Open Research Online

Measuring musical interaction: analysing communication in embodied musical behaviour

Thesis

oro.open.ac.uk

MEASURING MUSICAL INTERACTION:
ANALYSING COMMUNICATION IN EMBODIED MUSICAL BEHAVIOUR

NICOLA STEPHANIE MORAN

A THESIS SUBMITTED IN PARTIAL
FULFILMENT OF THE REQUIREMENTS
FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

DEPARTMENT OF MUSIC

OPEN UNIVERSITY

SUBMITTED 18 APRIL 2007

MEASURING MUSICAL INTERACTION: ANALYSING COMMUNICATION IN EMBODIED MUSICAL BEHAVIOUR

Abstract

This thesis addresses the ubiquity and necessity of embodied interaction to musical activity, using video analysis to observe communication in musical events. Through the specific study of classical North Indian instrumental duo performance, the thesis examines how processes of social interaction may inform human musical activity, using a combined methodology of ethnographic study and quantitative data analysis of original video-recordings. Proposing a pragmatic approach to the study of the meaningful nature of musical events, the thesis keeps sight of the generative context of the human body in social interaction, and offers a model of musical communication that privileges non-linguistic, socially co-regulative elements in its account of human musical interaction. The socially meaningful nature of the behaviour-in-time of the musicians included in the study is investigated by means of a novel methodology. This combines the qualitative exploration of emic concepts related to the practice of North Indian classical music with an empirical analysis of video data, based on a cognitive ethological framework. The thesis draws on current notions of embodied cognition and contributes to the growing corpus of musicological literature emphasising the embodied and social nature of musical communication. The results of this exploratory study suggest that both social-interaction and music-structural factors contribute to the organisation of the musicians' communicative behaviours and that, to a certain extent, these organisational factors can be separated in analysis.

TABLE OF CONTENTS

ACKNOWLEDGMENTS

LIST OF FIGURES

TRANSLITERATIONS

Many of the terms used in discussion of North Indian music are drawn from the ancient literary language, Sanskrit, which uses the Devanagari script. Other terms in the modern Hindi language are also called on; this also uses Devanagari script but with modifications due to the language's inclusion of words from Muslim sources (Jairazbhoy, 1982:523).

Certain issues arise in the transliteration of these terms through the English language, since the Roman alphabet does not have as many different vowels and consonants as does Sanskrit. The academic standard system for the Romanisation of Sanskrit is IAST (the International Alphabet of Sanskrit Transliteration); this system uses diacritical marks to extend the alphabet - for example, the vowel sound 'a' as used in the word father is distinguished from the 'a' used in above, with the use of this mark: 'ā'.

Many Sanskrit words end with the vowel 'a', but this is not usually pronounced in modern Hindi. To take into account this speech convention, modern transliteration often omits this final vowel, as is the case in this document. For the purposes of consistency and simplicity in this piece of work, IAST transliterations have been adopted for the simplest use in the main body of the text, appearing without diacritical marks. The transliterated terms are *italisized* in the first instance and appear as normal text thereafter. All such terms are included in the glossary, where the correct IAST transliteration is also given.

1 INTERACTION I: MUSICOLOGICAL FRAMEWORKS

1.1 Contemplating musical engagement

When musicians participate in musical behaviour they are engaging in a specific form of social interaction; as individuals, musicians are socially-primed communicators as well as skilled and educated performers. In this sense, musical interaction can be seen to call on vitally human skills of interpersonal engagement, a notion that encourages a view of human communication that prioritises the dynamic, body-based source of social interaction.

This thesis approaches the subject of interpersonal musical engagement by considering three interrelated aspects of the topic. Firstly, music seems to be strongly linked to the human capacity for communication, and certain mechanisms for communication have to function at the immediate level at which social interaction takes place. Secondly, when viewed pragmatically, music might also be seen to function according to particular mechanisms of meaning generation. Finally, music's meaningful nature may be considered as something that is emergent during the interaction, and might therefore arise socially.

The functional approach taken in this thesis draws attention to this social aspect. It also highlights the concern that music happens in time, and it involves a durational aspect. These two concepts lend themselves to the notion that musical meaning is, from a functional perspective, something mediated by embodied action. A key element of the thesis, then, is to consider the way in which the agents who participate in musical interactions act together in time. On this basis, the research addresses the matter of how to explore the dynamic qualities of bodies in musical interaction.

The first two chapters of the thesis examine how intellectual perspectives and methods for the study of human communication during the twentieth century might have affected scholarship on musical means of communication. These chapters set out a broad overview that touches on the establishment of the social sciences, on socially-aware approaches to musicology, and on the effects of early cognitive and linguistic science paradigms. This overview demonstrates that an intellectually-driven separation might have occurred between the research areas of a) communication in relation to individuals' perception and meaning construction, and b) communication in relation to social-level, cultural meaningfulness. By exploring the implications of this divergence, these first two

chapters discuss how the resulting lacunae are currently being addressed in both music-specific (Chapter One) and general social interaction fields (Chapter Two). Such work is being developed in the research areas of embodied cognition studies, which include contemporary social interaction studies and developmental psychology research on infant intersubjectivity, and also in cross-cultural music cognition studies, for example, those looking to the topic of musicians' mutual co-regulation in order that they play in time and in tune with each other.

A prevalent view available in the scholarship on musical meaning is suggestive of an abstract and ethereal notion of music -- something that is accessed in the mental domain of an isolated individual. While this concept pertains to the values of certain cultures, it has little purchase at the widest level of investigation; in the first instance, musical interaction requires real-time, responsive, communicative behaviour.

As might be the case for an account of any human creative utterance, musical expression can be understood as individual expression and as something that is also available for individual interpretation by others. Therefore, in order to talk about music-making as a social activity, the social interaction of many individuals must be acknowledged. The functional approach sought in this thesis requires that music is discussed as an innate, human propensity, and while the musical capacities of individuals are to be considered, it is important also to consider the pragmatic social framework in which these capacities are nurtured, and under which broad social and cultural circumstances the behaviours that support musical interactions function.

Thus the primary notion of music in this thesis is an action-based definition similar to Small's notion of *musicking*, derived from the verb *to music*, which is used to encompass any act of musically-oriented behaviour, from listening to songs on the radio, to performing in a string quartet (Small, 1998). Small uses this as a practical device for a pragmatic discussion of musical meaning; for Small, musicking offers a way to include all participants (performers and audience) in socially-embedded acts of musical interaction.

1.2   Calls for embodied musicology

This first chapter examines how musicological accounts of musical communication that look to an individual, personal level depend on a perspective of musical meaning in which acts of interpretation occur in a private, mental and atemporal space. Such an

approach has contributed a vast body of research on meaning construction and musical value, but eminent musicologists are currently asking questions of music that reach out to an active, social level.

In the past few years there has been increasing musicological attention to scholarship which considers the embodied aspects of music[1]. Eminent scholars, including Nicholas Cook and Carolyn Abbate, have suggested that musicological research should consider the musical meaning from the perspective of its "drastic" (2004) and "emergent" (2001) properties, seeking to draw attention to the actual performance of music.

Abbate writes of the need to embrace the "drastic", dramatic action in musicological theory, and refers to "vanished live performances, musicology's perpetually absent objects" (Abbate, 2004:514). Meanwhile, Cook has suggested that it is an "emergent quality" that should be invoked in analyses of musical meaning (Cook, 2001:179). He reminds his readers that what they may consider to be "a 'piece' of music should really be conceived as an indefinitely extended series of traces", these traces consisting of artefacts of musical representation "instanced equally by scores, performances, or sound recordings" (Cook, 2001:179). But while Cook seeks performative interpretations of music as a dynamic process, according to Abbate he is preoccupying himself with mere "souvenirs" (Abbate, 2004:506).

Cook's "indefinitely extended series of traces" is intended to invoke the emergent quality of musically mediated meaning. Each trace in this series is, essentially, a technology designed to signify the dynamic, temporally-constructed musical act. While a type of emergent meaning is evoked, the observed musical action may be analogous to the movement visible in a flicker-book animation - the static representational forms appear to move when the series of traces are examined side-by-side. Rather than taking Cook's theoretical location for the source of emergent meaning, Abbate would rather approach "real music, the event itself", as "encouraging or demanding the drastic [performed] […] is what damps down the gnostic [theorized]" (Abbate, 2004:532). But musicology appears to have few tools to handle "the event itself". As Abbate's enigmatic style demonstrates, scholarship in this domain appears reliant on particular notions of

---

[1] The Columbia Music Scholarship Conference 2006 called for papers on music performance and improvisation tackling issues of "presence, materiality, and embodiment" in line with the redirection in humanities and social sciences scholarship "away from hermeneutical interpretation towards a focus on performance". *Call for Papers* in CMSC conference archive, <http://www.columbia.edu/cu/cmsc/2006/call_papers.html>, 14 November 2006.

knowledge and truth, and discussion of the "drastic" is a concept still far removed from the observation of an "event".

There is an element common to both scholars' arguments on which neither Abbate nor Cook focuses. Both wish to examine "event" over "text" but neither specifies that the event must happen in time; both wish to examine the dynamic quality of music as a human communicative phenomenon, but neither addresses the feature of durational time which separates their domain of study from fine art criticism, or literature. Music is created in time, and musical meaning seems largely to be about our experience of time, generated as it is through real-time acts of perception and interaction.

Clayton (2001) addresses this topic with particular reference to North Indian classical music performance, speculating on the place of the reality of experienced, live *Khyal* (classical North Indian vocal genre) performance in the discursive tradition of *ras* theory in North Indian classical music. Ras theory is an essential concept to the appreciation of classical Indian *rag* music, relating to the ideal of a performance that evokes a particular aesthetic response through the artist's ability to convey emotional expression[1]. In an account of his experience observing video footage of an event that he had himself attended, Clayton comments that he perceived that all the participants seemed "somehow locked into the same experience", and proposed that it may be the "very experience of an interactional synchrony - listener with musical sound […] that the discourse on […] rasa sought to interpret" (Clayton, 2001:3).

This exposition on the place of real-time social interaction in the emergence of an element of musical meaning appears to resonate with Cook and Abbate's claims. However, since the dominant musicological treatment of music as communication - the treatment which has impacted most strongly on studies of musical cognition and perception in empirical research disciplines - is based on analogy to propositionally structured communication, there is a lack of available methodological tools for the type of action-based analysis that such a perspective requires.

Therefore, the question of exactly *how* music communicates remains confined to analytic methods used to describe and explore the disembodied properties of music as, largely, imagined sound. While the study of music could benefit from "interpretive frameworks

---

[1] A detailed account of North Indian music is given in Chapter Three; refer to Glossary for further explanation of musical terms.

for human behaviours that have explanatory powers predicated on something beyond the specific circumstance of any particular act of interpretation" (Cross, 2001b:20), musicological enquiry seems best geared to post-action interpretative discourse to describe and verify imagistic aspects of music and elements of its expressiveness.

1.3   Pragmatic terms - language use and communication

Discussions of meaning must call on the terms *communication* and *language*, but the particular uses and meanings held by these terms require classification. For the purposes of this explanation, the reader is asked to imagine a silent yet dynamic vignette of actors in motion, interacting with and reacting to one another's positions, postures and intentions through the movement of their physical forms (see Figure 1.1).

Figure 1.1 *- Everyday social interaction (photograph by N. Moran)*

The imaginary actors could be given language, as verbal utterance or as written media, and this would imbue their community with greater power. But the actors are *using* the language; they are using it as a means to facilitate greater accuracy to their existing interactions. In this way, their acts of interaction can be seen to depend primarily on their physical presence and their bodies, not on their choice of words.

The imaginary vignette is intended to help to establish an aspect of the definition of communication that is subverted by contemporary use of information technology. While

the etymology of the verb *to communicate*[1] implies an act of sharing, the explosion of new communication technologies in the mid-twentieth century may have contributed to re-shaping the concept into one synonymous with information transmission: we transmit semantic information through words, producers to receivers.

However, when language is considered as a "mechanism serving cognitive purposes" (Wallin, 1991b:536), the printing press, telecommunications and the internet - even the very invention of phonetic alphabetism - can all be seen as technologies related to language. The technologies have provided opportunities for societies to harness the immensely powerful features of language structure through disembodied media; although individuals still talk to one other, there appears to have been an "uncoupling [of] language from its primordial face-to-face matrix" (Boal, 2001). Calling on the pragmatist tradition of language studies, to be discussed in greater detail in Chapter Two, the linguist Herb Clark makes a distinction between language *structure* and language *use* (Clark, 1996). This distinction helps to illuminate the notion of human communication as the "deportment of bodies in social space, and the gearing of language into the infinite variety of improvised and ritual encounters, [which] show that humans converse as 'communities of co-movers'" (Boal, 2001).

Language structure has proven to be a robust enough system to remain intact and to be developed as a technology in itself, through translation to symbolic representational form as the written word. But for the purposes of the study of human interaction it is very important that the active use of language structure should not be overlooked: language is used to create and maintain social relations through joint actions which sustain communicative events.

Of course, musical interaction is not (typically) silent, and language metaphors such as a musical 'conversation' and musicians who are 'saying something' are very useful in the description of musical events, particularly in accounts of jazz improvisation, or chamber music such as string quartets, for example. However, Clark's distinction between language's use and its structure can be helpful for examining musicological accounts of musical meaning, as studies of musical structure might be given more purchase - and make more sense - when the doing, dynamic, body-based origins of musical practice are considered as the primary context for music's meaningfulness.

---

[1] ORIGIN C16 (earlier (ME) as communication): from Latin communicat-, communicare 'share', from communis. "communicate v." (Soanes & Stevenson, 2004)

1.4   Existing musicological frameworks

In the contexts of Western European, North American and also North Indian classical music, performance norms pertain to the professionalized domain of concert hall or auditorium reception, and commercial recorded products. With regards to these locations of musical experience, the material traces available for musicological discussion after the individual's encounter with musical sound might include the concept of performance, the perception of performance, the interpretation of a musical score, or the experience of recorded musical sound. For the purposes of a discussion of the individual's internal experience of music according to all of the musical traces that may be construed from these locations, 'music' may be imagined to be an abstract, transcendent entity described as a *piece* or a *work*.

During the past century, the aesthetic philosophy of Carl Dahlhaus consolidated the musical work concept, and contributed to the formulation of a perceived canon of masterpieces (Dahlhaus, 1982; 1989).   Dahlhaus' influence may have added to the conflation of two distinct concepts: the musical work and the musical score. Writing about the influences that have shaped the reception of improvised music since the mid twentieth-century, Lewis notes that Dahlhaus proposed that a composition must be fixed in written form (*schriftlich fixiert* (Dahlhaus, 1979:10-1)) in order to be performed -- a view which compounded the notion that performance served only as a conduit for the genius of an absent composer (G. E. Lewis, 1996). The value of the musical score is paramount to the musical work concept for Western art music, and the use of the term 'music' to cover the two has become ubiquitous shorthand for the majority of music scholarship.

Further contributions to mid-twentieth century musicology saw aesthetic philosophers and music historians supporting scholarship of their canon with reference to music theoretical constructs, buttressed by a discipline of theoretical music analysis. However, while the experience of musical sound implicitly underlies the point of music analysis, the subject of the analysis prioritises the context-free, subjective experience of that sound. In this way, even the most objectively posed analysis calls into use a 'folk psychology' concept of music perception rather than a formulation based on empirical foundations (Cross, 1998:5), and tends to remain a highly individualistic pursuit.

The contribution of music critic and philosopher, Theodor Adorno to twentieth-century musicology was significant in calling for attention to the grand social level of music

reception. Addressing the effect of radio-broadcasting and music as an industry, Adorno wrote of social concerns of power and control (1984; 2002). But an implicit notion of passive reception by audiences underlies his philosophical musings on music, and brings with it an individualistic interpretation of musical meaning. Although sociological in scope, Adorno is not concerned with the social interaction level of musical activity and assumes that, while the effects of production and reception of music have social and political relevance, musical meaning is constructed in the individual's passive response to musical works.

However, such views drew attention to the limitations of existing historiographical musicology, and influenced a body of postmodern musicology in the 1990s. The work of musicologists including Kramer (1993), McClary (1994) and Subotnik (1987) is representative of a trend to embrace an apparently liberal concept of musical pluralism. Their sociologically-aware musicology accounts for musics, cultures and meanings by considering questions of social context, asking questions of the extra-musical factors that may affect how and where the music is heard.

The critical musicology of the 1990s aimed to offer a bridge between individually-interpreted meaning and the social construction of music. However, the method used to construct this bridge is the literary tool of metaphor, based on analogies between characteristics of music theoretical constructs and sociological agendas, such as queer theory (Brett, Wood, & Thomas, 1994) and postcolonialism (Born & Hesmondhalgh, 2000; Hesmondhalgh, 2000). But with music theory and analysis typically providing the empirical supporting reference, the meaning of a work of music is presumed simply to exist, available to be read through the score.

The concerns for the extra-musical context sought in these approaches resonate with this thesis, but while this area of musicological literature considers the social construction of music, the embodied and emergent aspects of meaning that might be mediated at the social interaction level are not addressed. Although musicology of the 1990s and beyond refers to context and culture, the methods of analysis come with inbuilt restrictions on the very dimensions of the musical act which is under scrutiny, as this must be treated as something partitioned for producers and receivers.

Certain consequences and assumptions arise from interpretive methods that are designed for the individual interpreter of musical knowledge and meaning. In particular, the focus

on the individual's own perception and interpretation process requires a strong distinction between the performer and the listener. It also emphasises the boundary between acts of composition, interpretation, performance and reception. The particular understanding of music as an abstract entity, and the accepted interpretation of music in the individual's mental encounter with the musical work, are vital categories of musicology. These categories deal most typically with the concerns of a Western art music repertory. However, acceptance of these ontologies implicitly extends into the public sphere of performance programming and media broadcast, and into education and arts funding. This ethnocentricism has also dominated the view of musical communication known to scholars and researchers outside of the domain of University music faculties, impacting on studies of musical cognition and perception by other research disciplines, particularly those which make use of methods available to neurosciences and linguistic research.

