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Imagination in practice: a study of the integrated roles of interpretation, imagery and technique in the learning and memorisation processes of two experienced solo performers

Patricia Holmes

Trinity College of Music, King Charles Court, Old Royal Naval College, Greenwich, London SE10 9JF, UK

pholmes@tcm.ac.uk

How can we use practice time in the best possible way? Do we, as performers, have a keen enough awareness of the workings of our mind and body to be sure we are learning in the optimum way for secure performance? If not, how can we readily convey to others good habits for learning and memorisation? By demonstrating aspects of how experienced solo instrumentalists prepare for performance, this paper makes some progress towards answering these questions. In order to extend existing piano based research and to establish possible instrumental differences in working patterns, this study is based on data from interviews with a guitarist and a 'cellist. Thematic analysis of the interview data reveals that despite some variation due to the respective nature of the instruments, most practice strategies are common to both and these strategies are always generated by interpretative goals. Firstly, the clear links between interpretative goals and the formation of playing techniques are demonstrated by the subjects' intuitive mental constructs involving imagery, giving considerable insight into their thought processes and working patterns. Among the forms of imagery identified, motor imagery was found to be unexpectedly significant. Next, there is some discussion of how imagery associated with simultaneous technical and emotional input can help to embed information securely in the memory. The value of creating idiosyncratic structures relating to learning and performance is then shown. Finally, advantages of introducing a more imaginative approach into practice at all levels are proposed, together with potential benefits for both motivation and memory retention.

Introduction

While advice on frequency and duration of practice is generally readily available, with the exception of Hallam (1997) very little research has been done on practice content and structure across a range of instruments. However, music performers will always be trying to find ways of using practice time more efficiently and this paper aims to make a contribution towards this goal. The principal aim was to explore ways in which the conscious development of instrumental technique might form an integral part of the learning and memorisation process. At the highest levels of technical expertise more choices become available to the performer and a sophisticated and ever changing synthesis of different skills becomes possible. It is therefore not surprising to find that at elite level a preoccupation with technique in some form will occupy a large part of practice time (on most instruments,

some technical knowledge will be necessary to make any sound at all). With this in mind, it seemed reasonable to surmise that, whether consciously or unconsciously, the many facets of technique will form a significant part of learning and memorisation. Should this be the case, the question arises: how can musicians develop practice strategies that employ a more conscious awareness of technique in order to embed music more securely in the memory? This study was undertaken as a first step towards answering this question.

Background

Music performance has been described as 'the formation of conceptual interpretations, retrieval from memory of musical structures and transformation into appropriate motor actions' (Palmer, 1997). This seems a logical sequence of events, but little attention has so far been given to how the performer achieves this 'transformation', or indeed the extent to which interpretation and resulting motor activity actually form part of the memory store. However, since previous research has shown that understanding musical structure will improve memory capacity (e.g. Rubin-Rabson, 1937, 1940), it seems reasonable that structures derived from technical or interpretative sources (or both) might do the same. By exploring the working methods of two expert solo instrumentalists, it is hoped to gain further insight into this aspect of practice and performance.

Review of existing research on instrumentalists' learning and memorisation strategies

Existing research is mostly piano based (Palmer, 1997) and references to 'technique' make little mention of the physical sensation of playing. It might be that this seems logical for the piano, but the *differences* in instrumental techniques would imply potential variation in the ways through which music is practised and learned.

The most extensive study of a pianist learning was undertaken by Chaffin and Imreh (1997) when they recorded Imreh herself, learning the third movement of Bach's *Italian Concerto* for keyboard. Since then, they have analysed the resulting data in a number of ways, all of which shed considerable light on the way in which a pianist might approach, learn and memorise a piece such as this (Chaffin & Imreh, 1997; 2001; Chaffin, Imreh & Crawford, 2002). The level of detail in this work makes it possible to identify some of the intrinsic working differences between the piano and other instruments, not least the nature of the score, the working mechanisms of the instrument itself and the consequent technical demands. The configurations of notes and the distances covered can be very complicated and decisions on fingerings must be made early in the learning process. For this reason, it is logical that in Chaffin and Imreh's work, most reference to technique concerns matters of fingering. Technical difficulties occur when the necessary fingering patterns are complicated, awkward, or require extended practice to execute them at speed. (As will be seen from the current study, for other instruments, technical difficulties go well beyond fingering.)

Chaffin and Imreh did find that technically difficult passages tend to remain secure in the memory (2001). This would seem to be due in part to much repetition, but also to the complexity of the perceptual and motor skills involved, certainly at a high level of technical skill. This would conform to the model of Ericsson & Kintsch (1995; cited in

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Chaffin, Imreh & Crawford 2002), that expert memory must involve meaningful encoding together with efficient and effective retrieval. It has also been proposed that musicians' own mental representations of music will support learning and memorisation (Lehmann & Ericsson, 1995; cited in Ginsborg, 2000).

Some interesting research subsequent to Chaffin and Imreh has been the work on retrieval structures by Williamon and Valentine (2002) which shows that pianists tend to start and stop practice on structural boundaries. Ericsson and Kintsch had predicted that at higher levels of expertise there are likely to be individual differences in the ways retrieval schemes function (1995; cited in Williamon & Valentine, 2002). However, for the purposes of the current discussion, the most significant of Williamon and Valentine's results is that the subjects' definitions of 'structure' varied and did not necessarily conform to formal analysis. The possible interpretative/technical nature of such individual variation has been identified as follows:

- Rubin-Rabson (1940) suggested that the cognitive organisation of material is likely to be individual dependent and that within the music, patterns delineated by their technical characteristics will undoubtedly appear.
- Rink (2002) proposed that 'intuition in the interpretative process' could be a significant factor.

