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Sounds of contrast: An empirical approach to phonemic iconicity

David S. Miall*

Department of English, University of Alberta, Edmonton, Alberta, Canada, T6G 2E5

Abstract

A strong intuition that phonemic qualities suggest meaning has motivated discussions of the sound of language since the time of Plato. However, studies of phonetic symbolism this century have been inconclusive: while systematic contrasts of meaning have often been found, these are not necessarily due to innate phonetic meanings. An alternative approach is presented based on a theory of phonemic iconicity, which suggests that phonemic patterns systematically support the presence of contrasts in meaning. A method for measuring phonemic distributions is outlined. Contrasts in vowel and consonant frequencies are shown to underlie not only differences between word groups, where phonemic contrasts can be expected, but also important differences in several literary texts. The method is tested empirically with data provided by readers of a short story. Here, phonemic contrasts were found to contribute to variations in reading speed and readers' ratings of story segments, suggesting that readers were sensitive to variations in tonal patterns while reading the story.

1. Introduction

The eighteenth-century English poet Pope provided the most succinct phonetic theory of poetry: "The sound must seem an Echo to the sense" (*Essay on Criticism*, II, 365). Since the time of Plato, many commentators have remarked that the sound of a word should suggest its meaning. In the *Cratylus*, Plato (1963) represents Socrates arguing that a legislator must "know how to put the true natural name of each thing into sounds and syllables, and to make and give all names with a view to the ideal name" (389d). Opposed to this view, the linguist de Saussure (1974: 67–70) asserted that the sound of language was arbitrary, and most recent literary theorists have tended to agree with him. Yet a number of empirical studies of

* E-mail: David.Miall@Ualberta.Ca

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phonetic symbolism carried out over the last century suggest that hearers may be able to make consistent phonetic discriminations, whether matching phonemic strings from different languages or judging which of two syllables is 'light' or 'dark'. In this paper I briefly review the empirical studies, but suggest that their atomistic and decontextualized approach, testing responses to small groups of phonemes, is responsible for their inconclusive findings. I outline an alternative approach based on studies incorporating all naturally occurring phonemes in standard English, and show its effectiveness in two respects: first, in measuring contrasts occurring within or between texts, including several literary texts, and second, its power in predicting readers' responses to a modernist short story. While numerous studies in stylistics have been devoted to examining the interpretive meanings suggested by phonetic phenomena, almost no empirical studies with readers have been carried out. The present paper thus outlines a new method for empirical examination of phonetic phenomena.

Do the sounds of words convey meaning? The sound of poetry, for example, is often held to be expressive. But as Tsur has pointed out, although an extensive literature is devoted to this topic, "much of it is ad hoc, arbitrary, or skeptical" (Tsur, 1992: 1). Do /i/ or /p/ sounds connote smallness or brightness? Does /g/ connote heaviness, and /u/ darkness? This is the hypothesis of phonetic symbolism, i.e., the proposal that specific phonemes encode innate meaning, whether visual, spatial, or kinaesthetic. The most familiar form of sound-meaning is onomatopoeia, the imitation of a natural sound by a word form: for example, the words *hiss*, *miaow*, or *crack* each appear to embody phoneme clusters that sound similar to the event they name. In a recent study of this phenomenon, Hugh Bredin suggested that "onomatopoeia is not a trivial and incidental phenomenon of usage, but answers to a deep-seated need that lies at the heart of the linguistic consciousness. We want language to be onomatopoeic" (Bredin, 1996: 560). Similarly, Genette's discussion of the principle of 'Cratylism', referred to it as "a myth: it is above all a *seductive* myth" (Genette, 1979: 361).

But in the current theoretical climate critics have set their face against such seduction. In his influential essay on stylistics Stanley Fish objected to any form of stylistics arising from "the desire for an instant and automatic interpretive procedure based on an inventory of fixed relationships between observable data and meanings" (Fish, 1980: 70–71). While Fish did not deny the existence of formal properties, he went on to argue that we come to them within a framework of meaning already in place: "[M]eanings are not extracted but made and made not by encoded forms but by interpretive strategies that call forms into being" (Fish, 1980: 172–173). The intuition that sound makes an independent contribution to literary meaning is thus unacceptable to Fish. The intuition, however, is in accord with some substantive phenomena: hearers do make consistent judgements about phonetic meanings under a number of conditions (e.g., Newman, 1933), and analysis of several literary texts has shown arrays of phonetic features that appear to be consistent with their tone (e.g., Fónagy, 1961). As I will suggest, while these studies are suggestive, we lack an integrative framework in which to relate such findings; such a perspective is required in order to examine to what extent systematic sound differences occur in literary texts, and, if so, whether readers are sensitive to them. In the following section a review of prior studies will indicate the basis for developing an integrated perspective on sound meaning in literature. In brief, I will argue that while studies in phonetic symbolism are suggestive, the evidence for innate meaning is inconclusive. I will present an alternative framework that I term *phonemic iconicity*, in which phoneme distributions are shown to systematically embody contrasts of meaning. This approach accounts for the existing findings as well as those to be presented later.

