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Abstract

This paper examines the social and musical co-ordination between members of a student string quartet in rehearsal and performance. Devised as an exploratory observation and interview study, a two-tier analysis of the data is undertaken. The first deals with broadly socio-cultural issues, the second with moment-by-moment social and musical co-ordination. The results indicate that there are many factors that influence the functioning of such an ensemble. These include personal concerns about particular social dynamics within the group, performance anxiety worries, as well as immediate musical demands relating to the co-ordination of content and process. The paper concludes with a discussion of ways in which further studies of social and musical co-ordination might be developed. In particular, emphasis is given to the need for the development of a comprehensive theoretical framework reflecting a more adequate conception of music ontology and encapsulating the mutuality of the multi-tier social and musical factors.

Introduction

Little research has been directed towards the communication required between players in order to create a co-ordinated musical performance (Williamon and Davidson, 2002). It is apparent, nonetheless, that the players depend on a highly complex set of interpersonal skills in order to produce a unified performance. In the case of musical repertoire from the Western canon, players typically work from a pre-composed score that is profoundly influenced by socio-cultural rules. Such rules dictate and give value to the composition and its performance (*e.g.,* the use of particular scale systems, a model aesthetic, the size of an ensemble, and specifically defined inter-performer, inter-audience and performer-audience behaviours). In the performance situation, it is the information about the musical score that provides the central *content* to be shared by the performers and communicated to the audience. The moment-by-moment *process* of co-operation between and feedback to and from co-performers and audience is necessary in order to co-ordinate the production and reception of the performance. Thus, there are general socio-cultural factors influencing the production of a musical

performance, and there are immediate issues of interpersonal interaction which determine the manner in which a performance unfurls in real time (see Davidson, 1997).

In the following article, drawing predominantly on theoretical notions from the psychological literature, we undertake an observation and interview study of a student string quartet. The principal aim is to describe as accurately as possible the communication between players in order to begin to understand formally the relative roles of general socio-cultural factors and moment by moment issues of *content* and *process* in the generation of a musical performance. Clearly, the exploration of musics from different socio-cultural traditions such as pop and non-Western folk would produce rather different but no less important perspectives. The current article thus aims to provide an initial framework for further more wide-ranging investigations that may gradually embrace other styles and traditions of musical performance. In this way, the investigation is an exploratory one.

The string quartet is of particular interest since all four instrumentalists contribute similar musical elements to the performance, and all use essentially comparable instrumental techniques. With such a common and pervasive connection to the musical score one aspect of group cohesion is achieved. Murninghan and Conlon (1991), however, who examined successful and failing British String Quartets, discovered that cohesion was also heavily dependent on organisational aspects of the group. In the majority of cases, for instance, it was discovered that the first violinist was the leader in both administrative and performance decision-making capacities. It was also found that in order to secure good group functioning, the second violinist had to be offered much social support by the group. This was partially because the violin scoring in quartet writing leaves the second violinist in a continually supporting role, and in order for this player to perceive him or herself as an equal musical contributor to the group it was necessary for the other quartet members to demonstrate that they valued the opinions and playing of their second violinist.

Murninghan and Conlon (1991) also found many moment-by-moment strategies in both rehearsal and performance that were vital to the functioning of the quartet. For example, recognition of the need for compromise was demonstrated in "time-out strategies" where individuals would leave discussion until another time. Additionally, action (music-making with the use of non-verbal gesture for indication) rather than talk would be used to work through a problem. Effective non-verbal communication between co-performers during the rehearsal period was thus found to be essential.

Like Murninghan and Conlon, Schutz (1951; 1976) noted that the immediacy and visual co-presence of the performers made it easy for each to take into account the others' activities. Each performer's musical actions were available to the others and each performer was able to anticipate the activities of the others. Schutz referred to this as a "mutual tuning-in relationship". Fuller (1988) reports an analysis of a jazz quartet's improvisation undertaken by Hostager and Bastien of the University of Minnesota. In this analysis, "tuning-in" is seen as being dependent on the use of shared knowledge and commonly adhered to rules. The researchers point out that the ability to "tune-in" to these socio-cultural features is a starting position, with the range and content of the performers' musical improvisations

developing over time as an understanding of each individual is developed by others within the ensemble. That is, they learn what to expect and how to meet each other's expectations.

