Misplaced Stress on Prosody:
A Reply to Black and Byng

Anne Cutler[1]
M.R.C. Applied Psychology Unit, Cambridge, U.K.

David Howard
University College London, U.K.
and
Homerton Hospital, London, U.K.

Karalyn E. Patterson
M.R.C. Applied Psychology Unit, Cambridge, U.K.

The recent claim by Black and Byng (1986) that lexical access in reading is subject to prosodic constraints is examined and found to be unsupported. The evidence from impaired reading which Black and Byng report is based on poorly controlled stimulus materials and is inadequately analysed and reported. An alternative explanation of their findings is proposed, and new data are reported for which this alternative explanation can account but their model cannot. Finally, their proposal is shown to be theoretically unmotivated and in conflict with evidence from normal reading.

INTRODUCTION

In a recent article in this journal, Black and Byng (1986) described the performance of nine deep dyslexic patients in oral reading of bisyllabic words with stress on either the first syllable ('XY words, e.g. *rampant)* or the second syllable (X'Y words, e.g. *portray).* The authors claim that, at least for some of the patients:

1. There were significantly more correct whole-word reading responses to 'XY than to X'Y words.
2. Amongst those reading errors where the patient either reproduced only a portion of the target word (e.g. *rampant* —> "ramp") or produced a response related to only a portion of the target word (e.g. *support* —>

"wine", a semantic error to *port)*, there were significantly more responses to stressed than to unstressed syllables, irrespective of 'XY and X'Ystructure.

On the basis of these results, Black and Byng draw the following conclusions:

1. The prosodic structure of a target word is one of the factors determining a deep dyslexic's reading response to that word, and one which has largely been ignored in models of reading typically used to characterise deep dyslexia.
2. The stage at which prosodic structure exerts its effect (for all readers, normal or impaired) is "early" in the reading process, indeed prior to and functional in lexical access.

Concerning the first of these experimental claims, we acknowledge that 'XY words may be easier for at least some deep dyslexic patients to read, though we argue that this is a small effect when all other relevant variables are properly controlled. Regarding the first of these theoretical claims, we acknowledge that prosodic structure as a factor germane to oral reading output is indeed one of various factors that have been under-represented in accounts of acquired dyslexia. But these two points are relatively uncontroversial and by no means form the "heart" of the Black and Byng paper. The substance, instead, comes with the second experimental claim and the second theoretical conclusion, and both of these we dispute.

Here, we first list our criticisms of the stimulus materials, data analysis, and data reporting. On the basis of these criticisms, we deny that the results actually constitute evidence for the phenomenon that the authors claim to have demonstrated. We then provide an alternative account of the effects that do appear to be genuine, and we offer some new data to support our portrayal. Finally, we explain why, in our view, Black and Byng's theory would not be adequate even if their data had been.

THE BLACK AND BYNG EXPERIMENTS

Our discussion will focus on the first of Black and Byng's three experiments. This is essentially because all of our criticisms of Experiment 1 also apply to Experiments 2 and 3; and in Experiments 2 and 3, the authors made no attempt to achieve the necessary balancing and matching of stimulus items. In Experiment 2, for example, all of the words (with the exception of one odd person out) had the prosodic structure 'XY, thus confounding first-syllable stress with orthographic word-initial prominence. In our view, Experiments 2 and 3 do not support any theorising about a role for prosody; but even Experiment 1 seems unsatisfactory on a variety of grounds.

Stimulus Materials

In the Method section for Experiment 1, Black and Byng describe the ideal stimulus words for this experiment, an ideal unrealisable because the language was not designed for psycholinguistic experiments. We all know and suffer from our inconsiderate language (Cutler, 1981), but failure to achieve ideal matching here may be serious. One problem is that, compared to the 'XY words, the X'Y set included many more items that begin with a prefix (or prefix-like string), such as *con-* or *de-*. As explanations for relatively poor reading performance on the X'Y words, then, prosodic structure and (real or apparent) morphological structure are confounded. A second problem (and a particularly worrying one, since Black and Byng's conclusions depend crucially on reading responses related to portions of target words) is that although the whole words in the 'XY and X'Y lists were adequately balanced for frequency and imageability, the part words (e.g. *just* and *ice injustice; sup* and *port* in *support)* were not. In the 'XY set, mean frequency (Kucera & Francis, 1967) of first-syllable words is 241.8 and of second-syllable words is 48.8. Admittedly, the first-syllable set contains two very high-frequency items *(just* and *can)* but even with these omitted the mean frequency of the first-syllable set is still 106.8.

