

Modern developments in notation

David Collins

July 3, 2010

Abstract

This paper discusses the limitations of Western score notation and alternatives for the modern musician. A tentative effort is made to evaluate the relative merits of each.

The LaTeX source and auxiliary files necessary for successful compilation are available in a ZIP archive at <http://indigo.uk.to/~david/notes/music/notation-source.zip>. Instructions on how to compile the document from source are contained therein. The audio samples which are referenced within the paper are available at <http://indigo.uk.to/~david/notes/music/notation-samples.zip>.

1 Introduction

Despite the seemingly mundane nature of the subject, notation is something which we, as musicians, all have to engage with to a greater or lesser degree in the course of our activities. And, to this extent, it seems only appropriate that we pay close attention to our notational practices. Furthermore, I believe that, for the modern musician, there is more reason than ever before to pause and consider this issue. My reasons for saying this are twofold. Firstly, the twentieth century witnessed a significant expansion of the sounds we consider ‘musical’. And simultaneously, the advent of the personal computer has had a profound and pervasive influence on musical practice, that of notation included.

Thus, in this essay I will provide an overview of two parallel, but related, developments. On the one hand, I will try to portray the increased facility which various computer softwares allow in the preparation of conventional score notation. But also, after briefly revealing some of the inherent limitations of score notation, I will discuss possible alternatives for the modern musician.

1.1 Purpose of notation

To begin with, let us remind ourselves, briefly, of what notation is purported to achieve. What, in other words, is its purpose? Charles Seeger distinguished between two functions of musical notation: 1. *to provide a 'blueprint for the performer'*; and 2. *to describe in writing a sound that has already been experienced* [Nettl, 2005, p. 77]. Seeger referred to the corresponding forms of notation as 'prescriptive' and 'descriptive', respectively. Notation, that is, can either *instruct* or *describe*. The melograph, for example, a device which plots a graph of pitch against time, produces a descriptive form of notation. And the alphabetic notation known as Parsons code is, despite its elegance and brevity, generally so ambiguous that it could never possibly be relied upon for the purposes of instruction. As an example of instructive notation, on the other hand, we need only consider the familiar format of the score.

This distinction is somewhat contrived of course. A notation which has been created for the purpose of instruction may also be descriptive, and vice versa. Nonetheless, it is potentially useful, when faced with the necessity of choosing one form of notation for a particular purpose, to evaluate the various merits of a notational system according to such characteristics.

1.2 The 'note' concept

It is worth returning to Charles Seeger, and further considering his observations on musical representation. He has explained that melody may be represented in either of two ways: 1. as a succession of separate sounds; or 2. as a single continuum of sound [Seeger, 1977, p. 169]. Neither, he cautions, 'tells the whold

story as the musician knows it' [Seeger, 1977, p. 169]. Either form exhibits certain limitations, the nature of which will be more or less apparent according to the particular context.

The former mode of representation—as a succession of separate sounds—is the basis for the ubiquitous 'note' concept. The concept of the note is one of discrete musical events, separated either temporally, by pitch, or by timbre. The edifice of the Western music tradition is largely predicated upon the representation of music by the use of these note objects. As Seeger has observed, Western notation is designed to indicate discrete events. As a consequence, however, it is deficient in its representation of what happens '*between the notes*' [Seeger, 1977, p. 179].

There seems to be little doubt that there are certain musics which do not exhibit this preoccupation with the note concept, even if they exist predominantly beyond the tradition of Western Art music. Bruno Nettl, for example, believes that in certain cultures there are categories of sound 'more significant than those that we label as the "notes"' [Nettl, 2005, p. 85]. And '[i]f we recognise notes as abstractions', he explains, 'the door is open for using other and often more appropriate transcriptions as well' [Nettl, 2005, p. 85]. Nettl is considering, here, mainly the task of 'descriptive' notation as it might arise in the context of ethnomusicological fieldwork. Nonetheless, some of his observations could be readily extrapolated to notation which is intended as instruction.