Berliner (1994) recognises this same principle when he discusses jazz ensemble playing, but the term he uses is "finding the groove". Based on the views of insightful practitioners (including himself) and an examination of the contingent exchanges between rhythm section members, between rhythm section members and soloists, and sequentially between soloists (as in "trading fours"), Berliner believes that "striking a groove" is the ability to find a collective energy for the music, but that this energy emerges out of general and shared socio-cultural knowledge, and social and musical skills in sign-reading which then enables shared moment-by-moment ideas to unfurl. Therefore, often highly surprising changes to "the groove" can occur if there is a "flow of ideas along a common line" between all performers.

In jazz improvisation, of course, there is an on-going interplay between the stocks of musical knowledge which heavily influence the direction of an improvisation, and the truly spontaneous musical utterances which appears to generate progression through the performance. In classical performance, the stocks of knowledge are the principle determinant of the musical outcome, but, nonetheless, the collective tuning-in and sense of groove appear to be equally necessary. Indeed, some features of the musical score can be more or less emphasised depending on quite spontaneous modifications to the interpretation (Palmer, 1997). Typically, though, expert classical musicians consolidate their ideas through rehearsal, usually to such a high degree that in performance very similar overall profiles (such as expressive effects and timing) occur, even when performances may be months apart (*e.g.* Shaffer, 1984). Overall, in classical performance, it appears that rehearsals are occasions to learn the score, to plan the co-ordination of timing and to establish general expressive features of the music. In the live performance situation, the spontaneous variations are critically dependent on the co-performers being able to detect and act immediately upon one another's ideas: "to find the groove".

There are, additionally, in performance contexts other factors that can influence the performance. These are most certainly social, but more obviously socio-emotional such as performance anxiety, distractions, etc. (see Evans, 1994).

Bearing the above factors in mind, it follows that any preliminary investigation of group communication in string quartets needs to explore both rehearsal and performance situations in order to arrive at a full understanding of the types of interaction involved in working towards and producing a music performance. Accordingly, the following study will explore both types of situations. Moreover, given that these general socio-cultural factors (aesthetic, rules of etiquette, etc.), socio-emotional concerns (performance anxiety, other personal stressors, etc.), and moment-by-moment aspects of musical give and take combine to produce a co-ordinated whole there are several levels of analysis that need to be undertaken in order to explore all the possible forms of interaction, communication and co-ordination that occur in a string quartet ensemble.

Davidson (1997) has developed a model of factors contributing to the rehearsal and performance process. Incorporating broad socio-cultural influences and

evaluations of the findings of general social psychological investigations, social studies of musicians and musicological evidence, she listed the following key contributing factors: historical practices (*e.g.,* Baroque performance style and efforts made towards creating historically informed "authentic" performances); performance etiquette (*e.g.,* behaviours expected by audience and performer alike such as audiences applauding the end of a performance and performers bowing as a reaction to the applause); the roles of key individuals (*e.g.,* teachers, parents in supporting/facilitating the learning and performance processes; and group influence (*e.g.,* social dynamics in groups – the leader, the follower, the scapegoat, etc.). It was decided to draw upon this model when examining general socio-cultural factors in the current study (for further details of the model, see Davidson, 1997).

For the moment-by-moment co-ordination of musical content and process, we draw on an analytical framework developed in the analysis of conversation by Herbert Clark and Susan Brennan (1991). The nature of the interaction and co-ordination in conversation are, we believe, analogous to that in small group music-making contexts, although the musical score fixes the content of the communication far more than the scripts that structure social discourse (Schank and Abelson, 1977). Clark and Brennen propose that conversation is "grounded" in our common knowledge and understanding of *content* – mutual knowledge, beliefs and assumptions. But, in order for a conversation to begin, develop and conclude it moves through a number of stages in an unfurling process. This process is dependent on the synchronisation of entrances and exits, dynamics, changes in tempo, etc.

As we have seen in the research of Hostager and Bastien, and Berliner, music-making is built on "common ground". In the present case of the classical string quartet, this "common ground" is provided by the musical score, the co-ordination of whose *content* requires the use of stocks of musical knowledge – a familiarity with performing traditions, musical notation practices, etc. Co-ordination on *process* requires an updating of common ground moment by moment. Clark and Brennan believe that there are two main factors that shape grounding: *purpose* – what the people involved are collectively trying to accomplish in their communication; and *the medium* of communication and the techniques available in the medium for accomplishing that purpose. Media of communication of particular interest to Clark and Brennan include face-to-face conversation, communication by telephone, video tele-conferencing, electronic mail, etc.