Black and Byng tried to forestall such criticisms as ours with a pilot experiment in which four of the nine patients were asked to read all of the part words *(sup, port* etc) from the word lists for Experiment 1. However, they do not actually present the data from this vital control experiment, merely stating (Black & Byng, 1986, p.373) that: ". . .no significant difference was found in their ability to read aloud portions which occurred in the 'XY list and the X'Y list, i.e., they were able to read as many words which occurred in the stressed position as in the unstressed position". Since the first claim of this sentence (equal performance on component words across the two lists) in no way entails the second (equal performance on the two portions of words within each list), the "i.e." connecting these clauses is inappropriate, and we remain uncertain as to whether the second crucial equality held true. Even if it did, however, there is the further problem that the behaviour of a morpheme in isolation need not be an adequate predictor of its fate when embedded in a word. Although the word port is both more frequent and more imageable than the word *sup, sup* might be high enough on these dimensions for a deep dyslexic patient to read it in isolation. However, if the patient has difficulty understanding or retrieving phonology for the whole word *support,* then *port* may be more salient than *sup* by virtue of its higher value on these dimensions. Finally, we note that the authors' partitioning (e.g. *impale* consists of *imp* and *ale)* does not always correspond to the way in which a patient might treat a word. If a patient's response to *impale* were "pale", Black and Byng would count this as a response related

to the stressed syllable; yet all we know (or rather can try to infer) from their control experiment is that the patients showed no difference in their ability to read *imp* and *ale; pale* could be a much easier word.

Data Analysis and Reporting

Our first and shortest objection is germane to all of the criticisms that follow: given the notorious problems of error classification, and especially in the context of a novel and controversial claim (like Black and Byng's) which depends decisively on error classification, we deplore the fact that the published article does not include a corpus of relevant responses.

When patients produced more than one response to a word (a not infrequent occurrence, apparently, since the total number of responses classified was greater than the number of stimulus words in 14 out of 18 cases; 18 corresponds to 9 patients by 2 prosodic structures), Black and Byng counted all responses. We sympathise with the difficulty of knowing which of multiple responses to count; on the other hand, it is worrying that some stimulus items should be allowed to carry more weight than others. The standard problem of whether effects apply to all items within a set is then compounded by the problem of items contributing unequally to the data.

Another problem with regard to Black and Byng's data analysis concerns their treatment of responses like *sundry* —> "sun; lots of little things". The patient's initial reading response fits the authors' category of responses preserving the stressed syllable; but since they want to use such responses as support for a role of prosodic structure in lexical access, the fact that the patient went on to demonstrate access to the meaning of the whole string is awkward for Black and Byng's theory. They acknowledge (p.378) that, in such instances, the response preserving the stressed syllable probably originated at a late stage involving retrieval or execution of the phonological representation for the whole target word. Nonetheless, in the data analysis, these responses are counted as instances of preserved stressed syllables. And although the authors state (p.379) that these were not a significant proportion of the responses so classified, we consider 50% (the proportion for two of the patients, and indeed two of the only four who showed this stressed syllable effect either with or approaching statistical significance) a noteworthy proportion.

Our final point in this section concerns the underlying assumption(s) about the basis for particular error responses. This problem is by no means unique to Black and Byng but rather plagues all who try to infer the nature of processing from the nature of errors. As with normal speakers' speech errors, many dyslexic patients' reading errors are "imperfect" by virtue of having more than one possible source. In reading (at least of alphabetic

languages, where even phonologically "deep" orthographies like French and English are characterised by a high degree of correspondence between orthography and phonology; see for example Derouesne & Beauvois, 1985), an incorrect response will often resemble the target word on both orthographic and phonological dimensions. One of our strongest objections to Black and Byng's analysis and interpretation of their data is that they have emphasised phonology at the expense of orthography. Thus, in a response like *tantrum* —> "tandem", their focus is on the fact that the stressed syllable has been preserved. We, on the other hand, are struck by the whole-string orthographic similarity between these two words, and might even argue that for some such responses, the phonological resemblance will be parasitic on the orthographic dimension (as it happens, all words beginning *tan-* have a strong first syllable). Needless to say, for such an "imperfect" error with more than one possible source, we cannot establish that our interpretation is right and Black and Byng's wrong. However, given what else is known about retained and impaired skills in deep dyslexic patients, we would expect orthography to be the most salient dimension in their reading; and more importantly, theories built upon imperfect errors are surely perilous.

AN ALTERNATIVE INTERPRETATION

The literature on oral word reading by deep dyslexic patients suggests at least four different factors which might result in a patient producing a response which preserves part, but not all, of the stimulus word.