1.5   Language and music comparisons

Since the early to mid-twentieth century, various music theoretic approaches have devised analysis techniques to explore logical aspects in musical structures. Heinrich Schenker's enduring system of music analysis, based on the unitary notion that a single, 'deep' structure underlies musical masterpieces in the Western classical canon, offered the first, culturally-specific generative approach (Snarrenberg, 2001). The value of the problem-solving techniques, which were largely derived from linguistics research for use in musicology, have been seen in several more generative theories of music constructed with the explanatory device of 'surface' and 'deep' structures in memory and perception of music, most successfully in Lerdahl and Jackendoff (1983), also in Sloboda (1988), and Longuet-Higgins (1978).

Materially speaking, music-as-event and language use are based on similar modes of production, including human body as sound source and, in particular, the use of vocal apparatus. Units for production and perception of both linguistic and musical sound include pitch contour and rhythm; physiological limitations for discrimination of these are equivalent for both systems and the capacities for signal-production can be used for either music or language. These obvious links between the acoustic structural similarities of music and speech in their prosodic form and the use of both as bases of meaningful, socially-cohesive activity have invited much speculation about the evolutionary origins of the two (Bickerton, 2000; Brown, 2000; Mithen, 2005). Musical sound can be examined on a fine-grain level analogous to the phonological level of speech sounds, and the use of

symbolic representation for transcription and analysis is also a shared technology in musical and speech systems - although the extent to which notation features as an ontological category in a culture's music varies considerably cross-culturally.

In the study of music and language development, comparisons of the two areas have included the homologous features of vocal communication, treating both music and language as abstract, logical systems. Comparisons of the development of music and language such as McMullen and Saffran (2004) typically focus on Western art music, and tend to emphasize the development of grammatical rules for harmonic structure over, for example, rhythmic features. The ethnocentricism of such a view restricts the findings and is not compatible with an understanding of music - or language - as embodied activity.

For the purposes of this thesis, musical communication is considered at a social level for its emergent and embodied properties. Therefore, a comparison between the two systems of music and language may be most useful at the functional end of the spectrum, as opposed to a consideration of representational elements. Although musical structures have audible traces which can be recorded for reproduction, this is not their sole attribute. While audible traces can be represented in symbolic and graphic text, most of the world's musical systems use notation in a far less formalised and concrete manner to that familiar to classical Western musicians. The functional view taken in this thesis considers the affective consequences of these communication systems, and therefore seeks to explore the way in which the affective capacity of musical structures appears to allow the perceptual mapping of non-musical experience into musical interaction events to yield musical expressiveness.

Meyer (1956) makes explicit the various standpoints that musicologists may take to explore the expressive properties of musical activities, distinguishing between formalist versus expressionist, and absolutist versus referentialist stances. The formalist view takes meaning construction as an intellectual process dependent on the understanding of music structural relationships in a work, whereas the expressionist line argues that there is something inherent in the work that evokes emotion in the listener, and that meaning is derived from this. Either view might presume music's meaning to be contained within the musical work, or to exist through reference to external structures, ideas or emotions.

Meyer's musical expectancy theory offered, in *Emotion and Meaning in Music*, the first cognitivist perspective on the topic. This linked a pragmatic view of language and

meaning construction to psychological research on arousal from a stimulus. Emotional responses in music were seen to arise through aspects of pattern perception in the musical structure and the fulfilled or denied expectations implicit in habitual learned responses to the stimuli (Meyer, 1956). The functional perspective of Meyer's view provided a new lens for musical expressiveness studies, opening the door for more specific accounts which could offer a way to join the psychological expectancy theory to a structured, symbolic system of musical meaning. Meyer's theory proposed an element of generic, transferable meaningfulness in the "connotative complexes" that music makes available - for example, not through an evocation of "the concept or image of [for example] death itself" but in the connotation of "a rich realm of experience in which death and darkness, night and cold, winter and sleep and silence are all combined and consolidated" (1956:265).

Whilst broad and connotative rather than prescriptive, the question of musical emotion evoked here is that of something which must be articulated in relation to linguistically-defined categories of affectiveness, and the theory focuses on the individual's perception of musical sound. The philosophy of Suzanne Langer (1942) offered modern musicology an alternative to lexically-biased definitions of musical emotion, presenting the effect of music as something which is ambiguous in its expressivity. For Langer, music is something that causes us to *feel*, but music is non-specific in its symbolism: "Music is revealing, where words are obscuring, because it can have not only a content, but a transient play of contents. It can articulate feelings without becoming wedded to them." (1942:243-4). Langer proposed that musical structures might somehow correspond in form to the dynamics of human experience ("...what music can actually reflect is only the morphology of feeling" (1942:238); "The physical characteristics of a tone, which we describe as "sweet" or "rich" or "strident", and so forth, may suggest a momentary interpretation, by a physical response" (1942:244)), proposing this isomorphism as a contributor to music's expressive capacity. Through such ideas, Langer offered an alternative theory of meaning in music which diverted the focus away from the referentiality of musical meaning, an account that suggested music's meaning is not expressible in words.

This made an early challenge to linguistic dominance in accounts of meaning construction in music. Critics of Langer's isomorphism theory have suggested that the account can only attempt to explain a "crude, traditional view of emotions", and that it does this through an essentially "indescribable" connection between mental process and

musical structure (Davies, 2001:622-3). Others, most notably Davies and Kivy, have since developed what has become known as the contour theory of musical expressivity (Davies, 1994; Kivy, 1989), continuing to theorize the connection between "a resemblance experienced between human appearances with an expressive character and the dynamic contour and pattern of the music" (Davies, 2001:622-3). But while contour theories seem to press most closely to the matter of music-as-performance, they do not satisfy Cook:

> The relationship [this approach] posits between music and meaning is inherently mysterious […] because of the impossibility of defining the 'logical form' of human feelings except in terms of such behavioural expressions of them as music or dance, from which it follows that the invocation is redundant.
> (Cook, 1990:176).

To music theorists and analysts, contour theory must be void: while the argument may continue as to which structural aspects of music yield expressiveness, the requirement is that the work, somehow, contains it. Jean-Jacques Nattiez tackled this problem through the application of semiotic analysis to musical discourse, with a framework that aimed to reconcile formal with hermeneutic levels of analysis by which the material trace and its interpretation could be brought together (Nattiez, 1990:28). The view of music's dynamic, emergent meaning as something contained within the work is clarified by Nattiez:

> A symbolic form [...] is not some 'intermediary' in a process of 'communication' that transmits the meaning intended by the author to the audience; it is instead the result of a complex process of creation […] that has to do with the form as well as the content of the work; it is also the point of departure for a complex process of reception […] that reconstructs a 'message'.
> (Nattiez, 1990:17)

Nattiez clarifies that music's symbolic form should not be treated analogously to an information-transmission process between author and audience as it acts through a complex process of creation and reception. However, his semiological account is, naturally, very strongly linked to linguistic knowing and meaning construction; the use of terms 'music' and 'musical work' are blurred, and the reconstruction of a "message" (Nattiez, 1990:17) subscribes to transcendent meaning, removed from the physical, embodied act of musical creation. The work of both Meyer and Nattiez is underpinned by the agenda of the early cognitive science programme and the related dominance of

structural linguistics, a topic explored further in Chapter Two. In Meyer's model there is a particular focus on the individual's perception of musical sounds; in Nattiez' there is a view of music that privileges the notion of a disembodied, symbolic system.

But physical objects and bodies must move to create those acoustic signals whose structures can leave meaningful audible traces, and the dynamic properties of the movement relate to its affective content (Scherer, 1985). For example, words spoken over the telephone while the speaker smiles are qualitatively different to those same words spoken while the speaker frowns. While music's structural elements such as pitch-content, instrumentation, rhythmic units and accentuation, may be conceived of as components of a language-like system, with a strong audible trace and a capacity to be represented and explored through techniques of notation, the elements must all be generated through action in time.

Ethnomusicologist Steven Feld has noted that "perspectives that focus on the functional or formal oppositions between speech and music may obscure the poetic and pragmatic connections between the modalities" (Feld & Fox, 1994:32). Feld has played a key role in establishing the value of linguistics to musicology and ethnomusicology, charting the implications and value of structuralist and semiotic methods in music research since the mid-1970s (Feld, 1974; Feld & Fox, 1994). The analytical connection that Feld has sought between music and language, based on their shared function on the shaping of human experience and emotion, acknowledges the relationship between musical practice and traces of "social imagination, activity and experience" (Feld & Fox, 1994:25).

Further research into the relationship between music, activity and emotional experience has offered a clutch of literature that is essentially based on the development of the contour view of musical expressivity. Davidson (2004) proposes that mental representations link physical movement for performance and cognitive motivation for the movement. Other studies have examined the relationship between music and dance by looking at the commonalities and differences in expressive potential (Camurri, Coletta, Ricchetti, & Volpe, 2000; Camurri, Lagerlöf, & Volte, 2003; Malloch, 2002; Mitchell & Gallaher, 2001; Stevens, Malloch, McKechnie, & Steven, 2003). However, these music-dance studies tend to be based on a concept of individualistic, passive music perception, observing stylised Western dance forms. These styles are not necessarily typical of the way in which many humans experience music and dance as indivisible, participative and social events.

1.6   Musical meaning and sociality

In contrast to what might be termed as mainstream musicology, the establishment of ethnomusicology in the mid-twentieth century superseded an earlier comparative musicology. Ethnomusicology has always focused on the sociality of music. Founding attitudes to ethnomusicological study included intentions to tackle music-as-culture, as well as music-as-practice, as represented in the works of Alan Merriam (1964) and Mantle Hood (1971) respectively. The anthropological basis for ethnomusicological study is often construed with a humanistic interpretation of music's relation to social organisation, best represented in the work of John Blacking (1971; 1974; 1977). This focus on the social role of musical performance means that ethnomusicological accounts look to musical action, as opposed to musical 'work' (cf. Feld, 1992; Seeger, 1958), giving grounds to resist the individualistic notion and also the very concept that music must always come in 'pieces'. Ethnomusicology's traces therefore have differences from those that comprise the musicological materials for analysis. Since the mid-twentieth century, ethnomusicologists have applied a combination of participant-observer ethnographic techniques, audio and visual recordings, and analytical approaches employing transcription tools to examine musical sound structure.

The explosion of linguistic research in the 1960s after the publication of Chomsky's transformational-generative grammar (Chomsky, 1957; 1968), with its implications for universal human cognitive processes, had repercussions on ethnomusicological debates regarding musical universals and the place of comparative studies. While Western music theory developed the analysis of music-structure along the lines of generative linguistics approaches, the paradigm from linguistic research which most strongly influenced ethnomusicological studies came from Kenneth Pike, a pragmatic linguist.

Pike worked towards a unifying theory for the two systems of human communication and the social organisation of communication events. In doing so, he established a framework by which participant-observers could strive to interpret the culturally- and socially-embedded ways of knowing that language structure is used to articulate (Pike, 1967). By drawing on linguistic terms *phonetic* (representation of sound as symbol) and *phonemic* (the smallest unit of sound in a language which provides distinction in meaning, for example between one word and another), Pike made a distinction between *etic* (an outsider view of a system of communication) and *emic* perspectives (concerned with the structure of a system of communication from an insider's own view) (Pike, 1967:35-6).

This distinction has contributed hugely to the methodological toolkit and consequent findings of both anthropologists and ethnomusicologists. Ethnomusicology proceeds with methods of analysis that draw on forms of transcription for the study of musical sound organisation and ethnography, for social and culturally-embedded accounts of musical activity.

1.7   The validation of action-based knowledge

A particular element of ethnomusicological study is the value placed on immediate musical experience, which provides epistemological validation for the concept of action-based knowledge. At the social level with which ethnomusicology might generally be seen to be concerned, musical meaning is not wholly describable through formalist or literary accounts. Since the research domain is accepted as inclusive of participative and embodied phenomena that are inseparable from social context, musical meaning cannot be evaluated without recourse to the acceptance of personal, subjective experience. The ethnomusicological approach thus embraces a pragmatic view of human communication, and respects the integrity of a musical performance as a social event (Feld, 1992; Qureshi, 1994; Rice, 1994; Stone, 1982). This is evident in the remarks cited earlier by ethnomusicologist, Clayton, regarding the importance of the participants' co-presence in the event of a Khyal performance, for the moments during which "all participants in the session [were] somehow locked into the same experience" (Clayton, 2001:3) in the very creation of that event.

The 'doing' aspect of social events is included as an object of ethnomusicological enquiry - for example, the socially-constructed boundaries which mark out ceremony and ritual from everyday behaviour, or the requirement of social complicity in their success. For ethnomusicologist, Regula Qureshi, it is "the interactive and variable nature of musical execution that rivets the music to human agency" (1994:525). With reference to contemporary performance events in London, Cottrell comments that, "in many different cultures across the globe, musicians are frequently cast in the role of ritual specialists" (2004:150). Cottrell draws on concepts explored by Turner's anthropological study of ritual (Turner, 1969), after van Gennep (1909 (1961)) to explore the element of *ritual* in music performance. The ambiguous state that participants involved in ritual processes enter, evoked in Clayton's account, is described by the term *liminal*: the ambiguous state of participants who are "betwixt and between" a sense of high, individual consciousness or the levels of consciousness of normal behaviour (Turner, 1969:95). After Turner,

Cottrell suggests that a state that engenders liminality may be described as a moment of *communitas*, defined by the participants' sense of "shared experience - mutual tuning in - and social antistructure" (2004:159).

Since the notion of social behaviour in the context of musical events is accorded primacy in many ethnomusicological accounts of musical interaction, particularly influential texts have sought frameworks to apply perspectives which include this culturally pragmatic approach to musical meaning. Particular examples include Feld's account of the relation of musical sound and movement to the social organisation and cultural life of the Kaluli people in 1980s Papua New Guinea (Feld, 1992). Feld uses three sets of conceptual constructs - ethnographic, theoretical and personal - to describe the "richness and relevance of Kaluli cultural patterning of sounds" (1992:217) Also, Berliner's ethnography of Shona music accessed and recorded detail of musical systems such as tuning and compositional form within a socio-cultural account of the musical tradition (Berliner, 1978). A further example includes Timothy Rice's hermeneutic approach to his study of Bulgarian song and dance (Rice, 1994), for which he used reflexive ethnographic and historical accounts to validate his subjective experience of the 'truth' in culturally-specific musical knowledge and meaning. While Berliner and Rice use ethnography to record the role, function and organisation of a music's sound in great detail, Feld provides new terms and novel ground for the explication of Kaluli music, and develops a complex semiotic interpretation where sound is one of various cross-modal experiences of music, inextricable not just from an individual's body, but from the social presence of the community.

For ethnomusicology, the importance of music as an embodied act has always been a significant topic which relates to the process of transcription of music as patterned sound

> When we seem to hear a rest between two drum beats, we must realize that for the player it is not a rest: each drum beat is the part of a total body movement in which the hand or stick strikes the drum skin.
>
> (Blacking, 1971:91)

Methodology for investigating such an action-in-time view of musical behaviour has been made increasingly plausible since the advent of hand-held video cameras which could be used in the field (Myers, 1992), and various ethnomusicologists have devised novel and effective uses for video recording technology in the field. The method of transcription devised by Kubik (1987) took advantage of the visual aspect of such body-movement in

performance, and developed a system of frame-by-frame video analysis for transcription "to obtain a visual representation of the sound event exclusively through movement analysis", which "turned out to yield results that would be more accurate than any transcription from a recording by ear could be" (Kubik, 2000:8). Regula Qureshi included 'videocharts' to represent the occurrence of interactions between performers and audience in research on Sufi music. Her form of transcription employed notated events from videos alongside other forms of representation, such as musical notation and timeline (Qureshi, 1986; 1987).

A contrasting use of video technology by Ruth Stone (1982) developed a different aspect of the phenomenon described by Blacking regarding the body movement involved in each rest between drum beats. Stone's research particularly emphasises the importance of a united approach to sound and behaviour, stating that as "a unit of study, the Kpelle music event is a bounded sphere of interaction. That is, it is set off and made distinct from the world of everyday life by the participants" (Stone, 1982:2). For Stone, meaning in music is something which is created by the participants in the course of social interaction, a view also shared by Waterman's practice theory (Waterman, 1990), and Monson's account of jazz musicians in interaction (Monson, 1996). Stone's conceptualisation of music is a process of symbolic behaviour and interpretation by both performer and audience, consonant with the notion of music as ritual explored by Cottrell (2004). In order to access these dynamic qualities and interpret them in a way which is congruent with Kpelle perceptions of the musical interaction, Stone used video recordings so that she might closely observe behaviour and also in order to use the material in 'feedback' interviews with the musicians, contextualizing her interpretation of the recorded images within the views of the other participants (Stone, 1982:52-4).

Such uses of musical ethnography and the development of rigorous and useful frameworks for its interpretation are vital to the interpretation of the role of musical action in a society. This aspect of the ethnomusicological approach demands that each culture's musical activity is treated as something which is deeply embedded in a specific social occasion. Consequently, such studies have offered access to the social location of musical interaction, and interpretations of the immediate social interaction level. Where music's function as social interaction is concerned, those studies which focus on non-Western cultures embrace notions of communication in Clark's (1996) language *use* far more openly that do those studies that have been termed here as mainstream musicology,

whose essential categories of musical work and individual-centred perception of musical sound dictate the dominance of propositional meaning in language *structure*.

However, it could be argued that an element of an ethnomusicological approach is a tendency to limit the extent of any generalisation which might compromise or reduce the very difference between the musical culture in question and dominant (Western) musical constructs which typically form the basis of the scholar's first perspective. This may have tended to restrict behavioural studies of musical interaction, since the indivisibility of the whole musical event and social context does not lend itself to enquiry at the physical action and behavioural level.

1.8   Emergent quality of musical communication

Broadly speaking, the scope and methods of both musicological and ethnomusicological enquiry into musical meaning described this far could be seen to have considered aspects of music two conceptual extremes; at a highly individualistic level, and also in wide, historically-constituted social trends. There appear to be limits to the way in which the emergent quality of musical forms of communication has been tackled. It was suggested earlier that musical events take place through physical change in time, as "drastic" acts (Abbate, 2004), but that many accounts of music's meaning focus on static, trace texts. Historical musicology has sought a particular context-free, timeless, autonomous musical meaning -- a counterpart to a literary, or language-structure dependent, way of meaning. The leaves of a score are treated as the pages of a book, and the approach is validated with reference to apparently external music theoretic constructs. A main body of musicological research appears to be restricted from access to the study of "drastic", physical movement by the literary terms of its scholarship, and the disembodied object of its study. In this way, Western classical art music might be said to aspire to a state of "near-transcendental" signification (Tolbert, 2003), dependent on the existence of distinct composer and performer roles, and a degree of redundancy on the part of the audience.