2 Changes to Western notation

Despite potential misgivings about the predominance of Western art music in discussions of musical notation, it would be a serious oversight to afford it no consideration whatsoever in this context. Kurt Stone refers to three milestones in the history of Western musical notation: 1. the advent of staff and mensural notation in the High Middle Ages; 2. the increasing significance, *c.* 1600, of the horizontal elements of music, and the consequent replacement of part books with scores; and 3. the changes introduced by avant garde composers

in the mid-twentieth century [Stone, 1980, pp. xv–xvii]. The latter, he explains, was characterised by a bifurcation in compositional practice. On the one hand, there was a demand for a *greater level of precision* in various aspects of the notation—such as pitch, rhythm, sound source, etc.. On the other, certain composers introduced unprecedented levels of *indeterminacy, chance and performative freedom* into the musical performance [Stone, 1980, p. xv–xvi]. Traditional notation was not designed to cope with such demands, and composers introduced an array of new symbols to compensate for its deficiencies.

The Index of New Musical Notation Sensing a certain level of dismay and confusion amongst performers due to the lack of consistency with which these symbols were being employed, Stone spearheaded a four-year effort to categorise and standardise these extensions to traditional notation [Stone, 1980, pp. 332–41]. The project became known as the Index of New Musical Notation, and culminated in a conference in Ghent, Belgium, in 1974. A means by which to denote quarter-tones—one of the many aspects of notation studied by Stone—is depicted in Figure 1 [Stone, 1980, p. 69]. Stone was concerned, first and fore-

Figure 1: A quarter-tone scale (Audio Sample 3)



most, with adaptations of score notation. He devoted little attention to entirely new forms of notation. With increasing frequency in the latter part of the twentieth century, however, composers abandoned score notation entirely. Some of the alternatives they have used are discussed below. I have chosen not to focus on the adaptations studied by Stone in this paper. Despite the comprehensiveness of the survey he initiated, musical practice has changed significantly since the publication of his treatise.

The advent of electronic music Modern electronic music provides abundant evidence for the shortcomings of score notation. To relate this more clearly to musical practice, we can consider, as an example, the ‘soundscape’ in Audio Sample 1. This was notated and produced by a musician named Matthew Mariano, using a music language known as Csound. The aural experience, in this instance, undermines our common assumptions regarding pitch and rhythm. Apart from a vaguely-articulated melodic contour in the foreground instrument, there are no pitch-defined boundaries that enable us to draw upon the familiar note concept, for example. Some of these sounds simply cannot be represented using the five-line staff and note values that we are accustomed to. Ultimately, this music requires a different form of representation from that which the Western art music tradition has furnished.

3 Modern forms of notation

Of the forms of notation discussed below, it is worth noting that both Lilypond and Abc notation are primarily *intermediary* formats, which are rarely, if ever, used directly. They are, generally speaking, converted into score notation before being used in performance. (Having said that, it is conceivable, as indicated in Table 2, that a performer would read from them directly.) They are perhaps best regarded, thus, as alternative forms of *score preparation*, rather than new forms of notation *per se*. Mondrian and Csound, however, are not in any way subservient to score notation.

3.1 Lilypond

The first form of notation I want to consider is Lilypond. Lilypond originates from the year 1996 and was designed with the express purpose of producing high-quality scores. In this regard, it invites comparison with softwares such as Finale or Sibelius, which many musicians might be more familiar with. Lilypond differs in one significant respect from these softwares however. As indicated in

Table 2, it requires, as a preliminary stage in the preparation of the score, that the composer or transcriber provides a *textual* representation of the music. To this end, it has an associated vocabulary and syntax.

The opening bars of J.S. Bach's Fugue in G minor BWV 578 are shown in Figure 2. (A number of the snippets of notation in the accompanying figures are based on this excerpt.) The Lilypond notation used to prepare the first five bars of this extract is shown in Figure 3.

Figure 2: J.S. Bach, Fugue in G minor BWV 578, bars 1–10 (notated using Lilypond)



Figure 3: J.S. Bach, Fugue in G minor BWV 578, bars 1–5: Lilypond notation

```

\relative g' {
  g d' bes4.\mordent a8
  g8 bes a g fis a d,4
  g8 d a' d, bes' a16 g a8 d,
  g8 d16 g a8 d,16 a' bes8 a16 g a d, d' c
  bes a g bes a g fis a g d g a bes c d e
}

```

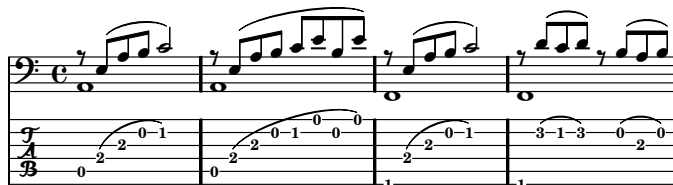
Lilypond has limited scope for non-Western notation. It includes a special symbol for the flattened third of the Arabic scale for example. It also has limited features for the notation of world music and ancient music. An example of mensural notation is shown in Figure 4. And an example of guitar tablature

Figure 4: Mensural notation typeset with Lilypond



created using Lilypond is shown in Figure 5. Lilypond can also create files in the common MIDI format. The result of converting the music in Figure 5 to an audio file, using Lilypond's MIDI output as an intermediary format, can be heard in Audio Sample 4.