Visual Factors

Shallice and Warrington (1975) showed that, when their patient KF made visual errors, the response was particularly likely to preserve the letters at the beginning of the word; Morton and Patterson (1980) showed that the same was true for their two deep dyslexics, PW and DE. All three of these patients had lesions of the left hemisphere. With another deep dyslexic, TM, whose lesion was in the right cerebral hemisphere, Howard (1987) showed the opposite effect: in TM's visual errors, the response was particularly likely to preserve the letters at the right-hand end of the stimulus words.

Articulatory Factors

Many "nonfluent" aphasic patients have articulatory difficulties in speech production; some are especially likely to omit unstressed initial syllables. Patterson (1980a) noted that PW often omits unstressed initial syllables, or marks them with "uh".

Morphological Factors

All deep dyslexic patients on whom there are published reports make errors on affixed words which involve substitution, deletion, or addition of a prefix or suffix (see Patterson, 1980b). As Funnell (1987) demonstrated, some patients are more likely to delete true suffixes (e.g. reading *singer* as "sing") than appropriately matched suffix-like portions (e.g. *corner* —> "corn"). The mechanism responsible for these errors remains unclear; what is clear is that they occur.

Strategic Factors

A patient, given a word that s/he cannot read, will often cover over some letters with a finger and read the remaining portion; it is clear that such responses cannot be intended as a response to the whole word. We have, on occasions, asked deep dyslexic patients to read word lists where the items, as in Black and Byng's materials, can each be decomposed into two real words. When they fail to read the whole item, patients will sometimes read the two parts (as prosodically separate words) and then try to assemble these components into a single prosodic unit. This strategy can be successful, but need not be: HRM read *doorway* as "door. . . open . . . /'derevpen/", and PW read *drainage* as "drain . . . old".

These factors will, we claim, apply to differing extents to individual deep dyslexic patients. Only with specific knowledge of the factors affecting the performance of each subject can one make predictions about the effects of word stress on oral reading. We attempted to repUcate Black and Byng's results with two of the patients who had been among their subjects. One subject, HRM, showed the largest effect of word stress on reading accuracy in their Experiment 1; the other, PW, had a tendency to produce part-word error responses that were based on the stressed rather than the unstressed syllable of the stimulus word.

In our replication we used word sets very closely matched for word frequency (as assessed by the Kucera & Francis, 1967, word count), word imageability values (from the M.R.C. psycholinguistic database, Coltheart, 1981) and word letter length. To minimise any tendency of the patients to use a part-word reading strategy, we tried to avoid words that could be analysed into two component words. We generated a list of 35 'XY words matched to 35 X'Y words and a third set of monosyllabic words matched with the other 2 lists in terms of imageability and frequency. (It was not possible to match letter length exactly across mono- and bisyllabic words.) The complete word sets and the matching data are given in the Appendix.

We presented these words, in random order, to PW and HRM for oral reading. Both of the subjects show some tendency to make visual reading errors which involve the letters at the right-hand end of the word; but since these visual errors make up only a small proportion of total responses, we

would not expect this to have a detectable effect on their response patterns with sets of this size. PW tends to omit unstressed initial syllables in oral reading; he shows the same kind of effect in spoken picture naming[2]. We therefore predicted that PW would read X'Y words less successfully than 'XY words but would show no difference in accuracy between 'XY words and monosyllables. Only with X'Y words should there be any tendency for responses to preserve the stressed syllable, and this would be for purely articulatory reasons.

HRM, in contrast, does not have marked problems in speech production. We therefore predicted that his reading would be equally accurate for all three word sets, and that part-word responses, when they occurred, would be independent of word prosodic structure.

The patients' success in reading these three word sets is shown in Table 1. PW, as we predicted, made more errors with X'Y than 'XY words, but showed no difference between monosyllables and 'XY words. For HRM there was no difference in accuracy on the two classes of bisyllables; the apparent difference in performance between the monosyllables and the bisyllables fails to reach statistical significance (Fisher exact, z = 1.49, $P > 0.06$)[3].

TABLE 1
The Effects of Prosodic Structure: Correct Responses in Reading Matched Word Lists

	Monosyllables	*Stress First*	*Stress Second*
PW	21/35	21/35	11/35
HRM	26/35	19/35	21/35

[2] The experiments reported by Howard, Patterson, Franklin, Morton, and Orchard-Lisle (1984) included five pictures with names of two or more syllables where the first syllable was unstressed, which were presented on five separate occasions. Overall PW named 40% of these pictures correctly, and 52% of his responses involved omission of an unstressed initial syllable (eg GIRAFFE —> "/raef/". THERMOMETER —> "/'momete/". SPAGHETTI - "/'keti/". BANANA —> "/'nane/"). On a set of five pictures with names of comparable length and frequency where the first syllable was stressed. PW produced 76% correct names and did not omit any initial syllables.