These media of communication vary on many dimensions that effect grounding. These dimensions include *co-presence* – whether two or more people share the same physical environment; *visibility* – whether the people are visible to each other; *audibility* – whether they can hear and be heard by one another; *co-temporality* – whether one receives at roughly the same time as the others produce; and *simultaneity* – whether each can send and receive at once and simultaneously (Clark and Brennan, 1991). It should be apparent that these dimensions are clearly involved in situations of small-scale music-making but that some of the dimensions are not available to performers in larger-scale orchestral music.

Allied to Clark and Bennan's emphasis on co-presence, visibility and simultaneity, it is important to point out that Yarbrough (1975) has shown that co-performer interactions were successful in choirs when there were high levels of eye contact, and extensive use of facial and bodily gestures. Davidson (2001) has demonstrated that particular non-verbal gestures are used by musicians for specific ends. Illustrators occur to trace ideas, *e.g.,* they are often self-explanatory gestures of emphasis such as the downward nod of the cellist in a quartet to signify that the phrase begins "now". Emblems (a non-verbal symbol with a direct musical or speech translator, *e.g.,* a "thumb's up" symbolising a positive or good response) are used in a more varied manner than illustrators, with some being frequently used in everyday body movement whilst others are far more abstract. Thus co-performers may need to work together for a fairly substantial period of time in order to develop a familiarity with and understanding of some of the gestures used. Therefore, there is potential value in knowing whether a recently formed ensemble are able to understand one another's communicative behaviours. It is a subsidiary aim of the current study to examine a string quartet with only limited previous rehearsal experience.

Building on the frameworks outlined above, in what follows we consider our data in two ways: an analysis of the socio-cultural/socio-emotional phenomena which may have had a general and perhaps more immediate impact on the rehearsal and performance processes (*e.g.,* gender roles and performance anxiety) and an analysis of the moment-by-moment musical co-ordination. While we see this research as contributing primarily to an understanding of the social processes involved in music-making, given that these processes are among the most complex and elaborate of all forms of human communication we believe that our results are likely to be of interest to a wider audience.

The case study

Participants

An undergraduate student ensemble in a British university music department was selected for the investigation. The quartet had formed only six months earlier and was preparing for its first public recital. It was recognised that the "newness" of the ensemble would provide rather different data from that of a professional quartet of many years standing. However, in line with research by Yarborough and Davidson, it was felt that important information about new colleagues trying to "find the groove" and understand one another's gestures could help to clarify some of the main issues concerning the establishment of communication between ensemble members. Additionally, it was felt that the student players would not be besieged by some of the problems Munringham and Conlon (1991) had discovered in their studies (boredom, over-familiarity, etc.), and thus might be rather more open to discussing how they felt about working together and having their rehearsal and performance recorded than a well-established group with set views about their form and function.

All members of the quartet were 20 years old, and displayed similar levels of musical skill, though the second violinist was regarded to be the weakest player by the two specialists string teachers who ran the chamber music module within the music department. In part, the second violinist was weakest because he was

the only member of the ensemble not to be studying music as his main subject, and therefore tended not to practice his instrument or work at repertoire as much as the other three players. He was the only male in the ensemble. All four players regarded themselves as friends, socialising together very regularly, and two of them (first violin and viola) shared a house. They had spent their twice weekly rehearsal sessions over the six-month period since they had formed building up repertoire.

Procedure

For the purposes of the current study, the players were video recorded on three occasions: in a rehearsal which immediately preceded a public lunchtime concert; during the concert; and in an informal meeting one day after the concert, during which the players observed and commented on video footage of the rehearsal and the concert, and addressed a number of questions about their ensemble work. The questions were of a semi-structured format (according to Smith, 1995) and ranged from issues connected with their selection of repertoire, to requests for moment-by-moment commentaries about musical aims and objectives at particular points in the music. See Table 1, below which summarises the interview schedule.

TABLE 1

Interview schedule summary.

Area	*Question type*
General Section	
Background	How did you form this quartet?
	What decided you to work on your chosen repertoire?
Group process	How do you typically work together? . . . Has this changed over the six-month period since you first met?
	How would you define the roles of leading and following?
	What are the issues of leading and following in this ensemble?
	How are decisions made about interpretative issues?
	What do you know about one another as a consequence of ensemble playing that perhaps you did not know before?
Rehearsal video	
Tracking	What is happening here?
Interpreting	Is this a typical action/statement?
	Can you explain this more fully?
	What was your intention here?
	How did that make you feel?
	What do you make of this watching it now?
Performance video	
Tracking	What is happening here?
Interpreting	Is this a typical action/statement?
	Can you explain this more fully?
	What was your intention here?
	How did that make you feel?
	What do you make of this watching it now?

