Psychol. Belg.
1991, XXXI-2, 147-162.

SOME COGNITIVE ASPECTS OF MOTOR PLANNING IN MUSICAL PERFORMANCE

John BAILY
Music Department
Goldsmiths' College
University of London

The interest of comparative musicologists and ethnomusicologists in musical cognition is reviewed in brief and anthropological and psychological approaches to this topic compared. Research on two contrasting Afghan lute types is discussed with reference to inter-relationships between instrument morphology, movement and music. A grammar of rhythmic improvisation utilizing permutations of right hand stroke patterns is examined, and perceptual and motor factors identified which explain why some rhythmic patterns are used more than others. The paper argues that greater importance should be given to spatio-motor aspects of musical cognition.

ETHNOMUSICOLOGY AND THE PSYCHOLOGY OF MUSIC

That branch of musicology known originally as comparative musicology, and since the 1950s as ethnomusicology, has had strong connections with psychology since its earliest days. Comparative musicology was originally established as an academic discipline at the Institute for Psychology in Berlin, then under the directorship of Carl Stumpf. Stumpf himself carried out one of the earliest studies in comparative musicology, investigating songs of the Bellakula Indians (from the Canadian Pacific coast). The invention of sound recording technology greatly facilitated the development of the new discipline, and the research carried out by these pioneers consisted largely of the transcription and analysis of field recordings collected by anthropologists, explorers and missionaries. A Phonogram Archive to hold such materials was established at the Institute in 1902. The most important of the Berlin comparative musicologists was Erich von Hornbostel, who became the focal point of a small group of students and colleagues, some of whom later emerged as important figures in their own right, such as George Herzog, Mieczyslaw Kolinski, and Fritz Bose. The Institute in Berlin remained the international centre for systematic research into the music systems of the world until the 1930s, an era that ended with the rise to power of the National Socialists. Von Hornbostel died in England in 1935. (See Christensen, 1991, for a succinct account of the Berlin School of Comparative Musicology.)

In accordance with the orientation of the Institute to which they were attached, von Hornbostel and his group took from the outset an interest in the biological foundations of music making, including aspects of musical cognition. They were concerned with fundamental questions about the nature of musicality; with its biological origins and evolution, and with the search for universals in music. A thorough review of von Hornbostel's many publications pertaining to the psychology of music has yet to be carried out, but would certainly reveal important insights relevant to the study of music today (see Blum, 1991, for an interim account). However, the handful of comparative musicologists were diverted from their early interest in fundamental questions about musicality as they began to realise the magnitude of the task before them, which was to research and describe the many music systems of the world as parts of coherent cultural systems before starting to make comparisons between them. An anthropological approach needed to be worked through before the discipline could be in a position to answer questions about the psychology of music, and this has taken a long time to achieve. Only since the 1950s have the methods of anthropology been systematically applied by ethnomusicologists, and in recent years ethnomusicological theory has tended to follow developments in anthropological theory quite closely. An example of this is the adoption of an approach to the study of musical cognition derived from the study of what is variously called *ethnoscience, ethnosemantics* or *cognitive anthropology*.

Theories about cognition proposed by anthropologists are very different from those with which psychologists are familiar. Almost by definition, they deal with matters which are normally verbalised, or are at least capable of verbalisation without too much difficulty. Thus they focus on the study of semantic domains and the way words are used to label categories within classificatory systems. Perhaps the best known studies of this kind concern the music theories of the 'Are'are of the Solomon Islands (Zemp, 1979) and of the Kaluli of Papua New Guinea (Feld, 1981). Both reveal sophisticated ways of conceptualising and talking about music structure, though it is unclear what role such knowledge has in actual performance (Baily, 1988).

In contrast, the psychologists' interest in musical cognition is concerned with dynamic processes which are not necessarily available for introspection and verbalization, and which have to be approached through specially devised empirical tasks, usually conducted in a laboratory situation. It is perhaps possible to bring together anthropological and psychological approaches to musical cognition through the investigation of what I term "the cognition of performance", which is directly concerned with questions of the *subjective* experience of mental processes in the act of performance. How does the performer consciously represent the task performed? How is that representation utilised in the process of performance? What do musicians have to tell us about their introspections regarding performance?