One would expect such models of potential for individuality to apply to all expert instrumentalists, although with a variable hierarchy of technical considerations.

Despite the potential for idiosyncratic structuring identified by Williamon *et al*., in most studies of pianists' memorisation processes, 'analysis' mostly refers to a formal analysis of the score (Rubin-Rabson, 1937; Chaffin and Imreh, 1997; Miklazewski, 1989), rather than including the physical processes of producing the sound. Undoubtedly, the complexity of a piano score requires multi-layered processing of a particular kind, involving the recognition of large and small scale musical structures (Chaffin & Imreh, 2002), but there is a very different set of inherent difficulties for instruments where the means of making the sound are not necessarily obvious. It follows that information to be encoded during the learning process and the encoding mechanisms themselves will both vary from one instrument to another.

In summary, the elements of musical memory emerging as most critical seem to be:

- The ability to organise the music in some way (Rubin-Rabson, 1937; Rubin-Rabson, 1940b; Miklazewski, 1989; Chaffin *et al*., 2002).
- The ability to hear the music in the head (Kovacs, 1916: cited in Rubin-Rabson, 1937; Hallam, 1995).
- Meaningful encoding and retrieval (Ericsson & Kintsch, 1995; Williamon & Valentine, 2002).

However, none of this literature deals directly with the players' use of technical resources and there is an apparent gap between the mental representation of the score and the onset of the sound. Seashore, originally writing in 1938, mentioned the concept of 'imagining in music' and this may be a useful term in this context. He identified motor imagery as a form of imagery that he thought would probably be shown to be 'the outstanding characteristic of a musical temperament's responsiveness to a musical situation'

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(Seashore, 1967: 169). This must surely to some extent fill that gap. Seashore uses the analogy of a dream to show how an action can be felt. When dreaming of singing, one has all the experience that comes from the kinaesthetic (motor) sense, living through the same sorts of actions that would be experienced if one were actually singing. The motor image would then become the 'raw material from which emotion is built up' (Seashore, 1967: 168). If Seashore's statement is true, technique is clearly linked with interpretation through a web of internal representations. It does seem reasonable to hypothesise that, certainly at the highest levels of expertise, as the performer's emotional concept is translated into sound, an emotional element might be present in motor programming. The motor memory then becomes much more sophisticated than the kinaesthetic memory generally referred to in relation to repetition of actions.

Imaging movement is mentioned by Miklazewski in his study of an advanced piano student practising the prelude *Feux d'Artifice* by Debussy (Miklazewski, 1989). He relates technical (fingering) problems to musical understanding and auditory imaging to the acquisition of necessary techniques (Miklazewski, 1989), but does not explain exactly *how* hierarchical links might be made. In this study Miklazewski found that technical issues such as fingering and position of hands were put in place so that the interpretation could evolve. Given the textural characteristics of a piano score and co-ordination demands of piano technique, this does appear to be logical. For other instruments however, especially when decisions are made regarding the quality of the sound to be produced, interpretative goals could actually be the precursors of technical decisions.

The direct link between the visual representation of the music (the score) and its audible realisation (the sound) must be a series of instrument-specific technical constructs, of which the planning and control of movement will form a fundamental part. Since in elite performers one can assume that the creation of sound will always be related to expressive intent, and since both these will inevitably be directed towards the ultimate goal of communicating a personal concept of the music, one might also assume that they feature strongly during learning. Such assumptions regarding the chain of cognitive events between musical concept, technique and performance form the background for the preliminary study.

Preliminary study

From an extensive review of existing literature relating to expert instrumental performers learning and memorising music, there appeared to be no direct model for the proposed research. In view of this, and in order to establish the feasibility of the main study, it was necessary to run a preliminary study (Holmes, 2003). It was clearly important to discover the self-reporting ability of the subjects. Since any individual interpretation of a musical performance is dependent upon adequate technical expertise for its realisation (Juslin & Persson, 2002), the seemingly effortless technical fluency of the expert performer means that the connections between interpretation and technique are not necessarily apparent to an observer (Lisboa, 1992). For the purposes of a preliminary study, it was therefore decided that the most productive data was likely to come from subjects with the highest levels of expertise, who are also articulate and self-aware. In order to conform to these criteria and to ascertain whether there might indeed be instrumental differences, a 'cellist and a guitarist

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were chosen, both experienced solo performers.[1] Following a partial model provided by an earlier related study (Hallam, 1995), a semi-structured interviewing technique was adopted. Questions centred on:

- how the 'cellist and guitarist learn and when and how they memorise
- exploration of their use of visual, auditory and motor imagery
- how they structure music
- practicalities and the subjective experience of performing from memory, including their perception of music during performance.

Interpretative Phenomenological Analysis (IPA) was used (Smith, Jarman & Osborn, 1999),[2] in order to provide an in-depth analysis of the interview data and to allow any recurrent patterns or themes to emerge.

