QUATRAIN FORM IN ENGLISH FOLK VERSE

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Quatrains in English folk verse are governed by laws that regulate the patterns of truncation (nonfilling of metrical positions) at the ends of lines. Each truncation pattern (we claim 26) is adhered to consistently through multiple stanzas and defines a verse type. Our descriptive goal is to account for why these and only these truncation patterns exist. Our crucial hypothesis is that the function of truncated lines is to render SALIENT certain layers in the natural constituency of the quatrain: the line, the couplet, or the quatrain as a whole. All three cannot be rendered salient at once, so the saliency constraints conflict. Each saliency constraint also conflicts with metrical constraints, which require that metrical positions be filled with appropriate syllables and stresses. The twenty-six well-formed quatrain types each represent a particular prioritization of the conflicting constraints.

We formalize this in optimality theory (Prince & Smolensky 1993): the inventory of types is derived as the factorial typology of our constraint set; namely, the set of outputs of all grammars obtained by freely ranking the violable constraints. We also account for differing text frequencies in our data corpus by assigning each constraint a range of possible strengths, and from this develop an optimality-theoretic account of gradient well-formedness judgments.*

1. THE PROBLEM. Among the other well-formedness judgments they can make, English speakers can assess the goodness of verse quatrains. Consider the nursery rhyme quatrains below. In each, the line is felt to have four major beats, of which the fourth is sometimes 'silent' (Burling 1966:1420, Attridge 1982:87–88); that is, observed in the isochronous timing of the recitation but not aligned with a syllable.

(1) a. **3** Hickory, dickory, dock, Ø
3 The mouse ran up the clock, Ø
4 The clock struck one, the mouse ran down,
3 Hickory, dickory, dock. Ø

b. **4** One little, two little, three little Indians,
4 Four little, five little, six little Indians,
4 Seven little, eight little, nine little Indians,
3 Ten little Indian boys. Ø

The reader should have no difficulty reciting these quatrains while tapping sixteen times on a table, one tap to each underlined syllable or silent beat (denoted with Ø). It is also not hard to find other songs that show the same patterns of overt versus silent beats, described with the formulae 3343 and 4443.

Now consider modified versions of these songs, with different arrangements of 4 and 3:

(2) a. **3** *Hickory, dickory, dunn, Ø
4 The frightened mouse ran up the clock
3 Just after the clock struck one, Ø
4 Hickory, dickory, plickory, dock.

b. **3** *Nine little Indian boys: Ø
4 One little, two little, three little boys,
4 Four little, five little, six little boys,
4 Seven little, eight little, nine little boys.

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Listeners find examples of *3434 and *3444 crashingly bad, and indeed often laugh at them. Further, we found no quatrains of the *3434 or *3444 variety in the extensive data we examined. Surely, this indicates that there are ill-formed quatrain types.

Supposing for the moment that the basis of quatrain well-formedness is not simply membership in a list, there is a well-defined analytical problem: to establish which quatrain types are well formed, which are not, and what kind of rule system could determine which is which. Ideally, this system should be grounded in general principles of rhythmic and linguistic structure.

The quatrain well-formedness problem turns out to be more difficult than we had imagined. There are more categories of line than just **3** and **4**, and the combination of these additional varieties is likewise not free; thus hundreds of varieties must be considered. Developing a grammar that generates all and only the well-formed quatrains turns out to be a rather delicate task.

This article describes the progress we have made on the problem. Our work may be of interest beyond the field of metrics, for two reasons. First, our solution makes use of the notion of FACTORIAL TYPOLOGY in optimality theory (Prince & Smolensky 1993), not just as a means of checking the typological plausibility of our constraints, but as the core analytical device. Second, our data and theoretical model make possible an optimality-theoretic attack on the long-standing problem of gradient well-formedness judgments.[1]

2. BACKGROUND.

2.1. ART VERSE, FOLK VERSE, AND CHILDREN'S VERSE. Quatrains are available for study from many sources: (a) the canon of English literature; (b) popular verse and song of every description; (c) authentic folk verse, a now moribund tradition, sung mostly without accompaniment by ordinary people and transmitted orally; (d) children's verse such as nursery rhymes, of mostly folk origin, mostly sung or chanted, and to this day transmitted in part by word of mouth. Of these, we have made only a very casual examination of art verse and popular verse, have examined a large body of folk verse, and have supplemented our folk verse study with songs and chants remembered from our own childhoods.

We were guided in this choice by an idea from Burling 1966, a seminal paper on crosslinguistic patterns of children's verse. Burling found that children's verse types from unrelated, geographically distant languages tend to resemble one another very strikingly, far more than their art verse counterparts do. As an explanation for the resemblances Burling makes an appeal (p. 1435) to 'our common humanity', which we take to be a somewhat poetic invocation of the view that certain aspects of cognition are genetically coded. This could occur either directly or, perhaps indirectly, at a more abstract level from which the observed systems derive. Thus it seemed that children's verse would be a good place to start.

The folk verse we studied, though more complex and irregular than children's verse, has the compensating advantage of having been musically transcribed and published in great quantities; and, as will become apparent, it obeys essentially identical laws of quatrain form. Art verse and popular verse apparently also normally obey our laws, but since they are the productions of exceptional individuals, they might well be expected to involve greater complexity and idiosyncrasy, so we have largely avoided them in this study.[2] We also wanted to stick to verse that is chanted or sung, and this is the case

[1] The Web site for this article is located at http://www.humnet.ucla.edu/humnet/linguistics/people/hayes/metrics.htm. Readers may download our coded data, tableaux for the computed factorial typology, and three appendices discussing related issues.

[2] We follow here Jakobson (1960:369): 'Folklore offers the most clear-cut and stereotyped forms of poetry, particularly suitable for structural scrutiny.'

for both children's verse and traditional folk verse. We made this choice in part because sung and chanted verse is understudied, and in part because (as we show in §2.4) such verse offers a greater variety of line types to consider.

2.2. Constituency of quatrains. The fundamental basis of folk verse is a (largely) binary hierarchy. Thus a quatrain is not just a sequence of four lines; it is a pair of pairs, with the following structure:

(3)

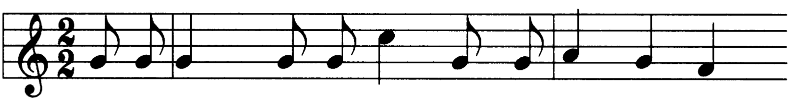
```
                 Quatrain
               /          \
        Couplet            Couplet
        /     \            /     \
    Line      Line     Line      Line
```

The justification for this structure is presented in Burling 1966, Lindblom & Sundberg 1970, Abrahams & Foss 1968:62, Stein & Gil 1980, Attridge 1982, Zwicky 1986, Hayes 1988, and Hayes & Kaun 1996. The levels of bracketing are diagnosed primarily by their correspondence with phonological phrasing: the higher the break in the constituency of the metrical pattern, the more likely it will coincide with a major phrasing break (Attridge 1982; Abrahams & Foss 1968:62). Moreover, the higher the metrical break, the larger the phonological break that will normally be aligned with it. For accounts of phonological phrasing in English and its application to metrics, see Hayes 1989 and Hayes & Kaun 1996.

The pair-of-pairs structure is also reinforced by rhyme, through identical couplet-endings (ABCB), couplet-internal parallelism (AABB) and couplet-external parallelism (ABAB).

2.3. Metrics and the grid. To scan sung or chanted verse requires representations of the alignment of syllables in time and their arrangement into strong and weak metrical beats. In our opinion, some earlier work on the metrics of sung verse has suffered from the lack of an explicit representation for these phenomena. This need is filled by grid representations, innovated by Liberman (1978) and developed extensively within musical theory by Lerdahl and Jackendoff (1983). Example 4 is a line of folksong, first as it appears printed in musical notation in its source (Karpeles 1932, #33A) then in grid representation:

(4) a.



It was late in the night when the squire came home

b.

```
        x                               x
        x               x               x               x
x       x       x       x       x       x       x       x
x   x   x   x   x   x   x   x   x   x   x   x   x   x   x   x
|   |   |       |   |   |       |   |   |       |       |
It  was late    in  the night   when the squire came    home
```

The grid consists of a sequence of columns of *x*s or other symbols, where each column may be associated with an event in time (in the present case, a syllable). The height of a grid column is intended to depict the strength of the rhythmic beat associated with the event. For the study of sung or chanted verse, we assume that all grid rows are performed isochronously, or more precisely, isochronously in theory; that is, abstracting away from various structural and expressive timing adjustments.

Isochrony holds of every row, so that for instance in 4b, the third row up from the bottom is aligned with the isochronous syllable sequence {*late, night, squire, home*} and the second row from the bottom with the isochronous sequence {*It, late, in, night, when, squire, came, home*}. The bottom row is likewise isochronous, though not every *x* in this row is aligned with a syllable. Our informal underlining system indicates the syllables that are matched to the four strongest positions of the grid.[3]

A number of different grids arise in the analysis of folk songs, involving different spacing and location of the strong rhythmic beats. Grid 4b is probably the most common, and it is the one that will appear in all the grid examples of this article. A brief survey of other grid structures attested in English folk verse is provided in online appendix C (see n. 1 for location).[4]

2.4. Rhythmic cadences. Our main topic is the principles of form that distinguish differing quatrain types, even among quatrains that share the same grid. These quatrain types may be defined by the distribution of rhythmic cadences. A cadence, generally speaking, is an ending within rhythmic or musical form. Cadences defined tonally are the crucial anchoring points in Western tonal music. We define a rhythmic cadence as a characteristic grid placement of the final syllable or two of the line. The three most common rhythmic cadences are listed in 5.

(5)a. **3**

```
              x                       x
              x           x           x           x
      x       x       x   x       x   x       x   x
      x   x   x   x   x   x   x   x   x   x   x   x   x   x   x   x
      |       |       |   |   |       |       |               |
      As    bright    as the sum-    mer     sun              ∅
```

[Ritchie 1965: 36]

[3] We have found that people sometimes have difficulty in apprehending a rhythmic structure from a grid. Readers seeking help may wish to download a small computer program we have prepared, playgrid.exe, which plays the tune and rhythm for all the grid examples in this article. The program is available at the Web site listed in n. 1. Readers may also obtain a tape recording containing chanted versions of all the examples in the article by sending a blank cassette with a self-addressed envelope to the first author at the address given at the end of the article.

[4] Grids as applied to music are unfamiliar to many linguists, and they give rise to questions too numerous to answer here. We refer the reader instead to other writings that attempt to answer them. For the most extensively developed theory of grids as applied to rhythmic analysis, see Lerdahl & Jackendoff 1983. For justification of the view that the grid of folk verse may be divided into separate lines (even though the lines are performed in uninterrupted rhythm), see Hayes & MacEachern 1996. On the view taken here that metrics should study linguistic material as aligned to a grid rather than the linguistic material alone, see Hayes & Kaun 1996:246–47. (As argued there, there is reason to think that this choice is correct even for spoken verse forms.) Finally, for discussion of the legitimacy of grid transcription (that is, whether grids reflect perceptual reality, as opposed to the whim of the transcriber), see online appendix A (n. 1).

b. **Green O**

```
        x                               x
        x               x               x               x
x       x       x       x       x       x       x       x
x   x   x   x   x   x   x   x   x   x   x   x   x   x   x   x
    |   |       |       |       |       |               |
    A- mong     the     leaves  so      green,          O
```

[Sharp 1916, #79]

c. **4**

```
        x                               x
        x               x               x               x
x       x       x       x       x       x       x       x
x   x   x   x   x   x   x   x   x   x   x   x   x   x   x   x
|   |   |       |       |       |   |   |       |       |
Lit- tle Mus-   grave   stood   by  the old     church  door
```

[Ritchie 1965: 36]

The cadence we call **3**, following earlier work, initiates no syllables after the third strong position of the line; all subsequent positions are filled either by pause or by lengthening of the line-final syllable, more or less in free variation.

