the BOSS at all (e.g., BABOON MIGUME). A phonological explanation for the results could be sustained if it were found that the matching medial consonant items produced the same number of nonword pronunciations with second stress as did the BOB items, which in turn was greater than for the nonmatching (i.e., control) items. For the

BOB explanation to be maintained, on the other hand, it would need to be found that more second-syllable stress pronunciations were given to the nonwords in the BOB condition than in both the control condition and the consonant condition.

In Experiment 2, no attempt was made to control frequency, length, and etymological origin of the priming words used under the three different second-syllable stress conditions. Although it is unlikely that such factors would have systematically influenced the results of that experiment, the design of Experiment 3 allows one to eliminate this as a possible explanation for the BOB condition bias. In particular, the priming words that were used in the BOB condition of Experiment 3 were all taken from the syllable condition and the 2nd stress control condition of Experiment 2, whereas the priming words used in the BOB condition of Experiment 2 were used only in the consonant and control conditions of Experiment 3.

## *Method*

*Subjects.* The subjects were 45 undergraduates at the University of New South Wales who were native speakers of Australian English.

*Materials.* Twenty-four new bisyllabic nonwords were constructed along the same lines as in Experiment 2. This time, however, the only requirement was that a word with stress on its second syllable could be found that shared a BOB with the nonword, as well as another word that shared only a medial consonant, specifically, the consonant that began the stressed syllable of that word.

The experiment included three conditions: (a) the BOB condition, in which the preceding word was stressed on its second syllable and shared its BOB with the nonword (e.g., CIGAR MIGUME); (b) the consonant condition, in which the preceding word was stressed on its second syllable and shared only a medial consonant with the nonword (e.g., LAGOON MIGUME); and (c) the control condition, in which the preceding word was stressed on its second syllable but whose BOSS shared no letters with that of the nonword (e.g., BABOON MIGUME).

The words in the BOB condition all came from the set of words used in the syllable and 2nd stress control conditions of Experiment 2. The words in the consonant condition came from the set used in the BOB condition of Experiment 2, as well as from the 2nd stress control condition; the words in the control condition also came from the set used in the BOB condition of Experiment 2, and from the syllable condition as well.

The items, which can be found in the Appendix, were arranged into three lists such that each list contained eight word–nonword pairings from each condition, and no list repeated any nonword. Filler words and nonwords were interspersed among the experimental items, although they never appeared between a word and its paired nonword. As in the second experiment, the filler items were 20 words with first-syllable stress (e.g., IGLOO and VOLUME) and 20 nonwords whose most likely pronunciation had first-syllable stress (e.g., DONGLE and QUEEVIL).

*Procedure.* The procedure was the same as in Experiment 2, except that each subject received a different random order and there were three groups of 15 subjects.

## *Results and Discussion*

Table 3 presents the mean percentage of occasions that second-syllable stress was given to the nonwords in the three conditions.

Table 3
*Percentage of Times the Nonword Was Assigned Stress to Its Second Syllable: Experiment 3*

| Condition | Example | | Bias (%) | *SD* |
|---|---|---|---|---|
| BOB | CIGAR | MIGUME | 61.5 | 19.9 |
| Consonant | LAGOON | MIGUME | 50.3 | 24.1 |
| Control | BABOON | MIGUME | 49.7 | 22.6 |

*Note.* BOB = body of the basic orthographic syllabic structure.

The pattern of data is exactly what was predicted by the BOB account. Subjects pronounced the nonwords with second-syllable stress significantly more often in the BOB condition than in either the control condition, $F_1(1, 42) = 16.64$, $p < .001$, and $F_2(1, 23) = 10.58$, $p < .01$, or the consonant condition, $F_1(1, 42) = 17.40$, $p < .001$, and $F_2(1, 23) = 23.61$, $p < .001$. There was no sign of a difference between the consonant and control conditions (both $F$s $< 1$).