However, the body in musical motion exists in the material world, with or without musical instruments, and certainly with or without notation. DeNora (1986) describes problems with musicological approaches to study of communication of music's meaningfulness:

> It is a pervasive idea in Western culture that music is in some way capable of symbolizing emotions, images or ideas. Equally pervasive however, within the fields of philosophy, musicology, social psychology and linguistics, is the view that, in spite of increasing attention devoted to the topic, attempts to explain empirically music's communicative ability have met with relatively little success.
>
> (DeNora, 1986:84)

DeNora's alternative proposal is to shift debate from the question of what music means to the question of how musical meaning is possible. She proposes that a useful theoretical framework might locate social and cognitive structures in the interaction between people in order to focus on the dynamic construction of meaning. Such a framework is problematic, however, because it is difficult to account for movement in musical communication where an existing, powerful view sees musical meaning as mediated by propositional, abstract symbolic structures. Meanwhile, although ethnomusicology approaches music as action, and accepts the subjective experience of musical action as a valid source of knowledge, much analysis is based on transcription of musical sound; interpretive frameworks that can accommodate movement - in particular, socially interactive movement – are highly complex and therefore elusive. At best, this may offer two distinct levels of analysis which consider both sound and social meaning; at worst, this effects the privileging of music's sound-structure and reduces the consideration of music's physical, ritual and social functions.

1.9   Understanding music as action-in-time

However, cross-cultural studies which focus on music-related behaviour at the action-in-time level have been approached in research at the intersection between ethnomusicology and music psychology, domains which share a focus on the constraints and potentials of the biological and social body. Research in this overlap area has applied cross-cultural awareness of music's embodied nature to the study of music cognition. This work offers insights that have prompted several scholars to suggest that ethnomusicologists should typically use a combination of quantitative analysis and insights from participant observation. Clark (2005a:x) suggests that studies of musical communication make reference to both "the physical apparatus (bodies and instruments) and cultural substances (stylistically-constituted musical materials and performance practices)", while Baily (1992) advocates that a music cognition approach should be included as a component of ethnomusicology training.

A major contribution to the development of embodied theories of music cognition has come from John Baily, whose research on the Afghan Dutar led him to develop a generative motor grammar for musical style and composition (1977; 1985; 1988; 1991). A further key contribution to cross-cultural music cognition studies is Stobart and Cross' (2000) analysis of embodied aspects of performed music, which examines the perception of musical time in Bolivian music and considers the role of proprioceptive experience. Through an analysis of the effects of linguistic prosody and movement patterns on the perception of musical time in the music, the study accesses the pragmatic aspect of language use, which most usefully bridges music and language by observing individuals' musical behaviour as integrated systems of social action.

Behaviour at the action-in-time level is precisely the target of a body of research which was initiated by Keil, who stated that

> Music is about process, not product […] it's not about composers bringing forms from on high for mere mortals to realize or approximate, it's about getting down and into the groove, everyone creating socially from the bottom up
>
> (Keil, 1995b:1)

This particular attention to rhythmicity led to a research focus on the microtimings of the experience of auditory events. Such studies of expressive timing and musical process provide a methodological contrast to the musical work, and focus instead on possible mechanisms for the functioning of musical interaction as physical, participatory activity. Initiated by Keil, the study of *groove* has emerged as an area of research in which music as social interaction and attention to rhythmic aspects seem to have come together.

Keil (1995a; 1994) aimed to highlight the importance of process in musical activity through the quantitative analysis of the microtimings of jazz musicians' performances. He described these microtimings as Participatory Discrepancies (or PDs) and worked with the assumption that these PDs are how musicians negotiate the "groove" of their music. Musicians - particularly those who play African-American derived blues, jazz and pop - often talk of groove, whose meaning is related to the success of a performance in engaging both performers and audience in a musical event. Groove is often referred to in connection with physical gesture exhibiting a repetitive, expressive trait that may be characteristic of a particular musical style.

According to Shepherd, Keil's approach offered a link between the study of performance involving bodies and movement, and the "object-like" study of sound - an alternative to structuralist music theoretical and analytical accounts which give primacy to the relationships between music's sonic events "at the expense of the sonic events themselves" (Shepherd, 1995:89). Keil's scholarship provided an alternative to the music theoretic approaches which examined a score-based repertoire and focused on rhythmic aspects, rather than the harmonic structure. The attention that this research gives to improvised forms of music that are not dependent on strict notation is crucial. The difference between a notated *representation* of a rhythm and the resulting sonic effect of the *execution* of that rhythm through musical performance can be negated when the main source of enquiry is a representational text.

Keil's argument also includes a social dimension that a score-based analytical approach excludes. In order for music to be somehow about the groove - and that groove to be about people negotiating Participatory Discrepancies - then there must be more than one person involved. In particular, Keil's process-dependent definition of music means that "everyone [is] creating socially from the bottom up", including the audience (Keil, 1995a:1). This strong version of musical sociality has its opponents ("I had been playing [alone] for a long time before I ventured to play for any audience who 'created' with me" (Harwood, 1995:76)). However, Keil's argument raises a matter of implicit ethnocentricism. Whilst a topic of interest for music historians, the social situation in which musical activity occurs cannot be included in musical *work*-oriented, structural analyses. The exclusion suggests, implicitly, that the audience may be deemed irrelevant to the process - or existence - of musical meaning.

Other groove research includes a cognitive psychology account by Benzon (2001), whose model of musical cognition proposes a two-level system for the neural basis of music perception. Benzon describes a *groove stream*, referring to the ability of performers to occupy an imaginary space whose boundaries are defined by predictable units of a virtual, musical time. Within the collectively-managed groove stream, the participants are able to play out the dramatic, gestural content of their individual musical expression, and still be together in time. Benzon's theory assumes the gestural content to be analogous to melodic narrative development, taking a contour theory of music's affectiveness that draws on the concept of Clynes *essentic forms* (1979) -- "precise temporal forms that embody emotion in touch and that can also be expressed in sound" (Benzon, 2001:99).

As approached by Zbikowski, the topic of groove is introduced with reference to Monson's ethnographic studies of musical interaction (Monson, 1996). Zbikowski suggests that musical knowledge involves a "network of information that includes assessments about bodily states or the possibilities for bodily motion, knowledge about the basis of musical interaction, and abstract concepts" (Zbikowski, 2004:273), and therefore musical meaning might relate sound to physical production. Zbikowski bases a conceptual model of groove on the cognitive anthropological notion that culture consists of knowledge which is organised through such models, "which act as guides for reasoning and inference" (Zbikowski, 2004:273). He proposes three separate applications of the model for examples of music by Eric Clapton, Miles Davis and James Brown. The strength of Zbikowski's approach is the integration of his theory with descriptions of the embodied experience of music: "Concepts like regularity, differentiation and cyclicity, all central to our understanding of musical rhythm, are a common ground where embodied and musical knowledge meet" (Zbikowski, 2004:278). Consonant with Stobart and Cross (2000), Zbikowski argues that the human conception of rhythm is informed by the regularities inherent in physical, proprioceptive human experience.

As video recording technology improves, a growing body of research now employs movement analysis. This has been fruitful in studies examining the Brazilian music-dance-martial art form, Capoeira (Downey, 2002; J. L. Lewis, 1995), and of Southwest American popular dance music (Sturman, 1997). Other research has focused on the potential application of video and tracking technology to explore the topic of music and gesture (Wanderley, 1999; Wang, Shum, Xu, & Zheng, 2001). As video technology improves, research groups such as those led by Kia Ng at Leeds University's Interdisciplinary Centre for Scientific Research in Music, and also the Interaction, Media, and Communication research group at Queen Mary, University of London, are developing 3D movement imaging and analysis techniques.

In the UK, particular contributions to the establishment of video analysis as a valuable tool for musicological research have been made by Jane Davidson (2004; 2002; (in press)), whose significant output addresses the role of the body in music performance and musical communication, using video recordings as the basis for analysis of expressive behavioural events. Williamon and Davidson (2002) examined the importance of eye-contact in music rehearsal and stated the predominance of this over spoken language for inter-performer communication. The element of non-verbal communication required in ensemble performance and conductor gestures has also been the focus of several studies

(Ashley, Mader, & Hasty, 2002; Luck, 2002). Research by King (née Goodman) has used video analysis to examine the discourse of an ensemble rehearsal, construing social roles enacted during the musicians' interaction (Goodman, 2000; King, 2006). Most recently, Clayton (in press) uses a novel application of current video technology, employing software for video analysis to observe and quantify subtleties of the timing of *tanpura* (North Indian open-stringed lute) players' string-plucking, demonstrating apparent correlations in the microtiming of movements that the musicians did not intend to be performed in musical time.

1.10 Scope of studies on musical engagement

These studies have all developed methods for approaching music as action, applying varying strategies contingent on existing technologies and the particular focus of the research. The social interaction aspects of the musical event where interpersonal musical engagement takes place have been addressed to varying degrees in the work reviewed here. The existing video analysis studies of music-related gestures have elicited a great deal of information about the nuances of co-performer communication and expressive gesture by musicians (Ashley et al., 2002; Davidson, 2004; Goodman, 2000; King, 2006; Luck, 2002; Williamon & Davidson, 2002). These are valuable studies of the particular epistemic category of Western classical music performance, but they do not examine anything of the social interaction demanded by types of musical activities that are unmediated by a score.

Collectively, groove studies state an intention to tackle this very level of social interaction. However, as Keil's critics dispute his assumption that an audience is part of the creative aspect of a musical event because they know audiences in a passive context, Keil knows jazz to be defined by swing and so his discussion of the social context and the way musicians groove quickly becomes subsumed into a theory of jazz swing. If groove is something that everyone can "get down and […] into" (Keil, 1995b:1) - something that is inextricable from a social context - then where does that audience fit in, and how do elements of the interaction apart from the negotiation of rhythmic microtimings take place?

Monson's (1995) response to Keil (1995b) specifically raises this concern. As she notes, "the ability to anticipate and participate is much more than a matter of just being ahead or behind the beat" (Monson, 1995:88). As Monson, Berliner and other ethnomusicologists

have shown, the clues to synchronous and satisfying musical performance might lie in factors such as

> the history of interaction between players, their cumulative musical knowledge of the repertory and transformative devices, their technical skill, their recognition of familiar passages and aesthetics in performance, and their ability to actively deploy sound to affect each other's musical behaviour.
>
> (Monson, 1995:88)

Furthermore, how does this interaction between players fit into a wider view of the role of musical events accorded by a particular culture, where participation and groove is a matter for instrumentalists, singers and musically-untrained audiences alike? For example, Stone's ethnographic account of the Kpelle music event suggests that participation in and entry to the 'inside' of an event is as much a social as a musical matter (Stone, 1982:67). Keil's emphasis on groove as swing timing in jazz does not in itself move the idea of embodiment of rhythm into an interactive social context, but keeps it in the domain of the virtuosic performer.

Zbikowski also travels far from the social interaction perspective of music-making; his model for groove is dependent on the idea that musical knowledge must involve a cerebral and abstract "network of information" (Zbikowski, 2004:273), and that it is through the conceptualisation of body knowledge into abstract mental models that musicians and audiences recognise, create or participate in a groove. His conceptual models focus on internal cognitive structures, leading to the conclusion that music is a "para-linguistic medium" (Zbikowski, 2004:295) - but not a para-gestural medium, which might have been supposed from such an apparent emphasis on embodiment of musical expression. Although Zbikowski begins by offering a human body-based, social interaction approach to the study of musical activity, the structural, information-based model of communication - his implicit beholding of the para-linguistic nature of music - prevents him from exploring further subtleties of human interaction in time.

Meanwhile, ethnomusicological research that has used video analysis to observe the action-in-time aspect of musical behaviour has spanned thoughtful, descriptive accounts of individuals' behaviour and their relation to one another (Davidson, 2004; 2006), to consideration of generative cognitive processes for the individuals (Clayton, in press; Stobart & Cross, 2000). This broad view of existing musicological literature has demonstrated that the body of research regarding musical communication is currently

weakest where the observation of musical interaction as social, interpersonal behaviour is concerned, suggesting a need to approach the study of musical interaction at the level at which it occurs in time.

In order to develop the thesis that musical communication may be achieved by the actions of individuals during jointly-established social contexts, the next chapter reviews literature that examines non-musical human communicative process, exploring the case for - and obstacles to - a pragmatic research approach.

2 INTERACTION II: SOCIAL COMMUNICATION STUDIES

2.1 Interaction studies in general communication research

The previous chapter indicated that musical communication studies could benefit from a pragmatic research approach, and saw that underlying trends in academia have affected the state of this type of music research. This chapter examines how certain features of wider intellectual agendas of the twentieth century and their associated new technologies may be related to the specific case of music research. Particularly, the chapter considers the effects of early cognitive approaches and structural linguistics research on the consequent development of research methodologies.

Social interaction research has traditionally been the domain of the social sciences, whose broad disciplinary foundations were set in the early twentieth century. While the study of social phenomena has attracted the attention of scholars since antiquity, the emergence of an alternative research agenda was primed at this time. In recognition that social, people-oriented research required terms and methods that were outside the ambit of the natural, physical sciences, the prevailing positivist attitudes to knowledge acquisition suggested a novel *social science* interpretation of social action. A driving force of the social sciences is the concern to account for the effect of social context on individuals' own behaviour. In the early twentieth century, the pioneering psychoanalytic methods of Freud promised a systematic process of evaluating an individual's mind and consciousness. For this method, the prime source of material was self-report by a participant's own use of language. This subjective approach appeared to lack the objectivity required of scientific enquiry to those motivated by the strengths of an empirical model of scholarship, and a trend towards behaviourism ensued during the 1920s.

Developing behavioural research paradigms served to expand the social science toolkit, as did participant observer methods and field recording techniques developed for anthropological study. As described in Chapter One, early linguistics research influenced the methods of analysis, contributing to an interpretation of social action in context through the study of features of language use. The early pragmatists, including C S Peirce, James, Dewey and Malinowski, placed emphasis on the performative aspects of language and on speech and treated language as inseparable from context, drawing attention primarily to action in order to contribute to an overarching concern -- the relationship of transcendent knowledge to social life. The inclusive scope of this vein of

pragmatics considered language and communication at the level of interpersonal interaction. For example, Malinowski's view of language use's function gave rise to his description of 'phatic communion' (Malinowski, 1974); a term accounting for the type of conventional greeting exchanges used to maintain good relations between individuals, serving primarily social interaction purposes. After Malinowski, Peirce proposed that language is in part made up from its use in a given context (Hoopes, 1991); the resulting body of research was highly compatible with the earliest concept of linguistics as associated with Edward Sapir (1977), who also placed emphasis on the importance of context in acts of communication.

Given the early pragmatic origins of the social science's interest in linguistics, it seems surprising that there have been frequent criticisms of the lack of social context in social interaction studies. In 1978, the cognitive anthropologists McDermott and Roth reviewed social interaction literature and described the "inadequacy of a traditional division between micro and macro studies of social order", stating that they wished to "make a claim to the centrality of interactional approaches in the social sciences" (McDermott & Roth, 1978:322). A similar deficiency was pointed out by social and animal interaction psychologist, Hinde, who suggested that the majority of social psychology texts neglected social, or dyadic-level, interaction by leaping from "aspects of the social behaviour of individuals (attributes, attraction, social influence etc) to aspects of group structure and dynamics" (1982:220). While, in a special edition of American Anthropologist in 1964, the anthropologists Hymes and Gumpertz set out a case for the reintegration of context into the study of language (Hymes & Gumpertz, 1964), linguistic anthropologists Goodwin and Duranti felt the need to reiterate their rallying call nearly thirty years later (Goodwin & Duranti, 1992).

The neglect of context in linguistic anthropology parallels the lacuna in musicological studies identified in Chapter One. There it was observed that a lack of research tackling musical interaction at a behaviour-in-time level led to a bifurcated scholarship that can address only an individualistic perspective, or social level approach ("micro" or "macro" in the terms of McDermott & Roth, 1978). Research reviewed in Chapter One included the work of scholars who have sought to study elements of the non-verbal communication required in ensemble performance and rehearsal (Ashley et al., 2002; Davidson, 2004; Luck, 2002; Williamon & Davidson, 2002), but it was suggested that the degree to which these studies could examine the pragmatic mechanisms of musical communication within social interaction was limited by a focus on score-based music, carrying with it the weight

of a propositional perception of musical organisation. The studies also tended to take a descriptive level of analysis and typically focused on accounts of individuals' movements. This approach suggests a simple sender and receiver transmission model of communication, and may give less insight to the dynamic and interactive elements of music as performance. The linguistic and propositional orientation of much communication research seems to be an obstacle to non-musical dyadic interaction research, and may have contributed to the lack of methodological frameworks for tackling music as a dramatic and emergent performed event, as highlighted in Chapter One.

The tendency to focus on language structure as the primary organisational factor in communication processes might also have contributed to the second obstacle in interpersonal interaction research, which is the disjointed nature of research on movement studies. Historically, research on the semantics of dynamic, physical, embodied motion constitutes a fragmented field, and this has weakened the fundamental claim of any such study - namely, that matters of human movement require interpretation through a different framework to those concerned with the abstract and propositional properties of linguistic meaning (Daly, 1988). The two, interrelated areas presented as obstacles to interaction research are discussed below.

2.2   Linguistic orientation of interaction research

Language research has particular authority in the study of human consciousness. Human language has the apparent capacity to reveal processes in thought, and to explore the source of human beliefs and ideals. While a social, pragmatic agenda for communication studies has many champions and has yielded a fascinating body of research over the past century, it appears not to be seen to hold the same value for scholarship as an agenda that addresses the internal and individual aspects of human language. The twentieth-century interest in *structure* - of society, of behaviour, and of language - drew attention to interrelationships among aspects of cultural activity. Sociologist, Kress, has suggested that in the use made of linguistic analysis of the systematic interrelationships among 'things' (aspects of cultural activity) as a source of meaning *about* those things, the linguistically-defined, structural interrelationships themselves could come to be seen as the sole source of abstract meaning and codes (Kress, 2001:31).