Spatio-motor representations of music structure

One of the great virtues of ethnomusicology is its embrace of musics that do not rely on a written score for performance and where highly specialised musical literacy skills are of no significance. The cognitive processes involved in European art music — which is the kind of music most commonly used in studies of musical cognition — are not necessarily the same as those used in performing or perceiving 'Are'are panpipe music or Kaluli lamentations. The majority of world musics are learned by their practitioners through processes of aural tradition, and it is normal for the musician to play from memory, augmented by procedures of variation or improvisation, rather than from a written score. For musicians who operate in this way we can identify two kinds of musical representation, an auditory representation in which musical patterns are recalled and configured as auditory phenomena, and a spatio-motor representation in terms of which movements are planned and experienced in visual, kinaesthetic, and tactile terms in relation to the spatial layout of the instrument.

Von Hornbostel tackled this issue years ago in his analysis of a recording of xylophone music, when he put forward the idea that the player "realizes melody above all as an act of motility, regarding its audible quality rather as a side-issue, though a desirable one" (von Hornbostel, 1928, p. 49; see also Blum, 1991, p. 10). Ideas of this kind have been further elaborated by Blacking (1955a, 1955b, 1961) and Kubik (1962, 1979), both scholars of African music, where the connection between music and movement seems particularly strong and obvious. A brief survey of these key African music papers can be found in Baily (1985, pp. 238-242).

There seems to be a tendency on the part of psychologists working on musical cognition to regard the spatio-motor representation as existing at a low level in a hierarchy of levels of abstraction, "...what we would call 'musicianship' seems to entail the ability to mobilize the higher, more abstract levels in a wide variety of circumstances" (Sloboda, 1982, p. 480). The ethnomusicologist, with the opportunity to observe the importance of human movement in certain music cultures, argues that one should regard auditory and spatio-motor modes of musical cognition as being of potentially equal importance. This approach introduces the human body, as well as the human auditory system, into the debate about the nature of musical creativity. The spatio-motor mode should be regarded as a legitimate and commonly used mode of musical thought, which is just as "creative" as the auditory mode, for creativity in music may consist of finding new ways to *move* on the instrument, which are assessed, and further creative acts guided, by the aesthetic evaluation of the resultant novel sonic patterns.

It is important to realize that the relationship between music and movement is not necessarily restricted to the kinds of music usually studied by ethnomusicologists, but may be a crucial factor in the creation and performance of Western music too:

> A pianist who plays the *Etudes* of Chopin or many pieces by Liszt cannot help being conscious of the sheer physical pleasure of numerous passages, and noticing how the music grows out of physical movement ... We find numerous examples of Western classical music, where the musical form is much influenced by the properties of the instrument for which it was written. (Blacking, 1955b, p. 52)

> When we analyze the music of Hector Berlioz it is useful to know that he often worked out harmonic procedures on the guitar, and that the structure of the instrument influenced many of his chord sequences. (Blacking 1973, p. 21)

The ethnomusicologist Paul Berliner carried out extensive research on jazz improvisation with musicians in New York in line with the cognition of performance approach outlined above. He gathered many interesting statements about the different forms of imagery or representation that musical ideas can assume and their interplay in the conceptions of improvisers, including the following comment about how stock phrases are transformed and "come out differently" in jazz solos.

> Saxophonist Harold Ousley indicates that different mental processes provide the inspiration for these transformations. "Sometimes the ideas come from my mind and I have to find them quickly on the horn, but other-times they come from my fingers. My fingers are 'walking through the

> yellow pages' so to speak. They'll come up with new things and I'll hear it and say, 'Hey, I like that'". (Berliner 1989, p. 4)

Recent research by Leslie Gay on rock groups in New York is also relevant. Many of the musicians he studied were trained in Western art music, could read music notation fluently, knew all about harmony and even about modern techniques of composition, but when operating in the rock music domain did not conceptualise the music they played in these formal terms.