One reason for selecting semi-structured interviews and IPA methodology for the preliminary study was to test the viability of such an approach in the context of music performance; the richness of the data and the emergence of strong and consistent themes suggested that this would indeed be the most appropriate way of continuing this research. For example, it was soon revealed that for both participants, decisions regarding the more tangible stages of learning, such as choice of fingerings or bowings are not made independently; they are generated by interpretative ideas. Both spoke of *'hearing the music in the imagination'* and continually striving to find ways of realising their own interpretation – technique is continually related to context through structure and emotional content. Though not in itself surprising, this did introduce a major new consideration into the sequence of events that might be contributing to the memory store. It became evident that interpretation and technique are integrated and interdependent; technical decisions being made in order to achieve the desired musical outcome. Moreover, it seemed likely that for the participants, their inner convictions that the music should be heard in a particular way often generate the drive to persist and experiment with new techniques that are beyond their existing capacity. It was also clear that the perception of the physical sensation of movement (as an integral part of intense thought processes) contributes strongly to the capacity to transfer information thus acquired into the long-term memory. Both participants spoke of mental rehearsal of movement and '*thinking it through*' as part of their preparation for performances.

Excluding data relating to subjective experiences during performance, these results then formed the basis for the main study. There were several reasons why the preliminary study seemed to warrant further research:

(i) despite the almost exclusive concentration on pianists as the subjects of existing research into preparation for performance, results suggested that there are fundamental differences between the ways in which pianists and other instrumentalists conceptualise music – structurally, technically and interpretatively.
(ii) there appeared to be a greater degree of inter-dependence between interpretation, technique and structure during rehearsal and performance than has been identified in piano based research.
(iii) although both instrumentalists made expected reference to auditory and visual imagery, the concept of motor imagery also emerged. This is barely mentioned in existing research literature relating to psychology of music, but seems to be particularly

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significant in linking interpretative concepts with technique and ultimately the sound produced.

(iv) since it also seemed clear that the two players sometimes differ in the ways they conceptualise music, it was thought worthwhile to investigate further into possible instrument or player specific differences.

In view of such evidence that interpretation is at the heart of technical decision making and execution, it seemed worth deeper investigation into how the integration of interpretation and technical activity might actually function, particularly in relation to the memory store. These elements of learning are not explored in any depth in existing piano based literature. However, performers at the highest levels will carry an internal, constantly refining blueprint of their ideal performance and are prepared to work long and hard in order to follow it. This level of intensity during learning is likely to contribute significantly to effective memorisation (Ericsson, Krampe, & Tesch-Römer, 1993).

In order to further explore particular aspects of the preliminary study interview data, the main study attempts to discover

- to what extent does the embedding of increasingly complex technical information become central to learning and memorisation?
- to what extent might this process be influenced by subjective interpretative ideas?
- how is music conceptualised and structured during practice and performance?
- are there clear instrumental differences in working patterns?

The main study

Method

From critical examination of previous research methodologies and bearing in mind the informative outcome of the preliminary study, it seemed that for further phenomenological study of this nature, the most fruitful source of data would indeed be the players' descriptions of their own working practices (Chaffin & Imreh, 2001). This approach also allows the exploration of personal representations of structure and deliberate or co-incidental use of auditory, visual and motor imagery, all of which are implicit in the research questions upon which the present study is based.

The participants

When choosing the participants, it was decided that for the interview/analysis approach to have the optimal chance of demonstrating both working methods and instrumental differences, the following criteria should be met:

The instruments:

- contrasting non-keyboard instruments with widely differing playing techniques, sound qualities and repertoire
- instruments demanding a wide range of perceptual-motor activities and abstract representations in order to transfer concepts into sound.

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The instrumentalists:

- professional solo performers with comparable levels of expertise
- able to demonstrate a high degree of meta-cognition and meta-perception
- articulate in verbal explanation.

Since the two participants in the preliminary study fulfilled all the above criteria, the same two players were approached again. Both the 'cellist (aged 55) and the guitarist (aged 33) have wide experience as professional solo performers in a variety of contexts and have both mainstream and contemporary works in their repertoire. Both think in considerable depth about all aspects of learning and performing and are willing and able to communicate their thoughts verbally, whether in a teaching context or more informally. Neither has difficulty in identifying their personal concept of the music and both spend most of their preparation time deciding and practising *how* that concept is to be conveyed. Both the 'cello and the guitar, when played at this level of expertise, demand a wide range of perceptual-motor activities and abstract representations in order to transfer concepts into sound. Although both are technically stringed instruments, the demands are clearly very different and so within the same research model, instrumental differences might be identified. The viability of a phenomenological approach had been tested in the pilot study, (conducted one year earlier) and the consistent and illuminating data it revealed, suggested that a similar approach would be appropriate.

Since it was considered particularly important that possible pedagogical implications should be explored, a vital factor was that both participants are also established teachers. Both are professors at London conservatoires and have experience of teaching in other contexts and both have published written work about technique (Holmes, 1994; Ryan, 2004).

The interviews

A semi-structured interview lasting 45–50 minutes was conducted with each participant. The schedule for the interviews was prepared as a more focused and refined version of that used in the preliminary study (Holmes, 2003). Since the aim was to gain as much detailed information as possible about the participants' perceptions of their own working methods it was understood that the questions were open ended and the participants were encouraged to develop their ideas as much as possible. (At times the questions probed more deeply and occasionally diverged from the formal schedule.) A short preliminary briefing with each of the participants immediately prior to the interviews was to ensure that these points were fully understood.

The questions were designed to elicit information relating to:

- cognitive processes and physical means contributing to the transfer of interpretative/ emotional concept into sound
- associated imagery and its possible function in encoding and retrieval
- the nature and function of mental rehearsal
- practice content

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- conceptualisation of structure
- specific strategies for memorisation.