Green O, which we name after the example of it in 5b, fills the third and fourth strong positions, but initiates no syllable between them. The Green O cadence has been noticed by Zwicky (1986) and by Attridge (1982:104). We will designate it with the abbreviation **G**.

4 designates a cadence in which the fourth strong position is filled, with the proviso that any line that fits the description of **G** will be designated as such, and not as **4**; that is, there has to be at least one syllable between the third and fourth strong beats.

We also define a **3**-feminine cadence. Here, the last strong position to be filled is the third, but an additional syllable (always with weaker stress than its left neighbor) is placed in the interval between the third and fourth strong beats. Here is an example:

(6) **3-feminine**

```
        x                               x
        x               x               x               x
x       x       x       x       x       x       x       x
x   x   x   x   x   x   x   x   x   x   x   x   x   x   x   x
|       |       |   |   |       |       |       |       |
She's   gone    with the gyp-   sen     Dá-     vy      ∅
```

[Karpeles 1932, #33A]

The term FEMININE to describe line endings with falling stress sequences is taken from traditional metrics. Our abbreviation for 3-feminine will be $\mathbf{3_f}$.[5]

The rhythmic cadences appear to be a major element of sung verse form. In songs

[5] It is worth mentioning that G is also a feminine cadence: in the vast majority of G lines, the final syllable bears weaker stress than the penult. This will be important in the analysis below. G and 3_f are not distinguished in verse forms where the spoken rendition does not respect an isochronous rhythm, for example, English art verse. The possibility of including the G vs. 3_f distinction in the analysis was one reason we adopted sung and chanted verse data for our study.

Our definitions of the cadences generalize in most cases to grids other than 4b. A few other cadences are mentioned in online appendix C.

with more than one stanza, the same pattern of rhythmic cadences is normally repeated from stanza to stanza. This is true for stanzas that include two quatrains, as well as other stanza types.[6] The focus here, however, will be on the quatrain as a unit.

3. THE QUATRAIN DATA. This section presents our typology of quatrain types and elaborates on findings in Attridge 1982 and earlier work. The main empirical basis of our project was the examination of numerous English folk songs. These were taken largely from the monumental body of field research carried out in the early twentieth century in rural areas of the English-speaking world by Cecil J. Sharp and Maud Karpeles: rural England (Karpeles 1974), Newfoundland (Karpeles 1970), and the Southern Appalachians.[7] The Appalachian material is what we have examined most carefully, by coding it in a database, which includes 1028 songs, 951 from Karpeles 1932 and an additional 77 from Ritchie 1965. The patterning of the database has been amplified by children's songs from our own memories and by our own well-formedness judgments. Anticipating the analysis to follow, we present the quatrain inventory in a taxonomy that matches categories generated under our analysis.

3.1. COUPLET-MARKING TYPES. Consider a quatrain in 4343:

(7) **4** There's two little brothers going to school.
3 The oldest to the youngest called: Ø
4 Come go with me to the green shady grove
3 And I'll wrestle you a fall. Ø[8] [Karpeles 1932, #12I]

The 4343 meter, traditionally called COMMON METER (Malof 1970), is the most frequent instance of what we will call a COUPLET-MARKING quatrain type. We anticipate that readers who recite it in rhythm will hear 'first one couplet, then another'; that is, the couplet constituency is perceptually salient. We discuss the basis of this intuition below.

There are several other quatrain types that our analysis classifies as couplet-marking. In the examples below, **G** cadences are marked with long hyphens for clarity.

(8) a. **4** The squire come home late in the night,
G Enquiring for his la——dy.
4 She answered him with a quick reply:
G She's gone with the gipsy Da——vy.[9] [Karpeles 1932, #33J]
b. **4** Send for the fiddle and send for the bow,
$\mathbf{3_f}$ And send for the blue-eyed daisy; Ø
4 Send for the boy that broke my heart
$\mathbf{3_f}$ And almost sent me crazy. Ø[10] [Karpeles 1932, #127C]
c. **G** The war——fare is rag——ing

[6] The stanza may be defined operationally as the minimal unit sung to the same music. For stanzas that are not coextensive with single quatrains, see online appendix B.

[7] For background on English folk song (as distinguished from its popularized modern descendents) the reader is referred to Sharp 1907, Karpeles 1973, Abrahams & Foss 1968, and the prefaces to Karpeles 1932.

[8] We will list in footnotes examples of songs and chants familiar to many American children that also embody the patterns in the text. For 4343 these are numerous and include: 'Hey Diddle Diddle, The Cat and the Fiddle', 'Jack Sprat', 'Little Jack Horner', 'Old King Cole', 'Old Mother Hubbard', 'Rub-a-Dub-Dub, Three Men in a Tub', 'The Queen of Hearts', 'Old MacDonald Had a Farm' (first quatrain), and 'Oh Where, Oh Where Has My Little Dog Gone?'

[9] More 4G4G: 'Jack and Jill', 'Little Bo-Peep', 'See-Saw, Marjorie Daw', 'Pop! Goes the Weasel', 'Yankee Doodle'.

[10] More 43_f43_f: 'Billy Boy', 'Six Lumberjacks'.

3 And Johnny you must fight. Ø
G I want——to be with——you
3 From morn——ing to night. Ø[11] [Karpeles 1932, #113A]

d. 3_f Last night as I lay on my pillow, Ø
3 Last night as I lay on my bed, Ø
3_f Last night as I lay on my pillow Ø
3 I dreamed little Bessy was dead. Ø[12] [Karpeles 1932, #152B]

3.2. Quatrain-marking types. In 9 below, we have an example of 4443, which we will call a quatrain-marking type.

(9) **4** There was a little ship and she sailed upon the sea.
4 And she went by the name of the Merry Golden Tree,
4 As she sailed upon the low and the lonesome low,
3 As she sailed upon the lonesome sea. Ø[13] [Ritchie 1965:80]

Readers who share our intuitions will find that in such a stanza, the whole quatrain sounds like a single, uninterrupted unit. Other cases that our treatment classifies as quatrain-marking are given in 10.

(10) a. **4** Next morning a burning sun did rise
4 Beneath the eastern cloudless sky,
4 And General Beauregard replied:
G Prepare to march to Shi——loh.[14] [Karpeles 1932, #136]

b. **4** London Bridge is falling down,
4 Falling down, falling down
4 London Bridge is falling down,
$\mathbf{3_f}$ My true lover. Ø[15] [Ritchie 1965:14]

c. **G** When boys go a-court——ing.
G A-court——ing, a-court——ing,
G When boys go a-court——ing.
3 And then they stay all night. Ø[16] [Karpeles 1932, #269B]

d. $\mathbf{3_f}$ Up Eliza, poor girl; Ø
$\mathbf{3_f}$ Hoot Eliza, poor girl; Ø
$\mathbf{3_f}$ Up Eliza, poor girl; Ø
3 She died on the train. Ø[17] [Karpeles 1932, #244B]

3.3. Line-marking types. Example 11, a 3333 quatrain, is what we will call a line-marking construction; we expect the reader to hear all the lines perceptually separated from one another. GGGG (in 12) is also treated as line-marking in our analysis.

[11] More G3G3: 'Goosey, Goosey, Gander' (second quatrain), 'I've Been Workin' on the Railroad' (first quatrain), 'The Eensy-Weensy Spider' (first quatrain), 'Sing a Song of Sixpence' (first quatrain).

[12] More 3_f 33_f3: 'I Have a Little Dreydl', 'The Yellow Rose of Texas' (first quatrain).

[13] More 4443: 'Mary Had a Little Lamb', 'Polly Put the Kettle On', 'Jimmy Crack Corn' (chorus), 'The Muffin Man', 'Old MacDonald Had a Farm' (second quatrain), 'Three Blind Mice' (second quatrain), 'Battle Hymn of the Republic' (first quatrain).

[14] More 444G: 'Here We Go Round the Mulberry Bush', 'Skip to My Lou', 'My Little Red Wagon'.

[15] More 4443_f: 'Michael Finnegan.'

[16] More GGG3: 'Go Tell Aunt Rhody', 'Ring Around the Rosie', 'Battle Hymn of the Republic' (second quatrain), 'For He's a Jolly Good Fellow/The Bear Went Over the Mountain' (first and last quatrains).

[17] More $3_f3_f3_f3$: 'Go Round and Round the Village'.

(11) **3** Lilly, lilly hoo, Ø
3 Sweet Lilly I love you, Ø
3 Lilly, lilly hoo, Ø
3 Sweet Lilly I love you, Ø[18] [Karpeles 1932, #65R]

(12) **G** Father get ready when He calls——you,
G Father get ready when He calls——you,
G Father get ready when He calls——you
G To sit on the throne with Je——sus.[19] [Ritchie 1965:50]

We have been unable to locate an authentic folk song instance of $3_f3_f3_f3_f$, analogous to 3333 and GGGG. A children's song from the collection of Raffi (1980), whose songs in general have the quatrain forms seen here, does contain verses of this type (13a); and a concocted folksong verse (13b) strikes us as well formed.

(13) a. $\mathbf{3_f}$ Willoughby, wallaby, wustin, Ø
$\mathbf{3_f}$ An elephant sat on Justin, Ø
$\mathbf{3_f}$ And Willoughby, wallaby, wanya, Ø
$\mathbf{3_f}$ An elephant sat on Tanya. Ø [Raffi 1980:92]

b. $\mathbf{3_f}$ The first time I saw darling Corie Ø
$\mathbf{3_f}$ She had whisky in a tumbler, Ø
$\mathbf{3_f}$ She was drinking away her trouble, Ø
$\mathbf{3_f}$ And a-going with a gambler. Ø [construct, after Karpeles 1932, #152B]

We will assume below that $3_f3_f3_f3_f$ is in fact well formed.

3.4. THE METRICALLY REPLETE QUATRAIN. The typology of quatrain types implied so far provides no place for 4444 (called LONG METER), which is attested in many examples such as 14.

(14) **4** She fold her arms around him without any fear.
4 How can you bear to kill the girl that loves you so dear?
4 Polly, O Polly, we've no time to stand,
4 And instantly drew a short knife in his hand.[20] [Karpeles 1932, #49A]

For reasons to be made clear below, we will not classify this quatrain as belonging to the line-marking variety. Instead, we will refer to it as METRICALLY REPLETE, since (by our definition of **4**) it can fill its grid with more syllables than any other quatrain type.

3.5. LONG-LAST CONSTRUCTIONS. SHORT METER (3343) is exemplified by 1a above, 'Hickory, Dickory Dock'. It is also sporadically found in our folk song corpus (e.g. Karpels 1932, #42A). The 3343 quatrain belongs to a class of cases we will call LONG-LAST CONSTRUCTIONS. We anticipate that the reader in reciting 1a will perceive a line, relatively separate from its surroundings, followed by a similarly separated line, followed by a relatively integral couplet; thus the longest unit comes last.

Our folk song database includes no instances of the parallel long-last construction GG4G, but we know of three of them from our childhoods; ex. 15 is one.[21]

[18] More 3333: 'Three Blind Mice' (first quatrain), 'Here We Go Looby-Loo' (chorus), 'Jingle Bells' (first quatrain of verses), 'This Little Piggy Went to Market' (on which see Burling 1966).

[19] More GGGG: 'Goosey, Goosey, Gander' (first quatrain).

[20] More 4444: 'Baa, Baa, Black Sheep', 'Humpty Dumpty', 'Rock-a-Bye Baby', 'Pat-a-Cake, Pat-a-Cake, Baker's Man', 'Oats, Peas, Beans and Barley Grow', 'Starlight, Star Bright', 'Georgy Porgy', 'To Market, to Market to Buy a Fat Pig', etc.

[21] The others are 'It's Raining, It's Pouring' and 'A-Tisket, A-Tasket, A Green and Yellow Basket'.

(15) **G** What are little boys made——of?
G What are little boys made——of?
4 Snakes and snails and puppy-dog's tails,
G And that's what little boys are made——of.

In principle, one might expect also to find 33G3 and 333_f3, to fill out the paradigm in 16.