The implications of such structural concerns shaped the development of such concepts as Malinowski's notions of listener role, the conveying of emotion, and phatic functions of language use. The concepts of indexicality and referentiality of language developed by

Peirce were continued in structural linguistic approaches that placed emphasis on the contextual issues surrounding the production of linguistic meaning (Hoopes, 1991). But the general intellectual preoccupation of the time was with structure - reliability of structure and generative capacities of structure - and these elements of meaning construction could most obviously be explored through the atomisation and transcription of spoken language. This process of analysis began to lift 'meaning' away from context.

Semiotics, the study of signs and symbols and their interpretation, is associated with the linguistics of Ferdinand de Saussure. Saussure's linguistics took as its departure point the idea that language could be perceived as one example of the cognitive process of signification that was assumed to underpin human communication and meaning construction (Bally, Sechehaye, & Reidlinger, 1974). After Saussure, the study of linguistics seemed to offer the means to explore the external and abstract qualities of spoken language. Saussure invited his students to "consider an isolated individual living for several centuries", commenting that "we probably would notice no change; time would not influence language" (Bally et al., 1974:78). At the basis of this approach lies the notion that the structure of an objectified instance of language use in time may be vital to the study of communication (Kress, 2001).

The concern with abstract, timeless instances of language use suited the emergence of structural linguistics in the 1950s and 1960s, which proceeded by breaking language down into the smallest meaningful units of sound (phonemes) and the smallest units of grammatical function (morphemes) to seek out the underlying systems governing individual utterances. Language in real, everyday use, in this view, could be perceived as a "kind of distortion of the real structure, which lay beyond or behind it" (Kress, 2001:32). 'Meaning' in communication could become increasingly abstracted from pragmatic context.

The epistemological technology of this particular intellectual trend may have been less potent had it not been for an elision with the development of dramatic new research tools, in the form of computational modelling technologies. Chomsky's (1957; 1968) theory of human innate grammar competencies, Universal Grammar, secured linguistics a particular status in academia as the natural science of communication. The concept of transformational-generative grammar lent itself perfectly to the possibilities of computational modelling of artificial intelligence, an extremely powerful device that yielded a new domain of research into human cognition. At its mid-twentieth-century

conception, cognitive science promised to explain observed phenomena by accounting for the function and internal structure of hypothetical cognitive information processing systems (Heijden, 1998:122).

This early agenda was unambiguously influenced by the prevailing philosophical premise of a human capacity for disembodied, abstract reasoning. According to Lakoff and Johnson (1999), the consonance of Universal Grammar and the early cognitive science agenda is not surprising, since both are conceived within an Anglo-American rationalist, Cartesian philosophy which sees language as an autonomous, independent entity that exists somehow externally to the embodied human brain (Lakoff & Johnson, 1999:475). Both rely on a premise of analytic philosophy, which equates 'thought' with 'language' (Lakoff & Johnson, 1999:250). The perceived equivalence of mind with computer, and thought as language, has further confused the issue of language function and language structure. Contemporary cognitive linguists are now unravelling this problem and reasserting the need for both semantics and pragmatics in the study of linguistic meaning, refuting cognitive linguistic approaches that use the 'abstract truth of language system' as the verification for an external, core truth (Evans, 2003:54-5).

However, a consequence of such intellectual shifts is that pragmatic studies of language in context, and structural linguistics' dependence on analysis of the written word, exist as distinct and rather incompatible fields of scholarship. While the pragmatic approach seeks a sociologically-minded view, the structural linguistics approach is highly individualistic, dependent on the notion of a single mind's capacity for reason through recourse to abstract symbol manipulation. 'Language' is associated with 'language structure' -- a view that such contemporary pragmatists as Clark (1996) now rally against, and which bears analogy to the association in musicological literature between 'music' with both musical *work* and musical *score*.

Apart from the computational linguistic stream of communication research, social science and its attendant methodologies were providing alternative means to analyse the semantic content of social interaction, pursuing aspects of the pragmatic tradition. *Ethnomethodology* (or *sociolinguistics*), as practiced by Garfinkel (1967), emphasised the use of language to 'do', focusing on the creation of social order. This decision to examine the "characteristics of the reasoning and the rationales which, at whatever level of conscious orientation, enter into choices among courses of action" made a highly significant contribution to observation of language use in communication studies

(Heritage, 1987:265). A further contribution of Garfinkel's observations and insights on people's use of talk to make sense of everyday actions included the continuing development of qualitative research methods, such as participant-observation, and the use of "quasi-experimental" (Heritage, 2001:50) settings by which Garfinkel succeeded in joining "empirical findings about the organisation of action and interaction to other characteristics of social actors and the settings they act in" (Heritage, 2001:54). While certain aspects of Garfinkel's ethnomethodological studies might originally have been considered controversial, the notion that everyday talk contributes to meaning construction of something that might be described as social reality has been fully accepted as a tenet of sociological study.

Other contemporaneous developments in ethnomethodology include Conversation Analysis. This field developed from the work of sociologists Sacks and Schegloff, for whom recordings of instances of talk in social interaction are the very subject of their study. Sacks and Schegloff segmented individuals' speech acts with a view to gleaning knowledge of the structure of talk and, particularly, how this related to social relationships (Atkinson & Heritage, 1984:1). Conversation Analysis has produced many key observations of acts of human interaction which take place in everyday speech. As a pragmatic approach, its concern lies with the ways in which people organize their social interactions and an aim to "describ[e] the procedures by which conversationalists produce their own behaviour and understand and deal with the behaviour of others" (Atkinson & Heritage, 1984:1). With this agenda, the field has contributed a valuable vocabulary with which acts of meaning construction and management in conversation can be explored. Concepts such as *topic* of conversation, *turn-taking* acts by which the participants manage the interaction, and the notion of *repair* as the means by which individuals resolve ambiguities or errors during the act of conversation, all contributed to the methodology of subsequent pragmatic studies of communication.

Discourse Analysis, in part a consequence of the modern and post-modern deconstruction of truth and knowledge whose earliest repercussions might be seen in ethnomethodology, constitutes a broad field of communication studies that might now be considered to include Conversation Analysis (Wetherell, Taylor, & Yates, 2001). The notion of discourse here offers a way to describe systems of communication that include both language structure and the practice of talk. Through a methodological drive to reconcile empirical investigation with a qualitative, hermeneutic approach, discourse analysis developed as a rule-based analysis that could integrate both talk and text. For example,

Goodwin states his intention to examine the domains of both actual, performed speech and the abstract units of structural linguistics. Using the term *utterance* for speech stream, and defining 'sentence', 'phrase' and 'clause' with reference to "abstract entities capable of describing distributional relationships within and between utterances" (Goodwin, 1981:7), Goodwin's contribution usefully clarifies distinctions between language structure and language use.

Conversation Analysis and Discourse Analysis both examine verbally-produced speech. While Conversation Analysis uses a methodology that segments individuals' speech acts according to aspects of the talk's function, Discourse Analysis assigns boundaries to elements of speech in accordance with hypothetical sentences. The topic of human communication common to both is tackled through analysis of language *use* rather than language as a system. However, in both approaches the mode of analysis could be seen to be based on a language-structure-first epistemology of communication. Discourse Analysis can tackle issues like responsiveness in interaction only by apprehending static instances of transcribed material. For example, the sequential interpretation of linguistic and paralinguistic ("um", "ah") events in transcription allows the analysis to tackle whether or not a feature of conversation (or topic, or affective or emotive signal) is responded to within that conversation. But the quality of responsiveness demands a dynamic measure that accounts for the timing of the reaction at a fine-grained level. Responsiveness in interaction is also a property of other-directed, relational body movement that cannot be fully accounted for in a transcript of speech acts.

2.3   Human communicative movement research

In the shadow of the vibrant new field of cognitive science, the strong behaviourism approach to understanding social interaction may have become less popular. But many scholars pursed the observation of real-life behaviour in their study of communication, although here, too, the focus was consistent with a structuralist viewpoint. The anthropologist, Ray Birdwhistell's study of body movement for communication made a contribution firmly entrenched in structuralist ideals, seeking repeatable and predictable patterns in the data of coded observations of facial expression and gesture. Birdwhistell claimed that "no motion is a thing in itself. It is always part of a pattern. There is no 'meaningless' motor activity" (1952:10). His study of body movement - *Kinesics* - begins from the assumption that the verbal modality is not dominant in interpersonal communication. Birdwhistell's sought a taxonomy of movement and gesture in a vast

corpus of data, including film recordings and still images of both experimental settings and field observations. He was wary of ethnocentric assumption, suggesting that n "ethnocentric definition of 'natural' may provide burial grounds for…revealing research" (Birdwhistell, 1952:7)

This perspective can be compared to that shown in the work of anthropologist, Pike (whose use of linguistics terminology to form the distinction between *etic* and *emic* perspectives was introduced in Chapter One). Pike's observations of the co-ordination of social events by the movement and actions of bodies were based on specific examples of culturally-recognised events, such as sports games or a church service, which he used to examine the structure underpinning human communicative behaviour. His work is derived from Sapir's stance on the structural equivalence of the function of verbal and non-verbal modes of communication. Pike's unifying theory of the two systems of human communication and social organisation of event is expounded in *Language in Relation to a Unified Theory of the Structure of Human Behaviour* (1967). Pike grounds his theory in a pragmatic philosophy of science, where theory is taken as the tool with which one might probe the phenomenon, granting "that in the universe some structures occur other than in the mind of the analyst" (1967:38).

Pike (1967) describes how social interactions can be seen to be organised on multiple levels by viewing whole events and lower-level parts, which he describes as *segments*. The boundaries of these units of the event, according to Pike, can be allocated according to the mid-point of peaks of physical activity. Markers such as the passing of a plate during a church service's collection, or the act of a choir rising to sing a hymn, are seen to indicate the boundaries of the segments which make the whole church service a whole 'event'. Though placing all emphasis on human behaviour and the observable nature of it, Pike does not adopt a strong behaviourist view. Defending a hermeneutic position with methodology derived from an explicit distinction and subsequent reintegration of *etic* and *emic* viewpoints, Pike supports the value of speculation regarding the inner states and intentions of the individuals in his research - a contentious issue to which this chapter returns in section 2.8.

Subsequent research which took specific chunks of observed human interaction as its data source, collectively described as Context Analysis by Kendon (1981b), sought out instances of dyadic and small-group communication and made use of film recording technology. The field of Context Analysis includes the work of such scholars as Irving

Goffman, Kenneth Pike and Adam Kendon, and is distinguished by its focus on the study of interaction for itself, as opposed to a greater sociological or linguistic agenda. With its emphasis on the cross-modality of human interaction, Context Analysis can be seen as a derivation of Sapir's emphasis that all modes of communication could have equal importance in an interaction event.

Goffman's study of social interaction established certain concepts regarding the management of the interaction by participants. In *The Presentation of Self in Everyday Life* (1959), Goffman is widely considered to have made a key contribution to the sociological research paradigm of symbolic interactionism. In opposition to the prevailing strong, rationalist sociology, this movement located meaning and motivation in individuals' action at a pragmatic, microsocial level. The concepts of *frame* and *footing*, developed in subsequent works (Goffman, 1974; 2000), have become essential descriptive and analytic terms for the study of interaction, offering theoretical foundations that permit consideration of the subjective interpretations of participants. With use of the term, frame, the sociologist is able to invoke the motivation of an individual who assesses "what the situation ought to be for them" so that they might "then act accordingly" (Goffman, 1974:2-3). The concept of framing thus describes the "principles of organization which govern events--at least social ones--and our subjective involvement in them" (Goffman, 1974:10-1). Goffman's definition of footing acknowledges the complex, shifting nature of individuals' roles within social interaction, thus defying a view of communication which invokes simple speaker and hearer distinctions.

Such examples of Goffman's insights can be seen as Kendon's point of departure, providing elements for a methodology that allows the interactional frame to be examined as a system for focused interaction. Through minute observations of the types of non-verbal behaviour that guide our communicative actions, such work by Kendon as his "Kissing round" analysis (Kendon, 1981a) has explored the way in which people use their bodies' orientation in a functional manner, known in Context Analysis as *F-formation*, to maintain and develop relationships in communication (Kendon, 1990). Kendon's study of movement coordination in social interaction is significant in its capacity to foreground the embodied nature of language use. By examining mediation of interpersonal meaning through interaction space, Kendon accesses the topic of physical human bodies that exist in time and space, as his description of focused interaction takes into account a system of skeletons, muscles, gravity and environment in its ecological approach.

2.4   Information Theory and non-verbal communication research

Kendon has noted that particular advances in contemporaneous fields of research strongly influenced Context Analysis (Kendon, 1990:28). Alongside the influence of linguistics, and an anthropological approach that examined communication in context for the benefit of ecological validity, new technologies were emerging from the Information Theory science of communication (Kendon, 1990:25). Information Theory was developed by research at Bell's Telephone Laboratories during the 1940s and 1950s, in order to model mathematically aspects of the system of signalling on which new possibilities for telecommunications technology could be based. Communication could thus be analysed by the quantity of information that could be transferred through the process. The theory attracted attention by scholars who saw the system as applicable to any system of transaction, as it proposes that a communication system can be assessed by its potential to predict a signal. For example, if there are only two possible signals that a system can give, the accuracy of the prediction must be higher than if there were ten possible signals. The quantity of information in the signal is therefore seen as inversely proportional to the number of different signals that might be sent (Kendon, 1990:25).

The central components of the Information Theory model include *producers*, *codes* and *receivers*. Instances of normal human interaction could be modelled through the concept of information-exchange, but such models assume a degree of turn-taking, sequential flow in meaning production and reception that does not necessarily fit well with the event of real-time, social interaction. This view particularly supports the notion of communication as a process which involves acts of linguistic transmission, and is compatible with a language-structure focus of communication. However, it was also adopted for the study of other aspects of communication. In applying the communication engineer's perspective to non-verbal human communication, MacKay (1972) sought to distinguish acts of signalling and those of communication. Describing the artificial intelligence paradigm of this period, MacKay suggests that

> "We look upon the recipient as a system with a certain repertoire of possible modes of action, both internal and external, which must have some central 'organising system' to set targets for, and control, the running selection from the repertoire which we call its behaviour."
>
> (MacKay, 1972:5),

demonstrating the influence of computational methodologies on the interpretation of communication systems. Kendon has suggested that the key development in Information Theory that was essential to the Context Analysts' study of the topic of human interaction was the notion of the *feedback loop* (Kendon, 1990:27), devised by information theorist, Norbert Weiner (Weiner, 1965 (1948)). This provided a computational model of reflexive meaning construction: while purely linear accounts of speaker-listener communication could model the transmission of information, the feedback loop allowed the development of *transaction* models, which represented something more of the complexity of real-time occurrences of social interaction.

By use of logical flow diagrams to distinguish goal-directed from non-goal-directed acts of signalling, MacKay intended to offer direction for research in the field of non-verbal communication studies. He suggests that only those signals which take place as goal-directed action should be examined as truly communicative behaviour. This definition of communication, given in MacKay's 1972 report, is an often-cited reference for subsequent non-verbal communication research (cf. Losely, 1978; Slater, 1983). It captures both the excitement of the time regarding new technologies available through computational modelling, and also demonstrates how the cognitive science paradigm of the mind as a computational black box gave rise to a serious problem in how to assess the intention of communicative behaviour.

2.5   Non-verbal communication studies as microsociology

By this stage of communication research in the 1970s, the ethological aspect of such earlier work as that by Birdwhistell (1952) continued to influence the field. To many researchers the strength of new information technologies suggested not a diversion from the sociological agenda of social interaction research but an extension of the ethnomethodologically-grounded Context Analysis of such scholars as Kendon, Goffman and Michael Argyle. On emphasising the contribution of sociological and social psychology approaches to the topic, Argyle suggested that "there is no reason why [structural analysis of non-verbal communication] should not be able to accommodate meanings of a universal biological origin" (1972:266).

Observation at this highly individual level of physiologically-grounded process was developed by those scholars who saw continuity between the biological origin of non-verbal communication (NVC) and the outcomes of human communication. In particular, the focus on structural aspects of communication led to a domain of research on

interactional synchrony. This field sought out a hierarchical structure by which NVC signals might be organised to converge with the verbal modality (Condon, 1975; 1985; 1974; Newtson, Enquist, & Bois, 1977; Newtson, Hairfield, Bloomingdale, & Cutino, 1987). Studies on interactional synchrony have become the bedrock for valuable and revealing studies of interpersonal communication, and their continuing contribution is explored in the subsequent section of this chapter (see section 2.6).

However, it is important to note that such dyadic interaction-level approaches to communication were not universally welcomed by all scholars of social action, since the microanalysis of communication systems was not seen to tackle sociology's mainstream themes of people relations and power (Attewell, 1974). The de-centring of the pragmatic side of communication studies, demonstrated in the introduction to this chapter, now comes to light -- the emerging individualistic, case-by-case approach to communication studies was not methodologically consistent with the concerns of those who discuss the consequences of such social communicative action:

> There seems to me to be no use in throwing out all the sociologically relevant levels of data in the vain hope of finding the "basic" properties structuring experience at some other level. What results is a psychology devoid of any sociological relevance.
> (Attewell, 1974:209).

But in calling for less distinction between "micro" and "macro" approaches, such scholars as McDermott and Roth (1978) challenged the view that there could be no convergence between biological and sociological perspectives on the topic. They proposed that study at the level of the communicative behaviour between individuals was an aspect of the study of relations between groups of people on a larger scale.

Various microanalytical approaches of the 1970s were setting forth terms on which pertinent issues of interpersonal interaction could be tackled, and asking questions of the intentionality and volition which motivate individuals' communicative action. For example, studies of eye contact and mutual gaze revealed the relationship between looking patterns and attention on the dynamics of a spoken conversation (Argyle, 1976; Exline & Winters, 1965), and such research into interactional synchrony as by Condon and Newtson, has led to a larger body of research on interactional rhythms in dyadic communication. By the second half of the previous century, research on communication

included an array of specialisms which all sought to explore, in some way, pragmatic questions of function and the operation of non-verbal communication mechanisms.