Each interview was recorded and later transcribed.

The analysis

The resulting data were analysed using the techniques of Interpretative Phenomenological Analysis (IPA) (Smith, Jarman & Osborn, 1999) and according to the principles of Grounded Theory (Charmaz, 1995). Although originally used in the context of health psychology, the term 'phenomenological' refers to people's own perceptions, particularly in relation to their bodies (Smith *et al*., 1999) and there are clear parallels with the technical aspects of playing a musical instrument, where the descriptions of the use and management of different technical elements form a significant part of learning and memorisation. By allowing the gradual emergence of dominant themes, IPA gives considerable flexibility and this was considered essential for the current study, particularly in view of the degree of integration in the data. While several predominant themes emerged, it became clear that none of these could be discussed in isolation. A further reason for using IPA techniques was the potential flexibility for exploring the patterns and relationships of both individual and shared themes (Smith *et al*., 1999). This approach has also enabled a more thorough comparison with relevant literature.

Results and Discussion

Many similarities in the participants' overall working methods and conceptual frameworks were evident, but there were also significant and illuminating differences at a more detailed level of work. The data revealed much about how the players manage technical resources in order to express and communicate their own interpretative insight; they also highlighted much about the players' individual cognitive processes and priorities, particularly with regard to structure (of both music and practice) and use of imagery.

Emerging from the analysis of interview data, themes relating to the characteristics of expert performance, practice strategies and interpretative goals were to some extent expected. However, a number of less predictable themes also emerged. These fell into three main groups:

- various types of imagery (particularly motor and emotional imagery) and the degree to which these are inter-related at all stages of learning and performance
- idiosyncratic methods of structuring
- the function of emotion within the framework of technical decision making

Since these three themes were undoubtedly the most novel and potentially the most interesting, they are presented in more detail below.

(It should be noted that indicative comments are generally used where the participants concur. When there are significant instrument or person specific differences, then both will be quoted.)

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The role of imagery in memorisation

It is clear that a rich tapestry of mental images is a normal part of the everyday working life of the two participants; for them, auditory, visual and motor imagery are vital to all aspects of music making. Since for them, images are so multi-layered and interdependent, their level of integration will be evident in the presentation of results. The following categories of imagery are included for clearer identification, but cannot therefore be regarded as discrete.

Auditory imaging

The interviews showed that auditory imaging in various forms is an integral and indispensible part of learning and memorising at all stages of preparation and for performance; natural, ever-present and largely automatic as is illustrated here by the guitarist:

> . . . as soon as I hear something I'm starting to memorise it anyway because I can recall the sound of it.

and

> . . . I can imagine before I play it how it's probably going to sound and what I'm going to do with it.

This combination of auditory imaging and realisation of musical concept suggests that there is a 'perception' element in auditory imaging that is critical in the playing process. The extent to which auditory imaging might comprise perception or memory has not yet been established, but both are clearly present here. Anticipatory auditory imaging emerged from the data as an important theme, but seems unlikely to be isolated from other forms of imagery:

The guitarist (in the context of saying that the right and left hand movements act as memory triggers for each other):

> . . . it's most important not only to know what it should sound like in advance, but be able to characterise what it's going to feel like as well.

In this example, the anticipatory imaging contributes to memorisation in both auditory and motor modes. He also refers to the simultaneous occurrence of auditory and visual imaging:

> It's always in connection with the sound of the music in your head. If I'm thinking of how something sounds, I can see the movements at the same time.

The constant presence of an auditory image is made very clear here as is the practised use of dual-modality encoding. The guitarist also relates the anticipatory auditory image to mood:

> I will hear in my head how I want the first note to sound and the mood I want to convey.

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As well as habitual auditory monitoring, it is clear from the participants' statements, that their memory store is formed of multi-layered images that are recalled, arranged and developed (*cf*. Kosslyn *et al*., 2001) during practice. This is entirely consistent with recent research in neuroimaging, which showed that brain activity is similar, whether music is being heard or imagined (Zatorre *et al*.; cited in Kosslyn *et al*., 2001). This in turn goes a long way towards explaining the usefulness of that valuable tool for the musician – mental rehearsal.

Mental Rehearsal

Mental rehearsal, or 'thinking through' music is generally accepted to be of value in learning, but a wide awareness in either music pedagogy or music psychology has not so far been evident. This may be because it is more likely to be practised at an advanced level of expertise than by the novice (Bird & Wilson, 1988). The participants in the current study have a pre-study auditory image of music (either from the score or from another performance), but neither mentioned that they necessarily undertake a formal analysis of the score before beginning to play. Mental rehearsal as imagining music, without actually playing, is also valued as a practice strategy in a number of ways and for several reasons. For example, the 'cellist uses it as a feedback channel:

> your attention can actually concentrate on the … music, rather than being so involved with it as you are when you're playing.

and for reflective study of interpretation:

> It's rather interesting … just sort of imagining you were playing through the piece – it is the important notes, the big gestures, the loud notes, the difficult gestures that tend to be very vivid in your mind – not actually playing the instrument frees your brain to study it in more detail from the cerebral point of view …

Mental rehearsal is clearly consciously employed here as a practice strategy and for added security of memory in performance:

> … it's a way of going through the piece and checking that it's all there, secure in the memory – keeping it on the boil … ['cellist]

It is also extremely important immediately prior to a concert in that it enables deep concentration, without being physically tiring:

> One thing that's very helpful is that you can be in a relaxed physical state when you're thinking about things, which are technically demanding. You can be relaxed while listening in your head to the most difficult technical parts of the piece. [guitarist]

It is clear from all these statements that imaging in this context is consciously and productively used as a normal part of the practice routine and in each case it has a specific purpose rather than being an incidental occurrence.