> In New York, rock music is guitar music... Not only is the guitar the central instrument of rock performance, it also serves as the principal medium for developing and communicating musical ideas. Because of this emphasis on guitar as performance medium and as compositional tool, the guitar becomes in effect the lingua franca of rock musicians. In this process of oral composition without written references and without a standard set of musical terminology, communicating musical ideas means demonstrating them on the guitar. When a songwriter brings a new idea to band, he will play his ideas several times emphasizing the changes on the guitar fretboard until the others can copy it. (Gay, 1990)

The implication here is that the spatial layout of notes and the physical structure of the guitar provides a framework for musical conceptualization, a "compositional tool" used for the "development of musical ideas", an interface to be manipulated and acted upon in certain specific ways. It is clear that the guitar lends itself rather well to spatial thinking (Baily & Driver, 1992). Preliminary work on this mode of cognitive operation has been carried out by the author with respect to certain Central Asian lutes, and it is to some of the ideas that have emerged from this work that we now turn.

Research on Central Asian Plucked Lutes

My early research on relationships between music structure and human movement looked at perceptual and motor factors affecting performance on the *dutār* and *rubāb*, long-necked and short-necked plucked lutes respectively. The *dutār* is an instrument that has undergone considerable morphological change since about 1950, and in examining these developments I was interested in the inter-relationship between three sets of factors: the morphology of the instrument, the movement patterns used in playing it, and the structural characteristics of the music produced. The results have been published in Baily 1977 and 1985.

Ergonomic factors in musical performance

The way the human body is organized to move is, in certain respects, a crucial element in the structure of music. A musical instrument is a type of transducer, converting patterns of body movement into patterns of sound. There is a precise isomorphism between music structure and movement structure: every nuance in the micro-structure of the sound pattern reflects a subtle adjustment of the motor pattern. The morphology of an instrument imposes certain constraints on the way it is played, favouring movement patterns that are, for ergonomic reasons, easily organized on the spatial layout. Thus, the interaction between the human body, with its intrinsic modes of operation, and the morphology of the instrument may shape the structure of the music, channelling human creativity in predictable directions. Musical styles vary widely with respect to the degree to which the motor patterns of the performance technique embody the constraints imposed by the morphology of the instrument, and utilize movements and sequences of movements that are intrinsically easy for the human sensori-motor system to organize. So we may speak of the degree of *compatibility* between an instrument and the human body.

An important difference between the *dutār* and the *rubāb* is that the former has only one melody string, so that the note positions are arranged in a single row (a *linear* array), while the latter has three melody strings, with the note positions mapped across them (a *tiered* array). This fact has implications both for stopping the strings with the left hand and for plucking them with the right hand. With respect to the left hand we may isolate two principal factors in the interaction between hand and layout:

a. Relative frequency of hand and finger movements. On the *dutār* hand movements are required to exploit the same musical range that can be reached with finger movements on the *rubāb*. This difference has important implications in the domain of motor control.

b. Spatial confusion. The linear array is a more confusing spatial framework in which to operate. Note positions are mapped in one rather than in two dimensions, and it is more difficult both to apprehend the spatial pattern, and to keep track of where you are within a sequence of positions around which the motor pattern is organised.

The relationship that emerges from this research is primarily between the spatial layout of the keyboard and the melodic contour of the music produced from it, a relationship that can be readily explained in terms of the mediating sensori-motor structures. The *dutār* and *rubāb* seem to demonstrate the shaping influence of the spatial layout rather clearly: *dutār* and *rubāb* tunes fit well onto their respective instruments, and in this sense are highly compatible with them. Whether the music can be said to have been generated from the instrument, or the instrument to have been adopted or designed so that certain pre-existing musical structures can be readily produced by patterns of movement, is perhaps immaterial, for both possibilities indicate the importance of human factors which interact with the spatial layout. These human factors are partly anatomical and physiological, but there are obviously cognitive components too, as the spatial confusions associated with the linear array demonstrate.

Motor grammars in composition and improvisation

If we compare different styles of playing an instrument, we find that they are characterized by particular patterns of movement which constitute the "motor structure" of each style. Intuitively, one might expect the motor structure to embody a set of rules which constitute a form of motor grammar. This determines the way movements are put together, both as simultaneous combinations and as movement sequences, and can generate novel sequences of movement, and hence of music.