Since the monosyllables differed from the bisyllabic words both in number of letters and in number of syllables, we tested HRM with two further lists of words closely matched for imageability and word frequency. On a set of 40 5-letter 1-syllable words exactly matched to 40 5-letter 2-syllable words with stress on the first syllable, there was no effect of number of syllables (1-syllable 29/40; 2-syllable 27/40). In contrast, with 40 3-letter monosyllables exactly matched to 40 6-letter monosyllables there was a marked effect of word length (3-letter words 37/40: 6-letter words 27/40: Fisher exact test, z = 2.50, $P < 0.01$). Word length rather than syllabic structure seems to be the important factor affecting HRM's reading accuracy.

Table 2 presents the complete set of errors for each patient. We have attempted to relate the patients' errors to particular segments of the stimulus words; in each case we base our classification on the final response produced. We found it impossible to classify these errors without considerable arbitrariness. With PW there are a number of responses to X'Y words where the first phoneme is omitted and the first syllable is represented by an unstressed vowel. Our confidence in describing these as phoneme omissions is bolstered by the occurrence of similar errors in PW's oral

TABLE 2
Error Responses

PW's Errors

MONOSYLLABLES
Related to Whole Word
WALK → walking
TREND → /strɛm/strand
WRITE → writing
COUNT → down . . boxing
BREEZE → wind
Related to Part of Word
SPRUCE → /splaɪt/
SCHEME → Schweppes
PHRASE → rack
THEME → seem
GRADE → rack
SPHERE → fear
TREAT → eating or . . er meal
Not Obviously Related to Word
PAUSE → flaw? perhaps?
SOON → perhaps

'XY WORDS
Related to Whole Word
FANCY → fantasy
MANAGE → manager
RESCUE → /ˈreʃu/
VISION → omen
SULTAN → yes please /ˈstʌltən/
RECENT → forward no
SUDDEN → shock or er
UTTER → gut . . gutter
ARGUE → argument
Related to First Syllable
NURSERY → nurse nurses nursing
Related to Second Syllable
FURNACE → fire no . . ace

TALENT → lent
Not Obviously Related to Word
FAMOUS → head or er
BOTHER → —

X'Y WORDS
Related to Whole Word
DEFEAT → disaster no. . lose
RETURN → home
SEVERE → seven
SALOON → birds? . . loo . . America
SELECT → super or er
RELAX → relaxed
ANTIQUE → ornament or er
SECURE → surety
CIGAR → pipe
DEGREE → career
Related to First Syllable
MATURE → mat
ROUTINE → out . . outclassed
MANURE → man . . horses . . man
Related to Second Syllable
ATTACK → tacker
AFRAID → fear or er raid
DESIRE → love or er sir . . surge
DEBATE → parliament no . . eat
Deletion of First Phoneme
BALLOON → /əˈlun/
CEMENT → /ɪˈmɛnt/
CANOE → /əˈnu/
SALUTE → /əˈlut/
AFFAIR → fair
Not Obviously Related to Word
PARADE → /mɪmɪˈlad/
UNIQUE → —

TABLE 2
Error Responses

HRM's Errors

MONOSYLLABLES
Related to Whole Word
HARSH → harass . . harrassment no
SKILL → skilled
WRITE → writing
LEARN → learning
SAINT → saints
TREND → the mill and er British
miners and er [via TRENT?]
Not Obviously Related to Word
PHRASE → —
STRAIN → —
GRADE → —

'XY WORDS
Related to Whole Word
MANAGE → management
RESCUE → the lighthouse and the seas
and rough and er stormy winds . . .
PATENT → patient
GALLON → the boat and er 14th 15th
16th and er . . .
SEASON → seasons
RECENT → current
BOTHER → /'brɒðəl/ no/'brɒðəl/
GENTLE → genteel
Related to First Syllable
MENACE → men . . craft . ./'mɛnkraft/ no
SURPLUS → surprise
Related to Second Syllable
None
Not Obviously Related to Word
FANCY → —
STEADY → —
ANXIOUS → —
EQUAL → —
SUDDEN → —

X¹Y WORDS
Related to Whole Word
EVENT → events
BALLOON → a large place and the ladies
and the men and the orchestra and so on
ANTIQUE → exquisite no Fourteenth
century for example and painting. but alas . . .
SECURE → /'ʃuərəns/
Related to First Syllable
ROUTINE → the guide to the car and . . .
POLITE → politics
Related to Second Syllable
None
Not Obviously Related to Word
DECAY → /ə'kɒɪt/
RELAX → asphyxiate no no
DEFEAT → —
RETURN → —
SEVERE → —
SELECT → —
ARRAY → —
DESIRE → —

picture naming. In addition to these deletions, five of PW's errors are
related to the stressed syllable and five are related to the unstressed. With
HRM there are two responses related to stressed and two related to
unstressed syllables. Re-analysis of our data might yield slightly different
results: when HRM said *gallon* —> "the boat and er 14th, 15th, 16th and er