The rehearsal lasted for 1·5 hours, the performance was 40 minutes in duration, and the discussion ran for almost three hours. The repertoire they played was:

Mozart's *String Quartet in G*, K156 and

Britten's *Rhapsody.*

When these data were all collected, in line with the techniques of descriptive observation and analytic induction (see Robson, 1993: 200), our analysis took the following form:

(i) together, we observed all material once to establish the nature of the material;

(ii) together, and taking regular breaks, we observed the rehearsal and performance over a period of two days, firstly recording every single perceivable event – *e.g.,* the sequencing of rehearsal, areas where stops and starts were made, kinds of discussion undertaken by the players, frequency of talk and musical action – then cataloguing events by theme;

(iii) together we looked for and noted general social factors influencing the rehearsal and performance process;

(iv) employing Clark and Brennan's notions of content and process, together we discussed which of our themes fitted/did not fit these labels;

(v) individually, we re-observed the raw data and checked the theme labels;

(vi) together, we discussed similarities and differences of opinion.

Six examples representative of our categorisation and labelling processes were presented to two independent assessors (a technique used in interpretative phenomenological analysis of transcripts as reported by Smith, 1999). These individuals were asked to observe the footage and comment on the appropriateness of our labelling and analysis criteria. It was necessary to provide the assessors with this information because we were labelling actions and comments according to either general social categories or Clark and Brennan's categories of content and process. Thus the assessors needed to know what we were looking for and whether the labels used fitted the material we had selected. The assessors were experienced judges of string quartet performances and in discussion independently confirmed our labelling and criteria.

The above methodological procedures – though exploratory – were consistent with the techniques used in observation and interview studies in other domains (see Bakeman and Gottman, 1986; Smith, 1995; Smith 1999). One additional methodological point to note is that knowledge about music was a pre-requisite for this form of analysis.

Results

Themes related to general socio-cultural and social-emotional issues

Perhaps the most striking issue to emerge from the videos of the rehearsal and the discussion concerned the extra-musical interpersonal dynamics of the players. From both our observations and the players' comments, it was evident that very

particular individual roles were adopted in the group. The first violinist often acted as technical adviser and supporter of the second violinist and viola player. The cellist was the most independent and isolated in terms of not offering suggestions to the group. The viola player quietly made all of her communications to the second violinist. The second violinist completely dominated the group: he cracked jokes, teased the others – particularly the first violinist about her non-verbal cues and her tendency to slow – and was always the most adamant in voicing his opinions. The others merely seemed to listen and respond. As observers it was hard for us to resist the possibility that there was a gender dynamic to the style and content of the exchanges, with the male being able to make his voice more easily heard. However, at one point, during the players' observations of the rehearsal, the first violinist burst out:

> I just want to say that he is not normally like that. He usually waits for his instructions!

The second violinist responded:

> I'd had lots of thoughts about the music before, but I knew these were important bits, so I'd save them until just before the concert [the others laugh].

We cannot be sure which version is representative of how they were interacting, but there was clearly something happening which allowed him to voice his opinions above everyone else's. During the discussion, in social as opposed to musical terms, he was certainly the dominant figure. All the players were asked to define their musical roles. The female players in their comments focused on their solo contributions while also expressing a concern about not wanting to over-emphasise their individual importance. As the cellist commented:

> I think "Oh, it's the bass-line, I'm important, play out!" But, maybe I should relax a bit more and push less.

The second violinist felt more flexible in his role:

> I'm the middle: middle part in tune with [the viola player], and just under [the first violin]. I am both the harmony and the first violin too. I suppose it's like being deputy leader of an orchestra.

He seems more aware of the need for interaction and interchange, yet his presentation of self during the discussion is one of dominance.

There can also be internal distractions such as intrusive thoughts about personal events, specific mood states, or performance anxiety. In our data such internal distractions appeared as a second concern: confidence about or security with the piece and more general performance anxiety. From our data it was apparent that all the players were concerned about the technical and musical demands of the Britten, and as a consequence felt least happy with their performance of it. Representative of their opinions about this piece is the first violinist's comment:

> There's lots of textural stuff in this piece that we've not even covered in rehearsal. So far, we've just decided who will lead sections, and what the tempo will be. . . . It's a bit embarrassing having so little control over the music.