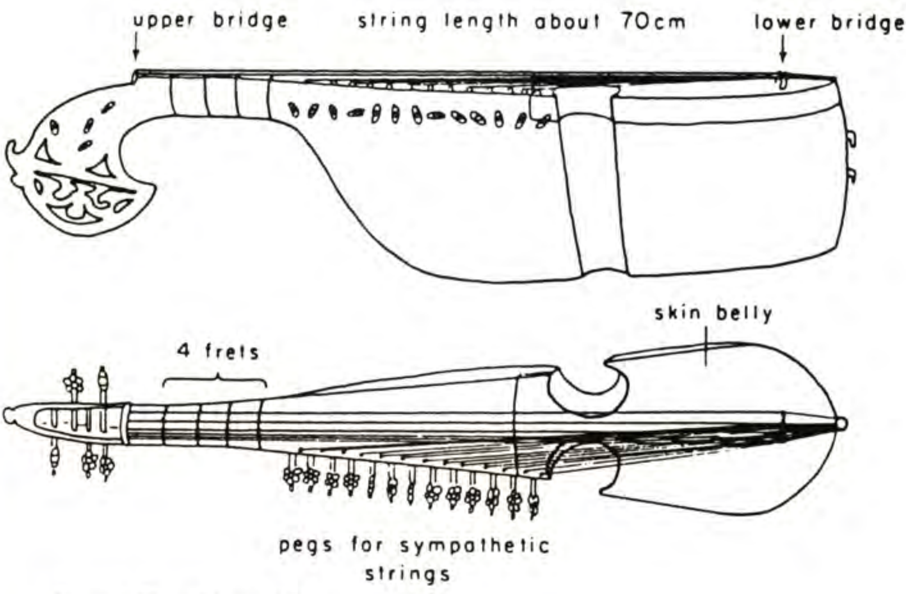

Figure 1. The Afghan *rubāb*.

My research on a genre of instrumental art music associated with the Afghan *rubāb* revealed a mode of improvisation in which a short fixed composition is subjected to a sequence of rhythmic episodes in each of which there is a progressive increase and then release of "rhythmic tension". The *rubāb* has three main strings tuned in 4ths (B_1 E A) and sets of drone and sympathetic strings, see Figure 1.

The instrument is played with a plectrum held between the thumb and forefinger. A small but significant morphological feature of the *rubāb* is the way the shortest sympathetic string is raised by a protuberance on the bridge, as shown in Figure 2. This allows it to serve as a high drone string, which is struck in alternation with the main strings in complex right hand patterns.

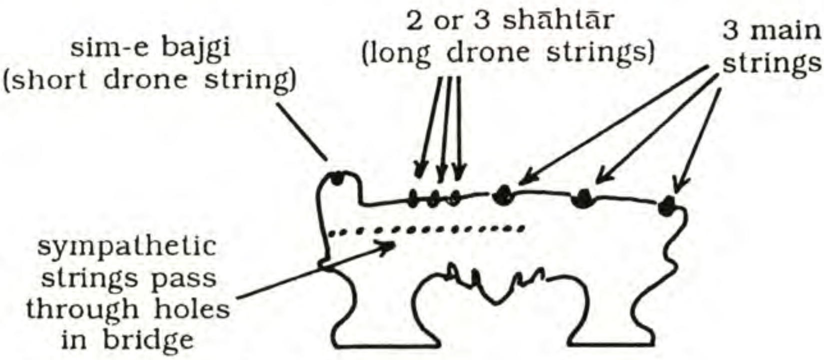

Figure 2. Bridge of the *rubāb*.

The art of playing the *rubāb* resides in producing extended sequences of rhythmic patterns from a variety of right hand stroke patterns, many of which involve the high drone string. It seems probable that when the high drone string is used it creates a perceptual streaming effect (McAdams & Bregman, 1979), being heard as an independent rhythmic pattern. For example, the pattern

(which we discuss later) is probably heard as

In Baily (1987) a motor grammar is described which generates rhythmic units one, two or four *matras* (equal time units) in length. The basic rules of the grammar are shown in Table 1.

Table 1. — *Generative Rules for* Rubāb *Playing (see Baily 1987, 1990)*

Rule 1.	∨ is the dominant stroke
Rule 2.	∧ only occurs in association with ∨
Rule 3.	∧∧ is an impossible combination
Rule 4.	The maximum number of ∨s in a row is 3
Rule 5.	When two ∨s follow a ∧ the first ∨ can become $^{\mathrm{v}}$
Rule 6.	4 *matras* shall be the longest patterned unit

Note. ∨ = downstroke, ∧ = upstroke, $^{\mathrm{v}}$ = downstroke on the high drone string.