2. Studies in phonetic symbolism

Onomatopoeia is only one small and perhaps unsystematic dimension of phonemic iconicity, and it was a dimension that de Saussure was easily able to dismiss. But his influential claim that the sound of language is arbitrary, or conventional, overlooks a wide range of other types of evidence, some of which have been studied as far back as the ancient linguist Panini (for reviews and additional studies see Brown, 1958; Pinker and Birdsong, 1979; Taylor and Tayor, 1965). In this section, however, I mention only those studies that examined phonemic contrasts, a type of study in which dimensions of meaning (light–dark, small–large) are supposed to be symbolized by particular phonemes.

In order to isolate the tonal qualities of phonemes, the early studies used nonsense syllables. Sapir (1929) carried out a study that examined contrasts between phonemes: he asked participants to classify pairs of verbal items, such as the nonsense words *mil* and *mal*. Asked to say which was light or heavy, respondents showed a high level of agreement. Building on this study, Newman (1933) investigated a wider range of phonemes, obtaining judgements on pairs of nonsense syllables that systematically contrasted short 'words' devised from 9 vowels and 21 consonants on the scale small-large. Again, a high level of agreement was obtained, showing a consistent ordering of vowels and consonants from front to back of the oral tract. From this he derived a 'magnitude scale' which he tested against a set of actual English words. Using a thesaurus, he extracted a range of words connoting smallness (183 words) and largeness (167 words), and computed the magnitude of each word. But the resulting scale showed almost no difference between the two sets of words, leading him to conclude that the distribution of phonemes in the two categories was 'fairly random'. The study thus appears to dismiss any more general relation of sound and meaning. A similar study by Bentley and Varon (1933) arrived at the same conclusion: while obtaining consistent results from comparing nonsense monosyllables (e.g., *fim* and *fam*) on several dimensions – small–large, angular– round, hard–soft (Study 4), they called in question the phenomenon of phonetic symbolism. Simply making a choice about 'some sort of difference' doesn't establish the inherent validity of the meaning. While such contrasts may have aesthetic value, they concluded, it cannot be said that "these graded attributes of sound carry in their own right (so to say) a symbolic reference" (Bentley and Varon, 1933: 85).

A different approach to phonetic symbolism was employed by Tarte and his colleague. Two types of graphical figures, elliptical or triangular, were used to represent sounds considered to be round, sharp, large, or small. In several studies (Tarte and Barritt, 1971) they were able to show that subjects consistently related these shapes to nonsense words consisting of consonant-vowel-consonant (e.g., *wus*, *kas*). For example, large figures were paired with the broad vowel /a/, and small figures with the narrow vowel /i/. In general, triangles were associated with /i/, and ellipses with /u/. In Tarte (1982), nonsense words were paired with tones of different pitch, and judged using semantic differential scales. In both studies a high level of consistency was found in subjects' judgements. They suggest that the sound frequency of vowels is the critical factor in judgements of phonetic symbolism. Tsur (1992: 21–23), on the basis of acoustic analysis, suggests that the position and relation of the first and second formants plays the key role in such perceptions.

In two studies, Taylor (1963) and Taylor and Taylor (1965) reviewed the evidence for phonetic symbolism: this led them to dismiss any underlying physiological or acoustic basis for it. The strong hypothesis of phonetic symbolism suggests a fixed relationship between sound and meaning in any language (Taylor, 1963: 200), but in word matching studies across languages results have been contradictory. Participants are given a word or pair of words, and attempt to identify the corresponding words in an unknown language on the basis of sound. While participants appear able to perform this task at above chance levels of correctness (Brown et al., 1955), comparisons show that the same phonemes often represent different qualities across the languages studied (Taylor and Taylor, 1962). Studies such as that of Newman (1933), in which participants judge pairs of nonsense words on small–large, or bright–dark dimensions have been more successful, but it is unclear whether the results generalize beyond English.

Taylor and Taylor (1965) compared responses to nonsense syllables in four unrelated languages, and found that while in each language consistent judgements were made, little similarity occurred between languages: for example, a phoneme judged large in one language was judged small in another. Taylor (1963) suggested an alternative explanation for the findings, what she called the 'feedback' theory: it is the word meanings in a given language that accustom speakers to associate given sounds with meaning. For example, since a number of English words connoting large size begin with /g/ (grand, great, gross), this leads to the promotion of /g/ for bigness, hence the choice of words beginning with /g/ when largeness is in question. Taylor re-examined Newman's (1933) lists of large and small words: she showed that a significantly higher proportion of large words begin with /g/ or /k/, whereas more smaller than large words begin with /t/ or /n/. In addition Taylor and Taylor (1965) also re-examined the lists for initial vowel differences: they found /ɪ/ and /ɛ/ (small vowels) to predominate in small words, and /u/ and /o/ (large vowels) to predominate in large words. Both findings are statistically significant.