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There is a sound scientific basis for the participants' numerous ways of employing mental rehearsal. It has been shown that mental rehearsal improves performance and also memory (Feltz & Landers, 1983; Bird & Wilson, 1988); through neuroimaging techniques, researchers have found that imagining an activity activates the same neural pathways and low level muscle response, as would the performance of the same activity (Kosslyn *et al*., 2001). This can explain why mental rehearsal is found to be so useful by the participants. The guitarist gave a distinctive account of this phenomenon:

> . . . the other week when I was about to do that concerto (Rodrigo), I listened to it on a recording the night before and I could imagine every single movement in my hands as I listened.

And from the 'cellist's statement (when speaking about the positive outcomes of learning music from memory):

> . . . it enables you, having worked on a piece of music, to go away from the instrument and carry on thinking about it consciously or subconsciously . . .
> . . . it's absolutely vital – the possibility of imagining a piece rather than looking at the notes . . . .

it is clear that mental rehearsal is a regular and highly valued rehearsal technique. That the guitarist employs mental rehearsal involving varying levels of physical activity is also consistent with the findings of Kosslyn *et al*. (Ibid.):

> sometimes I like to . . . look at the music and feel my arms and shoulders . . . moving around and other times you like to just sit still and imagine the music.

There appears to be little distinction here between real or imagined awareness of movement, which may help to identify the source and functioning of motor imagery, still in many ways an elusive concept for musicians.

Motor imagery

Some of the most interesting data that emerged from the interviews concerned motor imagery. There were numerous occasions when reference was made to imagining movement and the feeling of movement, for example:

> . . . you can imagine yourself playing it and you feel[3] what it's like to play. ['cellist]

It was clear that imaging movement (particularly for the guitarist) is essential to learning, memorisation and performance. The following statement vividly depicts his thought processes:

> . . . if you're playing a slow piece, it might be a very relaxed shift, but if you're playing a fast piece, it's going to be very energetic. In many ways the shift looks the same, but you would remember the vigorousness with which you actually move. It's an interesting exercise to try with your eyes shut, so that you just feel what you're doing . . .

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His use of the word 'vigorous' rather than just 'speed' suggests that the musical character is an influence on the imaged movements in his memory. This would provide evidence that these movements are an important part of learning and would support Todd's model, relating kinetic energy to expression in performance (Todd, 1992; cited in Palmer, 1997).

Further clues to the extent to which integrated imaging contributes to the learning process came when the guitarist's meta-cognitive approach revealed a wealth of vivid and illuminating metaphor, for example:

> . . . I tend to think of them now more as gestures and the way they feel – for example, are you stretching or squashing your hand – is your hand in a relaxed state – what's the angle of your elbow – are you playing from above the string or slightly to one side? A lot of it is physical – it's to do with gesture and movement, like a choreography of some kind.

He then continued the dance analogy, relating it to memory in the following way:

> . . . you move in the way you feel – literally, that's how you remember it. In the same way that a dancer has the floor available – that's sort of what you do when you're playing a piece – you have the floor and you can decide to move off in a certain way, in a certain direction, which is associated with something you hear and you feel . . . an emotional reaction and a musical response . . .

This comparison with dancing not only gives a clear illustration of the simultaneous involvement of emotion and motor and auditory imaging, but also a strong indication of how these can exist within the framework of spatial awareness.

Although motor imagery has been identified in other contexts and was described as far back as 1938 (Seashore; cited in Persson, 2001) as a *necessity* for memorising music, it has received little attention in the literature of music psychology. It is difficult to find research models for the concept of imaging movement as it might apply to playing a musical instrument. However, it has been established that meaningful encoding is a feature of expert memory (Baddeley, 1997) and for the two subjects, this type of imagery clearly forms a significant part of encoding.

Visual, spatial and emotional imagery as retrieval cues

Although it is unlikely to exist on its own, visual imaging, for at least one of the participants, is likely to be present to a greater or lesser extent. The guitarist illustrated the difference between reading a piano score (where the vertical representation of pitch is directly transcribed into the horizontal on the keyboard) and a guitar score, with the following visuo/spatial metaphor:

> . . . [some] times it does very counterintuitive things, so you might be playing a high note on a lower string and the easiest way I can think of describing that, literally is that sort of idea . . . like following the string on balloons – you know, those puzzles you have when you're a kid . . .

From quotations relating to auditory imaging it can be assumed that he has an auditory representation of the music that is triggered by the sight of the score. From the last statement,

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he then appears to transfer this auditory representation into the physical production of real sound through an abstract conceptual framework involving both visual and spatial imagery. Transference between different aspects of visual imagery during the learning process is illustrated by the following statement:

> . . . your fingers become a little bit like notes – so you can see the notes on the page and then the movements of the fingers are – what's the right word – almost like one and the same thing, so if I see two notes at the beginning of the piece . . . inevitably, by association of having played them, you see your fingers at the same time.

From this description it appears that the technical process of choosing the fingering and then placing the fingers on the string, actually transforms his image of the notes on the score into an associated representation of his fingers on the strings. It is interesting to note that Baddeley (1997) suggests that visual and spatial imagery might well function concurrently, thus making a significant contribution to the functioning of the long-term memory.