A major related issue was performance anxiety. The first violinist commented thus on the performance:

> . . . I was really nervous before going on, and then when I sat down I was even more concerned about it being okay.

It was her opinion that the huge variation in tempo that occurred in the opening bars of the Mozart was largely due to her attempts to absorb herself in the music to forget her "jitters", and that by so doing she "indulged" herself as she played the melody lines, and thus slowed down. The other performers also commented on feelings of anxiety – "what will my friends think", "I hope I don't cock it up" – but none was as concerned as the first violinist, and none seemed to be as negatively affected in the performance with the exception of the second violinist. In his case an allied third issue emerges: that of self-recovery.

In the performance of the slow movement of the Mozart, the first and second violinists were required to exchange melodic phrases in a question-and-answer manner. On his first playing of a particularly high and exposed line, the second violinist completed missed his finger position for the location of the correct note, and as a consequence played a sequence of notes that was incorrect. After a few seconds, he repeated the same sequence again and it was completely accurate. As he watched the video he commented:

> Can you see me going a lovely shade of red there? That was awful. I tried to put it behind me, but it hit me about fifteen bars later. It got worse as the movement progressed. I tried to recover by really getting into the third movement.

Strategies for self-recovery were, it seems, at the forefront of the second violinist's mind during his performance of most of the Mozart.

The fourth issue that affected the players was again related to the performance context. During a particularly quiet section of playing, a member of the audience got up from her very creaky seat, and exited down a central aisle via some steps, in full view of the players. The cellist noted:

> When that person got up and went out, it's the noise of the seat and the footsteps that put me off, and so I lost my place for a second!

External distractions are clearly a potential source of disturbance to the flow of a musical performance.

These themes clearly highlight the importance of a variety of socio-cultural and socio-emotional influences and how these impact upon personal agendas. The following analyses of moment-by-moment issues concerning musical content and process are presented employing Clark and Brennan's framework.

Co-ordination of content

In this section, the Mozart and Britten pieces are considered individually.

Mozart

The players were acutely aware of the nature of the scoring. From the analysis of their discussion, issues relating to the overall style of the music emerged which appeared to have an impact on how they approached both the rehearsal and the performance. This was summarised by the second violinist who commented:

> It's easy to function as an ensemble in the Mozart, because of the writing. . . . You're a real team, sharing the harmony, together. You've got to be aware of one another, because of the music.

In other words, the harmonic writing required the players to co-ordinate the individual component notes of chords. Indeed, examining the score, it is evident that all players were often required to co-ordinate on a single chord, having played through a passage of counterpoint, or at other times, shift from chord to chord in synchrony.

Not only did the musical style facilitate the ensemble's establishment of co-ordination, it actually enabled them to recover the co-ordination, especially when there were problems in the playing. For instance, the second violinist commented on the second movement in the performance:

> I'm using my semi-quavers here to push forward the tempo, back into the original speed. [First violinist] tends to slow us down, and as she's on a held high note, I can move the tempo forward.

But, the musical content was not always facilitative. The local technical demands of the piece often caused the players concern. For example, the first violinist commented on a passage in the opening movement:

> We're holding the tempo steady there because the violins are in parallel and it's a really technically demanding passage.

Other constraints on co-ordination of content derived from the musical structure not presenting sufficient challenges for the players on the more supportive inner parts – second violin and viola. An example of this is apparent in a commentary by the second violinist who notes that he has a musically uninteresting inner part – "the Mozart dum, dum chords", as he put it. This leads him to adopting radical measures to impose himself onto the score. For instance, in the performance, after playing the second movement (which comprises of largely supportive inner harmonies), the second violinist starts the final movement by making a canonical entry slightly after the other three instruments. In the rehearsal, he uses a completely different, and altogether fiercer attack on the musical figure than the other players. The others all commented that this suddenness made them acutely aware of his presence.

Britten

In this piece the issues connected with content were similar. In terms of the technical demands of the piece, the performers had to be more rigorous in their counting than in the Mozart because they could easily lose their place as a result of the frequent variations in time signatures and the emphasis on melodic canon, rather than more static harmony. Therefore, the music did require a very particular type of performing approach. As the second violinist commented:

> In the Britten, you're much more of a soloist, so you've got to have a different approach. . . . More confident and secure. Actually its more difficult to pull off the Britten because of this.