Figure 5: Lilypond tablature (Audio Sample 4)



3.2 **Abc notation**

Another important and recent form of notation is one which was originally devised in the nineteen-eighties, by a man named Chris Walshaw, and which has subsequently become known as Abc notation. The most immediately striking aspect of the Abc language is that, as its name implies, it is an alphabetic form of notation. Walshaw, in a brief historical overview of the language, mentions that the alphabetic representation of music is not without precedent [Walshaw]. Abc, that is to say, was not the first form of notation in which music was

depicted by the use of letters. It was, however, the first to gain widespread currency amongst computer-literate musicians.

Abc notation does not offer as much scope as Lilypond in some respects (see Table 2). It is not possible, to my knowledge, to perform Schenkerian analysis using Abc notation, for example. Nonetheless, it has an intuitive and elegant syntax, and will be more than adequate for many notational tasks. Although it was originally used to notate folk and traditional tunes, Abc can also be used to notate classical music. Figure 6 shows the beginning of Bach's G minor Fugue (shown in Figure 2) in Abc notation.

Figure 6: J.S. Bach, Fugue in G minor BWV 578, bars 1–5: Abc notation

```
X: 1
T: BWV 578, Fugue in G minor
C: J.S. Bach
M: C
K: Gm
L: 1/8
G2 D'2 B3 A | \
GB AG ^FA D2 | \
GD AD BA/2G/2 AD | \
GD/2G/2 AD/2A/2 BA/2G/2 A/2D/2D'/2C'/2 | \
[L:1/16] BAGB AG^FA GDGA BC'D'E' | \
```

3.3 Mondrian

The desire for a means of rapidly notating musical ideas is alluded to in Section 4.2. And one means of achieving this is by using a music description language called Mondrian. Mondrian is named after the Dutch painter, Piet Mondrian, whose visual structures Peter Brinkman (the designer of the Mondrian language) considered a suitable counterpart for the structure of a musical composition.

One or two aspects of the notation (that larger numbers represent shorter note values for example) are somewhat counter-intuitive, but the syntax is otherwise accessible. Some of the commonly-used Mondrian symbols are shown in Table 1.

Table 1: Commonly-used Mondrian symbols

<i>Symbol</i>	<i>Meaning</i>	<i>Default</i>	<i>Comment</i>
n	note of length $\frac{1}{2^n}$	1	note-lengths are expressed as fractions of a whole-note (i.e. semi-breve)
mn	note of length $\frac{m}{2^n}$	$m = 1,$ $n = 1$	e.g. 33 is translated to $\frac{3}{2^3} = 3/8$ (a dotted crotchet)
$n >$	move up n scale-degrees	1	
$n <$	move down n scale-degrees	1	
$n+$	move up n semitones	1	
$n-$	move down n semitones	1	
$n\mathbf{n}$	set pitch value for next note		
$n\mathbf{r}$	insert rest of duration $\frac{1}{2^n}$	1	can also be preceded by m , as a note can
$n\mathbf{g}$	insert gap between notes	1	useful for staccato effects
$n\mathbf{T}$	set tempo	120	
$n/$	increase volume by n	16	
$n\backslash$	decrease volume by n	16	

In all cases, m and n are to be replaced by a number of appropriate value.

A possible Mondrian representation of the beginning of Bach's G minor fugue (the subject marked A in Figure 2) is shown in Figure 7. This particular transcription does not include dynamics, although it is possible to specify these in Mondrian notation. After converting this representation to a MIDI file, and

subsequently to an audio file, the result can be heard in Audio Sample 2.