These rules can generate various one *matra* units, such as ∨∧∨∧, ∧∨∧∨ and ∨∧∨∨, which can then be combined in two *matra* units such as ∨∧∨∨ ∨∧∨∧ and ∨∧∨∨ ∧∨∧∨, or four *matra* units such as ∨∧∨∨ ∨∧∨∧ ∨∧∨∧ ∨∧∨∧. The ∨∧∨∨ unit is the key pattern for generating many other patterns, especially when Rule 5 is used to give transformations such as $\vee\wedge^{\mathrm{v}}\vee$, $\wedge^{\mathrm{v}}\vee\vee$, $^{\mathrm{v}}\vee\vee\wedge$ and $\vee\vee\wedge^{\mathrm{v}}$, and these can be combined with other units. Not all combinations are possible: for example, ∧∨∨∨ ∨∧∨∧ contravenes Rules 3 and 4.

The structure of these rhythmic units arises in part from the physical characteristics of the movements used to pluck the strings, notably the inequality between the strong downstroke and the weak upstroke inherent in the posture of the right hand. The downstroke is not only downward but also inward towards the belly of the instrument, and the hand hits onto the skin belly, adding a percussive component to the sound of the stroke. A specific stroke sequence produces a particular rhythmic pattern, and there are clearly audible differences between patterns such as

depending on the temporal distribution of the downstrokes.

In the kind of *rubāb* performance under consideration here the strategy is to subject the composition to a succession of rhythmic treatments, passing from one rhythmic pattern to another, usually sustaining each one for a complete round of the composition. Performance is organized through the sequential retrieval from memory of motor programs which together constitute a vocabulary of stroke patterns. The player makes choices between over-learned patterns (already generated from the grammar) to create the structure of the "episode", with its gathering rhythmic tension and perceptual confusion. Sometimes a new motor-rhythmic pattern is generated from the motor grammar, which can then be elaborated in the development of an episode (see Baily, 1987, for a detailed analysis of a recorded example of such rhythmic improvisation).

Re-phasing the stroke pattern

The motor grammar described above can generate a large number of seemingly equivalent units but they are not equally easy to control. For example, by employing the principle I call "re-phasing the stroke pattern" seven inter-related sequences can be derived from the commonly used asymmetrical $^{\vee}\vee\wedge^{\vee}\ \vee\wedge\vee\wedge$ two *matra* sequence. The eight patterns use the same sequence of eight strokes, starting on each of the eight points in the cycle, see Figure 3.

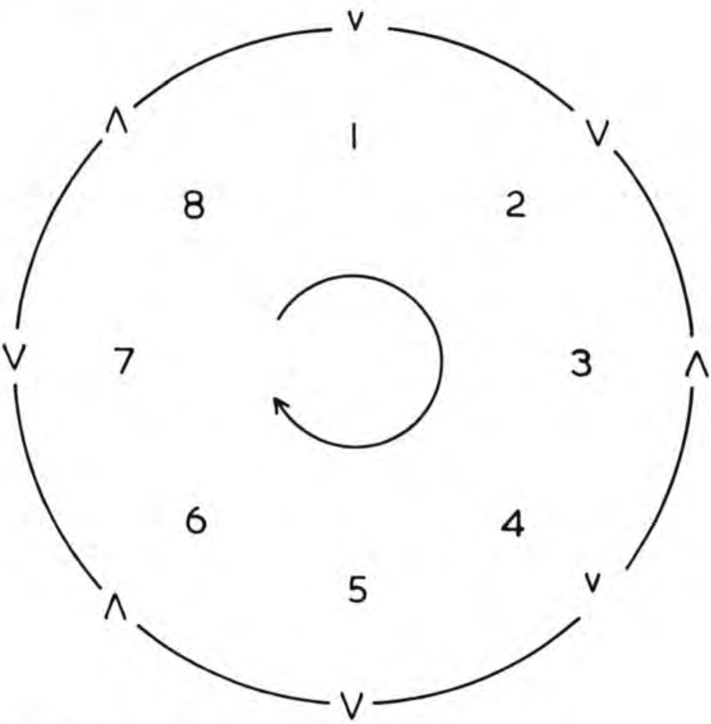

Figure 3. The stroke cycle.