But Taylor and Taylor (1965) make an important distinction between objective and subjective phonetic symbolism. While words of a particular type are found to contain a higher than expected proportion of a certain phoneme (such as Newman's large words that begin with /g/ or /k/), this can have no general significance if hearers are unaware of it: we must also study subjective symbolism and show that such differences have an impact of some kind on hearers or readers. This is a key issue for the present study. While literary studies of stylistic features at the phonetic level are common, and often highly suggestive (e.g., Masson, 1967), critics make no attempt to verify their intuitions with readers.

Whatever its source, however, several other studies point to the validity of phonemic contrasts as an underlying source of meaning. Just as Newman's lists of small and large words are found to be phonetically distinctive when closely examined, so are the differences between men's and women's names. Cutler et al. (1990) studied 884 female and 783 male names. Among other differences, they found that more male than female names started with a strong stress; they also found female to be longer than male names. In a study of vowel frequency, female names were shown to contain a significantly higher proportion of the brighter /i/ vowel (usually stressed, as in *Lisa*, *Mimi*), and fewer of the darker vowels /ɑ/ and /ɔ/. In seeking to explain this finding, they suggest this may be due to the association of the small, bright vowels with the type of sound produced by the smaller vocal tract of the female. No studies of names in other languages have been carried out, as far as I am aware.

A few empirical studies of literary examples have been reported. For example, Fónagy (1961) examined the different tone qualities in a group of Hungarian poems according to topic. In six aggressive and six tender poems by Petöfi, /l/, /m/, and /n/ were more frequent in the tender poems; /k/, /t/, and /r/ predominated in the aggressive poems (a number of other examples are described in his report). Tsur (1996) suggests that the speech sounds acquired later by infants possess greater emotional and aesthetic value (1996: 62; cf. Tsur, 1992: 52–58). This helps to account for the power of the frequent nasal vowels and '-eur' word endings that occur in the symbolist poet Baudelaire: these two features are said to be 2.5 times more frequent in a sample of Baudelaire than in a similar size sample from a seventeenth-century poem by the French author Boileau (Tsur, 1996: 63). Tsur suggests that in the case of symbolist poetry "the rich precategorical auditory information may get out of control, reverberate at large, and assume the emotive affects of nonreferential sound gestures" (Tsur, 1996: 74).

In a more systematic, statistically-based study, Bailey (1971) applies information theory to a group of texts to show whether in certain literary texts some phonemes have a tendency to occur more frequently than expected, when compared with samples of normal prose. A higher than expected frequency of certain phonemes in several poems leads him to propose a 'prominence index' for phonemes. The frequency of phonemes in a given poem is used to place phonemes in rank order; these ranks are then compared with the ranks in a sample of standard English. Higher frequency of a given phoneme is more likely to be noticed by a reader, especially where a phoneme is relatively rare. This method revealed a high frequency of the low, back vowel /ɔ/ in one text examined. It also revealed meaningful patterns in Dylan Thomas's poem 'Fern Hill', such as a preference for voiced over unvoiced consonants. In a second poem, a preference for back over front vowels could be demonstrated, which could be related to the aesthetic quality of the poem.

Finally, Lindauer (1988) was able to demonstrate an appreciation of meaning in the titles of short stories in an unknown language. Lindauer suggested that the title of a short story conveys its meaning in part through its sound. Using several different tasks, such as multiple choice, or the matching of pairs of titles, participants unfamiliar with one language compared Hungarian and English versions of titles. Among English-speaking subjects a significantly higher proportion of correct responses was obtained than would be expected by chance: for example, for 28 titles in the multiple choice study, the mean number correct per subject was 17.4 compared with 9.2 incorrect, a significant difference, $p < 0.01$. Hungarian speakers showed a similar level of response.

This brief review of the main studies in phonetic symbolism shows that the concept has some support. Judgements on dimensions such as small–large are consistent among speakers of English, although speakers of other languages may map different phonemes onto this dimension. But it remains unclear whether symbolism is generated from word meanings in a given language, as Taylor (1963) argued, or is an innate quality of the acoustic components of phonemes, an issue judiciously examined by Tsur (1992). At the same time, several studies have shown systematic differences in phonetic frequencies in poetic texts that correspond with their tone and meaning. The examination of phonetic distributions in the words for smallness or largeness, or in male and female names, also appears to show the effectiveness of phonetic analysis within specific domains. It seems probable, then, that while phonemes have no intrinsic meaning – /i/ is not invariably small or bright – they possess a potential meaning capable of realization when a contrast is in question (/i/ is more likely to contribute to smallness or brightness). In other words, phonemic contrasts can help to motivate meaning in a literary text, as well as direct choices in nonliterary contexts such as the formation of names. No method so far, however, has been proposed for examining phonemic contrasts systematically. In the next section I outline a new method for modelling such contrasts and describe its application to several sample texts.

3. Modelling phonemic contrasts

The physiology of pronunciation appears to offer a basis for the meaning dimensions attributed to phonemes. For example, Tsur (1992: 5–6) suggests that the position in the oral tract, that is, the contrast of front and back vowels, underlies such dimensions as bright-dark. Such a dimension is inherent in the typical vowel-space diagram (e.g., Clark and Yallop, 1990: 67; O'Grady et al., 1989: 30), which displays both a front–back dimension, and a high-low dimension. A similar arrangement is possible for consonants (although this is less commonly displayed graphically, since more variables enter into the question: e.g., voiced vs. unvoiced); but here also, two overall dimensions are evident, front–back and soft–hard.