Primary assumptions of the function of NVC were summarised by Argyle (1972), and included three main themes: a) that non-verbal signals are used to manage social situations, with intentionality that animal signals do not include; b) that non-verbal signals are used to sustain verbal communication and "probably have a complex temporal structure" which permits close co-ordination with speech; c) that non-verbal signals replace verbal communication "when language is inconvenient" (Argyle, 1972:264). Reflecting back to the topic of musical interaction, it is clear that in the case of musical communication, the matter of interactional synchrony and interaction within a temporal flow (such as that defined by a musical pulse) may be key to any understanding of a communicative framework. Chapter One observed the most successful cases of musical interaction studies and noted the importance of the groove studies and their attention to co-constructed interpersonal behaviour in time.

At this point in social interaction research during the 1970s, Argyle flags important features of the function of movement in interaction, citing the "complex temporal aspects of interaction". However, a second feature of Argyle's definition is the dependence on the language-structure-first perspective that it suggests. This was primed by the influence of the early cognitive approach and of computational linguistics; while the integration of NVC and speech is not in doubt, the function of NVC is defined by its supporting relationship, as signals which supplement the primary purpose of referential language through speech. But this perspective is supplemented by Argyle's prior observation that the reverse can be true: that NVC can also impart specific information, and that verbal communication can serve to manage and sustain interpersonal relationships (Argyle, 1972:253), as in Malinoswki's example of phatic communion.

The unresolved view of the function of NVC is evident here in the very description of communicative movement as something identified with reference to its non-verbal nature. The diffuse and sidelined nature of communicative movement research can be traced along branches of study that were established during throughout the 1970s and 1980s. These include the specific fields of manual gesture and facial expression.

The study of gesture has, during recent decades, become a thriving area of research[1]. While the description of gesture could, in general, include all patterned movement for non-verbal communication, the field is dominated by the manual movements associated with language production, particularly speech, and also by the categorisation of gestural acts (Rimé & Schiatura, 1991). As reported in Kendon (2004), the study of such human communicative gesture and its associated taxonomy is not a recent endeavour. In 1785, Engel proposed a set of categories for actors' bodily expression, including the category of physiological actions which included "'involuntary phenomena, physical effects of the internal movements of the soul'", then in 1802, Austin developed these categories and added the class of "gesture involved in structuring or punctuating verbal discourse" (Kendon, 2004:89). The methodological requirement to parse, catalogue and describe acts of gesture in order to consider the organisational effect of such behaviour in communication has, naturally, preoccupied the field. After Birdwhistell, such scholars as Kendon (1990; 2004; 1981b), Tuite (1993), McNeill (1992; 2000; 1993) and Feyereisen (1991) have contributed to a coherent body of research which provides evidence to support the integral nature of manual gesture and non-verbal communication to human communication in general.

A key publication by Watzlawick, Bavelas and Jackson (1967) examined the role of gesture as something which fulfils an imagistic, *analogic* aspect of communication alongside the *digital* (representational) component of speech. Such research has made a considerable impact in the rebalancing of the verbal language weighting of communication studies as a whole, although the value of the analogue and digital distinctions has now been questioned by Kendon, for the way in which it set all studies of expressive communicative action and vocal communication into isolated tracks (see Kendon, 2004:355-61). For example, the *lexical retrieval* function of manual gesture during interpersonal communication has commanded a great deal of research effort and journal column inches. While the hypothesis that manual gestures assist with recovery in memory of specific words for the act of speaking (Alibali, Kita, & Young, 2000) has been substantially refuted (Bates & Dick, 2002; Beattie & Coughlan, 1999), the field of gesture studies has been dominated by its association with aspects of language production in a way which assumes its function to be a secondary, supporting role.

---

[1] For example, the publication of the journal, *Gesture*, and biennial meetings of the International Society for Gesture Studies; also *The Journal of Nonverbal Behaviour.*

Apart from gesture studies, NVC research might also be seen to include literature on facial expression, which is directly tied to research into the communication of emotion. As such, it supports a strand of enquiry in communication research that is distinct from the type of semiotic linguistic analysis derived from Information Theory-influenced techniques, and more congruent with microanalysis techniques that have incorporated a biological evolution approach to explore evidence for universality of NVC signals in various emotional states (cf. Eibl-Eibesfeldt, 1972). Since the 1950s, psychologists have debated the role of faces in the expression and experience of human emotions. An accepted tenet of modern psychology sees the face as a tool in the communication and experience of emotion, superseding the Darwinian concept that assumed facial expression to project outwardly a mirror of internal state. With the construct of emotion as *motivational amplifier*, Tomkins proposed that sensory feedback from the perception of changes in our own face when we experience an emotion like happiness in turn amplifies our sensation of happiness (Tomkins, 1980). A further significant contribution to emotion studies over the past decades has been the research of Ekman and Friesen, whose cross-cultural empirical studies suggest evidence for a "pan-cultural element in emotional facial behaviour" (Ekman & Friesen, 1998:71), although Ekman's research has been criticised for implicit ethnocentricism, with claims that the presentation of universal terms regarding emotion are given "through the prism of [his] own language and culture" (Wierzbicka, 1999:175).

Emotion research has a complicated relationship to communication studies due to its de-centred role in early cognitive science paradigms. Musicologist Nils Wallin refers to this effect with regard to its consequence in music research when he asks,

> Have [the emotions inherent in music] any intersocial existence and constancy? The difficulties and hesitations probably depend to a large degree on the deeply rooted Western positivistic repugnance against emotions as a legal part of our psychobiological heritage, and thus as objects for 'real' scientific research. The reason should, in other words, be our blind faith in what we quite unbiologically assume would be 'pure rational' thinking without any emotional colouring.
>
> (Wallin, 1991a:234-5)

This incongruity relates to the problem of a certain loss of context in both gesture studies and aspects of NVC associated with the expression of emotion, such as facial expression studies. The continued emphasis on language as the principal form of communication means that the search for underlying, repeatable and predictable rules which show

structure and can therefore be modelled has required a focus on abstract syntax. Such grammars are sought in communication which is, in a sense, disembodied. This linguacentricism forms a link between gesture studies and facial expression and emotion research, which must both then deal with static interpretations of emotion and meaning in abstract mental processes. Thus, the hierarchy of body movement and timing in gesture and facial expression that exist with every utterance is susceptible to an analysis that seeks out syntax in the computational linguistics sense. Given the free and improvisatory nature of human interaction, the emphasis on syntactical structure may not be the most appropriate means of approaching such communicative mechanisms.

2.6   Embodied cognition, interaction and entrainment

It has been stated that the initial philosophical premise for cognitive science's research agenda was based on the notion of the human mind as a computational black box, primarily operating with recourse to an abstract symbol manipulation paradigm (Heijden, 1998; Newell, Rosenbloom, & Laird, 1989). However, certain findings from the field soon undermined this concept. For example, Rosch's (1973) work on perceptually-salient natural categories that inform colour discrimination established a continuing body of research on prototype theory (Lakoff, 1987). Such research suggests that physical attributes of our neurophysiological system account for the categorical perception of colour, and that the system is based on interaction between our perceptual system and the environment. Therefore, colour appears to have no reified existence but is an experiential product of our embodied perception of the environment.

A further important finding relates to the apparent cognitive function of concepts regarding spatial relationships, such as language that might refer to emotional 'distance', or a 'close' call between competitors, for example. Such concepts appear to be based on image schemas which might ultimately arise from the structure of visual and motor systems. It appears that what individuals know of the organization of space "serves as a 'cognitive interface' between abstract or non-perceptual knowledge and the 'real world'" (Freksa, 1991:362). This has led to a rethinking of philosophy whose basis lies in an implicit Cartesian duality of mind and body, since reasoning capabilities might ultimately arise from the sensory-motor system of the brain and body, and not from a disembodied form of abstract reasoning (Johnson, 2005; Lakoff & Johnson, 1999).

Such findings call into use the term *embodiment* to provide an alternative philosophical premise, a term essential to the burgeoning field of cognitive linguistics (Rohrer, 2006).

The embodiment concept arising from cognitive psychology research provides a better fit for the study of musical performance than that of mind-as-processor. Janata and Grafton (2003), for example, show evidence that motor areas are involved for listening to music as well as performance, undermining analytical distinctions between audience and performer, and supporting the notion that the emphasis of this delineation in Western art forms might be atypical. Musical performance is typically co-constructed by more than one individual, but the individualistic theories of music perception and language cognition dominant in the fields of musicology, predicated on mind-as-processor models, are not consonant with either evolutionary accounts of human musical capacities or ethnomusicological enquiry, which focus on the social nature and value of musical behaviour. While there may be repeatable and predictable elements of human communication when it is modelled as individual-centred information exchange systems, research based on such a computational linguistic paradigm does not highlight the relationship of such behaviour to matters of interpersonal awareness.

Where behaviour is proposed as something that is socially meaningful, a question arises regarding the mental representation and interpretation of such meaning. Semiotic analytical approaches theorise about the representational process that could inform interpretations of musical meaning (Lidov, 1999). The insights drawn from such scholarship contribute hugely to the academic study of music; however, the approach is limited in the essentially abstract, out-of-time accounts that it can generate. As semiotic methods of analysis must begin from the assumption that information about a sender's motivational state is coded in signals, to be de-coded (or interpreted) through reception, this theoretical method largely relies on the "Mind as Computer metaphor" (Lakoff & Johnson, 1999:253) transmission model of communication.

Valuable theories on the motivation for human communicative behaviour have strayed from the information-processing line to avoid the propositional restrictions of early computational models of communication systems, and better account for the large numbers of variables acting in complex social and biological systems. The work of James Gibson significantly contributed to a turn away from symbol processing models of perception. Gibson's (1950) concept of ecological visual perception offers a model of goal-directed perception by which individuals detect opportunities for action by *affordances* in the environment that invite continuous intervention. This offers the view of a reciprocal relationship between individual and the environment, where information is

something that links the body and the environment, rather than something that must be constructed through cognitive processes (Bechtel & Zawidzki, 1998:758).[1]

The most valuable epistemological shift in cognitive science for this literature is the effect of this enactive, embodied view on matters of human perception, such that it can be interpreted as an integrated perception-action system (Leeuwen, 1998:265). Action-perception processes are now seen to underlie the co-ordination of fine-grain and broad motor behaviour of the sort that must be used to mediate musical action and interaction. The embodied cognition perspective helps to foreground the fact that any moment of musical performance has duration. This perspective offers an alternative take on the construction of musical meaning to that which proposes an origin in abstract, timeless symbolic form. Significantly, the importance of real-time, durational action-perception processes privilege the interactional, co-constructional nature of musical activity.

Musicians can play in a way which can, to the ears of the musicians and their audience, be considered as qualitatively 'in' or 'out' of time or tune. A key topic of music perception literature suggests that mechanisms of visual and auditory feedback, and those of proprioception (monitoring of the physical behaviour that must be acted out for sound production) supply the means for musicians to play together in time and in tune. However, these accounts appear to lose explanatory power when certain circumstances are considered. For example, many individuals with auditory or visual disabilities have demonstrated exceptional musicianship skills; studio-based musicians work to multi-track recordings; and in plenty of cases musicians play together out of sight of one another. These exceptions are, in fact, typical of musical interaction scenarios; in considering this social interaction context the problem can be addressed.

A musician who is participating in musical behaviour is engaging in a specific form of social interaction, and when musical interaction is considered as social action, it can be seen to call into use key human skills of interpersonal engagement. Musicians - as socially-primed individuals - receive a considerable amount of socially-relevant cues in an auditory signal. Furthermore, while the capacity to intervene interactively is constrained in audience-role listening, such an activity may not be qualitatively different to real-time, interactive performance. As a cultural, collaborative activity, music is socially meaningful in a manner that relates to its dependence on 'joint action' (Clark,

---

[1] For a recent application of Gibson's theory to music perception, see Clarke (2005b).

1996), and the emergent properties of musically communicative events are based on typical outcomes of interactive behaviour. When musical performance is examined as a form of social interaction, the physical behaviour of those bodies becomes important, and music as behaviour-in-time may be better explored by examining constraints of action-perception limits which inform the durational perceptual present than by analogy with linguistic grammars to seek propositional rules that may govern music's meaning construction.

In experience, the mutually-negotiated event of successful interaction is conducted by participants who are stably seated in what the pragmatist philosopher and psychologist, William James, referred to as the "saddleback" of the cognised present - the perceptual sense of *now*. James was refuting the implicit notion of a "knife-edge" moment in time which seems to hold for traditional musicological frameworks for the study of musical meaning (James, 1890:609), and which might be construed in each of Cook's "indefinitely extended series of traces" (Cook, 2001:179). Almost a century later, Ernst Pöppel (1978) discovered an organising principle for the structure of human behaviour in research which established a perceptual present of an approximately three second period, during which individuals appear to perceive relationships between events. Subsequent research by Pöppel (1989; 1999), Lemke (1999), Schleidt (1990; 1988; 1987) and Gerstner (1995; 1994) has further proposed that this unit of time acts as an organising principle for both perception and behaviour, tying closer the action-perception concept of behaviour.

Certain of the pragmatic approaches outlined earlier in this chapter are consonant with the functional action-perception view of behaviour, and are particularly valuable to the study of music as action-in-time. For example, Context Analysis research paradigms demonstrate that constructivist approaches to the study of social interaction might provide a solid base for the study of music as embodied, communicative behaviour. In particular, research that observes features of rhythm and synchrony as aspects of communicative process may provide powerful tools for the observation of communicative mechanisms in musical interaction. These offer a way to look beyond the internal-mind view of communication, and may provide insight to the way in which relationships are constructed and maintained by non-verbal communication in time.

2.7 Interaction through joint action and relationships

In 1985, Wylie claimed that, "Forty years ago such linguists as Pike […] stressed the learning of rhythm of language classes but the lesson did not sink in. We are prone to

forget that speech is essentially music and that rhythm is its basis." (1985:780). This statement highlights the importance of those studies that have focused on the "complex temporal aspects of interaction" noted by Argyle (1972:264).

As reviewed in the previous section of this chapter, the earliest attention to the rhythmic aspects of cross-modal interpersonal interaction, including research by Condon and Newtson (Condon, 1975; 1985; 1974; Newtson et al., 1977; 1987), used the microanalysis of filmed instances of interpersonal interaction to explore the synchrony of speech rhythms with body movement in action. From such film analysis, psychologists concerned with whole-body movement developed new concepts and terminology with which to describe communication processes that were clearly independent of a linguistic channel in order to explore such features as mimicry and synchrony that were observed in the postural dynamics of individuals in interaction. In a recent review of interpersonal interaction studies that have looked to the means of nonverbal communication used by individuals in their encounters with strangers, Baaren et al (2003) summarise that the "simplest and most fundamental social behavior is the tendency for people to nonconsiously mimic others" (Baaren, Chartrand, Maddux, Bouter, & Knippenberg, 2003:1095).

Contemporary research into the interactive process of mutual gaze revealed particular functions of social management by communicative behaviour. Such scholars as Argyle (1972; 1976) examined the case of eye gaze, with significant findings including the realisation that

> 1. Eye contact can stimulate social interaction; 2. Eye contact can establish a particular type of relationship; 3. Eye contact has a feedback function; 4. Finally, eye contact and eye movements have a regulatory function; interacting partners speak in a controlled and co-ordinated way. Only when pauses and interruptions are sensibly placed can there be a sensible flow in the conversation.
>
> (Fassnacht, 1982:141, citing Argyle, 1969)

Such interpersonal dynamics as mutual gaze and mimicry appear to engender the relationship quality of *rapport*, associated with the process by which unfamiliar individuals negotiate their interactions and build relationships. Rapport can only exist in interactions between individuals, demonstrating the emergence during interaction of "cohesiveness" through which the participants "become unified, through the expression of mutual attention to and involvement with one another" (Tickle-Degnen & Rosenthal,

1990:286). Based on an understanding of the vital role of body-movement in communication facilitated by such notions as rapport, researchers including Bernieri and Rosenthal developed methods of video analysis to observe and measure elements of interactional synchrony (Bernieri, Davis, Rosenthal, & Knee, 1994; Bernieri, Reznick, & Rosenthal, 1988; Harrigan & Rosenthal, 1986). The findings of such research increasingly supported the view that communication processes must be examined for their emergent and co-constructed properties, and prompted a branch of literature that examines how the concept of self might be construed in relation to others (Baaren et al., 2003).

These embodied interaction studies reflect an increasing awareness of the need to address the complex durational aspects of interaction. In the specific attention that these studies paid to the movement processes used in real-time interaction, an important distinction became clear between aspects of mutual influence, such as "static" mimicry of body postures, and of mutual adaptation at a "dynamic" level (Cappella, 1996). Bernieri, Reznick and Rosenthal describe the

> apparent unification of two behavioural elements into a meaningfully described, whole, synchronous event […] The essential feature is that when the elements are put together, they create a 'whole' or 'perceptual unit' […] Synchrony, therefore, is operationalized here […] as the extent of gestalt-like harmoniousness or *meshing* [italics added] of interpersonal behaviour.
>
> (Bernieri et al., 1988:244)

The particular aspect of communicative movement that Bernieri et al describe variously as "behavioural meshing" (after Hinde, 1979), "unification", "come[ing] together" (Bernieri & Rosenthal, 1991:413), and also referred to by Cappella as "communication style meshing" (Cappella, 1984), all describe the dynamic, coordinative aspects of interaction (Tickle-Degnen & Rosenthal, 1990:289). The term *entrainment* is also used here to describe "the process whereby our body is 'captured' (i.e. modified in periodicity and phase) by an external cycle with a rhythm near to the one the body would have had, had it not been affected by any external force" (Bernieri & Rosenthal, 1991:410).

The extension of Context Analysis into the co-regulation communication studies outlined here offers a bridge between social and musical interaction, and certain scholars of ethnomusicology and music cognition have begun to examine this topic. That the musical event even occurs is validation that, to a certain degree, participants share an

intention to behave in an other-related manner, and it also seems likely that musical interaction involves aspects of co-regulatory social interaction common to any other communicative event. Groove studies, examined in the previous chapter, have certainly considered this topic, and recent adoption of the entrainment concept in cognitive music psychology and ethnomusicology has provided a way to consider the application of embodied, enactive cognition in music research next to the concept of co-regulation.