(16) 4343 4G4G G3G3 3_f33_f3
3343 GG4G ? ?

But the data peter out. The only examples of 33G3 we have found occur in stanzas that are ambiguous between two quatrains and one (see Hayes & MacEachern 1996 for discussion and references for this phenomenon). They are plausibly treated as 44 couplets within a larger 4444 quatrain:

(17) **3** ?Young Johnny's been on sea, Ø
3 Young Johnny's been on shore, Ø
G Young Johnny's been on is——lands
3 That he never was before. Ø
or:
4 Young Johnny's been on sea, young Johnny's been on shore,
4 Young Johnny's been on islands that he never was before.[22]

[Karpeles 1932, #58B]

We will refer to such cases as SEMIQUATRAINS, and discuss them further below.[23] The 333_f3 construction is of more marginal status than 33G3: we have found no clear examples of it even as a semiquatrain. The more awkward status of 333_f3 compared to 33G3 can be checked by reciting the 33G3 form (17) above as a 333_f3 instead.

For now, we will somewhat artificially treat 33G3 as fully well formed and 333_f3 as fully ill formed. Later, when we develop an account of gradient well-formedness, we will be able to integrate these quatrains into the system more accurately.

3.6. QUATRAIN TYPES WITH THREE DIFFERENT CADENCES. In our data corpus there are a few cases of quatrains in which three different cadences appear.

(18) a. $\mathbf{3_f}$ It's miles I have travelled, Ø
3 Some forty miles or more, Ø
4 A milk-cow with a saddle on
3 I never saw before. Ø[24] [Karpeles 1932, #38B]

b. **G** I would not marry a black——smith,
3 He smuts his nose and chin; Ø
4 I'd rather marry a soldier boy
3 That marches through the wind. Ø [Karpeles 1932, #272A]

[22] The rest of the quatrain is: 'What's happened to you Johnny, since you have been on sea?/Nothing in this wide world, only what you see on me'.

[23] More 33G3, both semiquatrains: 'There Was a Crooked Man', 'The Eensy-Weeny Spider' (second quatrain).

[24] More 3_f343: 'Frosty the Snowman'.

c. **3_f** One mor——ning, one morning, Ø
3 One mor——ning in May, Ø
G I heard——a fair dam——sel
3 Lamen——ting and say, Ø [Karpeles 1932, #157A]

Although these are not common, and we cannot find children's song analogues for 18b,c, we will include them in the target set for our analysis: we judge 18a,b to be perfect, and 18c seems roughly as good as the similar 33G3 in 17. As would be expected, our only example of 3_f3G3 is in a semiquatrain.[25]

3.7. Quatrain types with free variation. In the normal case, all the stanzas in a song employ the same quatrain type. But there is a significant minority of songs in which some positions in the quatrain are allowed to display different cadences in different stanzas in free variation. The most common of these free variation types is between **4** and **G.** Other types also occur, but to keep the problem to a manageable size we will ignore them here. In what follows, the symbol **F** is to be interpreted: position that may be filled with either 4 or G. The choice between the two is actually not random, as we will show below.

Our data corpus attests only one quatrain type with F, namely F3F3. The song in 19 manages to show all four logical possibilities in the first quatrain of the first four stanzas (each stanza has two quatrains, of which only the first is given here).

(19) **F** (4) Young Edward came to Em-i-ly
3 His gold all for to show, Ø
F (4) That he has made all on the lands,
3 All on the lowlands low. Ø
F (G) Young Emily in her cham——ber
3 She dreamed an awful dream; Ø
F (4) She dreamed she saw young Edward's blood
3 Go flowing like the stream. Ø
F (G) O father, where's that stran——ger
3 Came here last night to dwell? Ø
F (G) His body's in the o——cean
3 And you no tales must tell. Ø
F (4) Away then to some councillor
3 To let the deeds be known.
F (G) The jury found him guil——ty
3 His trial to come on. [Karpeles 1932, #56A]

3.8. Data summary. To sum up to this point: we assume that the inventory of well-formed quatrains with cadences drawn from the set {4, F, G, 3_f, 3} must include at least those shown in Table 1. We will consider the possibility below that more data should be added to the set, but the cases in Table 1 account for the great bulk of the quatrains we have seen (in our database, over 95% of all quatrains) and can serve as a starting point for analysis.

[25] Example 18c continues: 'I heard a fair damsel lamenting and mourn:/I am a poor strange girl and far from my home'.

METRICALLY REPLETE	LINE-MARKING	COUPLET-MARKING	QUATRAIN-MARKING	LONG-LAST	THREE-CADENCE
4444	GGGG	4G4G	444G	GG4G	G343
	$3_f3_f3_f3_f$	43_f43_f	4443_f	3343	3_f343
	3333	4343	4443	33G3	3_f3G3
		G3G3	GGG3		
		3_f33_f3	$3_f3_f3_f3$		
		F3F3			

TABLE 1. Data survey results.

4. ANALYSIS. Before we plunge into the formal account, it is worth pondering the data in a pretheoretical way. Clearly, the quatrains in Table 1 are far from a random set, so it should be possible to characterize them with general principles rather than as an arbitrary list.

One intuitive characteristic of the data is that patterns of same versus different are repeated using different cadences; see for example the quatrain-marking types, all with *same-same-same-different.* Another intuitive characteristic is a kind of scale, which looks like this: $4 >> \{G, 3_f\} >> 3$. Looking at the cases of the third column in Table 1, one can see that WITHIN A COUPLET, 4 can precede G, 3_f, and 3; G can precede 3; and 3_f can precede 3; but other orders are not attested (and indeed sound odd if one constructs a hypothetical example). The same kind of obligatory precedence relations hold elsewhere in the chart. There appears to be some scalar property that is possessed by the different cadences in different amounts, a property that has something to do with metrical repleteness at the end of the grid.

The data also show some puzzling asymmetries: (a) F fails to show the kind of free combination that other cadences show, and is attested for only one quatrain type; (b) 3_f and G form couplets with 4 and with 3, but not with each other; (c) there are asymmetrical quatrains like 3343 in which the SECOND couplet (43) has nonmatching lines, but there are no asymmetrical quatrains like 4333 in which the lines of the FIRST couplet do not match. We address these asymmetries below.

4.1. CADENTIALITY AND SALIENCY. The basis of our analysis is the idea that quatrains have the binary constituent structure shown in ex. 3, namely $[_{\text{Quatrain}}\ [_{\text{Couplet}}$ Line Line$]$ $[_{\text{Couplet}}$ Line Line$]]$. As noted earlier, the linguistic structure of quatrains (phonological phrasing and rhyme) is typically arranged to illuminate this bracketing. Our suggestion is that the rhythmic cadences are likewise so arranged.

Suppose, following Lerdahl and Jackendoff 1983, that the surface events of a rhythmic pattern induce the listener to perceive a hierarchical GROUPING STRUCTURE. We suggest the following partial account of grouping perception.

It is known that in speech as well as in music, there is a kind of slowing down at the ends of phrasal units. In phonetics, the phenomenon is known as final lengthening, and is well documented (see, for example, Beckman & Edwards 1990, Wightmann et al. 1992). A tendency to slow down at the ends of musical phrases is likewise known to musicians, and has been demonstrated experimentally by Bengtsson and Gabrielsson (1983).

Turning this tendency around, we posit that final lengthening is itself a cue to phrasehood, that is, a kind of constituency marker. Our hypothesis is that the rhythmic cadences are ranked according to their ability to induce the perception of a group ending. The groups that the cadences mark are the natural constituents of folk meter, namely line, couplet, and quatrain.

We will use the term CADENTIALITY to mean the degree to which a line ending possesses the ability to induce the perception of a group ending. We hypothesize that the rhythmic cadences we have examined here can be ranked in cadentiality as in 20.

(20) 3 >> 3_f >> G >> 4
more cadential less cadential

Such a hierarchy is deducible from the number of metrical beats occurring in domains initiated by the final and penultimate syllables of a cadence. These are shown in 21.[26]

(21) a. **3**

```
        x                       x
        x           x           x           x
x       x     x     x     x     x     x     x
x   x   x  x  x  x  x  x  x  x  x  x  x  x  x  x
                             ...σ
```

b. **3_f**

```
        x                       x
        x           x           x           x
x       x     x     x     x     x     x     x
x   x   x  x  x  x  x  x  x  x  x  x  x  x  x  x
                             ...σ     σ
```

c. **G**

```
        x                       x
        x           x           x           x
x       x     x     x     x     x     x     x
x   x   x  x  x  x  x  x  x  x  x  x  x  x  x  x
                             ...σ           σ
```

d. **4**

```
        x                       x
        x           x           x           x
x       x     x     x     x     x     x     x
x   x   x  x  x  x  x  x  x  x  x  x  x  x  x  x
                             ...σ     σ     σ
```

Table 2 summarizes the numbers from 21.

Evidently, the cadentiality of a particular line type is determined primarily by the

[26] The diagrams assume that the grid space occupied by each syllable is initiated at the beginning of the syllable, and lasts until the beginning of the next syllable or the end of the line. If in actual fact, the line-final syllable is followed by a pause, so that it does not extend phonetically across its entire domain, the PERCEPTUAL outcome is likely to be the same, since silence will serve to separate the line from the following one and thus mark it as a unit. Compare Selkirk 1984, who argues for the perceptual and functional equivalence of final lengthening and pausing in phonology.

CADENCE TYPE	GRID POSITIONS, FINAL SYLLABLE	GRID POSITIONS, PENULTIMATE SYLLABLE
3	6	varies
3_f	4	2
G	2	4
4	2	varies: 1–3, usually 2

TABLE 2. Grid position counts affecting cadentiality.

number of grid positions assigned to its final syllable. For the one case where two cadences tie on this measure, cadentiality is determined by the number of beats assigned to the penult. We assume, then, the cadentiality hierarchy of 20, with the rationale for it provided by 21 and Table 2.

As stated earlier, the function of cadentiality is assumed to be the highlighting of constituency: intuitively, a particular constituent (line, couplet, or quatrain) is rendered salient by the patterning of rhythmic cadences of greater or lesser cadentiality. Pursuing this intuition, we adopt the word SALIENT as a technical term of the theory, defining it as follows:

(22) A metrical constituent is SALIENT if
  (a) its final rhythmic cadence is more cadential than all of its nonfinal cadences.
  (b) all of its nonfinal cadences are uniform.

Under this definition, the salient quatrains are [444G], [4443_f], [4443], [$GGG3_f$], [GGG3], and [$3_f3_f3_f3$]. The salient couplets are [4G], [43_f], [43], [$G3_f$], [G3], and [3_f3]; and all lines are (vacuously) salient. Intuitively, we suggest that the listener will notice a constituent as salient provided that (a) its terminus is cadential; (b) the constituent is not disrupted by an internal cadence of equal or greater cadentiality (for example, [G4] or [33]), or by a perceived internal nonuniformity (for example, [G443]).[27]

For the cadence **F**, we evaluate forms on a worse-case basis: thus [FG] is not salient, because one of its two instantiations, [GG], is not salient. [F3] is counted as salient because both of its instantiations, [43] and [G3], are salient.

It will be useful to supplement 22 with an additional, gradient criterion of saliency. Intuitively, a salient constituent is more salient if its final cadence is more cadential. Lines fall into a hierarchy of saliency if assessed by this gradient definition; that is, $3 >> 3_f >> G >> 4$; and those couplets and quatrains that qualify as salient by the all-or-nothing definition of 22 can likewise be placed along the gradient scale [X3] >> [$X3_f$] >> [XG] according to their final cadence. The notation we will use for saliency is given in 23.

(23)

Notation	Meaning
ns	Not salient at all (valid for couplets and quatrains only)
***	Salient, ends in 4 (valid for lines only)
**	Salient, ends in G
*	Salient, ends in 3_f
√	Salient, ends in 3

To make the saliency values fully explicit, we repeat in Table 3 our list of observed quatrain types (from Table 1), with markings for saliency at all levels. In the left column of Table 3, brackets are provided for a constituent only if it qualifies as salient by the all-or-nothing criterion of 22.