On the basis of these dimensions, it is possible to place the vowels experimentally into two orders: (1) a front–back ordering with /i/ first in the list and /ʊe/ last, including dipthongs; and (2) an order corresponding to high–middle–low position;

given the coarser framework this provides, the vowels at each level are also sorted by their front–back position. Although the position of each vowel in these orderings is not without question, after some trial and error I produced orderings that appear satisfactory, as the analyses to be reported suggest. Each vowel was given a number corresponding to its rank in the two orderings. To foreground the dimensions in question, the ranks range from +9 to +1 for front vowels, and from 0 to −10 for back vowels, with a similar range for high-low. The rank orders are shown in Table 1, together with the IPA symbol for each vowel. To facilitate analysis, the vowels were also placed in four groups: two front (high and medium) and two back (medium and low), as shown in the left-hand column of the Table. Two other features of vowels were also considered, given their potential contribution to sound: first, absolute vowel length, which involved identifying such long vowels as /a/ in bard, and /u/ in food, and all the diphthongs; second, the vowel lengthening that occurs before voiced stops and fricatives, known as the vowel shift. Thus two measures based on the frequency of long vowels and the frequency of vowel shifts were devised.

Table 1
Rank orderings of 20 vowels

Group[a]	IPA	Example	Front–back	High–low/front–back
v-f1	i	bead	9	9
	ɪ	bid	8	7
	e	day	7	5
	ɛ	bed	6	1
v-f2	ɪə	beer	5	−2
	ɛə	bare	4	−1
	æ	bad	3	−7
	ay	eye	2	0
	ɔ	cord	1	−5
v-b1	ʌ	bud	0	−3
	a	bard	−1	−8
	aʊ	cow	−2	−4
	ɑ	cod	−3	−10
v-b2	ɜ	bird	−4	4
	ə	the	−5	3
	ʊ	good	−6	6
	oʊ	go	−7	2
	u	food	−8	8
	ɔɪ	boy	−9	−6
	ʊe	tour	−10	−9

[a] Key to Groups: v-f1: vowels, high front; v-f2: vowels, medium front; v-b1: vowels, medium back; v-b2: vowels, low back.

The consonants were also placed in two rank orders, as shown in Table 2. Again, the positive ranks are used to indicate front consonants, beginning with /b/, and negative ranks are assigned to back consonants, ending with /k/. The consonants are also placed in four groups, which cut across the two rank orderings: these are (1)

Table 2
Rank orderings of 24 consonants

Group[a]	IPA	Example	Front–back	Soft–hard
fa-u	f		6	−1
	θ	thin	2	−2
	s		−1	−3
	š	shed	−5	−4
	h		−6	1
	č	etch	−8	−6
fa-v	v		7	4
	ð	then	3	3
	z		0	2
	ǰ	beige	−4	1
	dʒ	edge	−7	−5
g-l-n	w		8	11
	y	yet	−10	10
	l		5	9
	r		4	8
	m		10	7
	n		1	6
	ŋ	sing	−9	5
pl	b		11	−7
	p		9	−10
	d		−2	−8
	t		−3	−11
	g		−11	−9
	k		−12	−12

[a] Key to Groups: fa-v: fricatives and aspirates, voiced; fa-uv: fricatives and aspirates, unvoiced; g-l-n: glides, liquids, and nasals; pl: plosives.

unvoiced fricatives and aspirates; (2) voiced fricatives and aspirates; (3) glides, liquids, and nasals; and (4) plosives.