Clayton, Sager and Will (2004) review literature on rhythm perception and interaction in musical performance to explore the potential application of the concept of entrainment, offering the definition that "entrainment describes a process whereby two rhythmic processes interact with each other in such a way that they adjust towards and eventually 'lock in' to a common phase and/or periodicity" (Clayton et al., 2004:2). Clayton et al. develop the definition with reference to two different parameters: self-entrainment, describing the event of two or more of the body's oscillatory systems (for example, respiration and heart rhythm patterns) becoming synchronised (2004:7); and interpersonal synchrony (2004:6). Early experimental studies, such as Clayton (in press) appear to confirm that methodical observation of music as a process of communicative behaviour might reveal visible manifestations of entrainment. The construction and maintenance of musical time structure through entrainment mechanisms may serve as common ground for joint action in musical events; in order to consider musically communicative acts as, primarily, intention-sharing events, a fundamentally action-first rather than language-first approach to human communication is required.

2.8   Intersubjectivity research

Much of the action-first, embodied perspective has been progressed in developmental psychology literature, where the rich and interactive nature of preverbal stages of communication is most fully appreciated. For example, Bernieri and Rosenthal (1991) cite early studies by Cappella on infant-carer vocal timing- and duration-matching (Cappella & Green, 1982:121), and Tronick, Als, Adamson, Wise and Brazelton (1978), whose studies demonstrated intensifying actions of infants apparently attempting to communicate with non-responsive adults. Given the early integration of music elements such as prosody and rhythm in mechanisms of infant-carer communication, it seems plausible that study of the preverbal stages of development could also reveal links between adult social interaction and culturally-mature musical interaction. With this perspective, there may be some explanation of the *aboutness* of music; this is not

linguistic and is not specfically referential, and yet something imbues music with an expressiveness that "articulates forms which language cannot set forth" (Langer, 1942:233).

While a considerable amount of research on communicative development focuses on spoken language acquisition (see Locke, 1993), the rise in embodied theories of cognition has brought into question the motives that may underlie the particular interest in development through words and spoken language. Drawing attention to the lasting effects of a structural linguistic claim for language as "an autonomous faculty of mind, independent of 'external' aspects of body and brain" (Lakoff & Johnson, 1999:475), the authors propose that a 'Thought-as-Language' metaphor exists in the philosophy on which much twentieth century psychology is based (1999:250). The alternative embodied approach de-emphasizes the notion of Thought-as-Language and provides a link between developmental studies of pre-verbal communication and mature manifestations of culturally-specific communicative practice.

Concepts of apprenticeship (Rogoff, 1990), or social imitation (Meltzoff, 2005), consider the social interaction-embedded nature of child development, and provide a better fit for the view of communication as interpersonal behaviour; as Meltzoff points out, carers acculturate their young "long before verbal instruction is possible" (2005:55). Rogoff further argues that social interaction contributes to cognitive development, with collaborative problem solving with peers as well as "experts" valuable for the "creative elaboration of the activities of their community" (Rogoff, 1990:ix). Apprenticeship in music education has been explored in musical contexts by Neuman (1980) on North Indian music's gharana system, Brinner (1995) on learning Javanese gamelan and Bailey (1992) on jazz. The findings of these studies are consonant with developmental psychology accounts that emphasise the need to study the development of the individual in a social context, since "societal practices provide definitions, tools for problem solution, and particular tactics of solution" in the acquisition of cultural skills such as communicative acts and play (Rogoff, 1990:viii).

Developmental psychology research has also focused on the prosodic aspects of infant-directed speech, suggesting that maternal speech carries a melodic message (Fernald, 1989). Trevarthen and Aitken (2001) review the vast body of research which has focused on the emergence of infant awareness of self-and-other, considering the development of such intersubjective awareness through acquisition of communicative skills (cf. Beebe,

Sorter, Rustin, & Knoblauch, 2003; Reddy, Hay, Murray, & Trevarthen, 1997; Trevarthen, 1979; 1986). The emergence of intersubjectivity appears to be facilitated by a process of *attunement* between the infant and carer (Stern, 1993). Such accounts of preverbal communication assume that the content, or *aboutness*, of any message transmitted through the process of attunement does not depend on referential, linguistic meaning. Before looking to the question of how such attunement is seen to occur, a question of what the message content of such a process might *be* is raised. To answer, such theories look to the communicative function of emotion.

2.9   Emotion as intentional action

Emotion research such as that by Ekman (1998), Wierzbicka (1999) and Tomkins (1980) suggests a set of primary emotions which are evidenced by an apparently universal and innate propensity to display and decode them in a similar fashion. As evolutionary adaptations, innate emotional responses improve an animal's chances of survival (Lazarus, 1991). It may be that human infants have, at birth, the potential for reacting to types of *aboutness* that relate to human survival. Emotions, as adaptations to problems in the human environment (Keltner & Gross, 1999:470), thus perform a dual communicative function according to Oatley and Johnson-Laird -- to induce *action* through the event of their *expression* (Oatley & Johnson-Laird, 1998:85).[1]

Trevarthen suggests that emotions serve to "transmit the colour of *motives* to others" (1982:79); therefore, an ultimate human motive might be to share primary motives (underpinning the primary emotions) with others. The unconscious expression of these motives ties the human knowing of *aboutness*es to other people: individuals express these motives as emotion as they are bound, developmentally, to other people. Trevarthen's account suggests another extremely important facet of communication that is omitted in the discrete-state analyses of communication offered by structuralist linguistic and pragmatic studies: in communicative action there lies the inherent assumption of anticipated reaction. An *intention* to reciprocate and to witness reciprocation must also be crucial to an interpretation of communicative behaviour.

The concept of intentionality has different meanings in different research literatures. In the context of its thirteenth-century usage by the Scholastic philosopher, Aquinas, intention (*intendere*) was used to define the concept of a distinction between logical intent

---

[1] Keltner & Gross (1999) provide a further review of functional accounts of emotion.

and Christian will (Dennett & Haugeland, 1987; Freeman & Núñez, 1999:x). For contemporary analytic philosophy, intentionality refers to the *aboutness* of conscious states of mind as articulated through language (Blackburn, 1996; Crane, 2005). The mid-twentieth century phenomenological philosophy of Merleau-Ponty calls on the notion of intentionality as the "outward tending" of brain activity, which results in final, sensory consequences (Merleau-Ponty, 1964). This notion pushes against the epistemology of passive perception conceived in the strongest information processing model of cognition, where perception is conceived as a form of "imprint of objects and events from the environment" (Freeman, 2000:212).

Current, functional accounts view emotion as propensity to action; the biological bases for human action are examined as elements of a combined action-perception system and draw on a use of intention most closely related to Merleau-Ponty's notion of the "outward tending" of brain activity. Cognitive neuropsychologist, Freeman, proposes that a functional link between emotion and action suggests that a key characteristic of emotion "is that the action wells up from within the organism. It is not a reflex" (Freeman, 2000:214). This interpretation of emotion as intentional action suggests a role whereby affective responses are harnessed to drive towards a particular cognitive goal. For Oatley and Johnson-Laird, too, emotions as individuals recognise them "typically arise from evaluation of events relevant to goals" (Oatley & Johnson-Laird, 1998:93).

For Freeman, emotion *includes* the behavioural expression of certain internal states of the brain. In order to lend "internal states" neural substrates, Freeman's account proposes that a synchronisation mechanism consolidates various levels of activity in the nervous system, suggesting that "actions are constrained or deferred by a global self-organising process" (Freeman, 2000:216). This theory is supported and developed by Lewis and Todd (2005), who suggest that synchronisation of neural substrates can be viewed as a "rapid self-organising process" (M. D. Lewis & Todd, 2005:4), and further propose that emotional states occur when a plan to act out an intention is blocked, hence a type of violation of expectancy occurs. On certain levels, this cognitive explanation fits Meyer's (1956) account of emotion in musical experience. However, an account of musical experience needs more explanatory power than that of a passive listener attending to musical sound, and a crucial difference given in Lewis and Todd's (2005) account is that it is an intention to *act* that gives rise to emotional experience when violated, rather than a passive perception of an aurally-conceived cognitive schema.

Returning to the empirical studies and theoretical papers on the subject of the development of infant intersubjectivity, and the question of how attunement processes may occur, Trevarthen and Aitken refer to "narrative envelopes" (2001:8) used by the mother in infant-carer interactions. Within these "envelopes", affective protoconversations are mediated through the dynamic contours in vocal, facial and gestural expressions. The authors propose that a motive (intention) for communication in infancy serves to regulate the aspect of companionship inherent to mother-infant dyadic interaction, suggesting that the "experiences and skilful actions directed to the environment" that such a motive calls on are "shared and learned socially" (2001:10). This view is in line with other theories of early forms of communication, such as Fogel's developmental theory of social co-regulation:

> Communication, self and culture arise in the infant's experiences of the body, via feeling and movement. Communication, self and culture are just different ways of talking about relationships, different points of view in the same phenomenon (Fogel, 1993:24).

This formulation is based on such notions as Beebe, Stern and Jaffe's (1979) observation of the *mutual coordination* describing the continuous, anticipatory action shown in mother-infant interaction. Fogel suggests that interpersonal interaction has a "special" role in human development because it "enhances the individual's likelihood of detecting self referent information, of detecting the individual's relationship to the environment" (1993:148).

Ontogenetically-early modes of communication do appear to be far more creative and reflexive processes than the adult producer and infant receiver that a traditional theory of mind would suggest, and also confirm the view that interaction as preverbal, interpersonal communication is an essential foundation for any further development of language. The aforementioned studies of mimicry (Baaren et al., 2003; Bernieri et al., 1988) and behavioural matching (Bernieri & Rosenthal, 1991) in mother-infant dyads certainly support an action-first, social learning emphasis in development, as does the associated notion of an other-directed, relational concept of self (Baaren et al., 2003; Brewer & Gardner, 1996). According to Fogel (1993), the human mind and sense of self start to develop at birth through communication and relationships between individuals. This view is strongly supported by Trevarthen and Aitken (2001):

> We believe that the prevailing logic needs to be reversed; that object cognition and rational intelligence in infants, and their perceptual preferences, should be viewed as the outcomes of a process that seeks guidance by person-perception and through communication with equivalent processes, of cognition-with-intention-and-emotion, in the other person.
>
> (Trevarthen & Aitken, 2001:4)

The study of intersubjectivity as explored by Stern (1993) and Trevarthen (1979), Melzoff and Beebe (1979) among others offers terminology to describe how social behaviour might be conditioned and mediated, particularly at these developmental stages. This research supports an alternative epistemology of social action in place of the individualistic perspective that the rational worldview inherited by mid-twentieth century philosophy of science assumes.

The interpretation of an infant theory-of-mind which considers innate, communicative potential as a hard-wired form of human functioning, similar to the basic need for warmth and food, offers better purchase for the question of music's function. For example, the emotional affectiveness of musical behaviour may be related to the use of the voice as our primary expressive tool, and therefore links directly to knowledge of emotive states, many of which cause us to behave with involuntarily communicative signals (Tomkins, 1980). Levenson (1994) suggests that an important function of emotion is "to create the optimal physiological milieu to support the particular behaviour that is called forth" (Levenson, 1994:126). Therefore, an aspect of the relationship between musical structure and music's affective nature may be attributable to the evolutionary benefits of being able to communicate and interpret acoustic cues for emotions - predispositions to action - and enable us to successfully engage with our environment. A pragmatic approach to musical interaction holds potential for such evolutionary interpretations of musical communication that are simply not available in accounts that do not consider social context and interpersonal interaction.

2.10 Ethological approach for social and musical interaction

The most current research on nonverbal communication now begins from a version of embodied and ecological perception-action: human interaction and behaviour cannot be observed as though they are the only dynamic element on a stage with static scenery since the environment includes change, and includes other, dynamic individuals, such that "addressees in conversation can be thought of as co-creators of the utterances" (Schober & Brennan, 2003:123). In method, approaches to interaction research could typically be

described as ethological, using the same principles of rigorous, reliable and systematic observation and description. Animal behaviour study techniques may be equally appropriate for the study of social interaction, although, as Hinde points out, "...in the human case it is clearly necessary to come to terms with the affective/cognitive concomitants of social interactions and relationships" (Hinde, 1982:205).

Throughout the twentieth century, the ethological approach has represented a broad and interdisciplinary body, including work by a collection of researchers united in "the problems to which they address themselves, their method and ways of analysing data" (Fassnacht, 1982:137). Hinde defines the field by the interest with which practitioners address questions about behaviour, and that they act on the view that, "although logically distinct and independent, questions concerning immediate causation, development, function and evolution are sometimes inter-fertile" (Hinde, 1982:21). Importantly, an ethological approach considers that "the investigation of dyadic interaction can be carried out from the functional point of view" (Fassnacht, 1982:141).

Classical ethology was established through the work of Konrad Lorenz and Niko Tinbergen in the 1930s and 1940s, following the notion that behaviour as well as physical characteristics of organisms could be inherited. The method prioritised ecological validity of the scenarios of behaviour for which observation took place. In the first instance, exploratory observations of the behaviours were used to produce an *ethogram*, intended to provide classification for each type of behaviour exhibited by the organisms during the scenario in question. After Hinde's method whereby behaviour might be described by either "physical description", or by a "description by consequence" (Hinde, 1979), ethologists maintain that natural units of behaviour exist to be observed (Fassnacht, 1982; Gerstner & Fazio, 1995; Hutt & Hutt, 1978; Lemke et al., 1999; Newtson et al., 1977; Schleidt, 1988). Following the exploratory observations and classification of behaviour descriptions, an ethological approach quantifies descriptive categories, measuring duration and frequency of behaviour.

In the work of classical ethologists, such as Lorenz and Tinbergen, the term *intention* appears once more. In this instance, however, intentional movement refers only to "preparatory movements that might communicate what action individuals are likely to undertake next", and not, necessarily, their beliefs and desires (Beckoff, 1998:371). More recent developments, however, have brought about the field of comparative cognitive ethology (Griffin, 1976). Cognitive ethology includes a vital extension to classical

ethology, giving licence to hypotheses about the internal states of animals. In terms of practical observation and study of animal behaviour, debates surrounding cognitive ethological approaches suggest that certain presumptions made regarding the underlying intention of behaviour are problematic.

Critics suggest that there may be a problem of verification in any study seeking proof of a behaviour's internal motivational origin in the observation of an external outcome which may or may not be the result of that internal motivation (Beckoff, 1996; Dittrich, 1998; Ristau, 1991). However, cognitive ethologists, including Griffin, Beckoff and Ristau, have successfully approached topics such as vigilance and anti-predator behaviours, and such exploratory features of animal behaviour evident in animal play. These areas all focus on the potential of "primitive, packaged response patterns" (M. D. Lewis & Todd, 2005:14) to be revealing of social issues of communication, role-playing and co-operation (Beckoff, 1998:377).

Current social interaction research builds on the foundations developed in the concepts of rapport and interactional synchrony (Bernieri et al., 1994; 1988; Bernieri & Rosenthal, 1991), and also depends on the notion of entrainment between social interactants. Such work successfully bridges applied experimental psychology and social cognition studies. Richardson, Marsh and Schmidt (2005:62) recognise the importance of the co-construction of communication (citing Schober & Brennan, 2003), and consider how dyadic nonverbal communication might "periodically recur in a correlated fashion" (M. J. Richardson et al., 2005:63). By applying dynamical systems analysis of the movement patterns, their research tackles aspects of cognition related to complex social (non-linear) factors. From the hypothesis that natural human movements occur rhythmically with a co-ordination "constrained by the same dynamical processes of self-organisation that constrain interacting physical oscillators" (M. J. Richardson et al., 2005:63), the researchers observed movement co-ordination in dyadic interaction. Newtson, whose research contributed to the earliest studies of physical synchrony in dyadic interaction (1977; Newtson et al., 1987), has contributed to the number of studies that are taking a dynamical systems approach (Newtson, 1994).

Richardson and Dale (2005), Richardson, Dale and Kirkham (in press) and Monk (2002) build on prior studies of other-directed behaviour in communication mechanisms, examining the coupling of eye-movements between individuals in dyadic interaction. Such research appears to provide a means for quantification of joint attentional behaviour,

demonstrating a link between visual attention patterns and mutual knowledge in dyadic communicative relationships.

Trevarthen's approach to early infant behaviour as something that is musical in its proto-conversational, cross-modal and intentionally communicative function suggests that the meaningfulness of human musicality can be explored in terms of its potential *to* communicate. This is consonant with the current evolutionary psychology perspective, where research seems to suggest that children's skills of shared intentionality develop within the first year and a half after birth, to include "a species-unique motivation to share emotions, experience and activities with other persons." Evolutionary cognitive psychologists suggest that "the developmental outcome is children's ability to construct dialogic cognitive representations, which enable them to participate in earnest in the collectivity that is human cognition" (Tomasello, Carpenter, Cal, Behne, & Moll, 2005:675).

Tomasello et al. have also suggested that classical theory of mind, which typically refers to "the belief-desire psychology with which school-age children and adults operate" does not account for such collective behaviour, which calls for a "form of theory of mind [that] is clearly derivative of more basic social-cognitive skills." (Tomasello et al., 2005:690). The access by means of proto-musical behaviours to the intersubjective needs of human social behaviour is a topic that has been explored extensively by cognitive musicologist, Cross, (1999; 2001a; 2003; 2005; (in press); 2002) and has led him to suggest that

> music appears to be a human universal in the form of communicative behaviour that under-specifies goals yet facilitates a sense of joint action, enabling participants to sustain interaction while holding to potentially conflicting personal interpretations of goals and meanings.
>
> (Cross, (in press) p. 24)

Many observers of human interaction have drawn on musical analogies. For example, see Pike's (1967) fascination with the communal negotiation of church services through hymn-singing, Scheflen (1963) describing the choreographed synchrony of orchestral performers, or Bernieri and Rosenthal's analogy of everyday conversation to jazz improvisation (1991:403). But in none of these cases does musical interaction analysis otherwise appear to have been called upon to further the study of embodied communicative processes.