. . .", he was clearly describing a *galleon,* and with *balloon* —» "a large place and the ladies and the men and the orchestra and so on", he was describing a *ballroom.* In classifying these as errors related to the whole word, we have emphasised the overall orthographic resemblance between *gallon* and *galleon* and between *balloon* and *ballroom;* we might, instead, have emphasised the fact that in both cases the first and not the second syllable is correctly represented in the word on which the response is based.

Except for PW's omissions of initial phonemes which we predicted on the grounds of his articulatory problem, the error patterns show no effect of the stimulus words' stress pattern. Moreover, PW's errors suggest that "syllable related" responses are unlikely to be attributable to any obligatory prelexical procedure on which semantic access is based, because on several occasions he produced a response related to the meaning of the whole word before continuing with a syllable related response:

furnace → fire no . . . ace
manure → man . . . horses . . . man
afraid → fear or er raid
desire → love or er sir . . . surge
debate → parliament no . . . eat

In summary, these data which are based on carefully matched experimental stimuli show no effect of a written word's prosodic structure on oral word reading by either of these deep dyslexic patients. We cannot of course claim that no deep dyslexic subject shows effects of stimulus word prosody in reading; we only know that Black and Byng's results are not generally true of all deep dyslexic subjects, nor of all the subjects who took part in their experiments.

BLACK AND BYNG'S ACCOUNT OF LEXICAL ACCESS
IN READING

Black and Byng conclude their paper by presenting a model of lexical access in reading, the crucial feature of which is that there is an operation of prosodic structure assignment which is carried out pre-lexically. According to this model, word reading consists of: (1) letter identification; (2) determination of the number of syllables in the word; (3) computation of prosodic structures compatible with that number of syllables; and (4) lexical access, guided by prosodic structure.

It should immediately be clear that this is a very radical proposal, at least in its application to English, for the simple reason that English orthography does not encode prosody. Black and Byng complain that theorists of reading have considered phonological representations only in the sense of strings of

phonemes. The reason for this, of course, is that strings of phonemes are the only phonological information which English orthography (with a greater or lesser degree of success) encodes. Some very similar orthographies do encode at least some prosodic information (for example, Spanish uses diacritics to mark exceptional stress patterns); and as Black and Byng point out (1986, p.397), there is no reason in principle why English orthography should not instantiate prosody in some aspect of graphic or visual representation. But the fact remains that it does not.

Thus there is nothing in the orthography to suggest different stress patterns for *nature* and *mature, mistress* and *distress, simply* and *imply,* or for the separate readings of *forbear, subject,* or *refuse.* Black and Byng are aware of this, and propose that the entire limited range of potential prosodic structures for each word is computed. For bisyllables such as those Black and Byng used in their experiments, four patterns are possible: (1) a syllable with a full vowel followed by a syllable with a reduced vowel *(nature);* (2) two full syllables of which the first bears primary stress *('forbear);* (3) two full syllables, with primary stress on the second *(for'bear);* or (4) a syllable with a reduced vowel followed by a syllable with a full vowel *(mature).* (Black and Byng in fact conflate these last two patterns.)

The phonological theory which Black and Byng adopt is that of Selkirk (1980). In this theory there is a level of prosodic structure above the syllable: the foot. A foot consists of one strong syllable followed optionally by one or more weak syllables. Thus of the four possible patterns for bisyllables, only (1) constitutes a single foot; the other three have a foot boundary preceding the second syllable.

Although Black and Byng go to some length to describe Selkirk's concept of the foot and its role in the potential prosodic patterns for bisyllables, it plays no real role in their model of how the lexicon is accessed. The first crucial feature of this final stage of their reading model is that prosodic structures are assigned and/or tested against the lexicon in a preferential order. Black and Byng specify only one component of this ordering: pattern (1), given here, is the preferred pattern for bisyllables. (Since pattern (1) is the most common prosodic pattern in the English vocabulary [Carlson, Elenius, Granstrom, & Hunnicutt, 1985], it would in fact not be surprising for it to be a preferred choice even in the absence of information about number of syllables!) The result of this ordering is that lexical access for any word with a minority structure involves one or more wasted attempts before access is finally achieved.