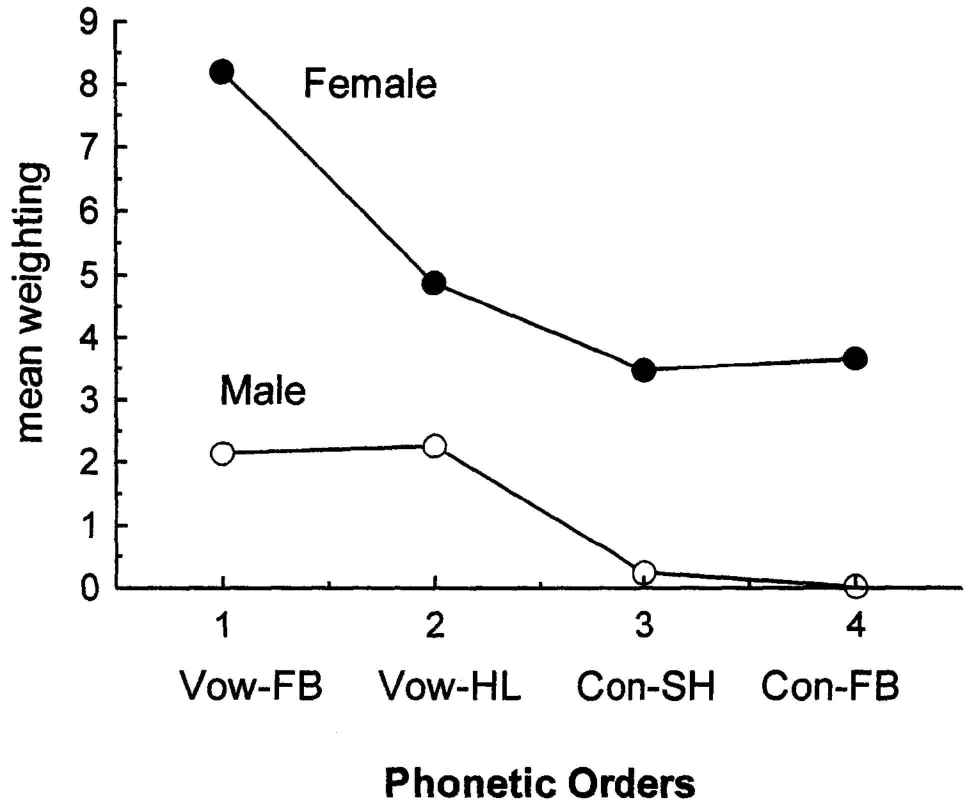
A suite of programs was created to obtain measures of vowel and consonant occurrences in texts. This was achieved as follows. First, the text to be examined was submitted to the Internet facility *Say* (Belinfante, 2000) for phonetic transcription: the program returns a phonetic code based on standard English pronunciation, comprising 20 vowels and 24 consonants. Taking each line of text, the code was then analysed to produce a mean count of vowel lengths (absolute length; vowel shift), and the mean ranks of the two vowel orderings and the two consonant orderings. In other words, the rank of each separate phoneme contributed separately to an overall numerical measure of the phonemes in a given line of text. Although the effect of a phoneme may change according to its context, such changes are probably minimal: the accumulation of separate scores is supported by the finding of Taylor and Taylor (1962) that on a small–large judgement for three letter syllables, no interactions between letters occurred; the best predictor of subjects' judgements was the sum of individual letter scores. Thus the output of the procedure was a set of scores for each line of text. For example, counting the vowels on the front–back dimension, the following line from *Paradise Lost* scores a mean rank of 46: "Satan, with thoughts inflamed of highest design" (II.630); this shows that the line is high in front vowels. This line – "If shape it might be called that shape had none" (II.667) – scores −65 on soft-hard consonants, showing that it has a concentration of hard consonants. A second program calculated a score for each line according to the frequency of phonemes in each group, i.e., the number of high front vowels, or the number of unvoiced fricatives and aspirates (eight scores in all). These measures were then applied to several texts and groups of texts to test their validity.

As shown by the analyses of Taylor (1963) and Taylor and Taylor (1965), the list of words for smallness and largeness, which Newman (1933) was unable to distinguish with his measures, were found to be significantly different. They reported that large words begin more often with /g/ or /k/ (hard, back consonants) and contain more back vowels /u/ and /o/. The present measures of phonemic iconicity validate not only these findings, but also show several other distinguishing features. Comparing the same groups of words for smallness (183 words) and largeness (167 words), on *t*-tests for difference (the mean rank data are normally distributed, making this test acceptable), large words contain a higher frequency of vowel shifts (means: Large, 0.395; Small: 0.290), $t(348) = 1.792, p < 0.05$. Small words contain markedly more front vowels (mean ranks: Large: 2.75; Small: 5.0), $t(348) = 2.537$, $p < 0.005$. No significant difference was found in the consonant rankings. On the phoneme groups, however, several differences in the predicted direction were found. (Since the large words were longer than the small, and the phoneme group data were not normally distributed, data were converted to a measure per phoneme (dividing by frequency) and the Mann-Whitney test of difference was used, with significance assessed by Z-score.) On consonant groups, Large words contained more voiced fricatives and aspirates, $Z = 2.95, p < 0.005$, and more unvoiced fricatives and aspirates, $Z = 1.75, p < 0.05$, while Small words contained more plosives, $Z = 2.43, p < 0.01$. On vowel groups, Small words contained more high front vowels, $Z = 1.63, p = 0.05$, while Large words contained more medium back vowels, $Z = 2.16, p < .02$ and markedly more low back vowels, $Z = 3.20, p < 0.001$.

The validity of the method was also tested by examining the difference between male and female names, following the report of Cutler et al. (1990). Since the extensive list of names they employed was not available, I took names from those given most frequently to babies in the U.S.A. in 1996, a list that provided 50 male and 50 female names (Campbell, 2000). Examination of the mean ranks showed a significant difference on both the rank order vowel and the rank order consonant measures in the predicted direction, as shown in Fig. 1. Similarly, grouped phoneme data showed female names to contain significantly more glides, liquids, and nasals and more front vowels, but fewer voiced fricatives and aspirates and fewer medium back vowels, as shown in Fig. 2 (each of these differences is significantly different on a Mann-Whitney test).