Figure 7: J.S. Bach, Fugue in G minor BWV 578, bars 1–5: Mondrian notation

```

67n naturalminor
84T
2 4> 2 2< 33 < 3 <
3 2> 3 < 3 < 3 - 3 2> 3 4< 2
3 3< 3 4> 3 4< 3 5> 3 < 4 < 4 > 3 4< 3 3>
3 3< 4 3> 4 > 3 4< 4 4> 4 > 3 < 4 < 4 > 4 4< 4 7> 4 < 4 <
4 < 4 < 4 2> 4 < 4 < 4 - 4 2> 4 < 4 3< 4 3> 4 > 4 > 4 > 4 > 4 2+ 4

```

3.4 Other notations

Forms of notation which I do not have time to consider in detail here include Csound and Parsons code. The Parsons code for the opening of J.S. Bach's Fugue in G minor (Figure 2) is shown in Figure 8. As may be already apparent, Parsons code offers no means by which to represent rhythm, or rests.

I have not included any Csound examples in the figures, as Csound compositions can be several pages long. The only comment I want to make in relation to Csound is that it is an enormously powerful language, and opens up almost limitless possibilities for a composer. Drawbacks of this versatility, however (which are indicated in Table 2), are its steep learning curve, and the relatively slow process of notation.

4 Characteristics of different notational systems

Table 2 offers a comparison of several methods of notation, based on various criteria. Even this superficial appraisal reveals that each system has its own weaknesses and merits. Each will be more-or-less appropriate for a certain

Figure 8: J.S. Bach, Fugue in G minor BWV 578, bars 1–5: Parsons code

```
* u d d
du dd du d
ud ud udd ud
udu udu udd udud
dddu dddu dduu uuuu
```

* = start note, u = up, d = down, r = repeat
--

context or project. Perhaps the most we can aspire to is to use the right tool for a particular task.

4.1 Difficulty

According to the International Folk Music Council, “notation tending to mathematical exactitude must necessarily . . . entail the use of signs intelligible only to the specialists” [Nettl, 2005, p. 87]. This remark seems more pertinent in the present day than ever before. One of the primary considerations that ought to be made by a musician wishing to employ these new forms of notation is their level of complexity. In certain cases, a non-trivial investment of time and energy will be required to become proficient in writing and reading the relevant language. In a language such as Abc notation (see Section 3.2), this is not particularly relevant—as the syntax is reasonably intuitive, and the symbols used are primarily the ones of everyday language. Languages such as Csound, however, are significantly more complicated in structure and syntax.

In the case of Abc notation, or Lilypond, the symbols used exhibit almost a one-to-one correspondence with those of a classical score. And in Csound, certain correlations may still be observed, although they are more scarce. The concept of a ‘note’, for example, is evident in a Csound score, but it is less rigid than its classical counterpart. The ‘note’, in this context, still has a clearly-

defined duration, but its pitch—if even relevant—may invoke Seeger’s concept of the ‘graph’ (see Section 1.2) rather than that of the traditional note [Seeger, 1977]. Moving into even less familiar territory, however, the syntax and symbols of various audio programming languages are likely to strike the classically-reared musician as scarcely comprehensible. And any hopes for a translation into score notation, in such cases, may be futile.

4.2 Efficiency vs. Precision

Other important characteristics to consider are those of efficiency and precision. How does one notate, or transcribe, efficiently without sacrificing the detail? This can perhaps never be resolved completely. Perhaps the best that we—whether transcriber, composer, or other—can do is to notate the bare bones of the music as it is heard or conceived, and then return at a later stage to embellish the basic material. Nonetheless, an efficient form of notation can be of significant benefit.

One may observe, in Table 2, that in two or three cases there is an inverse relationship between the speed of notation and precision. We can note in the case of a recording, for example, that although it can be created at relative speed, it is usually quite imprecise—in terms of rhythm at least. (We are considering its potential role as *instructive* notation in this context. Considered as *descriptive* notation, a recording is perhaps the most precise of all.) The same is true of Parsons code, and, to a certain extent, of Abc notation. Csound, on the other hand, exhibits almost the opposite characteristics. It permits an almost arbitrary level of precision, but can be somewhat cumbersome for certain purposes.

If a general maxim was to be derived from these observations, it would be the simple rule that to do something speedily is to potentially divest our ability to do it thoroughly, or precisely. Thus, to notate the ‘bare bones’ of a musical idea entails that some of the details of the music are left unspecified. In many cases, it is necessary to find a compromise between precision and efficiency. Bruno

Nettl has referred to this as a ‘balance between thoroughness and elegance’ [Nettl, 2005, p. 82].