Ethologists have also considered the properties of signalling in comparison to musical systems: "At least as plausible as either language or music is the possibility that bird song should be regarded as akin to hypnotic persuasion […] but it may be that these are not all that different from each other" (Dawkins and Krebs 1978:307, cited in Owings & Morton, 1998:58). Owings and Morton suggest that "[Dawkins and Krebs'] point is that animal signals may work like music does in humans, to influence the motivational states of listeners" (1998:59). Although this analogy perfectly suits the ethnocentric notion of music as a work or product to be consumed, it only hints at the whole picture of human musicality. By conceiving of music as interaction mediated by sets of behaviours, rather than a complete product to be passively received, the important questions become targeted at the types of behaviours used by musicians as social individuals to regulate their own environment through their management of other individuals.

With reference to the animal vocal communication theory of Owings and Morton (1998), Cross has discussed the possibility that basic materials of musicality such as vocal communication might be usefully compared in function to basic non-human animal vocal signals, "serving principally to manage behaviours of conspecifics - and of other species in the immediate environment - through direct expression of affective state" (Cross, (in press)). An interpretation of the communicative intentionality of participants in an interaction may provide a framework for describing their actions. This view of communicative intentionality is informed by Owings and Morton's (1998) model of social interaction as underpinned by *assessment-management* processes. The assessment-management framework provides a way to think about communicative processes that "emphasises that vocal output of animals may not be designed for transferring information, but that receivers are nevertheless capable of assessing such signals and acting upon them" (Soltis, 2004:473).

The concept of communication that is structured by an intention to manage and assess other individuals' behaviour by means of affective signals is an extremely interesting concept with which to explore musical interaction (cf. Lazarus, 1991). This ties in to the cross-modal, non-specific nature of musical transactions (cf. Langer, 1942), and holds as a theoretical model without the fixedness of grammatical structures or specific referentiality of language. The interpretation of musical behaviour as an innate propensity to intersubjective action leads to the notion that, developmentally and evolutionarily, musical capacities may underpin language abilities. Language is seen as a "mechanism serving cognitive and mnestic [relating to memory] processes" (Wallin,

1991a:536) which naturally shapes the process of meaning construction, but it is not the intention which motivates the process. Tomasello et al. clarify further, that

> language is not basic, it is derived. It rests on the same underlying cognitive and social skills that lead infants to point to things and show things to other people declaratively and informatively in a way that other primates do not
>
> (Tomasello et al., 2005:690).

Steven Pinker has claimed that music (more accurately in his usage, a musical 'work') is simply "auditory cheesecake" and holds no adaptive value other than the pleasure humans get from it (1994:534). An ethnocentric bias regarding music's social value may have influenced this theory; but it is also important to note that the theory is derived from Pinker's view of language evolution, which rests on an information-exchange perception of language in which words can always be conveniently codified and abstracted into grammar. Instead of this approach, and in light of this literature review, it seems prudent to strongly resist the concept of music as disembodied work, and to use methods of interpretation which are also consistent with an observational analysis of communication mechanisms.

It also seems appropriate to resist the distinction between listener and performer, and to embrace the embodied cognitive view of action-perception; and to resist the abstract symbol manipulation view of musical event organisation and hierarchy. Social interaction qualities of musical behaviour should be considered with equal attention as the individual expression qualities. Further, by considering the cognitive definition of emotion as action-readiness, or a motivation for intentional action, and by considering the durational quality of musical action in a social context, the sociality of a musical event can be seen to entail co-ordinated action by agents. This must require the motion of bodies in space and time; this view permits the interpretation of musical meaning during the musical event as something which may occur through action, not mental abstraction. The function of interpersonal relationships in musical interaction should, in the light of this summary, remain a key focus of this study. Relationships must operate between musicians, and between musicians and their audiences. At a functional level, relationships may be based on embodied communicative modes of co-regulation.

This view is consonant with the evolutionary perspective on communication by Tomasello et al., who suggest that, "the small difference that made the big difference" to human cultural evolution is not the technology of language structure, but "an adaptation

for participating in collaborative activities involving shared intentionality" (2005:32). Any sound, including musical sound, is loaded with movement information and imbued with humanly communicative characteristics such as the quality of movement, the body-part associated, localisation, and contour. The integrated expression of intent through body movement should be considered when observing the total sum of behaviour acted out by performing musicians - and, indeed, their audiences, since "two dimensions of human expertise - reading intentions and interacting with others culturally - are intimately related" (Tomasello, Kruger, & Ratner, 1993:2). Intentionality appears to be an indisputable element of all human communicative interactions, and as such it should obtain in musical interactions as well as any other socially communicative behaviour. A framework for the study of musical interaction seems most likely to be found where an action-first, language-second view of communication holds. A cognitive ethological paradigm appears appropriate to support a method for social interaction observation.

Certain restrictions and reconciliations are clearly required for the application of an ethological paradigm to musical behaviour research, as simple behavioural observation cannot access the complex social dimensions of interpersonal relationships and musical meaning, and there are also constraints in the socially-ordered contexts of performance and reception. A further difficulty may be in the potential of an action-first, ethological paradigm to separate behaviour related to musical time structure maintenance from that related to interpersonal social co-regulation. To address these issues, the next chapter considers the relationship of musical and social categories that are present in musicians' own discussions of their actions, using an ethnographic approach and ethnomusicological participant-observer methods for the study of communicative North Indian classical music.

3   A FRAMEWORK FOR STUDYING MUSICAL INTERACTIONS

3.1   Defining the research area

The two previous chapters demonstrated the need to approach musical events by examining the interaction of the participants, as an alternative to an approach to the study musical meaning that is available through the musical work concept. This is consonant with the increased interest in the study of performance aspects of music during the past few years. As suggested in Chapter One, section 1.6, the concept of music as a physical activity is one that scholars of non-Western music are most familiar with. The preceding chapters point towards the need for a research focus which explores the "interactive and variable nature" of music performance through an analysis of movement as indicative of real-time communicative interaction (Qureshi, 1994:525).   As musical activity is a process of communication, the research should find a method of exploring the mechanisms of musically communicative behaviour that may operate at an immediate, social level of interaction.

Such a study requires repertory that offers visible evidence of performers' co-operation. Improvised, or semi-improvised, music may be most revealing of the collaborative behaviour of musicians, and follows the research by Keil and colleagues discussed in Chapter One, section 1.9. However, a repertory's formal elements of organisation could provide valuable constraints for a potentially boundless investigation of physical aspects of musical interaction.

North Indian classical music performance offers both well-formed, culturally-specific constraints in factors of performance organisation, and also the spontaneity of co-performer interaction valued in this research approach. Inbuilt constraints of the genre include the boundaries of a culturally-governed relationship between *sitar* (long-necked, fretted lute) player and *tabla* (pair of tuned hand drums) player, where the latter usually occupies a slightly deferential position. The effect of this is that there are discrete roles to be carried out by soloist and accompanist. These roles influence matters of musical structure that define aspects of the musical interaction (for example, decisions about who plays first). Conventions of performance also determine the loose structure through which musicians deliver musical material with components of both pre-composition and free improvisation. Further elements of musical structure, such as the melodic and

rhythmic constraints, also help to provide a framework for studies of performer interaction.

The focus in this research on North Indian classical music draws specifically on a body of performance whose ensembles are typically small, featuring an instrumental soloist with tabla accompaniment. As the complete performance is negotiated by two musicians, this study of duo performances also provides a way to limit the complexity of the topic. The following section provides a more detailed account of particular aspects of North Indian classical music performance with two aims. Firstly, the following section introduces the author's status as a student of North Indian classical music - a position that has influenced the scope of the research. Secondly, the section provides a gloss for readers who are not acquainted with classical Indian music; subsequent chapters draw on this knowledge base. In first usage, novel terms are *italicised* and thereafter appear as normal text. All these terms are included in the glossary.

3.2   North Indian music performance

During the first year of an undergraduate degree at City University, London, the author encountered North Indian classical *sitar* music for the first time, and attended weekly group workshops for the subsequent three years with Professor Gerry Farrell. During 2002, Gerry arranged an introduction to *Pandit* Arvind Parikh, a senior sitarist of the *Etawah* sitar school (*gharana*), who was visiting SOAS in London to give a seminar. Following a series of preparatory sitar lessons in London with Mehboob Nadeem, a senior student of Arvind Parikh, the author took lessons with Mr Parikh himself at his home in Mumbai during August and September 2002. After this initial period of lessons, her sitar performance studies continued on several occasions when Mr Parikh travelled to the UK, and during another month in Mumbai in November, 2004.

There are certain striking features of North Indian classical music which lend themselves to a discussion of the embodied aspects of live performance. North Indian rag music is not performed from notation. The musical pitch system uses a form of solfège, called *sargam*, in which the tonic pitch is named (Sa). In comparison to the Western concept that a tone with a frequency of 440 Hz represents the note known as 'Concert A', Sa has no fixed pitch. Between one Sa and its corresponding octave-equivalent Sa, lie the notes Re, Ga, Ma, Pa, Dha, and Ni, which together form a heptatonic set that could be represented by a C major scale. Certain of the notes may also be sharpened or flattened, giving a total of twelve different pitch classes.

Many rags contain more than one version of these variable notes, and the degree to which they are sharpened or flattened is an aesthetic value that varies depending on the rag. Other factors that are subject to change and serve to define a particular rag include the melodic shape of the ascent and descent patterns; characteristic motifs; approaches to certain notes (for example, always from the note above); and the perceptual - or rhetorical - dominance of certain notes above others.

Therefore, despite some similarities to the twelve chroma of the Western classical system, the tonic-dominant hierarchy cannot be consistently applied to Indian music. In particular rags - for example, Rag *Bageshree* - the fourth degree of the scale, Ma, is melodically more salient than Pa, the fifth. In other rags, such as Rag *Marwa*, Pa is excluded altogether. These melodic features, and other aesthetic elements including the way in which a performance invokes the aesthetic construct, ras. Ras can be described as an experience, emotion, or feeling engendered in both the performer and the listener; this construct partly defines the concept of rag (see Chapter One, section 1.2).

After the melodic content, a second important source of organization in North Indian music performance is *tal*, the rhythmic structure that can be used to frame the performance of a rag. Using the example of the tuned hand-drums, the *tabla*, which accompany a large number of North Indian classical performances, the foundation of a rhythmic pattern used to create tal is the *bol*. This can be interpreted as another form of solfège, which uses specific syllables to describe individual sound elements.

The most common bols are Dha, Dhin, Ge, Ghe, Tin, Ra, Ki, Ta, Na, Tun, and Te. Combinations of these syllables in particular sequences can produce a particular *theka* - a basic rhythmic framework used to represent and deliver a particular time cycle. Two examples include *Jhaptal*, a ten-beat cycle, and *Teental*, a sixteen-beat cycle. The theka for Jhaptal can be given by the four phrases: Dhin Na [2 beats], Dhi Dhin Na [3 beats], Ti Na [2 beats], Dhi Dhin Na [3 beats = total 10 beats]. Teental can be represented by the four phrases: Dha Dhin Dhin Dha [4], Dha Dhin Dhin Dha [4], Dha Tin Tin Ta [4], Ta Dhin Dhin Dha [4 = total 16 beats].

The role of a tabla player is most significant during an instrumental recital, where the percussionist is expected to complement the melodic and rhythmic performance of the instrumentalist, extemporising and improvising beyond the basic theka. The interaction between the tabla and sitar player can be a source of excitement in itself - the

percussionist might imitate the rhythmic patterns created by the melodic performer (soloist). For example, after a jointly improvised phrase, the two artists may synchronize their approach as they return to beat one of the cycle, known as the *sam*.

As the music is not read or learnt from a score, every rag performance develops in a unique fashion. An instrumental duo concert of sitar and tabla might typically include the following elements:

Alap - performed by the melody instrumentalist (sitar player). This section has no tangible pulse. It is the section of performance when the essence of the rag is presented; the relationship of each note to another is explored, and the salient melodic material delivered. It usually progresses from the lowest to the highest part of the tessitura. The alap section may proceed for any duration between ten minutes to an hour.

Jor - at this stage the performance has a discernable pulse, but is still performed by unaccompanied sitar and has no particular metre - or tal - at this point.

Gat - the gat is a three or four-phrase pre-composed melody. The tabla player introduces the rhythmic support at this stage of the performance. Two or more gats, usually with different tempi, might be performed in succession. The phrases of the gat are developed by improvised permutations and variations within the boundaries of the rag's melodic and aesthetic framework.

Jhala - the previous development of the gat flows into the jhala section, and the tempo has usually increased by this stage of performance. The sitarist plays with the rhythmic aspects of the tal most during this final section, using the *chikari* strings (tuned to a drone, and not used for melody playing) for a combined melodic and percussive effect.

Before the ritual of tuning and retuning begins, the dignified acknowledgement by the musicians of one another, and of their audience - specifically of eminent musicians who are attending - is performed with directed gaze and nod as if to say, *I see you, we are all here*. Before beginning, performing musicians seek a nod of consent from experienced performers attending as audience members. The sense of being witness to something newly created in one's own presence draws the audience in: everyone in the room shares this moment in time. While musical performance occasions of all genres are charged with their own liminal thrall, the sense of co-presence of the musicians and audience in this particular form is a distinguishing feature.

Even to an uninitiated audience member, the apparent significance granted by performers for the inter-performer and performer-audience relations gives an immediate sense of the socially-embedded quality of the musical interaction. The performance moves from an initial unaccompanied introduction and unfolding of the contours of a rag; through the sensitive and unified presentation of the melodic and rhythmic components of a composition and its extemporisation by the duet of sitar and tabla; to a climactic period of sitarist and tabla-player virtuosity. The very notion of spontaneity and effective, real-time communication between performers - and performers with audiences - is characteristic of the genre.

In contrast to the scenario of an orchestral concert, the musicians' embodied presence is not obscured by any obstacle of music stand and paper score. While a large auditorium performance might require an arrangement of low microphone stands, in an informal event there might be nothing but a few feet of air between the seated performer and seated audience. In both auditorium and informal performances, musicians often take great care over the arrangement of their dress, and appear with graceful stage presence; it is right that an audience should be looking at them and valuing their presence as an aspect of the performance.

3.3 Developing research questions

The stated research intent is to find a method of exploring the mechanisms of musically communicative behaviour that may be associated with such collaborative interaction. Particular reference to North Indian classical music duo performance repertory offers an appropriate locus for this study. Within this research scope, the following areas were addressed as a set of primary research questions:

1. During real-time musical interaction, what types of non-verbal communication do the musicians appear to use?

2. How do the participants in a musical event feel that communication occurs?

3. What functions might be served by the different communicative, physical movements of musicians during musical interactions?

The nature of the data that could elucidate these research questions is essentially ethnographic, requiring an approach that combines "various research techniques, including interviews, observations and physical trace methods" (Sommer & Sommer,

2002:57). Such techniques are typically gathered during participant-observation research, derived from an anthropological approach that has become a staple research technique for ethnomusicological enquiry (see section 1.6, page 14). For this research, a broad, multi-faceted data collection method includes include various techniques of observation, through informal and formal interviewing and video, audio and personal diary recordings of interactions with North Indian musicians made during fieldwork and including accounts of sitar lessons.

Table 3.1 (next page) outlines the research questions. The table suggests appropriate data collection techniques and points to the different methods of data analysis which could be considered most appropriate to the question.

The nature of analysis that can respond to the research questions should thus include both qualitative and quantitative techniques, with the use of video data to explore attributes of the musicians' behaviour. The power of such a technique includes the potential of empirical observation to respond to the research questions that ask about the observable mechanisms of communication apparently employed by the musicians in interaction. A comparative design may probe the video data by examining the relationship of factors associated with musical organisation (such as musical time and performance structure) with the visible behaviour. Other factors that may impact on the behaviour of musicians during musical interaction, established during ethnographic analysis, can also be considered in the comparative design.

Table 3.1 - *Primary research questions with data collection and analysis methods*

Research questions	Data collection techniques to elucidate question	Suitable data analysis methods
1. During real-time musical interaction, what types of non-verbal communication do the musicians appear to use?	Observing entire process of music-making - written accounts (fieldwork journal), audio recordings and video recordings of music-making in different situations. Include not only final, public performances, but also rehearsal, lesson and practice sessions in the observations.	Quantitative study of empirical video data could examine the musicians' behaviour in the context of musicians' own descriptions of communicative action. Compare individual musicians' behaviour across different musical events.
2. How do the participants in a musical event feel that communication occurs?	Semi-structured interviewing for ethnographic information on 'feelings' and 'meanings', keeping questions very open - interviewer not to set predetermined categories of specific gestures, or finer/grosser movements, for the musicians to respond to but to encourage the discussion of all aspects of communication in musical interaction. Observation of musicians in lessons, rehearsal and concert. Use of fieldwork journal, supported by audio recordings and video recordings of some instances.	Qualitative analysis of interview transcripts and written accounts to examine how musicians refer to: 1. notions of connection, empathy, understanding between and amongst musicians and the audience; 2. their relationship with audiences.
3. What functions might the non-verbal, physical movements of musicians serve during musical interaction?	Personal reflection on the topic through research diary during fieldwork. Aspects of the musicians' interaction may well be related to their relationship as individuals, as well as their negotiation of the musical performance - use probe questions in informal discussions on the intersection of musical and social relationships. Video data of a range of musical interactions within the particular genre of duo performance, rehearsal and practice.	Qualitative analysis to examine how musicians refer to communicative aims during musical activities and the organization of their own behaviour regarding these aims. Comparative analysis of video data to explore distinction between musical or other factors of organization by identifying musical organization elements (rhythmic and performance structure constraints); use of these variables to explore the video data. Comparative analysis design controls for non-musical variables related to organization.

While observational video analysis offers many possibilities, it also has shortfalls. Firstly, the video-recorded instances used for the analysis could be seen to strongly limit the enquiry into those specific cases. Also, the individuality of musicians - and audiences – creates a highly changeable factor that may further limit the potential of the analysis to predict results beyond the particular cases in question. Finally, a quantitative behavioural

observation technique cannot be used to provide a conclusive account of the specific intentions and motivations of the participants.