It can be seen, then, that the bias effect observed in Experiment 2 for word–nonword pairs with matching BOBs has been replicated in Experiment 3 with a different set of items. In addition, it has been demonstrated that this BOB effect cannot be explained in terms of the BOB containing the first stressed consonant of the word. When the nonword and word share this consonant alone, there is no bias in stress assignment to the nonword. Thus, it seems that the explanation for the biasing effect of the BOB cannot be phonological in nature, but rather reflects the accessing of a shared unit.

# General Discussion

The three experiments reported in this article support the existence of the BOB as an important subword unit in reading. How, though, might the BOB be represented in the lexicon?

In its original conception (Taft, 1979), the BOSS was viewed as the code through which a word was accessed in the lexicon. That is, there were said to be representations of BOSSes in the lexical access system with which the BOSS of the presented letter string was compared. When a BOSS representation was found to match the BOSS of the letter string, the full information about the words that contained that BOSS became available. On checking these back to the original stimulus, it could be determined which, if any, of these accessed words was the appropriate one. Because it appears that the BOB is an important unit in lexical processing, one could suggest simply that the BOB, rather than the BOSS itself, is the access code.

The characterization of the BOSS (or BOB) as an access code, however, allows for little flexibility in lexical processing because the only pathway to the lexical entry for a word is via access to its BOSS. I have demonstrated (Taft, 1987) that such inflexibility could find this strong model wanting, in that the wordlikeness of a nonword influenced lexical decision responses even when the BOSS was disrupted (e.g., RODOT taking longer than RODUS because of its similarity to ROBOT). If the only way to access a word is through its BOSS (or BOB), then disruption to that BOSS (e.g., by converting ROB to ROD) should have prevented access to that word.

Because it did not, a weaker characterization of the BOSS seems appropriate. It seems that units other than the BOSS also provide access to the lexical entry. Such a conception seems to be most compatible with a model of lexical processing in which the activation of lexical units representing a range of different subword segments combines to activate the lexical entry for the word. Such an interactive-activation model has been put forward in relation to the research on word bodies (e.g., Glushko, 1979).

According to the interactive-activation model, in addition to there being nodes in the lexicon that correspond to words, there are nodes that correspond to subword units such as graphemes and bodies. These units are hierarchically organized such that activation of grapheme nodes will activate a body node that contains those letters, and activation of a body node will activate those words that contain that body (see Taft, 1991). For example, the body node EAD will be activated by the existence of EA and D in the letter string (presumably taking letter position into account), and this, in turn, will activate the word nodes HEAD, BEAD, BREAD, and so forth. As the higher nodes become activated, they pass activation back down to the lower nodes.

Associated with each of these orthographically defined subword nodes is a set of phonologically defined subword nodes. For example, the body node EAD will be associated with two phonological body nodes (which will be called rime nodes to differentiate them from orthographic body nodes), namely, /i:d/ and /ɛd/. The pronunciation of a word is based on the most activated rime node (e.g., Glushko, 1979). The correct rime node will be selected on the basis of the activation coming down from the whole word node. For example, although both /i:d/ and /ɛd/ will be activated as possible pronunciations of EAD when HEAD is presented, the /ɛd/ pronunciation will ultimately be selected because of the activation it accrues from the activated HEAD node. Such a model can explain the consistency effect observed by Glushko in terms of the competition between different rime nodes for words with inconsistent bodies.

The pronunciation of a nonword can also be synthesized on the basis of its subword phonological nodes; however, in this case, there is no activation coming down from any whole word node, so selection of pronunciation must be made on some other basis. Perhaps the pronunciation of a nonword is based on a combination of the most common pronunciation of the particular body and of the individual graphemes, thus biasing toward the regular pronunciation (e.g., /i:d/). When a particular rime node has just been activated, however, it can bias the selection toward that node. Hence, if the /ɛd/ node has just been strengthened by the processing of HEAD, there is an increased likelihood that that node will be used in the synthesis of the pronunciation of the nonword JEAD.

If this is a useful way to explain body effects, then it presumably is also a useful way to account for BOB effects. Simply, body nodes are actually BOB nodes. Thus, the node EAD is activated when MEADOW is presented and the node AM is activated when LAMENT is presented.