The measures thus appear to be supported by these two analyses: they not only confirm previous findings on the phonetic distributions in words for smallness and largeness, and for male and female names, but enable additional detail to be revealed. Two validation tests were then made with literary texts where distinctive

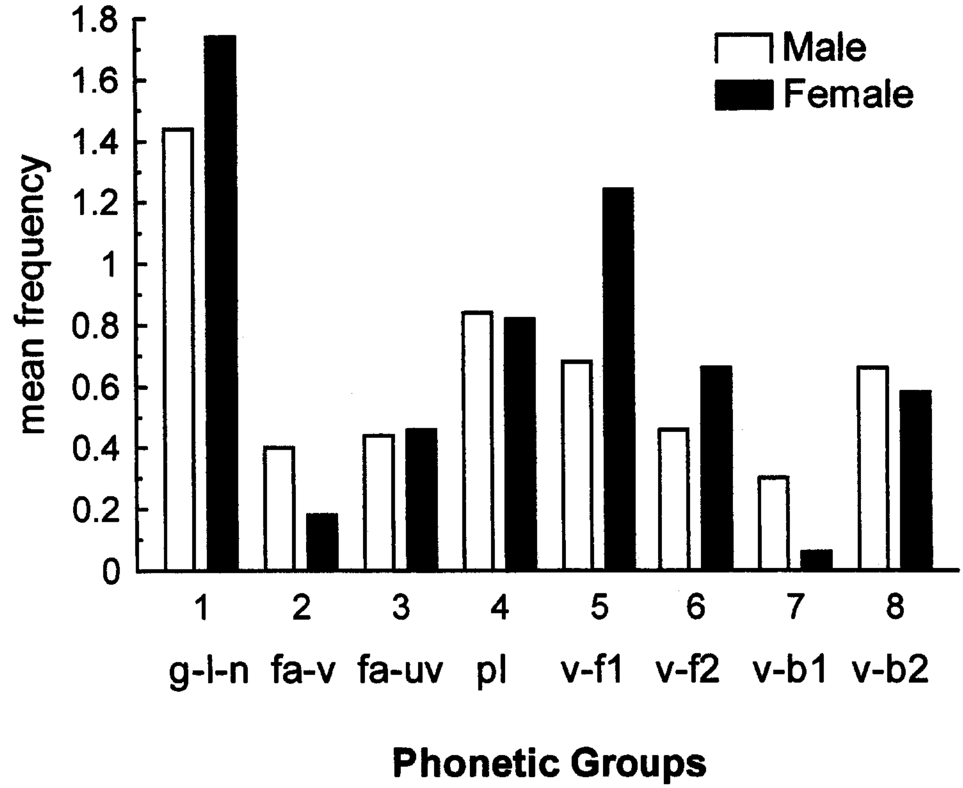
Fig. 1. Phonemic contrast of 50 male and 50 female names.



Key: Vow-FB: Vowels front-back; Vow-HL: Vowels high-low; Con-SH: Consonants soft-hard; Con-FB: Consonants front-back.

phonetic differences would be expected. First, two contrasting passages were taken from Milton's *Paradise Lost.* I compared samples of text from Book II dealing with Hell (Satan's encounter with Sin and Death at the exit from Hell: II.629–814) and from Book IV offering the first view of Eden (IV.205–355). If phonemic iconicity is drawn upon to create an underlying tone or mood, then one can expect these two passages to contrast systematically in their use of vowels and consonants: the confinement of Hell should be reflected by a greater proportion of narrow vowels and hard consonants than Eden, which will be characterized by light and space, hence more open vowels and softer consonants. Using the mean ranks of phonemes Hell was found to contain significantly more front vowels than Eden (i.e., the narrow sounds connoting confinement), $t(335) = 2.805$, $p < 0.005$; at the same time Hell contained significantly more hard consonants than Eden, $t(335) = 2.479$, $p < 0.02$. In Book II the line with the highest number of hard consonants was 714: "Each cast at th' other as when two black clouds". Lines with a high frequency of soft consonants

Fig. 2. Frequencies of phonemic groups in 50 male and 50 female names.



Key: g-l-n: glides, liquids, and nasals; fa-v: fricatives and aspirates, voiced; fa-uv: fricatives and aspirates, unvoiced; pl: plosives; v-f1: vowels, high front; v-f2: vowels, medium front; v-b1: vowels, medium back; v-b2: vowels, low back.

in Book IV are 207, "In narrow room, Nature's whole wealth, yea more" and 260, "Luxuriant; mean while murmuring waters fall"; and in Book IV a line with a high number of wider, back vowels is 256, "Flowers of all hue, and without thorn the rose". On vowel length, the vowel shift measure showed significantly more longer vowels in Eden in comparison with Hell, $t(335) = 1.822$, $p < 0.05$ (absolute vowel length was similar in both passages). These findings are supported by several phonetic group measures (making use of Mann-Whitney tests, as data was not normally distributed): Hell contains markedly more high front vowels, $Z = 2.42$, $p < 0.01$, while Eden contains more medium back vowels, $Z = 1.69$, $p < 0.05$; there is also a tendency towards more glides, liquids, and nasals in Eden, $Z = 1.34$, $p = 0.09$, but more unvoiced fricatives and aspirates in Hell, $Z = 1.55$, $p = 0.06$.