[27] Our account of saliency traces its ancestry to the connectivity constraint and terminal interval constraint of Stein & Gil 1980:203–4 f. In our view, Stein and Gil were on the right track in proposing these notions, but underestimated their importance.

	SALIENCY OF LINES				SALIENCY OF COUPLETS		SALIENCY OF QUATRAINS
QUATRAIN	1ST	2ND	3RD	4TH	1ST	2ND	
[4][4][4][4]	***	***	***	***	ns	ns	ns
[G][G][G][G]	**	**	**	**	ns	ns	ns
$[3_f][3_f][3_f][3_f]$	*	*	*	*	ns	ns	ns
[3][3][3][3]	√	√	√	√	ns	ns	ns
[[4][3]][[4][3]]	***	√	***	√	√	√	ns
$[[4][3_f]][[4][3_f]]$	***	*	***	*	*	*	ns
[[4][G]][[4][G]]	***	**	***	**	**	**	ns
[[G][3]][[G][3]]	**	√	**	√	√	√	ns
$[[3_f][3]][[3_f][3]]$	*	√	*	√	√	√	ns
[[4][4][[4][3]]]	***	***	***	√	ns	√	√
$[[4][4][[4][3_f]]]$	***	***	***	*	ns	*	*
[[4][4][[4][G]]]	***	***	***	**	ns	**	**
[[G][G][[G][3]]]	**	**	**	√	ns	√	√
$[[3_f][3_f][[3_f][3]]]$	*	*	*	√	ns	√	√
[[3][3][[4][3]]	√	√	***	√	ns	√	ns
[G][G][[4][G]]	**	**	***	**	ns	**	ns
[3][3][[G][3]]	√	√	**	√	ns	√	ns
[[G][3]][[4][3]]	**	√	***	√	√	√	ns
$[[3_f][3]][[4][3]]$	*	√	***	√	√	√	ns
$[[3_f][3]][[G][3]]$	*	√	**	√	√	√	ns

TABLE 3. Saliency values for observed quatrain types.

4.2. ANALYTICAL STRATEGY. We have established a notion of cadentiality (20), defined formally by how the final grid positions of a line are filled by syllables, and posited to correspond with the ability of the various rhythmic cadences to induce the percept of a group ending. We then used the notion of cadentiality to define saliency (22 and 23). Saliency is a property of all constituents, not just lines, and is posited to correspond with the degree to which the arrangement of cadentiality within the constituent induces a grouping precept. Formally, constituents are defined as salient whenever their internal cadences are uniform and inferior in cadentiality to their final cadences, and their degree of saliency is defined as being proportional to the final cadence's cadentiality.

A major goal of the metrical system of English folk verse, in our view, is to render salient the major structural units: lines, couplets, and quatrains. This is done by placing the final syllables of lines in appropriate arrangements of cadentiality.

We believe that there are so many possible quatrain types because each one represents a different way of prioritizing conflicting ends. There is no way to marshal the rhythmic cadences to make ALL units salient, so to some extent, a choice has to be made.[28]

In fact, there is more at stake than this. The most heavily cadential line endings are also the most metrically TRUNCATED: to serve their cadential function, they must fail to fill quite a few positions at the end of the metrical grid (see 5a,b and 6). As we demonstrate in §4.5, the metrical system prefers to deploy syllables and stresses so as to manifest the grid pattern of the line. Insofar as the grid is populated instead with substantial gaps, this task goes unaccomplished. There is thus another trade-off: highly cadential line types like **3** are superior at articulating higher-level bracketing structure,

[28] Even if many values of cadentiality are used, i.e. in 4G43, the uniformity requirement on nonfinal cadences (22b) prevents the quatrain from being counted as salient.

but they are inferior at articulating line-internal beat structure. The diversity of well-formed quatrains, then, reflects a diversity of ways in which these various conflicting factors can be prioritized.

A widely employed approach to grammatical description based on the resolution of conflicting priorities is OPTIMALITY THEORY (Prince & Smolensky 1993). Optimality theory construes grammatical processes precisely as the selection of an optimum candidate from a competing set of possibilities, following a strictly prioritized hierarchy of constraints.[29] Our analytical strategy invokes optimality theory in the following way. First, we state in explicit form, as optimality-theoretic constraints, the principles we have been discussing, along with few others to be developed below. Second, to provide the set of possibilities from which the optimum candidate is chosen, we assume a trivial generator function (= GEN; Prince & Smolensky 1993), consisting simply of a list of the 625 (= 5^4) logically possible quatrain types that can be constructed from the five cadences 4, G, 3_f, 3 and F.[30] Third, we will stipulate some of our constraints to be UNDOMINATED; that is, inviolable, so that no candidate that violates any of the inviolable constraints will survive to win the competition among candidates. Fourth, we construct from the remaining, violable constraints the FACTORIAL TYPOLOGY (Prince & Smolensky) of the analysis. The factorial typology consists of the set of candidates that win the competition under at least one ranking of the constraints.

What emerges from this process is a list of quatrain types, each one of which represents the best available quatrain under some particular ranking of the violable constraints. Under the assumption that ranking of the violable constraints is indeed free, this list should constitute the complete set of well-formed quatrain types, and as such may be checked against corpus data and intuitive judgments for its correctness. We claim that this scheme appropriately formalizes our view that each possible quatrain type exists because it is the best outcome under some specific prioritization of conflicting principles.

In the sections to follow, we implement this analytical strategy. Sections 4.3–4.6 complete the set of formal principles on which our analysis depends; section 4.7 finishes up the formalization and derives the predicted outcomes; and section 5 assesses the predictions against the data.

4.3. PARALLELISM. Merely arranging the cadences into salient lines, couplets, and quatrains will not alone suffice for an adequate theory of quatrain structure. For instance, [43][4G] consists of two reasonably salient couplets, but it is not a well attested quatrain type, and sounds ill formed (see 46c below). We will hypothesize that quatrains like 434G are out because they violate a requirement of PARALLELISM: intuitively, well-formed structures like 4343 and 4G4G show a parallelism that is lacking in ill-formed 434G.

Formalizing parallelism is a bit tricky: it cannot hold true at all levels, because in

[29] Since optimality theory is now the basis of a massive literature, we will not lengthen this article with a summary of its mechanics. The reader is referred to the original presentation in Prince & Smolensky 1993, or to a recent textbook, Archangeli & Langendoen 1997. The use of the theory here is quite simple and should be intelligible in context.

[30] Necessarily, the GEN is idealized: in principle, a real GEN would include all deployments of syllables in all conceivable grids. To use our simple GEN legitimately, we must assume that there exist additional, inviolable constraints that would exclude things such as illegal grids (on which see Lerdahl & Jackendoff 1983: chap. 4), or the wrong grid for the song in question, or impossible rhythmic cadences like **2.** Thus our working GEN can be conceived of as the real GEN as filtered through many additional constraints not stated here. We see no other choice for keeping the problem at hand within attackable size.

(say) 4343, the lines of each couplet (4 and 3) are not parallel. Rather, it seems that parallelism holds true in well-formed quatrains only at the coarser levels of analysis: in 4343, parallelism at the higher level of couplet suffices, even though sister lines of couplets are not parallel. What is needed is a means of singling out the particular coarse level of analysis on which the parallelism requirement can be properly stated. To this end, we propose the following formalization:

(24) **Def**: Let C_1, C_2, ... C_n be a sequence of adjacent metrical constituents exhausting the material of a quatrain Q. If for each **C** of C_1, C_2, ... C_n

(a) **C** is salient by the all-or-nothing definition (22); and

(b) there is no salient constituent **C′** dominating **C**;

then C_i, C_2, ... C_n is the MAXIMAL ANALYSIS of Q.

Intuitively, the maximal analysis of a quatrain is the largest sequence of salient constituents comprising the quatrain. Notice that even a quatrain like 4444 has a maximal analysis, since by our definition (22) **4** is salient (albeit minimally so by the gradient definition (23)).

For the set of quatrains in Table 1, the maximal analyses are shown in Table 4.

METRICALLY REPLETE	LINE-MARKING	COUPLET-MARKING	QUATRAIN-MARKING	LONG-LAST	THREE-CADENCE
$[\mathbf{4}][\mathbf{4}][\mathbf{4}][\mathbf{4}]$	$[\mathbf{G}][\mathbf{G}][\mathbf{G}][\mathbf{G}]$	$[4\mathbf{G}][4\mathbf{G}]$	$[444\mathbf{G}]$	$[\mathbf{G}][\mathbf{G}][4\mathbf{G}]$	$[G\mathbf{3}][4\mathbf{3}]$
	$[\mathbf{3_f}][\mathbf{3_f}][\mathbf{3_f}][\mathbf{3_f}]$	$[4\mathbf{3_f}][4\mathbf{3_f}]$	$[444\mathbf{3_f}]$	$[\mathbf{3}][\mathbf{3}][4\mathbf{3}]$	$[3_f\mathbf{3}][4\mathbf{3}]$
	$[\mathbf{3}][\mathbf{3}][\mathbf{3}][\mathbf{3}]$	$[4\mathbf{3}][4\mathbf{3}]$	$[444\mathbf{3}]$	$[\mathbf{3}][\mathbf{3}][G\mathbf{3}]$	$[3_f\mathbf{3}][G\mathbf{3}]$
		$[G\mathbf{3}][G\mathbf{3}]$	$[GGG\mathbf{3}]$		
		$[3_f\mathbf{3}][3_f\mathbf{3}]$	$[3_f3_f3_f\mathbf{3}]$		
		$[\mathbf{F3}][\mathbf{F3}]$			

TABLE 4. Maximal analyses for observed quatrain types.

We can now return to the definition of parallelism. Observe that for all of the well-formed quatrains of Table 4, the units of the maximal analysis terminate in identical cadences, shown in boldface. (This is vacuously satisfied where the maximal analysis is the whole quatrain.) We suggest that this is the proper basis for the PARALLELISM constraint, which we state as follows:

(25) PARALLELISM: The cadences ending the units of the maximal analysis of a quatrain must be identical.

Stated as in 25, PARALLELISM is never violated in a well-formed quatrain. The PARALLELISM constraint does a great deal of descriptive work in our analysis: of the 625 logically possible quatrains, all but 57 are excluded as PARALLELISM violations.[31]

4.4. LONG-LAST CONSTRUCTIONS. A quatrain like 3343 is of special interest for its asymmetry. If one switches the order of the couplets of 3343, yielding 4333, the result sounds very awkward. Consider, for instance, the familiar children's song in 26 that has been artificially inverted in this way.

(26) **4** *<u>Pease</u> <u>por</u>ridge <u>in</u> the <u>pot</u>,
3 <u>Nine</u> <u>days</u> <u>old</u>. Ø
3 <u>Pease</u> <u>por</u>ridge <u>hot</u>, Ø
3 <u>Pease</u> <u>por</u>ridge <u>cold</u>. Ø

In fact, all five asymmetrical quatrains in the inventory of Table 1 lack a well-formed inverted partner in this sense. Apparently, when the couplets of a quatrain are

[31] We note in passing that the maximal analysis and PARALLELISM seem to be intimately related to rhyming: the cadences of the maximal analysis usually rhyme with each other.

nonidentical, there is some principle that dictates an order. Our suggestion is that this principle is the well-known idea stated in 27.

(27) LONG-LAST PRINCIPLE: In a sequence of groups of unequal length, the longest member should go last.

For 3343, the implementation of the principle goes something like this: the maximal analysis of 3343 is [3][3][43], with the longest salient unit in final position. Ill-formed [43][3][3] violates the principle.