By representing the BOB as a node in an interactive-activation system rather than as an inflexible access code, one can explain how a word can be accessed even when the BOSS is disrupted. Apart from the partial activation of a body node that would occur when some of the graphemes coincide with it, there can also be activation of the whole word via nodes that represent the body of units other than the first orthographic syllable, and also via nodes that represent onsets. For example, MEADOW can be activated via two body nodes, EAD and OW, as well as the grapheme (or onset) node M, whereas ROBOT can be activated via the body nodes OB and OT, as well as the onset node R. It may be that the body of the first orthographic syllable (i.e., the BOB) is typically the most useful of these nodes in activating the whole word, because it is likely to be the unit that discriminates best between candidate words. For example, there are fewer words containing the body EAD than the body OW (half as many, according to a computerized search of an English dictionary).

Consistent with the idea that polysyllabic words activate body nodes for each of their syllables is a result obtained by Jordan (1986). He found that responses to a target word were facilitated when it was preceded by another word whose final letters coincided with the BOSS of the target word (e.g., LEMON MONARCH). If the bodies of all orthographic syllables are represented in the lexicon, then LEMON and MONARCH would share a node (namely, the node for ON), and this fact could lead to the priming effect. Of course, for this account to be convincing, one would need to demonstrate priming on the basis of the body unit alone (e.g., by looking at LEMON followed by TONIC). However, the interpretation of any studies using the priming paradigm must be viewed with considerable caution because conflicting results have been obtained using this technique with monosyllabic words. Whereas some studies have observed facilitation between words that share a body (and that rhyme), such as FENCE following HENCE (e.g., Hillinger, 1980; Meyer, Schvaneveldt, & Ruddy, 1974), others have actually observed inhibition (e.g., Colombo, 1986; Henderson, Wallis, & Knight 1984).

The experiments reported in this article have demonstrated that the subsyllabic structure of a word is important in lexical processing, even when that word is polysyllabic. In particular, the subsyllabic structure that was shown to be of importance was the body of the first orthographically defined syllable, that is, the BOB. The bodies of syllables other than the first syllable may also be involved in lexical processing, but this was not examined here. The results raise the possibility that the BOSS itself is not a unit of representation in lexical memory, but, rather, defines the terminal boundary of the first body of a polysyllabic word, and it is this body that forms a unit of representation in lexical memory.

## References

Anderson, J., & Jones, C. (1974). Three theses concerning phonological representations. *Journal of Linguistics, 10,* 1–26.

Andrews, S. (1982). Phonological recoding: Is the regularity effect consistent? *Memory & Cognition, 10,* 565–575.

Bowey, J. A. (1990). Orthographic onsets and rimes as functional units of reading. *Memory & Cognition, 18,* 419–427.

Brown, G. D. (1987). Resolving inconsistency: A computational model of word naming. *Journal of Memory and Language, 26,* 1–23.

Chomsky, N., & Halle, M. (1986). *The sound pattern of English.* New

York: Harper & Row.

Colombo, L. (1986). Activation and inhibition with orthographically similar words. *Journal of Experimental Psychology: Human Perception and Performance, 12,* 226–234.

Davis, S. (1989). On a non-argument for the rhyme. *Journal of Linguistics, 25,* 211–217.

Fudge, E. C. (1987). Branching structure within the syllable. *Journal of Linguistics, 25,* 219–220.

Glushko, R. J. (1979). The organization and activation of orthographic knowledge in reading aloud. *Journal of Experimental Psychology: Human Perception and Performance, 5,* 674–691.

Hansen, D., & Rodgers, T. S. (1968). An exploration of psycholinguistic units in initial reading. In K. S. Goodman (Ed.), *The psycholinguistic nature of the reading process* (pp. 61–102). Detroit, MI: Wayne State University Press.

Henderson, L., Wallis, J., & Knight, D. (1984). Morphemic structure and lexical access. In H. Bouma & D. Bouwhuis (Eds.) *Attention and performance X* (pp. 211–224). Hillsdale, NJ: Erlbaum.

Hillinger, M. L. (1980). Priming effects with phonemically similar words: The encoding-bias hypothesis reconsidered. *Memory & Cognition, 8,* 115–123.