The second crucial feature is that lexical access proceeds first by finding a match to the stressed syllable; only once that portion of the word is matched will a match be sought for the other syllable of a bisyllabic word. It should be pointed out that in this respect their model is internally inconsistent, since syllable-by-syllable lexical access (Black & Byng, 1986, p.400) requires

explicit syllabification, a procedure which they claim to be unnecessary in their model (op. cit., p.399). Black and Byng are not specific about the nature of lexical organisation: they do not consider, for instance, whether the syllable-by-syllable access process for bisyllables initially searches a list of all potentially stressed syllables, a list of syllables which can be stressed in bisyllables, or something else. But it should be pointed out that prosodically based subdivisions of the lexicon will not necessarily accomplish a large reduction of search set size in comparison with, say, subdivisions based on linear structure. By far the majority of English words are either monosyllabic or polysyllabic with an initial strong syllable; the set of potential stressed syllables and the set of potential initial portions will be not only similar in size but largely co-extensive.

Black and Byng's model can be distinguished, then, from a "traditional" view, in which lexical access is based on a linearly ordered orthographic representation, in the following way:

1. Access of *nature* and *'forbear* involves the additional operations of syllable counting, computation of prosodic structure, division into syllables, and separate search for the second syllable subsequent to successful matching of the first.
2. Access of *mature* and (presumably) *for'bear* involves the additional operations of syllable counting, computation of prosodic structure, division into syllables, unsuccessful search for a match for the initial syllable, and repeated separate search for a match for the initial syllable subsequent to successful matching of the second syllable.

No aspect of Black and Byng's model offers savings over the "traditional" model, e.g. by omitting an operation or reducing search set size.

It is worth noting, furthermore, that Black and Byng's proposal implies that mechanisms of lexical access are different in the recognition of written and spoken language. Prelexical prosodic structure assignment is not a possible operation in auditory word recognition. Prosodic structure can only be assigned when the number of syllables in the word is known; i.e. it is necessary to know (at least roughly) where a word begins and ends. However, there is no evidence that listeners delay initiation of lexical access until word-final boundaries have been established. On the contrary, there is abundant evidence that the auditory recognition of words both in continuous speech and in isolation is under way well before the acoustic realisation of the word has concluded (Marslen-Wilson, 1985; Marslen-Wilson & Welsh, 1978). Moreover, there is direct evidence that lexical prosody is *not* involved in the prelexical access code in auditory word recognition. Cutler (1986) demonstrated that the recognition of words like *forbear,* with two unrelated readings which are distinguished by stress but not by segmental phonetic differences, involves momentary activation of the

meanings of each reading, irrespective of which stress version is presented. In other words, prior to lexical access, *'forbear* and *for'bear* are as effectively homophonous as, say, *match* and *match.*

In summary, Black and Byng propose that models of reading should incorporate an operation which: (1) is supplied with no direct bottom-up input from the orthography; (2) offers no benefit of skipping or speeding other operations to offset the cost of extra operations in the recognition process, and in fact acts only to disadvantage the recognition of one set of words while not facilitating the recognition of any set; and (3) results in a claim that the lexical access process in reading uses phonological information for which the lexical access process in listening has no use. It is clear that such a proposal requires powerful motivation.

In fact, Black and Byng offer none. The sole justification for their proposal is explanation of their data; they make no attempt at independent motivation. As we have argued here, their data in fact do not warrant their explanation. Therefore their proposal is completely without foundation.

Black and Byng do, however, make certain subsidiary points in support of their proposal. Firstly, they argue that alternative models cannot explain some part of their data. For instance, they claim that a postlexical explanation of semantic and derivational errors involving stressed syllables is incompatible with those errors that involve missyllabification and erroneous instantiation of phonemes (1986, p.404); and that a prefix-stripping account of errors on X'Y words is incompatible with errors which involve segmentation in violation of morphological structure (1986, p.378). They continue (1986, p.378): "if errors were a product of such a . . . procedure, this should be true of all subjects and be consistently reflected in their errors". Such arguments can be dismissed; no model can rule out the possibility of occasional exceptions to a performance rule. Indeed, Black and Byng admit that a number of their subjects' responses did not conform to the predictions of their own model. It is unclear why they apply more stringent criteria to rival proposals than to their own.

Secondly, Black and Byng argue that prelexical prosodic assignment procedures must exist because normal readers can assign stress to unfamiliar and nonsense words, and, moreover, show specific preferences in doing so. However, the preferences which readers show may equally well be accounted for by proposing that stress is assigned to unfamiliar and nonsense words by analogy to existing words. Precisely such a procedure of analogy construction has been suggested by those who have carried out such studies (e.g. Baker & Smith, 1976; Ladefoged & Fromkin, 1968; Ohala, 1974).