There seemed to be little within the structure of the Britten that the players felt could facilitate co-ordination: the harmonies were not typically tonal, therefore they did not give rise to the "need for resolution" that the Mozart elicited in the

players. In sections where the piece was more static, the counting was not so regular as the Mozart, therefore it was often constraining. Of course, the difficulties in the Britten provided a challenge to the performers and required them to adopt new approaches in their ensemble playing. All the players commented that the Britten was a piece they could work on in many different ways.

Co-ordination of process

It quickly became evident that this notion was equally appropriate to both the Mozart and Britten pieces; therefore, it was decided to present the analysis of process co-ordination for the whole performance, rather than each piece in turn.

As noted in the introduction to this study, process and content are sometimes related. In the first category of process issues to emerge from our analysis we can see this overlap. This category deals with *constraints derived from performer indiosyncracies.* As noted by the second violinist above, the first violinist has a tendency to drag the tempo. So compensations, often moment-by-moment, had to be made either to re-establish the original tempo, or to make her aware of the slowing process.

The first violinist's idiosyncracies influenced the co-ordination of process in other ways. She commented on feeling quite separate from the group during the performance. Consequently she felt that her contribution was not as co-ordinated as usual, and so commented that the piece was less "together" than in the rehearsal:

> I'm most concerned [in the performance] that I'm not part of the group, as I felt so separate: physically and mentally. I'm not leading as I did in the rehearsal. I'm leaving it too late to give the others the correct signals. I'm not calm enough.

The second violinist, besides criticising the first violinist's tempi problems, was aware of his own idiosyncracies, as was the rest of the quartet. The three other members noted that he was not such a technically accomplished player, and that they gave him "space" within the timing framework to play particularly tricky solos. Indeed, while watching the video recording, the first violinist turned to him and said: "well done mate!" in a completely genuine manner when he apparently seemlessly negotiated a passage of semi-quavers which the rest of the group had accommodated by slowing for the duration of that particular sequence. This is an interesting and complex issue of process co-ordination, for at one level the second violinist was extremely critical of the first violinist's tendency to slow down. Yet without mentioning anything to him, the other three players immediately used slowing as a technique to allow him to get through a passage he could otherwise not manage to play at the original quicker tempo. In addition, the tuning of four part chords – one note per player – was also a cause for great concern, especially in the Mozart where the second violin and viola were often playing in thirds.

The notion of give-and-take and support for one another's concerns in a more or less immediate manner was raised by the cellist. She noted that in both rehearsal and performance contexts it was vital to be *"conversational with the eyes"*. Her term produces the third category of process co-ordination, for there were many glances between players to gain information, specifically for timing co-ordination, and all the players entered into a lengthy discussion about the nature of their

"looking" relationships. Through discussion, it emerged that the players believed there were a number of "directions of glance". These involved:

- direct eye contact between the first violinist and cellist;
- direct eye contact between the second violinist and viola player;
- a pivotal shift of position of the second violinist to facilitate looking between himself and the other players;
- first violinist being looked at by all other players.

Our observations confirmed these relationships. We were particularly struck by the fact that in the performance the first violinist did not "look" nearly as much as she had done in the rehearsal. We deduced that this may have been a contributing factor to why she felt so alone in that situation.

From our observations it was evident that "conversations with the eyes" conveyed important information during the process of playing. There were three specific uses of gesture, each of which we have allocated to a specific category in order to emphasise the importance of this aspect of process. The first category is the *gestural marking of exits and entrances.* There were many examples of this in both pieces, but a particularly striking example was seen in the rehearsal of the opening of the Mozart. There was a lot of laughing and joking as the four players tried to co-ordinate the entry which comprised of the first violinist playing a dotted crotchet tied over the barline in a 3/8 rhythm, whilst the second violin and viola entered after a quaver rest with a repeating two-quaver figure on the second and third quaver beat. It seemed imperative that the first violinist's opening note was clearly signalled, otherwise the other two players (i) could not establish the speed of the quaver movement, and (ii) would miss their brief quaver cue and potentially destroy the opening ensemble. The cellist was not as involved in this particular issue as she was playing crotchets, and had a full view of the first violinist. The other two players asked that the opening should be played several times, and on each occasion they asked the first violinist to make a gesture that was obvious enough for them to see at a glance where her opening note was going to fall. Eventually, the first violinist created a large upward sweeping gesture of her bowing arm and whole upper torso to indicate an imaginary quaver upbeat to precede her first played note. After four attempts, all players were satisfied that this movement would provide them with the information they needed to establish the quaver speed. The first violinist's gesture was also used in the performance.