The long-last principle has been noticed repeatedly in previous work. We briefly digress to review some of the empirical evidence for it. First, stereotyped phrases with conjunction tend to place the longer member second: *soup and sandwich; men and women; ladies and gentlemen; Arm and Hammer; bacon, lettuce and tomato* (Sadeniemi 1951:30–36, Malkiel 1959). Second, as Piera (1980) and Attridge (1982:143–44) have noted, when a metrical tradition divides its lines into two unequal parts, the longer part typically goes second. One example of this is the French decasyllable, where the caesura (obligatory word break) divides the line into 4 + 6 syllables:

(28) Frères humains qui après nous vivez
σσ σ σ / σσσ σ σσ [Thuasne 1923, Villon: 'L'epitaphe Villon']

Long-first divisions do occur, but typically only in the mature phases of an art verse tradition, when the basic possibilities of the unmarked configuration come to feel over-utilized (Piera 1980, Hayes 1988). Third, in Finnish folk metrics, specifically the meter of the folk epic *Kalevala,* words are preferentially placed in order of increasing length within the line (Sadeniemi 1951, Kiparsky 1968).

What remains is to define exactly what a long-last construction is in the context of English folk quatrains. We have opted to analyze the three-cadence quatrain types of 18 as somewhat loose long-last constructions, and therefore have adopted a relatively broad definition of long-last:

(29) A quatrain is a LONG-LAST CONSTRUCTION if:
(a) its second couplet is salient by the all-or-nothing definition (22);
(b) both its first and second lines are more salient (by the gradient definition of 23) than the third line.

We suggest that quatrains satisfying this criterion will be experienced as line + line + couplet. The relatively salient initial lines will be perceived as units, and the salient final couplet will also be perceived as a unit. All five of the long-last quatrains in our target set (3343, 33G3, 3_f343, 3_f3G3, and G343) meet the formal criterion of 29.

The long-last effect also seems to benefit from COHESIVENESS in the final couplet. That is, if the third line is 4, the least cadential of all line types, then the two lines of the final couplet will most easily be felt to form a single unit. Indeed, in most of the long-last quatrains we have seen, the third line is a 4. The effect seems to be gradient, in that the long-last effect works best when the third line is a 4, less well when the third line is a G, and least well when the third line is a 3_f (see discussion of 17 above). Later, we will encode this pattern with a hierarchy of constraints; for now, we will simply define cohesiveness:

(30) A couplet, if salient, is COHESIVE inversely to the saliency of its first line.

By this definition, 43, 43_f, and 4G are fully cohesive couplets; G3 and $G3_f$ are less cohesive, and 3_f3 is least cohesive.[32]

[32] The cohesiveness requirement suggests why the cases of 33G3 we have found occur (and sound better) in 'semiquatrains', that is, quatrains that are also treatable as couplets within larger quatrains: the closer spacing of strong beats at the semiquatrain level lessens the sense of rhythmic miscohesion created by the G line.

To summarize, our account of long-last constructions requires them to have a salient final couplet and two initial lines more salient than the third. We will propose below further constraints that formally implement the requirement of cohesiveness defined in 30.[33]

4.5. MATCHING THE METRICAL GRID. As noted above, the deployment of the more salient rhythmic cadences to articulate higher-level grouping is in conflict with the need to realize the metrical grid pattern. The issue of how such patterns are concretely instantiated with syllables and stresses has long been addressed in the research program of GENERATIVE METRICS, initiated by Halle & Keyser 1966. A review of generative metrics that outlines many of the views assumed here appears in Hayes 1988, and an account of the special properties of the metrics of sung and chanted verse may be found in Hayes & Kaun 1996. Although the constraints below will suffice for present purposes, it should be remembered that in a complete account of folksong metrics they would be only a part of a much fuller metrical system.

4.5.1. FILL STRONG POSITIONS. The metrical grid of a line is better manifested to the extent that its positions are filled with syllables. This is especially true of the strongest metrical positions. As one of a set of constraints requiring various parts of the grid to be filled, we posit 31.

(31) FILL STRONG POSITIONS: Fill the four strongest positions in the line.[34]

While 31 is a general constraint, for purposes of quatrain structure it has the specific consequence of forbidding the use of 3 and 3_f (see 5a and 6). In fact, FILL STRONG POSITIONS is seldom violated other than in the fourth strong beat, where the violation serves the purpose of rendering some constituent salient: of the 670 folk verse lines studied by Hayes and Kaun (1996), only one has an unfilled strong position other than the fourth.

4.5.2. AVOID LAPSE. The 3 and G cadences (5a,b) are metrically defective for a different reason: the grid region between the third and fourth strong beats receives no syllabic manifestation. For present purposes the relevant constraint can be stated as in 32.

(32) AVOID LAPSE: Avoid sequences in which no syllable is placed in the interval between any two of the four strongest positions in the line.

Again, the constraint is fully general, but violations arise principally at the end of the line, to obtain high cadentiality. For example, in the corpus of folk song lines examined in Hayes & Kaun 1996, only 6 violations occur between the first and second or second and third strong positions, out of 670 lines total. But between the third and fourth strong positions, violations of AVOID LAPSE are commonplace: they occur with any 3 or G line, motivated by the cadentiality this supplies.

4.5.3. MATCH STRESS. Syllables are under pressure not only to fill the grid, but to match their stress pattern to it: sequences of rising stress tend to fill rising grid sequences, and analogously with falling (Jespersen 1933, Kiparsky 1977, Hayes 1983,

[33] Attridge 1982:94–95 advances an interesting alternative account of long-last constructions based on an aesthetic principle that favors AABA structures, in areas going beyond metrics; see also Cureton 1992: 222–46. This idea has considerable support, but cannot count as a complete explanation, since it provides no obvious basis for the cohesiveness requirement on long-last structures and needs amplification to rule out quatrains like *4434.

[34] A more principled statement would be 'fill the positions of grid row **R**', where **R** is some particular (fairly high) row on the grid; this avoids actually counting out the four strongest positions and makes it nonarbitrary that the crucial count goes to four. The makeshift formulation of 31 must suffice for present purposes.

Hayes & Kaun 1996). This is the key to the presence of what we have called F (free variation between 4 and G) in the system. It turns out that the distribution of endings in F lines is not free at all, but depends entirely on the stress pattern of the last two syllables in the line. Below, we sort out all the F lines of the song given earlier in 19, according to whether they are 4 or G.

(33) a. **G** The jury found him **gúil——tў**
G Young Emily in her **chám——bĕr**
G O father, where's that **strán——gĕr**
G His body's in the **ó——ceăn**

b. **4** That he has made all on **thĕ lánds,**
4 She dreamed she saw young Ed**wărd's blóod**

c. **4** Young Edward came to Em**ĭ-lў**
4 Away then to some coun**cĭllŏr**

As can be seen, G is used for lines with feminine endings (falling stress (33a)), and 4 is used elsewhere; that is, for masculine endings (with rising stress (33b)) and pyrrhic endings (lines ending with two stressless syllables (33c)). This pattern holds for all quatrains with F lines.

We claim that, at least in songs that include G and F cadences, the odd-numbered strong positions are stronger than the even-numbered ones.[35] Formally, this is reflected in the topmost grid layer, shown in 34. Because of this grid configuration, a G cadence provides a good match for a feminine ending.

(34)

```
        x                               x
        x               x               x               x
x       x       x       x       x       x       x       x
x   x   x   x   x   x   x   x   x   x   x   x   x   x   x   x
|       |   |   |       |       |       |               |
Young   Em- i   ly      in      her     chám-           bĕr
```

Other possibilities for placing the feminine ending seem quite unpalatable:

(35) a.

```
        x                               x
        x               x               x               x
x       x       x       x       x       x       x       x
x   x   x   x   x   x   x   x   x   x   x   x   x   x   x   x
|       |       |       |       |       |       |       |
Young   Em-     i-      ly      in      her     chám-   bĕr
```

b.

```
        x                               x
        x               x               x               x
x       x       x       x       x       x       x       x
x   x   x   x   x   x   x   x   x   x   x   x   x   x   x   x
|       |       |       |               |       |       |   |
Young   Em-     i-      ly              in      her     chám-bĕr
```

[35] The reason to believe this is that G lines virtually always have a feminine ending, with the penultimate syllable bearing more stress than the final. Given the way the rest of the system works, this may be presumed to reflect a need to match a corresponding falling sequence on the metrical grid.

In particular, 35a involves a gross mismatch of the stress pattern of *chámbĕr,* whereas 35b involves a gross mismatch of appropriate syllable durations. Both of these problems are discussed in Hayes & Kaun 1996.

If one considers instead endings with rising stress, such as 33b, *thĕ lánds* or . . . *wărd's blóod,* exactly the opposite considerations will hold: the better textsetting will invariably be with a 4 cadence, not a G. Final level-stressed sequences also appear to prefer 4; apparently G cadences actually REQUIRE a falling-stress sequence, so that 4 remains as the only possible outcome for a pyrrhic ending.

Our claim, then, is that apparent free variation between 4 and G is not free, but depends on the poet's choice of words: a line with a feminine ending will naturally be set with G, and a line with a masculine or pyrrhic ending will be set with 4. In principle, one could derive this by integrating a complete theory of metrics into the grammar for quatrain structure. To keep the size of the problem manageable, however, we propose 36 as a stopgap.

(36) MATCH STRESS: Employ G in feminine endings, 4 elsewhere.

This formulation covers only G and 4, since to keep the problem manageable we have artifically restricted our account of free variation to G ~ 4 alternation, the most common type.

4.5.4. SUMMARY. We posit that the influence of metrics on quatrain structure is as follows: the constraints FILL STRONG POSITIONS and AVOID LAPSE require 'filled-in' grids; each bans gaps in ways that rule out certain rhythmic cadences. MATCH STRESS forces variation in the rhythmic cadences for certain positions, requiring G or 4 depending on the text selected by the poet; thus in our terms, F. Regarding their effects on rhythmic cadences, the three metrical constraints can be summarized in a coarse way as follows: FILL STRONG POSITIONS bans 3 and $*3_f$, AVOID LAPSE bans 3 and G, and MATCH STRESS bans all cadences but F.

4.6. STANZA CORRESPONDENCE. The use of F as a conjunction of cadence types raises a peculiar possibility, namely that the set of salient domains (as defined in 22) could vary from stanza to stanza in the same song. In an FG couplet, for example, the choice of 4 for F yields [[4][G]], with every domain salient, whereas the choice of G for F yields [G][G], with only the two lines salient. The same holds for 4F, with [[4][G]] and [4][4] as the two possibilities. In fact, we have found no quatrains that permit such variation, either with these hypothetical cases or any other similar form. We therefore posit the following inviolable constraint:

(37) STANZA CORRESPONDENCE: In a song, the set of salient domains must be invariant across stanzas.

Saliency for purposes of this constraint must be construed as the all-or-none variety defined in 22.

The STANZA CORRESPONDENCE constraint is largely responsible for the limited distribution of the F cadence. It must occur in the first line of a couplet, because this is the only position in which the salient domains remain constant; thus F3 = [[4][3]] or [[G][3]].

4.7. COMPLETING THE ANALYSIS. We will now bring together all the analytical ingredients discussed in the preceding sections, and arrange them into an explicit optimality-theoretic analysis.

4.7.1. FORMALIZING SALIENCY OF CONSTITUENTS. Recall from §4.2 that all levels of quatrain structure 'like' to be salient; and the more salient, the better. The saliency constraints stated in 38–40 serve to generate quatrains that render some particular level of structure salient; for example, a high ranking of the constraint COUPLETS ARE SALIENT is necessary to generate 4343.

To keep the grammar of manageable size, we have formulated just three constraints in this domain, one for each level of structure. Stated loosely, these are:

(38) LINES ARE SALIENT: Assess violations for any nonsalient line, according to its degree of nonsaliency.

(39) COUPLETS ARE SALIENT: Assess violations for any nonsalient couplet, according to its degree of nonsaliency.

(40) QUATRAINS ARE SALIENT: Assess violations to the extent that the quatrain level is nonsalient.