Thirdly, Black and Byng call attention to data from intact visual word recognition; they assert that Cutler and Clifton (1984) found lexical decision responses to be faster for 'XY words than for X'Y words, a result which their model would predict. In fact, Cutler and Clifton were not interested in the

simple issue of relative lexical decision time for 'XY and for X'Y bisyllables. Because of this, they had no reason to match the 'XY and X'Y sets on length, frequency, etc., and consequently they did not do so. Since the sets were not matched, it makes no sense to base any claims on lexical decision time differences across sets. The differences are easily explained by the fact that the 'XY words were on average both shorter and more frequent than the X'Y words. When 'XY words and X'Y words are matched on length and frequency, lexical decision response times do not differ (Fay, 1980).

The issue that Cutler and Clifton's lexical decision study did address, however, is directly relevant to Black and Byng's proposal. Cutler and Clifton manipulated *prior knowledge* of word prosody. Two presentation conditions were compared: one in which all words and nonwords in each block of items had the same prosodic structure (e.g. 'XY), and subjects were informed of this; and a second condition in which each block of items contained various prosodic structures, randomly mixed. The comparison of interest was whether response time to the whole set of items, or to any prosodic subset within it, was speeded in the blocked presentation condition in comparison to the mixed presentation condition, i.e. whether prior knowledge of prosodic structure could speed lexical access.

On its most plausible reading, Black and Byng's proposal makes a clear prediction on this issue. If prosodic structure assignment is a necessary prelexical operation in reading, and if the assignment procedure in bisyllables always or even only sometimes involves more than one potential structure, then prior knowledge of correct prosodic structure should be a great help in that it will remove ambiguity. Only one prosodic assignment need be computed, and the stressed syllable can be reliably located at first pass. For those prosodic structures (e.g. X'Y) which are disfavoured, and under normal circumstances are never tried out until alternative, more favoured, structures have been rejected, prior knowledge of prosodic structure should be particularly expedient. Not only is the assignment of prosodic structure simplified and the stressed syllable identified immediately, but futile presentation of the initial syllable for lexical access is avoided. Black and Byng should therefore predict faster responses under blocked than under mixed presentation conditions in Cutler and Clifton's experiment; moreover, they should predict a particularly strong effect for X'Y words.

In fact, Cutler and Clifton found no significant effect of the blocking manipulation at all, either for all words or for any prosodic subset. Thus Cutler and Clifton's results provide direct counter-evidence to Black and Byng's proposal. It might be suggested that this reading of the proposal is incorrect, and that Black and Byng would argue instead that the ordering of prosodic structures is involuntary and unalterable—'XY patterns will always be presented to the lexicon before X'Y patterns. However, this

interpretation of their proposal in turn makes a still more counter-intuitive prediction, namely that where both 'XY and X'Y versions of a word exist, the 'XY version will always be a preferred naming response, irrespective of, say, relative frequency of the two prosodic versions. Thus the written words *refuse* and *object,* for instance, should preferentially be pronounced *'refuse* and *'object.* Both possible pronunciations of these words share a two foot structure; if foot structure as well as stress pattern plays a role in Black and Byng's pre-lexical prosodic assignment procedure, it is conceivable that they could predict that the preferred pronunciations will be *re 'fuse* and *object.* Either way Black and Byng must predict that the *same* stress pattern will be preferred for both these words. But when we presented the word *refuse* to 32 normal subjects, 30 of them named it as *re'fuse;* only two said *'refuse.* With *object* 100% said *'object.* Clearly the preferred pronunciation of these words is not a result of any pre-lexical assignment of potential prosodic structures.

CONCLUSION

Black and Byng's proposal that prosody constrains lexical access in reading offers no theoretical advance and is in conflict with evidence from studies of normal reading. The evidence from impaired reading upon which they base their proposal is vitiated by inadequate control of stimulus materials and improper data analysis. An alternative interpretation accounts both for their findings and for new data which their model cannot explain. We conclude that the claim that lexical access in reading is prosodically guided must be rejected.

APPENDIX: STIMULUS MATERIALS

Monosyllable	*'XY Words*	*X'Y Words*
flask	tiger	canoe
mouse	salad	cigar
nurse	rabbit	saloon
plant	window	hotel
spruce	sultan	salute
freeze	gallon	manure
bronze	button	cement
sphere	saddle	parade
walk	season	attack
write	pretty	degree
scratch	furnace	balloon

Monosyllable	'XY Words	X'Y Words
sleeve	nursery	antique
breeze	thunder	romance
spring	corner	machine
clown	jelly	canal
phrase	patent	mature
grade	sudden	debate
treat	talent	secure
blame	bother	affair
scheme	manage	select
skill	steady	severe
theme	budget	unique
learn	famous	desire
brief	equal	event
soon	recent	return
sheer	gospel	decay
brave	gentle	alert
trick	rescue	reward
strain	argue	defeat
count	vision	afraid
harsh	utter	array
saint	fancy	relax
blunt	menace	polite
trend	anxious	mistake
pause	surplus	routine