The eight patterns are shown individually in Table 2. One might

Table 2. — *Right Hand Stroke Patterns Generated by Re-phasing of Stroke Cycle*

1.	$^{\vee}\vee\wedge^{\vee}\ \vee\wedge\vee\wedge$
2.	$\vee\wedge^{\vee}\vee\ \wedge\vee\wedge^{\vee}$ (derived from $^{\vee}\vee\wedge^{\vee}\ \vee\wedge\vee\wedge$)
3.	$\wedge^{\vee}\vee\wedge\ \vee\wedge^{\vee}\vee$ (derived from $\vee\wedge^{\vee}\vee\ \wedge\vee\wedge^{\vee}$)
4.	$^{\vee}\vee\wedge\vee\ \wedge^{\vee}\vee\wedge$ (etc.)
5.	$\vee\wedge\vee\wedge\ ^{\vee}\vee\wedge^{\vee}$
6.	$\wedge\vee\wedge^{\vee}\ \vee\wedge^{\vee}\vee$
7.	$\vee\wedge^{\vee}\vee\ \wedge^{\vee}\vee\wedge$
8.	$\wedge^{\vee}\vee\wedge\ ^{\vee}\vee\wedge\vee$

Note. $\vee$ = downstroke, $\vee$ = upstroke, $^{\vee}$ = downstroke on the high drone string.

hypothesise that here is an elegant and simple principle for generating a number of musical patterns through left and right hand patterns interacting with each other in different phase relationships. However, it is clear that the eight different patterns are not equally easy to sustain over a round or more of the short composition. Why not?

To go some way in answering this question, take a well-known composition for the *rubāb* in the melodic mode (*rāg*) called *Bihāg*. This composition is in a metric cycle of sixteen *matra*s with a structurally important stress on the first beat of the cycle. This metric cycle is called *Tintāl* and is very common in both Afghan and North Indian music. In Figure 4 the underlying model of the composition is expressed in the modified Western notation commonly used for North Indian music.

Figure 4. Underlying melody of the composition in *Bihāg*.

Each crotchet (quarter note) equals one *matra*; the bar lines indicate groups of four *matras*; only the lower two melody strings are required for this melody. Now let us apply Pattern 1 ($^{\vee}\vee\wedge^{\vee}\ \vee\wedge\vee\wedge$) of Table 2 — which is a very common pattern used by *rubāb* players — to this composition, see Figure 5.

As a player of the *rubāb* I also find this pattern easy to perform. It seems that in some sense it constitutes a good gestalt. Note that it has the internal grouping 332 ($^{\vee}\vee\wedge\ ^{\vee}\vee\wedge\ \vee\wedge$). The other seven patterns can all be applied to the melodic composition in the same sort of way. Some prove more difficult than others, even though they all employ the

Figure 5. The composition played with Pattern 1.

same *sequence* of strokes performed as a loop. As a performer, I find that Patterns 2 ($\vee\wedge^{\vee}\vee\ \wedge\vee\wedge^{\vee}$), 4 ($^{\vee}\vee\wedge\vee\ \wedge^{\vee}\vee\wedge$), 5 ($\vee\wedge\vee\wedge\ ^{\vee}\vee\wedge^{\vee}$) and 7 ($\vee\wedge^{\vee}\vee\ \wedge^{\vee}\vee\wedge$) are all readily playable and, at least for this composition in *Bihag*, it is difficult to discriminate between them in terms of performability. However, Patterns 2, 4, 5 and 7 seem to be much less readily used by Afghan *rubāb* players than Pattern 1.