The multi-layered imaging described above clearly implies meaningful encoding and a framework for a retrieval scheme that includes emotional as well as auditory, visual and motor elements (cf. Chaffin *et al*., 2002: 71–2). The 'cellist also identified emotional elements as retrieval cues:

> . . . not just emotional, but all sorts of feelings . . . a range of experiences – like telling a story – they are the trigger for the whole performance . . .

adding that ideally, in a performance, most of the 'triggers' (cues) will have become automatic and:

> You're not thinking about the notes and the technique, it's just a pure act of communication.

Further insight regarding retrieval cues comes from the guitarist's conscious use of metaphoric images in their organisation. When referring to the shapes and patterns of the fingers on the strings, he said:

> . . . there are shapes in the way you put the fingers down on the fingerboard – you could think of them forming constellations.

When using this analogy, the guitarist was in fact unaware that Baddeley had identified constellations of the stars as an example of finding order in apparently random patterns (1997). The chord shapes on the guitar are, of course, anything but random, but there is usually an element of choice when selecting a particular fingering and as has already been seen, that choice will be guided by interpretative concept:

> . . . the music and the energy of the music will trigger which fingerings I decide to use and which gestures and positional shifts I decide to make – and then . . . they have grown out of the music – it's not as though they are separate technical things. [guitarist]

The strong relationship between technical decisions and interpretative intent could not be clearer and the earlier reference by the guitarist to 'constellations' in this context evokes a visual and conceptual image that demonstrates this. That he went on to say how important

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it is also to *feel* these shapes in terms of the position of the hand and the degree of muscular activity, provides further insight into the multi-layered conceptual framework that for him, clearly underpins his memory. Only recently have there been attempts to discover how these conceptual processes might work (Kosslyn *et al*. 2001), but their strength in supporting the functioning of the memory is evident.

Structure and working methods

Is formal analysis necessary for memorisation?

The traditional view is that for music to be thoroughly learned, analysis of the score is necessary (for example, Rubin-Rabson, 1937). However, analysis alone cannot generate an individual interpretation (Palmer, 1997), which begs the question; 'what exactly constitutes analysis?' Certainly, for the participants, their ways of understanding the structure of the music appeared more idiosyncratic (and in some ways instrument specific) than implied by formal structural boundaries. When asked what the concept of structure means to him in the context of memorisation, the guitarist said:

> . . . er – well the first thing I thought about when you said structure was this kind of imaginary space – like the piece exists in 'this' and somehow things kind of happen in it [laughs] – it's not linear.

This suggests that for him, rather than a formal structural analysis, more abstract representations are fundamental to understanding.

The 'cellist spoke of '*understanding the whole logic of the piece*' and '*the relative importance of various notes – what makes it communicate to an audience*'. When asked if he would ever undertake a formal analysis he said:- '*if there was something you couldn't seem to make sense of, you'd have to . . .*', which implies that this would be an exception.

The development of a personal concept of structure can be given substance by looking at the participants' priorities and mental subdivisions within a holistic framework. Both talked about the importance of harmonic structure (modulation and harmonic rhythm), rhythm and phrasing:

> . . . the first time it modulates . . . you could visualise it's the first time the road turns – you could be hypothetically mapping it out. [guitarist]

> . . . rhythm is obviously a strong input in what [are] the important notes. ['cellist]

In these examples, the 'structuring' is generated by the expressive reaction to the harmonic, rhythmic and phrasing elements of the piece. It follows that this interpretatively led structuring must then contribute to the memory through the cognitive structures associated with harmony, rhythm and phrasing, rather than being in itself an aid to learning and memorisation. That expressive interpretation might 'emphasise different structural aspects', has been highlighted by Clarke (2000) and the data from the current study suggest that it might be possible to isolate some of these 'structural aspects'.

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A strong theme to emerge from the data was that the participants have a structural 'overview' more or less constantly in their minds as they rehearse and perform. In the early stages of learning, both clearly generate a concept of a piece as a whole, and this concept then forms a framework for their practice. This holistic framework is achieved through cognitive structures that are hierarchically generated during the learning process:

> . . . as you learn a piece, there's more and more to remember. Initially you're learning the melody line . . . and then you start to appreciate the structure and then the tone colours – the technique – you have to remember how you achieve the sounds you want. So this involves the particular . . . fingering and bowing techniques – it all becomes more complicated to give the subtle nuances of the finished performance. Hopefully you reach a level where it's the performance you want. You can forget all about it and just enjoy the music and let the emotional side take over! ['cellist]

Here, the participant's musical priorities seem to drive the generation of an organised hierarchy of conceptual structures. The lower level structures gradually become more automatic as he concentrates on the more conceptually demanding and creative aspects of performance. It seems evident that in a memorised performance, the cognitive structures are deeply embedded, largely automatic and only partially active at any particular time (*cf*. Clarke, 2000). It is difficult to define these structures and doubt has in fact been cast on the possibility of a '*totally unified structural knowledge*' as a basis for performance (Clarke, 2000), but some understanding may be gained from the guitarist's illuminating description of how he perceives music during a performance:

> . . . you hear the whole piece unfolding in your head – or you hear what's about to unfold and that reminds you of the (physical) movement you might decide to look at.

A conceptual understanding of the music has been achieved, although not through formal structural analysis, it derives its analytical framework from musical features such as rhythm and harmony and also the emotional content. Williamon *et al*. (2002) have shown that other representations of structure can be as effective as formal analysis.

How are practice strategies generated?