To interpret LINES ARE SALIENT and COUPLETS ARE SALIENT explicitly we must specify what happens when they are violated in more than one place per quatrain. The crucial issue involves the trade-off between the SEVERITY of individual violations (as given in 23) and the NUMBER of violations. Following a suggestion by Prince and Smolensky (1993:72), we assume that in general, severity is more important than number; thus, in hypothetical GGG4, the single violation of LINES ARE SALIENT with 4 is considered worse than the combined effect of the three lesser violations of LINES ARE SALIENT with G.

The specific implementation of the idea we used employs the proposal formalized by Prince and Smolensky (1993:§5.1.2.1). This formalization permits individual constraints to be violated in varying degrees, with severity taking priority over number of violations.[36]

4.7.2. FORMALIZING LONG-LAST CONSTRAINTS. We adopt three constraints governing long-last constructions. Most fundamentally, there is a constraint (41) that favors long-last as a quatrain.

(41) PREFER LONG-LAST: Avoid any quatrain that is not a long-last construction.

The definition of long-last assumed here was stated in 29.

Further, we mentioned in §4.4 the need for constraints requiring the final couplet of a long-last construction to be cohesive—more literally, for the third line of a long-last construction to be of low cadentiality. For this constraint, we employ a different method from above (38–40) in assessing violations of different degrees: here, it turns out to be crucial to implement the range of cohesiveness by positing separate constraints that define cut-off points along it. This is the method outlined in Prince & Smolensky 1993: §8.1.2.

(42) a. TOTAL LONG-LAST COHESIVENESS: Avoid long-last constructions whose third line is not 4.

b. PARTIAL LONG-LAST COHESIVENESS (inviolable): Avoid long-last constructions whose third line is not 4 or G.

In making only 42b inviolable, we have somewhat arbitrarily placed the outermost limit of well-formedness on long-last constructions whose third line is G, while favoring those whose third line is 4. An account that does more justice to the gradience of the well-formedness judgments is given in §6.

[36] The actual computer code we used for grammar-testing deployed an ad hoc system of numerical values, which served simply as a convenient way of implementing Prince and Smolensky's scheme.

4.7.3. CONSTRAINT LIST AND IMPLEMENTATION. Drawing on the discussion above, we state the full set of constraints below, notated for the constraints we stipulate to be inviolable:

(43) a. Constraints on saliency of domains
LINES ARE SALIENT (38)
COUPLETS ARE SALIENT (39)
QUATRAINS ARE SALIENT (40)
b. PARALLELISM (25) (inviolable)
c. STANZA CORRESPONDENCE (37) (inviolable)
d. Constraints pertaining to long-last constructions
PREFER LONG-LAST (41)
TOTAL LONG-LAST COHESIVENESS (42a)
PARTIAL LONG-LAST COHESIVENESS (42b) (inviolable)
e. Metrical constraints
FILL STRONG POSITIONS (31)
AVOID LAPSE (32)
MATCH STRESS (36)

As described earlier, the predictions made by our constraint set may be tested by the method of factorial typology: we (a) rank all three inviolable constraints at the top of the grammar; (b) examine all 8! (= 40,320) possible rankings of the eight freely rankable constraints; (c) determine which of the 625 logically possible quatrains is the winner for each of the 40,320 rankings; (d) collate the results, determining which of the 625 possibilities is the winner for at least one ranking. If the analysis is correct, this set should be coextensive with the set of well-formed quatrains. We carried out this task on a desk computer, checking a subset of the results by hand.[37]

The full set of tableaux that resulted is voluminous and cannot be printed here. A subset of the tableaux showing the crucial outcomes may be viewed as online appendix E. Here, it must suffice to assert that the factorial typology that emerges from our computations is that given in Table 5. The contents of the table are arranged according to the typology laid out in §3. This set includes all the members of the working-hypothesis set in Table 1. It also includes a few additional quatrains, shown in boldface, which will be examined below.

METRICALLY REPLETE	LINE-MARKING	COUPLET-MARKING	QUATRAIN-MARKING	LONG-LAST	THREE-CADENCE
4444	GGGG	4G4G	444G	GG4G	G343
	$3_f3_f3_f3_f$	43_f43_f	4443_f	3343	3_f343
	3333	4343	4443	33G3	3_f3G3
		G3G3	GGG3	$\mathbf{3_f3_f43_f}$	$\mathbf{3_f3F3}$
		3_f33_f3	$3_f3_f3_f3$	**33F3**	
		F3F3		$\mathbf{3_f3_fF3_f}$	
		$\mathbf{F3_fF3_f}$			

TABLE 5. Quatrains predicted by the analysis.

[37] We wish to emphasize the importance of machine checking. Our own experience, in which machine-coded grammars have revealed winning candidates that slipped through an earlier process of hand checking, suggests to us that hand-calculated factorial typologies of all but the simplest constraint sets should be considered unreliable.

To justify the rankings that yield each outcome of Table 5 would consume a great deal of space, so in the interest of economy we outline, in Table 6, a ranking procedure that can generate any of the quatrains listed. Where a column has no entry (and anywhere after the third column), it doesn't matter how the remaining constraints are ranked, so long as they are below the listed constraints. It should be fairly easy to see how the outcomes emerge from the constraint set. Roughly, the categories line-marking, couplet-marking, quatrain-marking, and long-last construction from §3 result from high ranking of the relevant saliency constraints and Prefer Long-last. Highly-ranked Avoid Lapse and Fill Strong Positions limit the ability of the saliency constraints to induce the more cadential line types, thus leading to additional quatrains. The long-last quatrains are more complex in their origin, but nevertheless seem on inspection to be relatively symmetrical as well.

Ranked First	Ranked Second	Ranked Third	Outcome
Lines Salient			3333
Couplets Salient	Lines Salient		3_f33_f3
	Fill Strong Positions	Lines Salient	G3G3
		Avoid Lapse	4343
		Match Stress	F3F3
Quatrains Salient	Lines Salient		$3_f3_f3_f3$
	Fill Strong Positions	Lines Salient	GGG3
		Avoid Lapse	4443
Fill Strong Positions	Avoid Lapse		4444
	Lines are Salient		GGGG
	Couplets are Salient		4G4G
	Quatrains are Salient		444G
	Prefer Long-last		GG4G
Avoid Lapse	Lines are Salient		$3_f3_f3_f3_f$
	Couplets are Salient		43_f43_f
	Quatrains are Salient		4443_f
	Prefer Long-last		$3_f3_f43_f$
Match Stress	Avoid Lapse		$F3_fF3_f$
Prefer Long-last	Lines are Salient		33G3
	Couplets are Salient	Avoid Lapse	3_f343
		Lines are Salient	3_f3G3
		Match Stress	3_f3F3
	Match Stress	Avoid Lapse	$3_f3_fF3_f$
		Lines are Salient	33F3
	Total Long-last Cohesiveness	Lines are Salient	3343
		Fill Strong	G343

Table 6. Quatrain rankings.

5. Empirical evaluation. To test our analysis, we scanned all the songs in the database described in §3. For each song, we established the stanzaic pattern of rhythmic cadences if this was feasible.[38] We filtered the data somewhat, as follows. First, we counted only quatrains: either whole stanzas, or clear quatrain constituents within stanzas (some nonquatrain stanzas are discussed in online appendix B). In addition, to avoid prejudicing the results in our favor, we included only quatrains that are indicated as such by the editor's capitalization and lineation; thus some songs that we would be tempted to analyze as two quatrains, with short lines, are treated by the editor as one quatrain, with long lines. Further, we limited ourselves to quatrains written with just the cadences 4, G, F, 3_f, and 3; for the other cadences, see online appendix C. Where a song includes more than one quatrain per stanza, we counted each quatrain separately. With this filtering and unpacking, the 1028 songs yielded a total of 627 quatrains.

Our survey produced the count of quatrain types listed below. We first give the number of quatrains found whose existence is predicted by our analysis (Table 7).

METRICALLY REPLETE		LINE-MARKING		COUPLET-MARKING		QUATRAIN-MARKING		LONG-LAST		THREE-CADENCE	
4444	203	GGGG	3	4G4G	38	444G	7	GG4G	0	G343	6
		$3_f3_f3_f3_f$	2	43_f43_f	21	4443_f	1	3343	6	3_f343	2
		3333	1	4343	188	4443	35	33G3	1	3_f3G3	1
				G3G3	26	GGG3	2	$3_f3_f43_f$	0	3_f3F3	0
				3_f33_f3	28	$3_f3_f3_f3$	1	33F3	0		
				F3F3	29			$3_f3_fF3_f$	0		
				$F3_fF3_f$	0						

TABLE 7. Text counts for predicted quatrains.

For the quatrains that are ill formed under our analysis, we break the cases down into cases with and without refrain (Table 8), for a reason to be mentioned shortly.

QUATRAIN	WITH REFRAIN	WITHOUT REFRAIN	TOTAL CASES
4433	5	1	6
43_f4G	0	4	4
4344	2	1	3
$4G43_f$	1	1	2
4G43	2	0	2
4F43	0	1	1
44G4	1	0	1
44G3	1	0	1
$3_f3_f3_f4$	0	1	1
4434	1	0	1
433_f3	1	0	1
434G	0	1	1
4GF3	0	1	1
3_f333	0	1	1
TOTALS	14	12	26

TABLE 8. Text counts for quatrains not predicted.

[38] In a number of songs, one finds a pervasive stretching and/or compression of the tempo, of a type discussed by Abrahams and Foss (1968:144–45). These tempo alterations, which are written into the musical notation with multiple time signatures, sometimes obscure the meter to the point that determining the pattern of rhythmic cadences would be quite subjective. We omitted these cases (about 10% of the total) from our counts.

To describe the data in bulk: 601 out of 627 quatrains, or 95.9%, are well-formed according to our analysis. Were the quatrains randomly distributed, one would expect only 4.2% to be well-formed, since the analysis licenses only 26 of the 625 logically possible quatrains.

In assessing this outcome, one must consider two classes of cases: quatrains that are supposed to be bad according to the theory but nevertheless exist, and quatrains that are supposed to exist but are unattested.

5.1. QUATRAINS ATTESTED BUT UNGENERATED. We note first an important empirical generalization made by Hendren (1936:21–23): quatrains of irregular structure tend to include or fully comprise a REFRAIN, defined here as any textual material that is invariant across stanzas. We do not know why Hendren's generalization should be true, but it is undeniably valid for our data: in our corpus, quatrains with refrain material fall outside the predictions of the analysis in 14 of 130 cases (10.8%), whereas in the population of stanzas without refrain, the ungrammaticality rate is only 12 of 497, or 2.4%.[39]

In our judgment, the refrain/nonrefrain distinction involves not just corpus frequencies, but intuitive well-formedness as well: some refrain examples sound fairly well formed to us where analogous nonrefrain examples seem rather lame. Compare the real refrain quatrain (refrain material shown in bold) in 44a with the concocted example in 44b.

(44) a. 4G43 in refrain:
4 There was an old woman lived on the seashore,
G Bow——down,——bow——down,
4 There was an old woman lived on the seashore,
3 And thou hast bent to me, [Karpeles 1932, #5L (first quatrain)]

b. ?4G43, no refrain
4 The squire come home late in the night,
G Enquiring for his la——dy,
4 She answered him with a quick reply,
3 She's up and left her home. Ø [(construct, after 8a)]

For cases like this, we would continue to draw the line at a place excluding 4G43 in nonrefrain quatrains. We discuss below what might be needed to permit 4G43 in refrains.

Among the nonrefrain counterexamples to our analysis, we find some that can be reconstrued as being in compliance with the theory, under certain assumptions. These are cases in which a line starts early, thus 'stealing' beats from a neighboring line's metrical pattern.[40]

[39] This difference is shown to be statistically significant by a chi-square test; $p < .0001$. For the irregular metrics of refrains, see also Zwicky & Zwicky 1987:532. The distribution of refrains in our corpus (see also Hendren 1936:chap. 8) is quite lawful: refrains usually form metrical constituents (line, couplet, occasionally quatrain); and they are virtually always located at the end of larger metrical constituents (e.g., $[XX_r][XX_r]$, $[XXXX_r]$, $[[XX][X_rX_r]]$, $[[[XX_r][XX_r]]\ [[XX][X_rX_r]]]$, $[[XXXX][X_rX_rX_rX_r]]$). We do not yet see a clear connection between this fact and the license for irregularity in refrains, but one seems possible.