	Monosyllables		*'XY Words*		*X'Y Words*	
	Mean	*S.D.*	*Mean*	*S.D.*	*Mean*	*S.D.*
Log K&F wf	1.393	0.441	1.385	0.448	1.389	0.449
Imageability	461	101	460	100	460	101
No letters	5.290	0.620	5.940	0.590	5.910	0.660

REFERENCES

Baker, R.G. & Smith, P.T. (1976). A psycholinguistic study of English stress assignment rules. *Language and Speech, 19,* 9-27.

Black, M. & Byng, S. (1986). Prosodic constraints on lexical access in reading. *Cognitive Neuropsychology, 3,* 369-409.

Carlson, R., Elenius, K., Granstrom, B., & Hunnicutt, S. (1985). Phonetic and orthographic properties of the basic vocabulary of five European languages. *Speech Transmission Laboratory (Stockholm): Quarterly Progress and Status Report, 1/1985,* 63-94.

Coltheart, M. (1981). The M.R.C. psycholinguistic database. *Quarterly Journal of Experimental Psychology, 33A,* 497-505.

Cutler, A. (1981). Making up materials is a confounded nuisance. Cognition, 10, 65-70.

Cutler, A. (1986). Forbear is a homophone: Lexical prosody does not constrain lexical access. Language and Speech, 29, 201-220.

Cutler, A. & Clifton, C.E. (1984). The use of prosodic information in word recognition. In H. Bouma & D.G. Bouwhuis (Eds.), Attention and performance X. Hillsdale, N.J.: Lawrence Erlbaum Associates Inc.

Derouesne, J. & Beauvois, M.-F. (1985). The "phonemic" stage in the nonlexical reading process: Evidence from a case of phonological alexia. In K.E. Patterson, J.C. Marshall, & M. Coltheart (Eds.), Surface dyslexia. London: Lawrence Erlbaum Associates Ltd.

Fay, D.A. (1980). Morphology and stress in the mental lexicon. Final report to National Institute of Mental Health, N.I.M.H. Grant No. R03MH32912.

Funnell, E. (1987). Morphological errors in reading: A case of mistaken identity. Quarterly Journal of Experimental Pyschology, 39A, 497-539.

Howard, D. (1987). Reading without letters? In M. Coltheart, G. Sartori, & R. Job (Eds), The cognitive neuropsychology of language. London: Lawrence Erlbaum Associates Ltd.

Howard, D., Patterson, K.E., Franklin, S., Morton, J., & Orchard-Lisle, V.M. (1984). Variability and consistency in picture naming by aphasic patients. In F.C. Rose (Ed.), Advances in neurology 42: Progress in aphasiology. New York: Raven Press.

Kucera, H. & Francis, W.N. (1967). Computational analysis of present-day American English. Providence, Rhode Island: Brown University Press.

Ladefoged, P. & Fromkin, V.A. (1968). Experiments on competence and performance. I.E.E.E. Transactions on Audio and Electroacoustics, AU-16, 130-136.

Marslen-Wilson, W.D. (1985). Speech shadowing and speech comprehension. Speech Communication, 4, 55-73.

Marslen-Wilson, W.D. & Welsh, A. (1978). Processing interactions and lexical access during word recognition in continuous speech. Cognitive Psychology, 10, 29-63.

Morton, J. & Patterson, K.E. (1980). A new attempt at an interpretation or an attempt at a new interpretation. In M. Coltheart, K.E. Patterson, & J.C. Marshall (Eds.), Deep dyslexia. London: Routledge & Kegan Paul.

Ohala, J.J. (1974). Experimental historical phonology. In J.M. Anderson & C. Jones (Eds.), Historical linguistics, Vol. 2. Amsterdam: North-Holland.

Patterson, K.E. (1980a). Reading errors of PW and DE. In M. Coltheart, K.E. Patterson, & J.C. Marshall (Eds.), Deep dyslexia. London: Routledge & Kegan Paul.

Patterson, K.E. (1980b). Derivational errors. In M. Coltheart, K.E. Patterson, & J.C. Marshall (Eds.), Deep dyslexia. London: Routledge & Kegan Paul.

Selkirk, E..O. (1980). The role of prosodic categories in English word stress. Linguistic Inquiry, 11, 563-606.

Shallice, T. & Warrington, E.K. (1975). Word recognition in a phonemic dyslexic patient. Quarterly Journal of Experimental Psychology, 27, 187-199.