There is a general acceptance that sections of music need to be practised in isolation, but perhaps the existence of a structural overview enables the subjects to sectionalise only when they have identified a particular need to do so. For example, when asked in what ways he divides the music for the purposes of learning, the 'cellist said:

> Well, as little as possible. Obviously you like to view the music as a whole . . . there tend to be a few problematic areas which you feel you want to spend more time on and then you might well practise various bits again and again.

He also said:

> . . . I don't like to repeat sections too much, certainly in the earlier stages . . . I feel you lose the thread of continuity from the beginning to the end . . . I just repeat a (section)

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> till I feel I want to move on. When there's a problematic bit, I'll do very concentrated work to cut down on waste of time . . .

illustrating the wish to keep interruptions to a minimum and to fit the repetition of short passages within the framework of the whole piece. Formal structure would not be necessary as a guide; rather an image of the overall concept of the music gradually evolves.

The guitarist gave a clear indication of how the sections to be practised will then be related to the memory through automatic perception of musical context (*cf*. Williamon *et al*., 2002):

> I often say when I'm teaching – 'blocks' or 'chunks', so that when you're remembering something, you're still thinking of the musical line . . . It's the closest I can come to how I remember things.

> I don't have a systematic way of breaking it down – say it was a fugue – I wouldn't sit down and practise just the exposition . . . I wouldn't say to myself I must practise the exposition and then move on to the next bit. I tend to fill in the gaps with practice – going through, stopping on things – this sort of jigsaw idea – you go back and fill in things that aren't working.

By the analogous use of the word 'jigsaw', he illustrates that he retains a representation of the 'whole picture'. When asked his reasons for stopping to repeat sections, he said: 'Just whether I can play it or not, really.'

The approach towards repetitive practice that is demonstrated by the participants seems to be very efficient in that they do not either repeat a longer section, or repeat it more times than is strictly necessary to learn the piece.

The results from this micro survey amply justify the line of questioning. To summarise, for these two players, technique clearly forms a fundamental part of the memorisation process, and technical choices and practice are generated largely from interpretative concept, through the cognitive structures associated with emotion and imagery. As a pianist myself, I found it particularly interesting to find substantial differences between pianists and string players (so far researched) in the use of imagery, and in particular, motor imagery. Imagery appears to have a specific function in transferring emotion, through motor control, to the memory. Consequently, the players' interpretatively driven technical choices will impact upon the memory processes. There seems to be no reason why pianists should not 'follow the lead' here and employ imagery more deliberately and freely as a learning strategy (Holmes, 2004).

There is undoubtedly a need for further investigation into artists' emotional drive in relation to their interpretative decisions, methods of rehearsal and performance (Persson, 2001). This statement is directly relevant to the current study, where it is suggested that during rehearsal, the perceptual-motor processes of technique seem to be cognitive channels through which emotional concepts can be communicated. It would seem that technical skill is therefore more than an enabling process; the wonderfully rich tone, or crystal clear articulation enjoyed by an audience are likely to be the product of great concentration, strength and control, much of which will not be obvious to the listener. It is not surprising that of the different ways in which expert performers analyse music they

are learning, their employment of technical strategies for expressive purposes will form a significant part. This would also help to explain this apparent contribution of technique towards memorisation.

Conclusion

The original intention in carrying out this research was to gain some understanding of just how an elite performance develops and evolves during practice; both the natures of the constituent elements, and their organisation. The memorisation process was taken as a focus because it represents a particular point of achievement in the learning process. It was also hoped that results could then be clearly identified and of potential interest in other contexts. This is a small-scale empirical study, but it demonstrates enough evidence of the integration of emotion, imagery and technique to suggest that further similar research would be worthwhile. Most of the data were corroborated and it is not clear whether the preponderance of different types of imagery *does* actually vary with instrument. Neither is it clear to what extent the individual player's personality and learner type affects their working processes.

However, even with the current level of insight into the working practices of elite performers, there are clearly many implications for teaching. In 'exceptional' performers, one is looking at an exceptional range of sophisticated, inter-related cognitive/physical processes, which differ in many respects from the mainstream of music preparation and performance. This should not prevent thought processes similar to those of the participants being introduced in an appropriate way to students at a variety of levels. Some of the participants' techniques and strategies have been consciously developed, others have evolved over years of practice and experience – they open up dimensions of thought, which could be freely and deliberately adapted to facilitate learning and memorisation at many different levels. When the guitarist in the current study was talking about a shift being "vigorous" or "relaxed" according to musical context, or a cellist about the opening of the Bach Suite with its "strong driving rhythm" requiring a particular angle and grip on the bow, clearly for them, the score is little more than an indication of the composer's wishes. The creation of sound is always related to expressive intent and there seems no reason why the same basic principle cannot be implemented at a much more elementary level as well. This would enable a much more holistic (and secure) approach and also encourage close attention to interpretation and its integrated relationship with imagery and technique.

The use of different types of imagery as a deliberate strategy among musicians is not unknown (e.g. Freymuth, 1999), but the particular concept of motor imagery – imagining the actual physical *feeling* of playing is probably the least understood. Evidence relating to motor imaging is both scarce and largely anecdotal and recent neuroscientific discovery about how imagery functions has not yet been applied to the playing of musical instruments in any organised way. Many questions remain. Is the ability to create images associated with particular levels of expertise and intuition? Does it depend on the strong motivational force of 'inspiration' or 'insight'? Probably, as with most musical abilities, learners will find themselves somewhere along a continuum in this respect, but there are good educational reasons to believe that the more the imagination and physicalities of playing can be integrated during learning, the more satisfying and secure will be the result.