5 Conclusion

‘Musical notation, after all, is not an ideal method of communication, utilizing, as it does, visual devices to express aural concepts. But it is all we have’ [Stone, 1980, p. xvii].

The sentiment expressed by Kurt Stone in the quote above bears comparison to ideas once articulated by the composer and pianist Ferruccio Busoni. In a commentary on the inherent limitations of notation, he remarked that ‘notation is to improvisation as the portrait to the living model’ [Busoni, 1911, p. 15]. The musical score, he believed, as a representation of the composer’s musical thoughts, was regrettably deficient in its communication of the details. ‘The instant the pen seizes it’, Busoni lamented, ‘the [musical] idea loses its original form’ [Busoni, 1911, p. 17].

Busoni’s comments, however, were made in 1911, during an era characterised by a relative paucity of options for a composer eager to explore new musical territory. In Busoni’s lifetime, the five-line staff and its associated symbols were the only form of representation at the composer’s disposal. Throughout the twentieth century, this circumstance very much changed. And on observing the wealth of options currently available to almost any musician, we may find reason to celebrate. As Guido Gonzato (one of the designers of the Abc music language) has explained,

‘[i]f you are a musician and can use a computer, you are lucky. First of all, because you are a musician; secondly, because the computer is a precious tool for writing music’ [Gonzato, 2005, p. 1].

The relevance of these developments It is perhaps worth noting, in regard to the complexity of the forms of notation discussed in this paper, that

the burden of understanding and interpreting them will not rest on composers alone. A vast amount of music in the future will be notated in a language which does not translate easily into the format of a Western score. And to the extent that analysts and music theorists choose to examine these musics, it may be incumbent upon them to acquire a familiarity with the relevant forms of notation.

A Audio samples

Below are listed the accompanying audio samples.

Matthew Mariano, *Vestige* a composition created using Csound

J.S. Bach, Fugue in G minor, BWV 578, bars 1–10 created using Mondrian

A quarter-tone scale a quarter-tone scale, produced using Lilypond

Lilypond MIDI output example the extract shown in Figure 5 converted to an audio file (using Lilypond’s MIDI output as an intermediary format)

References

Ferruccio Busoni. *Sketch of a new Esthetic of Music*. Schirmer, New York, 1911.

The Lilypond development team. Lilypond: Learning manual, 2009. URL <http://www.lilypond.org/doc/v2.13/Documentation/learning.pdf>. accessed 26/03/2010.

Guido Gonzato. Making music with abc plus: A guide to the notation and its applications, 2005. URL http://abcplus.sourceforge.net/abcplus_en-1.0.4.zip. accessed 26/04/2010.

Bruno Nettl. *The Study of Ethnomusicology: Thirty-one Issues and Concepts*, chapter 7. I Can’t Say a Thing until I’ve Seen the Score: Transcription, pages 74–91. University of Illinois Press, Urbana and Chicago, 2005.

Charles Seeger. *Studies in musicology, 1935-1975*, chapter Prescriptive and descriptive music writing. University of California Press, Berkeley, 1977. ISBN 0520020006.

Kurt Stone. *Music Notation In The Twentieth Century: A Practical Guidebook*. W. W. Norton, New York, 1st ed. edition, 1980. ISBN 0393950530.

Chris Walshaw. A brief history of abc. URL <http://abcnotation.com/history>. accessed 17/03/2010.

Table 2: Comparison of different notational systems

	Representation	Notation efficiency	Storage efficiency	Precision	Difficulty	Performer ability	Micro-tonality	Compatibility with notation	score
	(T=textual, G=graphical, O=other)					read-			
Western Score	G	5		3	3-5	10	1		
Lilypond	T	7	7	3-5	5-7	5-7	4	10	
Abc	T	9	9	3-5	3	6-8	4	8-10	
Mondrian	T	7-9	7-9	5-7	6	4	3	3-6	
Csound	T	3	5	9	7-9	3-4	9-10	1-4	
piano-roll	G	5-7	5-7	7	3	6	1	3-5	
Parsons code	T	10	10	1	1	1-3	0	1	
melograph	G	4		8-10	5	1	9	0	
audio recording	O	7-9		1	3	0	9	0	

Notes:

- Except where otherwise noted, values are based on a scale of 1-10.
- The audio recording, although generally not regarded as a form of notation, is included for the purpose of comparison.
- Since a number of the characteristics described are rather subjective, the values listed are contestable, and should only be regarded as approximate.