The second use of gesture was the *marking of dynamics.* The players led one another using bowing movements, other arm gestures, and head movements of various sizes to correspond with the loudness or softness they were attempting to achieve. These movements were particularly apparent in the Britten where most of the musical entries were canonical, so each player took it in turn to lead a particular section and how it should be played. Across both pieces and the rehearsal and the performance context, we recorded a direct correlation between large movements and loud sounds and small movements and small sounds.

Related to the two types of gesture described above, is the third use of gesture: the use of *"circular body sway"* which was used in the co-ordination of timing and expression. This rotational sway of the torso was evidently connected to both

timing – *i.e.,* keeping a phrase together – but also the shape and direction of the phrase and its loudness/softness. A very clear example of it was in the Britten, though it existed in all contexts. As each instrumentalist made an entry, s/he appeared to add an extra ripple to the wave of backwards and forwards movement that was passing between them. Just like waves, the movements were of similar shape and form to one another, and appeared to help in establishing a wholeness in the music which was written in a manner that could have been very fragmented as it involved principally a series of solo lines, rather than blocks of harmony that was characteristic of the Mozart.

Thus, in summary, issues of process were vital to the performers and most were typically managed through non-verbal gestures.

During the analysis it became apparent that there was a single musical issue which dominated much of the interaction. This was not directly related to either the content or process of the Mozart and Britten and concerned group and personal dissatisfaction with the overall musical sound. Tuning – producing justly pitched notes – was one example of this. All players noted that each instrument should be in tune, with every string having a good pitch relationship to the next. Indeed, all the players noted that during the performance the viola strings were badly tuned. More specifically, all were concerned that individual melody lines should be "well tuned". The cellist, in particular, constantly adjusted the tuning of her cello strings.

Discussion

In this study detailed analyses of the rehearsal and performance of a student ensemble together with their reflections on their work have enabled us to tease out important socio-cultural and socio-emotional factors influencing their preparation and presentation for the concert programme, and a whole series of moment-by-moment issues connected with the co-ordination of musical content and process. To our knowledge this is the first study of its type which describes the events and behaviours of an ensemble looking at both the broader socio-cultural context as well as the specifics of moment-by-moment musical co-ordination.

These broader socio-cultural and social-emotional issues included concerns about performance anxiety, the overall quality of the performance product, and external distractions from the hall. Some of these issues were principally of an interpersonal nature. For instance, our discovery of the tendency for the male member of the quartet to dominate discussions in rehearsal and the commentary session. At the same it is clear that musical considerations and interpersonal dynamics can interact. A very telling example was to be found in some of the exchanges between the male and female players. We noted above how the male player was not afraid to voice his opinions, especially when it involved teasing the first violinist about her inability to keep time. Yet in the rehearsal and the performance all three women accommodated the second violinist's technical weakness as a player by allowing him "musical space". This is a fascinating issue that we cannot fully interpret here, though it is important to point out that nowhere in any of the data does the male second violinist show an awareness that these timing modifications were in part at least happening for his benefit. He was thus criticising something that in fact he was partly the cause of.

Further studies with different ensembles are necessary to explore the full extent of the social exchange between co-performers and thus address what social and musical meanings are shared by an ensemble. Certainly in the case above, it would appear that the male and female players had slightly different perspectives on what performing together means, differing in their views about the relative importance of accuracy in timing, or accommodation to one another's strengths and weaknesses. Unfortunately, the players in this case study do not tackle the topic of musical meaning in their discussion, but this is not to say that it is not a potentially important issue for them. It is to be recalled that they have only worked together for six months and, as a relatively new ensemble, it is perhaps not that surprising that they tended to focus their exchanges on technical and individual concerns and therefore that a topic such as tuning emerged as a major issue rather than matters of musical meaning. Indeed, a clear indication that they are working at this technical level was revealed in the first violinist's comment that she was somewhat ashamed of the Britten performance because it had only been prepared in one technical area – timing. It would, therefore, have been interesting to have been able to re-visit their work on these two pieces after several months to see whether they still took a two-fold approach to negotiating their ensemble work: firstly, getting the notes right, and secondly making sense of the syntax to get at a cohesive expressive musical whole.

Inevitably some of the socio-emotional issues, especially the players' own concerns, may be specific to the particular quartet studied. It is likely that different ensembles will have different focuses of attention. Professionals, for example, may not be so concerned with the technical demands of the piece. And, people who have worked for long periods of time together may have different emphases on co-ordination. Obviously much further investigation of more quartets is necessary. There is, of course, also a strong case for continuing to observe this particular quartet over a long period of time to trace their development. Nonetheless we feel that some of the issues of co-ordination are germane to any analysis of communication in chamber ensembles.