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Notes

1 It was expected that a direct connection between technique and memory would be more clearly illustrated by the players' direct involvement with the sound source on these instruments, rather than the piano, where timbre and pitch are largely pre-formed.
2 For explanation of these techniques, see Main Study *The Analysis*.
3 Quoted words with underlining were those given particular emphasis by the subjects.

References

BADDELEY, A. D. (1997) (Revised Edn.). *Human Memory: Theory and Practice*. Hove: Erlbaum.

BIRD, E. I. & WILSON, V. E. (1988) 'The effects of physical practice upon psychophysiological response during mental rehearsal of novice conductors'. *Journal of Mental Imagery*, **12**, 2, 51–64.

CHAFFIN, R. & IMREH, G. (1997) 'Pulling teeth and torture': musical memory and problem solving. *Thinking and Reasoning*, **3**, 4, 315–336.

CHAFFIN, R. & IMREH, G. (2001) 'A comparison of practice and self-report as sources of information about the goals of expert practice'. *Psychology of Music*, **29**, 39–69.

CHAFFIN, R., IMREH G. &. CRAWFORD, M. (2002) *Practicing Perfection*. New Jersey: Lawrence Erlbaum Associates Inc.

CHARMAZ, K. (1995) 'Grounded theory', in J. A. Smith, R. Harré & L. van Langenhove (Eds.), *Rethinking Methods in Psychology*. London: Sage Publications.

CLARKE, E. F. (2000) 'Generative principles in music performance', in J. A. Sloboda (Ed.), *Generative Processes in Music*. Oxford: Oxford University Press.

ERICSSON, K. A., KRAMPE, R. T. & TESCH-RÖMER, C. (1993) 'The role of deliberate practice in the acquisition of expert performance'. *Psychological Review*, **100**, 3, 363–406.

FELTZ, D. L. & LANDERS, D. M. (1983) 'The effects of mental practice on motor skill learning and performance: a meta-analysis'. *Journal of Sport Psychology*, **5**, 25–57.

FREYMUTH, M. S. (1999) *Mental Practice and Imagery for Musicians*. Boulder, CO: Integrated Musician's Press.

GINSBORG, J. (2000) Proceedings of the Sixth International Conference on Music Perception and Cognition and Fourth Triennial Conference of the European Society for the Cognitive Sciences of Music. Keele University 5–10 August, 2000.

HALLAM, S. (1995) 'Professional musicians' approaches to the learning and interpretation of music'. *Psychology of Music* **23**, 111–128.

HALLAM, S. (1997) 'Approaches to instrumental music practice of experts and novices: implications for education'. In H. Jørgensen & A. Lehmann (Eds.), *Does Practice Make Perfect? Current Theory and Research on Instrumental Music Practice*. Oslo: Norges Musikhogskule.

HOLMES, P. A. (2003) 'How do they remember all those notes? A study of the integrated roles of emotion, imagery and technique during the learning and memorisation processes of two experienced solo instrumentalists'. *Unpublished MA Dissertation: University of Sheffield, UK*.

HOLMES, P. A. (2004) 'Emotion, imagination and movement: new strategies to help memorisation'. *Piano Professional*, EPTA UK. September 2004.

HOLMES, R. A. (1994) 'New Baroque bow grip for cellists'. *The Strad* January 1994.

JUSLIN, P. N. & PERSSON, R. S. (2002) 'Emotional communication', in R. Parncutt & G. E. McPherson (Eds.), *The Science and Psychology of Music Performance: Creative Strategies for Teaching and Learning*. New York: Oxford University Press.

KOSSLYN, M., GANIS, G. & THOMPSON, W. L. (2001) 'Neural foundations of imagery'. *Neuroscience*, **2**, 635–642.

LISBOA, T. (1992) '*Cello playing: a cognitive and postural approach*'. Unpublished MA Dissertation, City University, London, UK.

MIKLASZEWSKI, K. (1989) 'A case study of a pianist preparing a musical performance'. *Psychology of Music*, **17**, 95–109.

PALMER, C. (1997) 'Music performance'. *Annual Review of Psychology*, **48**, 115–130.

PERSSON, R. S. (2001) 'The subjective world of the performer', in P. N. Juslin & J. A. Sloboda (Eds.), *Music and Emotion*. Oxford: Oxford University Press.

RINK, J. (2002) 'Analysis and (or?) performance', in J. Rink (Ed.), *Musical performance: A guide to understanding*. Cambridge: Cambridge University Press.

RUBIN-RABSON, G. (1937) 'The influence of pre-analytic study in memorising piano music'. *Archives of Psychology*, **31**, 220, 1–53.

RUBIN-RABSON, G. (1940) 'Studies in the psychology of memorising piano music, III. A comparison of the whole and part approach'. *The Journal of Educational Psychology*, **31**, 460–477.

RYAN, G. S. (2004) '*Quantum Mechanics and Guitar String Theory*'. (In press.)

SEASHORE, C. E. (1967) *Psychology of Music*. New York: Dover.

SMITH, J. A., JARMAN, M. & OSBORN, M. (1999) 'Doing interpretative phenomenological analysis', in M. Murray & K. Chamberlain (Eds.), *Qualitative Health Psychology*. London: Sage.

WILLIAMON, A. & VALENTINE, E. (2002) 'The role of retrieval structures in memorizing music'. *Cognitive Psychology*, **44**, 1–32.

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