Jared, D., McRae, K., & Seidenberg, M. D. (1990). The basis of consistency effects in word naming. *Journal of Memory and Language, 29,* 687–715.

Jared, D., & Seidenberg, M. S. (1990). Naming multisyllabic words. *Journal of Experimental Psychology: Human Perception and Performance, 16,* 92–105.

Jordan, T. C. (1986). Testing the BOSS hypothesis: Evidence for position-insensitive orthographic priming in the lexical decision task. *Memory & Cognition, 14,* 523–532.

Kahn, D. (1976). *Syllable-based generalizations in English phonology.* Unpublished doctoral thesis, Massachusetts Institute of Technology.

Kay, J., & Bishop, D. (1987). Anatomical differences between nose, palm, and foot, or, the body in question: Further dissection of the processes of sub-lexical spelling-sound translation. In M. Coltheart (Ed.), *Attention & performance XII* (pp. 449–469). Hillsdale, NJ: Erlbaum.

Kay, J., & Marcel, A. J. (1981). One process, not two, in reading aloud: Lexical analogies do the work of nonlexical rules. *Quarterly Journal of Experimental Psychology, 33A,* 397–414.

Kaye, J. (1989). *Phonology: A cognitive view.* Hillsdale, NJ: Erlbaum.

Lima, S. D., & Pollatsek, A. (1983). Lexical access via an orthographic code? The basic orthographic syllabic (BOSS) reconsidered. *Journal of Verbal Learning and Verbal Behavior, 22,* 310–332.

Meyer, D. E., Schvaneveldt, R. W., & Ruddy, M. G. (1974). Function of graphemic and phonemic codes in visual word recognition. *Memory & Cognition, 2,* 309–321.

Patterson, K. E., & Morton, J. (1985). For orthography to phonology: An attempt at an old interpretation. In K. E. Patterson, J. C. Marshall, & M. Coltheart (Eds.), *Surface dyslexia* (pp. 335–359). Hillsdale, NJ: Erlbaum.

Pulgram, E. (1970). *Syllable, word, nexus, cursus.* The Hague: Mouton.

Seidenberg, M. S. (1987). Sublexical structures in visual word recognition: Access units or orthographic redundancy? In M. Coltheart (Ed.), *Attention & performance XII* (pp. 245–263). Hillsdale, NJ: Erlbaum.

Taft, M. (1979). Lexical access via an orthographic code: The basic orthographic syllabic structure (BOSS). *Journal of Verbal Learning and Verbal Behavior, 18,* 21–39.

Taft, M. (1985). The decoding of words in lexical access: A review of the morphographic approach. In D. Besner, T. G. Waller, & G. E. MacKinnon (Eds.), *Reading research: Advances in theory and practice, Vol. V* (pp. 83–123). San Diego, CA: Academic Press.

Taft, M. (1986). Lexical access codes in visual and auditory word recognition. *Language & Cognitive Processes, 1,* 49–60.

Taft, M. (1987). Morphographic processing. The BOSS re-emerges. In M. Coltheart (Ed.), *Attention & performance XII* (pp. 265–279). Hillsdale, NJ: Erlbaum.

Taft, M. (1991). *Reading and the mental lexicon.* Hillsdale, NJ: Erlbaum.

Taft, M., & Cottrell, D. (1988, August). *On converting print to sound and sound to print.* Paper presented at the 24th International Congress of Psychology, Sydney, Australia.

Taft, M., & Forster, K. I. (1976). Lexical storage and retrieval of the polymorphemic and polysyllabic words. *Journal of Verbal Learning and Verbal Behavior, 15,* 607–620.

Taraban, R., & McClelland, J. L. (1987). Conspiracy effects in word pronunciation. *Journal of Memory and Language, 26,* 608–631.

Treiman, R., & Chafetz, J. (1987). Are there onset- and rime-like units in printed words. In M. Coltheart (Ed.), *Attention & performance XII* (pp. 282–298). Hillsdale, NJ: Erlbaum.

Treiman, R., Goswami, U., & Bruck, M. (1990). Not all nonwords are alike: Implications for reading development and theory. *Memory & Cognition, 18,* 559–567.