In contrast to these *compatible* patterns, Patterns 3 ($\wedge^{\vee}\vee\wedge\ \vee\wedge^{\vee}\vee$), 6 ($\wedge\vee\wedge^{\vee}\ \vee\wedge^{\vee}\vee$), and 8 ($\wedge^{\vee}\vee\wedge\ ^{\vee}\vee\wedge\vee$) present real technical difficulties. All three start with an upstroke, and this poses difficulties of performance technique because the melody requires a change of string between a downstroke and the succeeding upstroke, a difficult movement to coordinate. Changing string is readily achieved when the change precedes a downstroke, that is, when the hand's starting position is above the strings and all that is required is a small change in the angle of the downstroke to strike the appropriate string. Problems arise when the change of string precedes an upstroke, which, according to the principles by which stroke patterns are organized, will occur only after a downstroke. Now the plectrum has to be moved from below one string to below the next string to reach the starting point for the upstroke; a change of hand position has now been inserted between V and $\wedge$ (see Baily, 1985, p. 255 for a fuller explanation). *Rubāb* players have found a solution to this problem, which is shown in Figure 6, where Pattern 8 is applied to the composition. The strategy here is to carry over the last note of the preceding *matra* for the first stroke of the succeeding one, which avoids the difficult change of string before an upstroke. For the composition in *Bihāg* this affects *matras* 1, 7, 11 and 13.

However, this adds a new degree of complexity to the performance, and pushes the composition as played out of its square relationship with the underlying melodic framework, being as it were *stretched* at these points. The same "stretching strategy" can be used in playing the

Figure 6. The composition played with Pattern 8.

composition with Patterns 3 and 6. From the subjective point of view I find Patterns 3 and 6 extremely hard to coordinate, and I think there are other, perceptual, considerations at work here, see below. Reference to Table 2 shows that in Patterns 2, 4, and 7 the second half of each pattern begins with an upstroke. This is not a problem in playing this particular composition in *Bihāg* because there are no string changes required at these points, but there are many other compositions where this is a consideration. The "stretching strategy" can again be used to get round the difficulty. This may also help to explain why these three patterns are not used more often.

Besides these problems of performance technique, some patterns may be difficult to organize as auditory gestalts. Thus, patterns with a 332 internal organization (Patterns 1, 7 and 8) may be easier to perform than patterns organized as 233 (Patterns 5 and 6) or 323 (Patterns 2, 3 and 4). It has yet to be established how the looped sequence $^{\vee}\vee\wedge^{\vee}$ $\vee\wedge\vee\wedge$ is actually perceived, both by Afghan and by British observers, and there is a need here for empirical laboratory research, using synthesised sequences to control for accentuation and slight inequalities in timing. It may turn out that patterns with a 233 or 323 configuration tend to be transformed into a 332 pattern, so that while the performer may conceptualise the pattern as starting at one point, it may be difficult not to hear it as starting somewhere else, resulting in a conflict for the performer between intention and perception and a consequent breakdown in performance. This may explain why Patterns 3 and 6 are so difficult — not only do they contain the initial upstroke problem but they give rise to unstable percepts.

What is going on at the conscious level of control? Choices are being made, such as planning ahead to the selection of the next pattern and bringing it in at the right point, etc. What can the *rubāb* player tell us about how he represents the various rhythmic patterns? Unfortunately, I have little field data to answer this question but it may be significant that there is a system for the verbal labelling of such patterns, which describes aspects of the movement of the right hand. This suggests that the musician is conscious of thinking primarily in terms of movements rather than sound patterns, and is confronted continually with the problem of "How do I *move* next?", rather than, "What's the next sound pattern I should produce?"

Speaking from my own subjective point of view I find that when I try to play this set of patterns I certainly think of them as movement sequences rather than as auditory patterns. Although my analysis has shown that the eight patterns are related in a certain way, that is not how I think of them while playing them. From this perspective they are eight *different* patterns, and I divide them intuitively into three groups, under the "headings" of Pattern 1, Pattern 7 and Pattern 8, the three patterns which turn out to have a clear 332 internal structure. Under Pattern 1, I would further group Patterns 4 and 5: like Pattern 1, Pattern 4 starts $^{v}\vee\wedge$..., while Pattern 5 is a direct transformation of 1 in which the two halves of the pattern are reversed. Interestingly, although there are three other "reverse pairs" amongst the eight patterns, I do not normally link them in the way I link 1 and 5. Under Pattern 7, I would group Pattern 2, which also starts with $\vee\wedge^{v}$... Under Pattern 8, I would group Patterns 3 and 6, which also start with an upstroke and which are even more difficult to play.