The second text to be examined was Coleridge's 'Frost at Midnight'. In this poem, Coleridge is located in his cottage at midnight where all is silent; he finds the silence disturbing, and this leads to a recollection of his days at school in London where he was unhappy. He continues the poem by anticipating a better future for his child, who will be raised amidst scenes of nature. To analyse the poem phonetically, I categorized the 74 lines of the poem into two types: 22 lines that discuss Coleridge's negative experiences in the present or at school, and the remaining 52 lines that are characterized primarily by positive experiences, either recollections of his home village or his anticipations of the future. Application of the phonetic analysis showed striking contrasts in consonant distributions in accord with this analysis: the negative lines contain markedly more back vowels, $t(72) = 3.41, p < 0.005$; from the phonetic groups, glides, liquids, and nasals are more frequent in the positive lines, $Z = 1.67, p < 0.05$, while the negative lines are higher in unvoiced fricatives and aspirates, $Z = 2.11, p < 0.02$ and plosives, $Z = 2.49, p < 0.01$. For example, line 8, classified as negative, "'Tis calm indeed! so calm, that it disturbs", contains several back vowels such as /t/, /k/, and /d/, each of which also occurs in the plosives group. Line 35, in contrast (a positive line), "Lulled me to sleep, and sleep prolonged my dreams", contains a high number of liquids, /l/ and /r/, and front consonants, such as /m/ and /p/. (More extended discussion of the stylistics of this poem is offered in Miall, in press.)

4. Readers' responses to phonemic contrasts

If phonetic differences are as systematic as the examples above suggest, then we should also expect to find effects on readers. To study this, I examined phonetic influences in a literary story for which data had already been obtained from readers. The story, 'The trout' by Sean O'Faoláin (1387 words), was divided into 84 segments (roughly one sentence) and coded for the occurrence of foregrounded features in each segment. This involved counting features such as assonance or metrical effects at the phonetic level, grammatical deviations, and semantic effects such as metaphor. A composite foregrounding measure per segment was compiled from these three sources. In a previous study (Miall and Kuiken, 1994) it was found that readers took longer to read segments high in foregrounding (after controlling for segment length), and they rated such segments higher in affect (i.e., whether the segment aroused feeling in the reader) and in strikingness (whether a given segment stands out as striking in some way). In this first study, 60 readers provided reading time data; of these, 15 readers rated for affect and 15 for strikingness. For the present study, the reader data (mean reading times and ratings per segment) were analysed in relation to the phonetic features of the story in two ways.

First, the mean phonetic ranks and the count of phonetic groups for each segment of the story was obtained. The data from readers was then correlated with each phonetic variable. The data for the first set of analyses is shown in Table 3. The data contributing to the correlations with reading time was converted to a measure per syllable in order to control for segment length. Since vowel shift and vowel length can both be expected to contribute to increased reading time, it is not surprising to find a high positive correlation between these measures and reading times. In addition, however, there are strong positive correlations with both of the vowel distribution measures (which, it will be recalled, overlap in part), but a negative correlation with the front–back consonant measure. Thus, while reading this story, readers appear to have lingered more over segments containing front and high vowels and back consonants. In rating for strong affect, on the other hand, segments with front or soft consonants and greater vowel length appear to have been more important; and in rating highly for strikingness, segments with greater vowel length or soft consonants were selected. The possible meaning of these findings will be examined shortly.

Table 3
Correlations of reader data for 'The trout' with mean phonetic variables

Phonetic variable	Reading time[a]	Affect	Strikingness
Vowel shift	0.309***	0.045	0.159
Vowel length	0.536***	0.190*	0.283***
Vowel: F/B	0.337***	–0.061	0.039
Vowel: H/L	0.316***	0.063	0.071
Conson: F/B	–0.295***	0.205*	0.037
Conson: S/H	–0.017	0.188*	0.201*

[a] Data converted to counts per syllable prior to correlation analysis
* $p < 0.1$ **$p < 0.05$ *** $p < 0.01$ (df 82; two-tailed)

Table 4
Correlations of reader data for 'The trout' with phonetic groups

Phonetic group[a]	Reading time[b]	Affect	Strikingness
g-l-n	–0.195*	0.387****	0.269***
fa-v	–0.370****	0.091	0.048
fa-uv	0.005	–0.021	0.070
pl	0.319****	-0.229**	–0.132
v-f1	0.291***	–0.252**	–0.238**
v-f2	0.211*	0.003	–0.058
v-b1	–0.246**	0.121	0.213*
v-b1	–0.250**	0.058	0.050

[a] Key. g-l-n: glides, liquids, and nasals; fa-v: fricatives and aspirates, voiced; fa-uv: fricatives and aspirates, unvoiced; pl: plosives; v-f1: vowels, high front; v-f2: vowels, medium front; v-b1: vowels, medium back; v-b2: vowels, low back.
[b] Data converted to counts per syllable prior to correlation analysis
* $p < 0.1$ **$p < 0.05$ *** $p < 0.02$ ****$p < 0.01$ (df 82; two-tailed)

The correlations with phonemic groups are shown in Table 4. Here it is again apparent that reading times were longer in segments with more front vowels and fewer back vowels; they were also longer in segments high in plosives but low in voiced fricatives and aspirates. In affective terms, readers were most influenced by segments high in glides, liquids, or nasals, and low in plosives and front vowels.