Treiman, R., & Zukowski, A. (1988). Units in reading and spelling. *Journal of Memory and Language, 27,* 466–477.

## Appendix

The following were the items used in Experiment 1 (the nonword target is given first, followed by its BOB condition prime, vowel condition prime, and control condition prime, respectively): JEAD: meadow, jealous, tunnel; LAUM: trauma, flautist, copy; CHALT: altitude, shallow, fragrant; FRALL: hallmark, fraudulent, genteel; TOVE: cover, stomach, journal; SHIND: mindless, childless, danger; ZEAR: bearings, zealous, journal; ROUL: boulevard, troubadour, danger; THALM: almond, halfway, genteel; SHON: honey, shovel, journal; BRULL: pulley, bushel, copy; TRYTH: rhythm, strychnine, tunnel; BALF: halfway, balmy, journal; COUT: routine, coupon, danger; HALK: alkaline, challenge, tunnel; REAT: sweater, treasure, fragrant; SPUSH: cushion, pudding, copy; THOME: somersault, thorough, genteel.

The following were the items used in Experiment 2 (the nonword is given first, followed by its BOB condition prime, syllable condition prime, 2nd stress control prime, and 1st stress control prime, respectively): CAMULK: lament, cavort, divert, silent; CARPEESE: harpoon, cartoon, pontoon, mansion; SAGADE: lagoon, saloon, cocoon, govern; TYRETTE: syringe, typhoon, mundane, jasmine; CRUNOSE: brunette, crusade, cascade, nitrate; BROTUNG: grotesque, brocade, roulette, challenge; HUPREE: superb, humane, vacate, famine; SEMOSS: cement, sedate, guitar, talent; SEVATE: revere, secure, police, malice; MOLEND: polite, morale, ornate, pirate; CRENOY: grenade, cremate, placate, frigate; BIROON: giraffe, bizarre, ferment, convent; CIVELGE: divan, cigar, taboo, organ; CAPANE: lapel, cadet, sedan, bigot; LONESK: donate, locate, mature, nature; BARILL: career, baboon, molest, python; GABINTH: caboose, gazette, sincere, lozenge; PACUND: lacrosse, pastille, stampede, porridge; FIVADE: divine, finesse, morose, zygote; CHAPOQUE: trapeze, charade, germane, vintage; MATERP: patrol, marine, ignite, petrol; CAREME: parade, canoe, hotel, yodel; MARONT: caress, manure, seduce, chisel; BAZATE: gazelle, baroque, eclipse, licence; MOTANE: rotund, moselle, canteen, stipend; SUTEEN: mutate, supreme, brigade, fragile; VECOO: decree, veneer, genteel, toffee; LAMBEER: bamboo, lampoon, maroon, turmoil.

The following were the items used in Experiment 3 (the nonword is given first, followed by its BOB condition prime, consonant condition prime, and control condition prime, respectively): DORUFT: morose, caress, brigade; BAVINK: cavort, revere, mundane; RALEND: saloon, polite, typhoon; CRATOSS: mature, rotund, ferment; TRUMOSE: humane, cement, career; SANTILL: canteen, pontoon, germane; VECOO: secure, tycoon, lapel; LOREESE: morale, parade, taboo; SEMOY: cremate, lament, gazette; FRIZOON: bizarre, gazelle, stampede; MIGUME: cigar, lagoon, baboon; GATINCH: platoon, mutate, divan; TOCURE: locate, vacate, ornate; BLOSIFT: moselle, crusade, caboose; NOLARM: police, roulette, baroque; ZADOOL: cadet, sedate, veneer; PINULGE: finesse, grenade, maroon; LARESK: charade, giraffe, molest; HAREED: marine, syringe, divine; THANESS: canoe, donate, sedan; JANOLD: manure, brunette, guitar; DUPITE: supreme, trapeze, cascade; BOCULD: cocoon, lacrosse, sincere; VOTIBE: hotel, patrol, superb.

Received May 28, 1991
Revision received December 16, 1991
Accepted January 6, 1992 ■