Looking at the nature of moment-by-moment musical co-ordination, we believe that Clark and Brennan's analysis of grounding in conversation provided a fruitful framework for our purposes. We have identified a number of aspects of musical co-ordination relating to content and process. The content issues focused on technical aspects of the performance related to stylistic and structural features of the music. Thus the Mozart piece afforded a more group-oriented style than the Britten with its soloistic lines and canonical entries. The process issues principally concerned the co-ordination of the individual contributions of the players with respect to such matters as entries and exits, expression, and dynamics in the music. These ranged from accounts of individual idiosyncracies and the group's attempts to accommodate these (for example, the tempo modification to accommodate the second violinist's weaker technique), to the use of non-verbal gestures to give moment-to-moment signals about timing (large sweeping arm movements to herald an entrance, for example).

Given that the players are focusing around a fixed score, the co-ordination of content and process is bound to be more predictable and to some extent more controllable than the impact of some of the socio-emotional issues mentioned

earlier, *e.g.,* performance anxiety, which emerged in performance. From this study, it has become apparent that in order to develop a theoretical framework which encapsulates both socio-cultural and musical co-ordination issues, further attention must be paid to the question of what it is around which the players are co-ordinating their efforts, *i.e.* the nature of a musical work. Above we have identified a variety of factors that contribute to the performance of a musical work – a musical score, socio-cultural rules, etc., and the players beliefs about the relative importance of such matters. But precisely where do we locate a musical work?

Discussing the limitations of a conception of culture as "shared knowledge of individual minds", the cultural anthropologist Clifford Geertz has made the following observation:

> If . . . we take, say, a Beethoven quartet as . . . [a] nicely illustrative sample of culture, no one would, I think, identify it with a score, with the skills and knowledge needed to play it, with the understanding of it possessed by its performers or auditors, nor with a particular performance of it or with some mysterious entity transcending material existence. . . . But that a Beethoven quartet is a temporally developed tonal structure a coherent sequence of modelled sound – in a word, music – and not anybody's knowledge of it or belief about anything, including how to play it, is a proposition to which most people are, upon reflection, likely to assent.
>
> (Geertz, 1973, pp. 11–12)

Following Geertz, we would not wish to identify a musical work with the score, the skills and knowledge needed to play it, or the players' understanding of it. Rather we would wish to see the musical work as mutually constituted by the score and the players' culturally-situated knowledge and abilities. Moreover, different criteria for a musical work may be needed for music of different styles or periods, as in the case of the rather different Britten and Mozart works discussed above (Davies, 1991). We believe that a concept developed by the perceptual psychologist James Gibson may be of value here – that of affordance (Gibson, 1979). An affordance is a perceived opportunity for action in the environment. As such it is neither a property of the environment nor the perceiver but points both ways – to organism and environment and their mutual constitution (see Still and Good, 1998). Music-making thus provides players with many affordances, each player taking the "meaning" that is specified at any particular point in the performance as a "means" for further specifiying what is afforded by both the part before him and the mutually constituted "musical product" of the joint activity of all the players.

It seems that researchers have been too quick to focus on only historical, or musicological, or psychological/sociological factors at the expense of how these individual elements interact. Our research has shown that the musical work (in the Western canon, at least) is not only a product of socio-cultural factors but is also influenced by the interpersonal dynamics of the musicians rehearsing and presenting the work. Furthermore, it is evident – given our observations as audience members as well as performance analysts – that the interpersonal dynamics between performers and audience can have significant bi-directional effects on how the performance is perceived and this in turn can influence how the performance unfurls.

We recognise that in this analysis we have been drawing upon interpretative resources which derive as much from our experiences as practising musicians as from our knowledge of psychology. These everyday musical understandings are also shared by the performers – the same stock of knowledge, socio-cultural rules, etc. While this may give us "insider" insights, other frames of reference might also cast light upon other issues. We hope that future projects would attempt to adopt a number of different methodological approaches to studying the musical and social dynamics of the quartet. In summary, however, our overall methodology seemed fruitful. We undertook the research in naturalistic conditions, and all the players felt relaxed. We were able to get them to clarify and confirm what they believed was happening to them and the group at specific points in time. Rehearsal and performance data were certainly useful for they gave a very full account of the co-ordination processes that may be missed in a simple, single observation study.

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