Our previous empirical studies with this story showed that readers were often specially attentive to those passages relating to a particular setting. In the story, Julia, a young girl, finds a live trout in a small hollow of water in a wooded pathway of her garden called the Dark Walk. Of the 84 segments, 32 describe this setting or Julia's behaviour in it as she contemplates the trout's predicament or, towards the end of the story, goes to the Dark Walk at night to rescue the trout. The phonetic differences between the setting and the rest of the story are suggestive. In setting passages, vowel length is significantly longer, as shown by a Mann-Whitney test, $Z = 1.71$, $p < 0.05$, and there is a higher proportion of front consonants, $Z = 2.483$, $p < 0.01$; among phoneme groups, setting passages contain significantly more glides, liquids, and nasals, $Z = 2.052$, $p = 0.02$, and voiced fricatives and aspirates, $Z = 2.534$, $p < 0.01$; but these passages are also marginally lower in plosives, $Z = 1.510$, $p = 0.07$; and contain fewer front vowels, $Z = 1.932$, $p < 0.05$. A comparison with the ratings for affect and strikingness suggest that it is these qualities in the setting passages to which readers are particularly attentive. Since the story opens with ten segments devoted to the Dark Walk and Julia's behaviour within it, it seems likely that readers soon recognized a specific affective tone associated with the setting; when they encountered this in subsequent setting passages, it helped to make reading more efficient, hence the shorter reading times apparent for each of these phonetic groups, as shown in Table 4.

The rating data, analysed in relation to the two types of passage in the story, provides some support for this view. Markedly higher affect ratings were given to setting passages, $Z = 4.142$, $p < 0.001$, as well as higher strikingness ratings, $Z = 4.276$, $p < 0.001$. But this latter rating raises the question what relation the phonemic measures have to foregrounding, given our previous finding that elevated levels of foregrounding are associated with longer reading times. While foregrounding is more frequent in setting passages, $Z = 1.65$, $p = 0.05$, overall the phonemic measures show a relation with foregrounding that cuts across the division of the story into setting and non-setting, as the correlations shown in Table 5 suggest. The most notable phonemic components of the passages high in foregrounding are front vowels, back consonants, soft consonants, and plosives.

In brief, the phonemic characteristics of foregrounding, which is defamiliarizing for readers and initiates shifts in story understanding, constitute one tonal quality of 'The trout'. The setting passages are distinguished from the rest of the story by a different tonal mix of phonemic features: these in part provide the background of the story, since reading times are generally shorter for passages characterized by this tone. The contrast, then, is between passages found defamiliarizing and those that, once reading is underway, are recognizable and provide an underlying tonal structure to the story. Phonemic patterns, in other words, do influence readers of literary stories, although in different ways according to which aspect of the story is in question.

In conclusion, the findings reported here have indicated the presence of phonemic contrasts in several domains: in words for smallness and largeness, in male and female names, and in two literary texts where differences could be expected. In addition, I have shown that readers of a literary story are responsive to phonemic differences, as their reading times and ratings suggest. Contrary to the earlier studies of

Table 5
Significant correlations of phonetic measures with foregrounding in 'The trout'[a]

Mean phonetic ranks:	
Front-back vowels	.309***
Front-back consonants	–.357***
Soft-hard consonants	.327***
Phonetic groups:	
Unvoiced fricatives-aspirates	–.190*
Plosives	.506***
Medium front vowels	.265**
Low back vowels	–.343***

[a] Data converted to measures per syllable
* $p < 0.1$ **$p < 0.02$ ***$p < 0.01$ (two-tailed)

phonetic symbolism, and in opposition to a persistent theme in stylistic analysis, phonemes do not appear to possess a fixed quality that can be translated into literary meaning. On the other hand, the physiological dimension of vowels and consonants provides a matrix of potential contrasts, such as high–low, long–short, or bright–dark, which can be realized, as Tsur puts it (1997: 286), "when in a specific context the sounds encounter some relevant meaning component". Thus, front vowels are able to connote the confined spaces of Hell in one context, but the feminine qualities of first names in another; plosives tend to characterize words for smallness, but are also prominent in Coleridge's reports of his negative experiences in 'Frost at midnight'. The specific qualities that emerge from the array of phonemes in a text depend on the contrasts offered by the text. This, in a word, is why such effects can be described as iconic rather than symbolic, suggesting a relative rather than a fixed meaning.

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David S. Miall is Professor of English at the University of Alberta. He is editor of *Metaphor: Problems and perspectives* (1982), *Humanities and the computer: New perspectives* (1990), *Romanticism: The CD-ROM* (1997), and the author of numerous articles on writers of the British Romantic period, studies of reader response, literary computing and hypertext, and teaching methods in English literature.