[40] Further discussion of these line boundary bracketing mismatches, which are relatively rare, may be found in Hayes & MacEachern 1996.

(45) 3_f Jimmy Randal (Ø) went hunting Ø
3 All about in (Ø) the dark.
3? He shot Mol——(Ø)——ly Varn/**And** Ø
3 he missed not (Ø) his mark. Ø [Karpeles 1932, #50d]

In a case such as this, it is not clear whether the line labeled **3?** here should be regarded as a 3 or a 3_f—the latter choice would render the quatrain a perfectly normal $3_f 3 3_f 3$.

In this particular case, consistency would seem to favor the 3_f analysis, since all seven of the remaining stanzas have completely uncontroversial 3_f endings (for example, *bósŏm, únclĕ, amóng thĕm*) in the corresponding position. We have found that, in general, the data are more coherent if such 'stolen beats' are NOT counted as part of the preceding line (so we have in fact always scanned them this way.) Cases like 45, however, suggest that stolen beats should perhaps be assigned intermediate status. See Attridge 1982:104–5 for related discussion.

In the end, however, we must appeal to the reader for agreement with our intuitive judgment that a small number of moderately ill formed quatrains have made their way into the data corpus. (How this happened is matter of speculation; perhaps they are due to memory lapse on the singer's part, or perhaps because minor unmetricality just adds a certain zest of unexpectedness to a song.) Example 46 contains representative examples of the quatrains decreed to be ill formed under our analysis, so the reader may assess them intuitively.

(46) a. *43_f4G
4 As I came over new London Bridge,
3_f One misty morning early, Ø
4 I overheard a tender-hearted girl
G A-pleading for the life of Geor——gie. [Karpeles 1932, #34D]

b. *$3_f3_f3_f4$
3_f What'll we do with the baby? Ø
3_f What'll we do with the baby? Ø
3_f What'll we do with the baby? Ø
4 O we'll wrap him up in calico. [Karpeles 1932, #228]

c. *434G
4 What's old women made of, made of,
3 What's old women made of? Ø
4 Reels and jeels and old spinning wheels,
G And that's what old women are made——of. [Karpeles 1932, #227A]

Our judgment is that all the quatrains above sound at least moderately odd, 46b and c more than 46a. Insofar as our judgments in this area match those of the original participants in the tradition, these examples should not seriously undermine the theory. The relative scarcity of such cases in the data reinforces this view.

The quatrains in the corpus that sound odd to us include some with refrain, as 47 illustrates.

(47) a. **4** The first landlord was dressed in white,
3 I am the lilino, Ø
4 He asked her would she be his wife,
4 And the roses smell so sweet I know. [Karpeles 1932, #6B]

b. **4 Soldier boy, soldier boy,**
3 Soldier boy for me; Ø
3_f If ever I get married Ø
3 A soldier's wife I'll be. Ø [Karpeles 1932, #272A, second quatrain]

Thus refrains do not appear to be a blanket license for metrical deviance.

Often, the aberrant cases seem to be providing hints about their well-formedness. Our only case of *43_f43 (Karpeles 1932, #28C), for instance, is actually a completely normal 4343 quatrain in three of its four stanzas; apparently the use of a 43_f43 quatrain is a one-time-only response to the need to use a feminine ending. Often, a quatrain counted as deviant in our theory occurs in a song of which variants exist whose quatrains do obey our principles. For example, the version we know of 46c (namely, 15) is the well-formed GG4G; likewise Ritchie's (1965) version of 46b adds 'O' to the end of the first three lines, turning the quatrain into a sensible 4444. While strange quatrains are usually alone in their batch of variants, regular quatrains (by our rules) are accompanied by metrically similar variants. This suggests that irregular quatrains may be diachronically unstable, which attests to their aberrance.

5.2. Quatrains generated but unattested. We must also consider cases in which the analysis predicts well-formedness for quatrain structures that are unattested. The relevant structures are GG4G, $3_f3_f43_f$, $3_f3_fF3_f$, 33F3, 3_f3F3, and $F3_fF3_f$. Of these, the first is likely an accidental gap in our corpus, since the instantiations we have found in nursery rhymes (see 15) seem metrically perfect. For the others, we construct examples below and provide our judgment.

(48) a. **3_f** And when you find my Maisie, Ø
3_f And send for the blue-eyed daisy; Ø
4 Send for the boy that broke my heart
3_f And almost sent me crazy. Ø[41] [construct, after 8b]

b. **3** Young Johnny's been on sea, Ø
3 Young Johnny's been on shore, Ø
F (G) Young Johnny's been on is——lands
3 That he never was before. Ø
3 What's happened to you, son, Ø
3 Since you have been on sea? Ø
F (4) Nothing in this lonely world
3 Only what you see on me. Ø
[construct; adapted from Karpeles 1932, #58B]

c. **3_f** Young Johnny's been a-sailing, Ø
3 Young Johnny's been on shore, Ø
F (G) Young Johnny's been on is——lands
3 That he never was before. Ø
3_f What's happened to you, Johnny, Ø
3 Since you have been on sea? Ø
F (4) Nothing in this lonely world
3 Only what you see on me. Ø
[construct; adapted from Karpeles 1932, #58b]

41 Many limericks, i.e. 'There was an old man from Nantucket', are in $3_f3_f43_f$. The status of this chanted verse form as folk verse is not clear to us.

d. $\mathbf{3_f}$ And when you find my Maisie, Ø
$\mathbf{3_f}$ And send for the blue-eyed daisy; Ø
F (4) Send for the boy that broke my heart
$\mathbf{3_f}$ And almost sent me crazy. Ø
$\mathbf{3_f}$ And when you find my honey. Ø
$\mathbf{3_f}$ And gather all your money; Ø
F (G) Think on my heart that's bro——ken,
$\mathbf{3_f}$ And tell her it was funny. Ø [construct]

e. **F** (G) Mammy loves her dar——ling
$\mathbf{3_f}$ And Mammy loves her baby; Ø
F (4) Go to sleepy, go to sleep,
$\mathbf{3_f}$ Go to sleep, my little baby. Ø
F (4) Mammy loves and Pappy loves
$\mathbf{3_f}$ And Mammy loves her baby; Ø
F (G) Go to sleep, my dar——ling;
$\mathbf{3_f}$ Go to sleep, you little baby. Ø [construct, after Karpeles 1932, #233]

Of these, 48a seems perfect; 48b and c are about as good as other long-last constructions that end in G3, and 48d and e seem a bit awkward, specifically in the places where they have G3_f couplets. Thus, the ability of the analysis to limit the predicted cases to the well-formed ones seems, on the whole, fairly good. We comment further on some of the problematic cases in §6.2, which discusses gradient well formedness.

5.3. The role of optimality theory. For the moment, we will claim a certain degree of descriptive success, and consider the role that optimality theory has played in our account. First, OT provides a way of taking a set of raw structural preferences and turning it into an explicit grammar. The grammar described above forms a concrete, falsifiable hypothesis, whereas our earlier discussion of structural preferences in the system was intuitive but vague. Second, OT provides a natural account for why there is such a diversity of quatrain types: the inherent goals of the system are in conflict, and each outcome represents a particular resolution of the conflict by assignment of priorities.

Finally, OT makes it possible to rule out certain forms without actually formulating a constraint against them (see Prince & Smolensky 1993:§9.1). Fully half of the 52 candidates that obey our inviolable constraints never emerge as a winner, because there is simply no prioritization for which they happen to be the best outcome. For example, *4333 is out because there is no constraint that can force a salient first couplet while at the same time enforcing two salient lines in the second couplet. (Were there a long-first constraint, it would permit 4333, but as we indicated above, such a constraint appears to be rhythmically unnatural.) Likewise, our system correctly excludes couplets that mix 3_f and G (except G as a variant of F), because 3_f and G meet contradictory requirements: G maximizes saliency with an overriding Fill Strong Positions constraint, whereas 3_f maximizes saliency with an overriding Avoid Lapse constraint. If both Fill Strong Positions and Avoid Lapse are placed at the top of the hierarchy, the result is not an alternating mix, but rather a sequence of **4** lines, which obey both constraints.

6. Gradient effects. Two further issues deserve discussion in evaluating our analysis: the greatly unequal corpus frequencies of attested quatrains (seen in Table 7), and the existence of cases that intuitively have an intermediate level of well formedness.

6.1. MODELING CORPUS FREQUENCY. Concerning corpus frequency, we are quite willing to posit that some quatrain types are missing by accident. The grounds for this claim are as follows: we hold that the experienced participant in a singing tradition does not memorize a large set of quatrain types; rather, the quatrain types are themselves only the overt manifestation of the principles that generate them. If it happens that the space of possibilities characterized by these principles is not fully explored by a particular folk tradition, then that should not be surprising—there is nothing in the system to guarantee that a complete exploration will take place. The crucial evidence for this view is precisely that one can examine novel quatrain forms (such as 48a) that are textually nonexistent, but are fully implied by the structural principles responsible for existing forms. Insofar as these novel forms sound well formed (especially in contrast to nongenerated forms like those of 2 and 46, then we are justified in labeling them as accidental gaps in the corpus.

That said, it remains an interesting problem to arrive at an account of the large frequency differences among types, which surely are not random. The following generalizations hold (see Table 7):

(1) When COUPLETS ARE SALIENT, LINES ARE SALIENT, QUATRAINS ARE SALIENT, and PREFER LONG-LAST compete for which will determine the overall shape of a quatrain, COUPLETS ARE SALIENT is most often the winner.

(2) The metrical principles AVOID LAPSE and FILL STRONG POSITIONS tend to be ranked together: either both quite strict (imposing the 4 cadence) or both quite lax (yielding 3). Cadences 4 and 3 are in fact the most common cadence types. This suggests perhaps that AVOID LAPSE and FILL STRONG POSITIONS belong to a constraint family (FILL GRID) which behaves roughly as a unit.

(3) The paucity of F cadences suggests that MATCH STRESS is seldom highly ranked among the constraints governing quatrain form.

A plausible approach to frequency, then, might be to assign RANGES OF STRICTNESS to the constraints, and model actual frequencies by letting the constraints vary—completely at random—within their strictness ranges. That is, the originator of a folk song, being familiar with the diversity of quatrain types, tacitly knows that the constraints vary in strictness, and knows their characteristic ranges. The choice of strictness within these ranges, being arbitrary, would proceed at random.[42]

We implemented a very simple model based on these assumptions, in which each violable constraint occupies a range of width 1, on a scale of arbitrary strictness units. The ranges we found that best fit the data are those in Table 9. These values were found by means of an iterated, hill-climbing machine search.[43] When we used the ranges to calculate the predicted frequencies of the various quatrain types, we obtained

[42] The use of quantitative formalisms to deal with varying corpus frequencies is not new here. Using devices predating optimality theory, the same issue has been addressed in the research tradition on variable rules, exemplified by work such as Labov 1969, Cedergren & Sankoff 1974 and Sankoff & Labov 1979.

[43] Details of the search: (a) Outer loop: perturb each constraint range in turn by a random amount. For each perturbation, execute inner loop. If accuracy improves, keep the altered constraint range. Repeat until no further improvement occurs. (b) Inner loop: determine predicted frequencies of a candidate set of constraint ranges by letting each constraint take on a random value within its range and locating the quatrain that wins with these values. Repeat until 20,000 outcomes have been gathered. AVOID LAPSE is given a special treatment, receiving at each of the 20,000 trials a value that is a compromise between tying it entirely to the strictness value of FILL STRONG POSITIONS in its range, and letting it vary randomly within its own range. This yields the rough strictness correlation of AVOID LAPSE and FILL STRONG POSITIONS, mentioned above.