The patterns generated from the motor grammar are not equally available, some are more compatible with the human sensori-motor system than others, and they are the ones that probably lie at the core of the repertory of patterns actually used by *rubāb* players. Those that are difficult to use, however, are the domain of the virtuoso, who may, for example, deliberately select patterns which begin with an upstroke. In this music varying degrees of perceptual confusion are engendered by using units which tend to group themselves progressively out of phase with the metrical framework of the composition. It is a play on rhythmic ambiguity, an effect enhanced by the use of the high drone string to create two perceptual streams with different rhythmic patterns, and by shifting the melody about in relation to the abstract melodic outline. The cyclic variations present a shift between stability and confusion, and conform to the principles of "simultaneous deviation" set out by Meyer (1956, p. 234-244).

This brief examination of Afghan lutes provides an example of how ethnomusicology can contribute to the debate about questions of music structure, musicality and musical cognition. Clearly there is tremendous potential for further research in this direction. Ethnomusicology can identify principles of musical organization which are unknown and unused in Western music, and recognise the significance of modes of musical thought which are undervalued in our art music culture. To claim any kind of universality, our theories of musical cognition will have to take this diversity of process and product into account.

REFERENCES

Baily, J. (1977). Movement patterns in playing the Herati *dutār*. In J. Blacking (Ed.), *The anthropology of the body* (pp. 275-330). London: Academic Press.

Baily, J. (1985). Music structure and human movement. In P. Howell, I. Cross, & R. West (Eds.), *Musical structure and cognition* (pp. 237-258). London: Academic Press.

Baily, J. (1987). Principes d'improvisation rythmique dans le jeu de *rubāb* d'Afghanistan. In B. Lortat-Jacob (Ed.), *L'improvisation dans les musiques de tradition orale* (pp. 177-188). Paris: SELAF. (English version published in *ICTM UK Chapter Bulletin*, 1989, No 22, 3-16)

Baily, J. (1988). Anthropological and psychological approaches to the study of music theory and musical cognition. *Yearbook for Traditional Music*, *20*, 114-124.

Baily, J., & Driver, P. (1992). Spatial thinking in playing the guitar. *World of music*. (in preparation)

Berliner, P. (1989). *Response to papers by John Baily and Jeanne Bamberger.* Paper presented at SEM Pre-Conference on Music Cognition and Ethnomusicology, MIT.

Blacking, J. (1955a). Notes on a theory of rhythm proposed by von Hornbostel. *African Music*, *1*(2), 12-20.

Blacking, J. (1955b). Eight flute tunes from Butembo, East Belgian Congo. *African Music*, *1*(2), 24-52.

Blacking, J. (1961). Patterns of Nsenga *kalimba* music. *African Music*, *2*(4), 3-20.

Blum, S. (1991). European musical terminology and the music of Africa. In B. Nettl & P.V. Bohlman (Eds.), *Comparative musicology and anthropology of music* (pp. 3-36). Chicago: University of Chicago Press.

Christensen, D. (1991). Erich M. von Hornbostel, Carl Stumpf, and the institutionalization of comparative musicology. In B. Nettl & P.V. Bohlman (Eds.), *Comparative musicology and anthropology of music* (pp. 201-209). Chicago: University of Chicago Press.

Feld, S. (1981). "Flow Like a Waterfall": The metaphors of Kaluli musical theory. *Yearbook for Traditional Music*, *13*, 197-217.

Gay, L. (1990). *Strings of knowledge, strings of power: Composition as negotiation among New York city rock bands.* Paper presented at the SEM Conference, Berkeley.

Hornbostel, E.M. von. (1928). African Negro music. *Africa*, *1*, 30-61.

Kubik, G. (1962). The phenomenon of inherent rhythms in East and Central African instrumental music. *African Music*, *3*(1), 33-42.

Kubik, G. (1979). Pattern perception and recognition in African music. In J. Blacking & J.W. Kealiinohomoku (Eds.), *The performing arts: Music and dance* (pp. 221-249). The Hague: Mouton.

Meyer, L.B. (1956). *Emotion and meaning in music*. Chicago: University of Chicago Press.

McAdams, S., & Bregman, A. (1979). Hearing musical streams. *Computer Music Journal*, *3*(4), 26-44.

Sloboda, J.A. (1982). Music performance. In D. Deutsch (Ed.), *The psychology of music* (pp. 479-496). London: Academic Press.

Zemp, H. (1979). Aspects of 'Are' are musical theory. *Ethnomusicology*, *23*, 6-48.

New Cross
London SE14 6NW
United Kingdom