PARALLELISM	(inviolable)
PARTIAL LONG-LAST COHESIVENESS	(inviolable)
STANZA CORRESPONDENCE	(inviolable)
COUPLETS ARE SALIENT	.900–1.900
TOTAL LONG-LAST COHESIVENESS	.895–1.895
FILL STRONG POSITIONS	.876–1.876
AVOID LAPSE	.800–1.800
QUATRAINS ARE SALIENT	.492–1.492
LINES ARE SALIENT	.272–1.272
MATCH STRESS	.111–1.111
PREFER LONG-LAST	.009–1.009

TABLE 9. Strictness ranges posited for the constraints.

the values in Table 10.[44] As can be seen, with a few exceptions, our model fits the corpus data fairly well.

The strictness ranges of Table 9, arrived at on a purely empirical basis, also match with what was said earlier concerning the strictness of the various constraints. Thus couplet-marking constructions are common (because they are enforced by a characteristically strict constraint), long-last constructions are rare (because they are enforced by

QUATRAIN	PREDICTED	ACTUAL
4444	202.7	203
3333	6.7	1
$3_f3_f3_f3_f$	0.8	2
GGGG	2.9	3
4G4G	40.8	38
43_f43_f	13.8	21
4343	194.3	188
$F3_fF3_f$	0.1	0
F3F3	17.7	17
G3G3	17.7	26
3_f33_f3	30.8	28
444G	10.4	7
4443_f	3.0	1
4443	28.5	35
GGG3	4.3	2
$3_f3_f3_f3$	6.4	1
GG4G	0.1	0
$3_f3_f43_f$	0	0
$3_f3_fF3_f$	0	0
3343	0	6
33F3	0	0
33G3	0	1
G343	6.8	6
3_f343	1.1	2
3_f3F3	0	0
3_f3G3	0	1

TABLE 10. Predictions of frequency model.

[44] The predicted values were obtained by re-running step (b) of the search algorithm (n.43 above) with the optimized constraint ranges it obtained, using one million trials instead of 20,000 to achieve greater accuracy.

a characteristically weak one), quatrains that violate TOTAL LONG-LAST COHESIVENESS are rare (because they are banned by a characteristically strict constraint), and so on.[45]

6.2. MODELING GRADIENT WELL-FORMEDNESS. More important perhaps than corpus frequency is the issue of gradient well-formedness judgments, which we have noted at various places in our data. For example, $3_f3_fF3_f$ or $F3_fF3_f$ (48d,e) strike us as somewhat awkward, but nowhere near as bad as 3434 or 3444 (2a,b). Similarly, we find that long-last examples fall into a continuum of well-formedness based on the cohesiveness of their final couplet: fully cohesive 3343 is better than 33G3, which in turn is better than 333_f3. How can our analysis, which in its present state rigidly classifies quatrains into well-formed and ill-formed categories, account for these intermediate cases?

We have recently developed a model to account for gradient well-formedness, which we have applied to problems of phonology and morphology as well as metrics. The model is described in greater detail in Hayes 1998, but for the present a brief description should suffice. Suppose that, in addition to a central range of permissible strictness values, a constraint may also take on PERIPHERAL values, but only at the cost of some well-formedness. In such a scheme, precisely those quatrains that can only be generated by using the peripheral values would be judged as moderately deviant. Speculating, one might imagine that the listener, confronted with a quatrain that is not generated by her grammar, would tacitly attempt to place an interpretation on the input by adjusting the constraint-strictness values slightly outside their normal ranges. The effect of having to do this would emerge consciously as a sense of moderate ill-formedness.[46]

We have tested this scenario using the constraint-strictness ranges obtained above from corpus-frequency evidence. In one instance, we have determined that if one posits for MATCH STRESS a central range whose maximum falls between .801 and .899, as well as an upper periphery extending above .900, then $F3_fF3_f$ comes out as marginal (as desired), whereas F3F3 is correctly predicted to be perfect. The reason lies in the rankings needed to derive these forms: F3F3 can be derived if MATCH STRESS merely outranks AVOID LAPSE (range .800–1.800), but to derive $F3_fF3_f$, MATCH STRESS must outrank COUPLETS ARE SALIENT (range: .900–1.900). Note that the range we must posit for MATCH STRESS to get this result is not wildly out of line with the statistically obtained range in Table 9.

We have also been able to model the well-formedness continuum 3343-?33G3-??333_f3, along with related quatrains like 33F3. With our constraint set, 33G3 can be derived only when the constraint TOTAL LONG-LAST COHESIVENESS slips below PREFER LONG-LAST on the strictness scale. We have determined that if TOTAL LONG-LAST COHESIVENESS can never be valued below 1.009 (the maximum value of PREFER LONG-LAST) without incurring partial ill-formedness, then 33G3 comes out as partially ill formed. Likewise, 333_f3 violates a constraint we have up to now assumed to be inviola-

[45] Gilbert Youmans raises an interesting and alarming possibility about our model: perhaps it sets so many numerical parameters (there are eight) that it could have fit virtually any data. If this were true, then the ability of the model to fit our own data would tell us nothing. We checked out this possibility by using the model to try to predict a FICTIONAL set of frequencies, namely, our actual corpus frequencies reassigned at random to the wrong quatrains. Here the fit of the model, despite many iterations, was very poor, with an average error of about 35, versus 2.4 for the real data. This suggests that the good fit we obtained with the real data reflects the appropriateness of the constraint system to the task. In other words, the procedure was not foreordained to succeed.

[46] Alternatively, one might suppose that the peripheral strictness ranges are the product of acquisition, reflecting a conservative strategy on exposure to extremely rare quatrain types. See Hayes 1998 and Boersma 1998 for discussion.

ble, namely PARTIAL LONG-LAST COHESIVENESS. We have found that if this constraint is violable, but may only very reluctantly be ranked lower than 1.009, then 333_f3 is generated, with a correspondingly greater ill-formedness burden.[47]

The quatrain $3_f3_fF3_f$ also emerges from our gradiency simulation marked with a ?. It is derived with both the upper fringe of MATCH STRESS and the lower fringe of TOTAL LONG-LAST COHESIVENESS.

To summarize our proposal, we offer in Figure 1 a graphical depiction of the strictness ranges of the constraints. The peripheries of constraints, within which ranking can take place only reluctantly, are shown with boxes bearing the traditional well-formedness diacritics ? and ??.

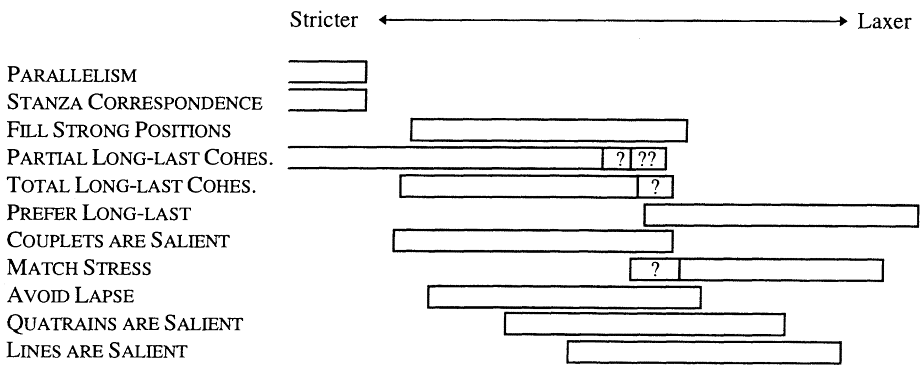


FIGURE 1. Constraint strictness ranges with peripheries.

To contrast the two crucial classes of cases: $F3_fF3_f$ is somewhat bad because it requires MATCH STRESS to be ranked too high for its natural range, whereas 33G3 and 333_f3 are somewhat bad because they require TOTAL LONG-LAST COHESIVENESS and PARTIAL LONG-LAST COHESIVENESS to be ranked too low.[48] Further, outlandish cases like 3434 or 3444 (2a,b) cannot be generated at all, short of introducing utterly novel constraints into the system.[49]

The analysis recognizes four categories of quatrains: (a) well-formed, well-attested quatrains, such as 4343, which derive from STATISTICALLY LIKELY rankings of constraints within their central ranges of strictness; (b) well-formed, poorly attested quatrains,

[47] In our machine implementation of gradient well-formedness, the only quatrain that gets added to the 26 generated earlier (see Table 5) is in fact 333_f3. The other quatrains just mentioned are marked by our program with appropriate degrees of ill-formedness. The detailed ranking arguments for the crucial quatrains may be downloaded, as part of the tableau set, from the Web site listed in n.1.

[48] $3_f3_fF3_f$ fits into both categories. The case of marginal 4G43 (44b) might likewise be incorporated into the system if one were to clone a more-permissive variant of the QUATRAINS ARE SALIENT constraint, one in which the uniformity requirement on saliency (22b) is weakened to permit cadentially similar lines like 4 and G to cooccur in nonfinal position of a salient quatrain. The original, less permissive QUATRAINS ARE SALIENT constraint would still be in place, as a constraint with characteristically high strictness. This would allow 4G43 as a marginal variant only, which is what is wanted. More work needs to be done on this, however, since a weaker QUATRAINS ARE SALIENT constraint would also allow 4GG3, which is quite bad.

[49] An example would be the principle of Bengkulu (Burling 1966) that stipulates that it is empty beats at the BEGINNING of a unit that render it salient. Bengkulu children's songs thus come in varieties like [34][34] and [3][3][34], analogous respectively to English [43][43] and [3][3][43]. Note that the symbol 3 in Bengkulu designates a completely different grid configuration from 3 in English (initial, rather than final empty beats), so the Bengkulu forms are not as outlandish as they may initially appear.

which derive from FULLY LEGITIMATE BUT STATISTICALLY UNLIKELY rankings ($3_f3_f43_f$); (c) marginal quatrains; these derive from ranking certain constraints slightly outside their normal range of strictness (333_f3); (d) ill-formed quatrains, poorly- or unattested, and not derivable within the system (3434). The empirical picture looks compatible with this view.

The constraint-range approach to gradient well-formedness outlined here strikes us as promising. In it, the existence of gradient well-formedness judgments does not mean that the rules of the grammar have to be 'fuzzy' or inexplicit in any way. The gradience resides solely in the constraint-strictness values, which are readily treated as quantities. Moreover, the grammar allows for a certain amount of PROJECTION beyond the input data corpus: a quatrain such as $3_f3_f43_f$ can be essentially absent from the learning set yet sound perfect to listeners, because it is generated by constraints and strictness ranges that are established from robust input data. Based on our experience so far, we think that this approach might well yield insight into many other areas of linguistic structure where gradient well-formedness judgments occur.

7. CONCLUSION. We have argued that English folk verse is tightly patterned at the level of the quatrain: the various rhythmic cadences are arranged in nonrandom, essentially strategic fashion. Our analysis of this arrangement does not regulate the cadences as such; rather, the role of the cadences is to induce perceived bracketings, which are then employed to structural ends: the enhancement of metrical constituents at various levels, and the placement of long elements last. In this view, the variety of quatrain types reflects different ways in which conflicting factors are prioritized. Among these are the line-internal principles of metrics: in return for the aid their cadentiality provides in articulating quatrain structure, the truncated line types impose a sacrifice in the clarity with which the beat structure of the line is realized.

We are encouraged by the effectiveness of the factorial typology analytic strategy, and suggest it may be useful in the study of other fixed inventories of linguistic objects. We also believe that the method of assigning ranges of strength to constraints offers a plausible account of corpus frequency and of gradient well-formedness.

At the most general level, we hope to have used folk verse as a positive example of a particular analytical strategy. We have striven to base our analysis on ingredients of a maximally primitive character, founded on intuitively plausible (or so we think) principles of how grouping and rhythmic structure can be cued with phonological material. The optimality-theoretic notion that well-formedness is computed by constraint ranking and candidate selection made it possible to mold primitive constraints into an explicit grammar, one capable of deriving an intricate and not fully symmetrical pattern of well-formedness. In short, OT makes possible the use of primitive analytical ingredients to capture complex descriptive results.

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