However, in conjunction with the qualitative data collection and analysis, conducted using an element of participant-observation, a valid, emic frame can be prepared for an observational analysis of the video material. In the first instance, the validity of the initial research questions can be established through the researcher's participant-observer status, which provides a degree of "theoretical sensitivity" (Glaser & Strauss, 1967:46). From this groundwork, the rich ethnographic data can be analysed to reveal themes pertinent to the research questions.

There are various methods of qualitative data analysis. One of these is Grounded Theory, originally devised by Strauss and Glaser (1967). The Grounded Theory method of data analysis is based on a systematic and reflexive process of data coding. Coding describes the acts of labelling and annotation associated with reading and re-reading qualitative data, in order to establish certain themes that can be seen to underlie the material. The labelling of these themes serves the researcher's aim of developing a suitable theoretical framework for the study of the phenomena in question - in this case, that of the communicative nuances of musical interaction that could be seen as socially-embedded.

From the discovery of themes, the researcher assigns descriptions to the themes, constructing categories that can be used to examine the discourse of the whole corpus of data. Reading and re-reading the ethnographic material with the research questions in mind, the researcher can explore the relationship of recurrent themes and categories to the research topic - in this case, asking broadly: what are the communicatively salient aspects of musical interaction in the words and opinions of the participants in the study? Categories that emerge as common to all of the musicians' accounts of their experience of musical interaction serve to ground the theoretical framework; as these core codes are developed from the re-reading of the data, the qualitative material is explored now with regard to both the research questions and the categories labelled in the data. In this way, the core codes can be used to examine the relationship of the emically-derived categories to the pragmatic context; in this case, the context of instances of musical interaction.

A further aspect of Grounded Theory method suggests that theory which emerges from data coding should not just fit substantive data, but should also be generalisable across contexts (Glaser & Strauss, 1967:51). The researcher asks whether the core categories

drawn out in the process of the analysis can apply in other relevant circumstances for the participants. In the case of this particular research: does the emergent theory regarding the ways in which the musicians communicate and interact hold explanatory power across the different performance contexts of various musical events?

The subsequent stage in the development of a grounded theory therefore requires the grounding of codes with reference to real circumstances - a process that Strauss and Corbin define as "axial coding" (Strauss & Corbin, 1990:96-115). Borgatti states that this method of analysis can be carried out according to a "basic frame of generic relationships" (Borgatti, 2005), so that categories found in the qualitative data can be examined with emphasis on their causal relationships in light of the phenomenon in question.

Table 3.2 sets out Borgatti's generic frame for the development of a conceptual framework for the analysis of complex social phenomena.

Table 3.2 - *Borgatti's (2005) generic frame for axial coding, after Strauss and Corbin (1990:96-115)*

Basic frame of generic relationships for aspects of complex social phenomena (Borgatti, 2005)	
The phenomenon	Concept of interest to researcher
Causal conditions	The events which lead to the occurrence of the phenomenon
Context	Specific values that influence actions related to the phenomena
Intervening conditions	Mediating variables which influence the occurrence of the phenomena
Action strategies	Purposeful, goal-oriented activities that agents perform in response to the phenomenon and intervening conditions
Consequences	The intentional or unintended consequences of the action strategies

The corpus of qualitative data on which the analysis is based consists of a thirty-two thousand-word fieldwork journal from a period of work in Mumbai and Kolkata from November to December 2004, including diary accounts of sitar lessons taken with Mr Parikh; audio recordings of lessons from this trip and also from a period of lessons in Mumbai and London between August 2002 and July 2004; and transcriptions of seven

interviews made with professional musicians. The complete data corpus also includes twelve video recordings, which were collected alongside the interviews and journal. Chapter Four describes the development of the method for a video analysis, drawing on a set of video recordings assembled from the corpus to explore various social contexts of musical interaction. The video analysis of these data and discussion of the results take place in Chapters Five and Six, and the qualitative data in this chapter is drawn on again in the final analysis Chapter Seven, as the results of both the empirical and ethnographic studies are brought together.

3.4   Validating the research questions for North Indian classical music

In conjunction with the theoretical position described in the literature reviews of Chapters One and Two, the author's status as participant-observer and sitar student contributed to the perspective of music as socially embedded interaction that is apparent in the research questions (see section 3.3). The validity of this perspective is established now in the subsequent section, 3.4.1, which describes the development of the author's "theoretically sensitive" (Glaser & Strauss, 1967:46) position.

A particular importance of participant-observer research in ethnomusicology is, as Chapter One illustrated, its embrace of an action-first approach. As the American scholar, Timothy Rice, demonstrated in his study of Bulgarian music in the twentieth century, a structured exploration of the subjective experience of musical action can provide a valid source of knowledge (Rice, 1994). Moreover, neglect of the discussion of subjective experience would preclude the discovery of vital aspects of the genre. The following account reflects on the author's encounter with sitar performance studies and the subsequent journey to a greater familiarisation with North Indian classical music performance. Starting from the initial viewpoint of a student taking group lessons, the account provided in the subsequent section demonstrates the development of a sensitive research position through the increasing insight gained from the lesson and a deepening immersion in the genre.

Two particular topics are highlighted in the account, as they serve to characterize the research position: awareness of the interrelationship of participation and trust in building and maintaining social relationships for musical interaction; and the relevance of physical matters to the process of musical performance education. To explore and to illustrate the topics described here, excerpts from a lesson diary after classes with the author's sitar guru, Mr Parikh, and reference to informal interview transcripts made during the course

of the research, are both used in the reflective account. In this way, the account also serves to introduce the musicians who contributed to the research through interviews, recordings and classes. The professional musicians, in some cases very well-known, have given permission to be included in this work and are named here. The author's fellow sitar students are described by pseudonyms. Throughout this chapter, Pandit Arvind Parikh is referred to as Mr Parikh, reflecting the author's relationship with her guru. In the presentation of the video data in Chapter Four, and throughout the analysis of Chapters Five to Seven, Mr Parikh is referred to with his full name, as are the other musicians who feature in the video data.

3.4.1 The author's personal perspective

Participation

On beginning to learn sitar, I was immediately aware of the aspects of social relationship that governed the process, and my continuing North Indian music education has followed a route of both participation and trust. During the University performance workshops, the teacher demanded with quiet authority that we would perform certain actions. We would sing note-names (sargam), we would learn, recite and clap the bol patterns of various tals; we would rehearse *tihais* (rhythmic cadences) and play *paltas* (melodic exercises designed to improve technical proficiency. We were told explicitly not to step over the instruments; we were implored not to play vulgar blues scales on the sitar; we were implicitly discouraged from questioning our teacher's devotion to his guru.

There were many things, in learning about the sitar and North Indian music, which I was very happy to take on complete trust. The weekly workshops were calm, still periods in the timetable; they were events during which, as a class, we would gradually establish familiarity from strangeness by appropriating a new role as educated audience and participant in North Indian classical music. The extremely lengthy repetition of what seemed at first to be simple pattern of notes (the ascending and descending notes included in Rag *Yaman*) was a novel concept to many of us at the time as we could instantly interpret the scale on our own terms of musical experience. But our crude assimilation of sargam vocals and basic sitar technique gave integrity and relevance to the act of repetition. At the time, I felt the workshops to be a very welcome exercise in doing something different for reasons that I was happy to know that I did not yet understand.

Trust

Recently, as a new student at a Hindustani singing lesson, I was reminded of the complex emotions and social demands that are summoned in the early stages of a relationship between music teacher and student. I had forgotten what it felt like to be forced to expose myself through my voice - or by my elementary ability to play a musical instrument - in front of strangers. While eight years' playing and listening to North Indian music allowed me to perceive the microtonal difference between two sung notes demonstrated by the teacher, I could not on first, second, third or even fourth attempt make my untrained, unrehearsed voice replicate any part of the subtlety of the his demonstration.

Although the experience of the lesson was ultimately positive and instructive, it was not particularly comfortable and I was reminded of the endless opportunities for frustration in music lessons and practice. While such participation during instruction is essential, the element of trust is vital to the exchange; we have to maintain faith that people who are acting as our guides into unknown territory are knowledgeable and trustworthy themselves. When getting involved in the acquisition of new skills through activity and participation, we must trust that the strangers to whom we openly reveal our ignorance and vulnerability are going to treat us with respect and not do us harm.

The teacher in that recent singing lesson, Mr Parikh, and also Gerry Farrell all spoke of the humility that is necessary to learn well in music classes, as the relationship - like all educative contexts - must function with an imbalance of power. Neuman's account of the guru-disciple relationship that underpins North Indian music education draws attention to other requisite qualities, including commitment, loyalty and respect, which students must deliver in return for the time and teaching of the master musician (Neuman, 1980:146), and other ethnomusicological accounts of systems of musical education, including Berliner (1978) and Brinner (1995), touch on the process of leaving ego and individuality at the door in order to avert some of the difficulties of negotiating those dynamics of power and trust. It seems that, whatever the processes of arbitration, the social relationships which house musical performance lessons appear to require solid foundations and careful maintenance.

Practice

Apart from the aspects of trust and respect that the teaching relationship requires, the skills of successful musical performance practice also involve more corporeal matters. Whether the object is a smooth viola bow-change, or a fast *'diri-da'* right-hand plucking

movement on the sitar, a phrase at the piano keyboard or a sung sequence of tones, musical technique requires physical rehearsal to achieve the complex, integrated patterns of motor behaviour.

In order to prepare for the first lesson in India, I took lessons with Mehboob Nadeem, a senior student of Mr Parikh who lived in London. I had begun to increase the duration of my practice towards the levels that Gerry had described as necessary - several hours of *riyaz* a day were to be expected during a stay in India to study with a guru. I found the practice to be physically demanding to the point of painful - the fine, steel strings of the sitar dug deeply into the fingers of my left hand and the misrab (finger pick) cut into my right index finger. The twined-leg seated position numbed my lower body within minutes, and within six months I acquired scoliosis and regularly woke at night with knee pain.

Musicians in general appear to take physical discomfort and deformity as part of their occupation. I am not alone in foolishly wearing my discomfort as a badge of honour and my meagre physical ailments do not come close to many others - Gerry's tale of slicing the tip of his finger off on the steel string was not the only case that I heard of ("Guruji, I've cut the top off my finger off." "OK. So, tell me, what have you been practicing since your last lesson?" "Well, I haven't done so much practice; I cut the top of my finger off" "Yes, you said. So why haven't you been practicing…?" - Personal correspondence with Gerry Farrell, 2000).

Reference to the raw physicality related to the acquisition of musical skills - physical effort, tension, muscle and motor control - is often a dominant feature in a musician's casual account of their instrumental study. But, with exceptions including John Blacking (1974) and John Baily (1992), the topic does not typically contribute to analysis or discussion of music's audible trace. While the type of effort experienced by students in achieving technical proficiency is eliminated - or at least reduced - by rehearsal, musical performance remains a physical, energetic occupation.

On arrival in India, my fingers were still rather soft and I did not manage to play through the ten different paltas that I had tried to prepare. For this reason, I felt dismayed because this, musically, was all I could offer. However, large parts of my earliest instruction seemed to have stuck, and there were moments of optimism in my first meeting with Mr Parikh. He was pleased for me to play with the tabla player sitting in on the lesson,

because he said that it had become evident to him that I had the 'feeling' for the tal, and that I was interpreting it appropriately. I know that this came from those initial group classes, clapping tals and inventing tihais in Teental.

The repetition of these patterns, under Gerry's direction that we should have, early on, an unquestioning acceptance that this particular sixteen-beat cycle should feel different to the way we might read music in common time from a score, meant that I had been open to the way in which Indian audiences respond to the arrival of the sam after a cross-rhythmic tihai. Congratulations were also to be relayed to Gerry on the way he had "placed my hands". My ability with the right hand was given some commendation, and I got through the first, nerve-wracking meeting with some hope and encouragement. I recognised at the time that this endorsement was vital to my motivation and any future I might have playing the instrument. I needed to feel that there was some reason to do what I was doing, as the strangeness of the situation and the lack of relevance to my usual life in the UK left me in a vulnerable position.

Building relationships for learning
After spending a little time taking lessons with Mr Parikh in Mumbai, it was not the lack of relevance to my usual life that I often thought about but my own strangeness and foreignness to my guru and his family. The presence of foreign students seemed to be a factor in the dynamics of many of the lessons that I witnessed - not least because I was one of them. Foreignness in this context suggests a different expectation of ability, and also a different expectation of the commitment, loyalty and expressions of respect that are vital aspects of the guru-disciple relationship.

For myself and Mark (another British student), there was no early cultural immersion in sitar music. During this period of study, a family of young Indian South African musicians were visiting. Their exposure to classical North Indian music was greater than Mark's or mine, but these students still only visit Mumbai perhaps once or twice a year. Many of Mr Parikh's students attend less frequently than he has suggested that they might. There are regulars who attend on a particular night of the week or month, and Indian students who live a long way from Mumbai who, like myself and the other international students, might attend every night of their stay in Mumbai.

During my second stay in Mumbai (November - December 2004) I observed aspects of the relationship between Mr Parikh and one particular, promising young sitar student,

Tariq, who lives locally and attends very regularly. Tariq's relationship with his guru naturally possessed different qualities to those nurtured by less regular students. The following diary excerpt gives an account of an eventful lesson, and offers a flavour of the interpersonal dynamics that colour the lesson:

FIELDWORK JOURNAL, TUESDAY 23 NOVEMBER 2004

Turns out it's not just Prabir who's arrived from South Africa to take lessons with Mr Parikh - he's got two sisters who are learning sitar and santoor! It's so amazing how this small fact changes lots and yet doesn't get mentioned. It was crowded up there last night. By the time Mark and I got there, there were already three young men in place tending to Guruji, massaging his shoulders and legs. Hafir's younger brother was there. Hafir is the tabla player from London[…]. Also another, unnamed tabla player who was lower in the ranks and only got a go on the tabla for a few minutes at the end - and, of course, Tariq had hold of a leg. Then these three South African students - Prabir, Paranita and Manjula - were sat on the carpet with their two sitars and two sitar flight cases and a santoor and box. It was all a bit of a squeeze.

Mr Parikh asked them, as he asks every student returning after a long time, to play something - play anything. Prabir, as most senior in the family, had to go first. I really felt for him - he asked, "Couldn't we all play together…?" but no. So he played the Pilu gat - m g mm pp g- gr -s r- g- gm -p m- p- p-[1]… It was ok. Mr Parikh looked on with his neutral, listening expression and when he had finished, asked Prabir to play some alap.

He stopped Prabir quite soon, and went on to Paranita, asking for alap. She said that she hadn't really prepared the alap and he said, fine, play me what you HAVE prepared. She started the Pilu gat… and transformed the composition that Prabir had played. She is GOOD! I had a feeling just before she started that she was going to pull something like that off - extremely composed and confident. Then the melody started flowing and she executed it immaculately. I realised that it was exactly the same sequence that Prabir had played and realised they were imitating a Vilayat Khan performance. She knew she'd done well, and after tailing off slightly at the end of the gat she said that she'd got some jhala too…? Go ahead. So she played EXCELLENT jhala. Afterwards, Mr Parikh (whose impassive expression had broken a bit) turned to me to check that I knew it was precomposed.

---

[1] These notes represent the sargam of the melody that Prabir played. m = Ma, s = Sa, etc. g represents the komal (flattened) version of the note, Ga.

Then it was Tariq's turn (although Prabir and Parinita's younger sister, Manjula, had not yet played a note on her santoor). It wasn't flawless, but with a lot of panache and showing such an impressive ear and memory - the near-complete alap, gat, paltas and jhala that must have been learnt from the same performance and recording that the South Africans were learning from.

It felt like quite an odd dynamic to me. This family were here on their first night, and Paranita in particular had done so well. This highly ostentatious display from Tariq seemed almost unnecessary. On the other hand, it was deeply impressive and though competition is always extremely close to the surface in group taleem, perhaps the South African family simply felt pleased that Tariq was doing so well, clearly nurtured and enjoying the close attention of Guruji[..].

The preceding discussion focuses on my continuing music education as a student of sitar, and naturally offers the perspective of a student-teacher relationship. The excerpt provides an illustration of the type of social frissons that typically occur, and demonstrates the stronger relationship being developed between Mr Parikh and Tariq than with the visiting students. A particular characteristic of the exchanges between Mr Parikh and Tariq lies in the approbation given by the guru to the flamboyant, expert-performer style of Tariq's playing. The accuracy of the intonation, and well-formedness of instrumental technique, appears to be considered a secondary concern after the most salient feature of Tariq's playing, which is the impression of expressivity and audience-awareness that he delivers.

Building relationships for performing

The primary research questions target particular aspects of performance situations, rather than the pedagogical scenario. From this perspective, how do the aspects of human interaction necessary for an educational relationship - in particular, trust and respect - compare to the relationship between performer and audience? The subject of the relationship between performer and audience frequently emerged during interviews or discussions with musicians, and ensuing debates often tackled opinions on the degree to which musicians perceived their role as educator or entertainer. Desirable properties of performer-audience relations were often cited as similar features to the relationship between student and guru; there is the matter of power to be considered, trust to be established and respect to be earned.

Although great performers of many genres might insist that they continue to learn and improve over their performing career, this notion is subverted by the professionalization and commoditisation of music performance that is known to many people in the UK today; when audience and performers are distanced by technologies of recording and

media, the performance goal is not so much an interactive, human act of communication but a final, concrete achievement. The guru-disciple system of musicianship schooling, with all its compulsory humility and automated rituals of respect, promotes the concept of lifelong, continuing apprenticeship of student to guru even after the student has come to be considered a guru in their own right. It also features a pedagogical style that emphasises an apprenticeship of all aspects of musical performance, a topic of social learning that was first mentioned in Chapter Two (section 2.8, page 47). The concept of *taleem* describes the time spent learning performance practice from one's guru, but is not restricted to instructional lessons. Taleem, in the early years of sitar education at least, includes all time spent in the company of one's guru.

Brinner describes, with reference to his experience of learning Javanese Gamelan, how musical learning must take place in many different forms than simply instructional lessons, as notions of behaviour not specifically related to technical (or even musical) ability are crucial to the relationship between teacher and student that will ensure continued development of skills that are *specifically* musical (Brinner, 1995:120). Neuman (1980) discusses the social aspects of the North Indian music lesson, and the role of taleem and riyaz in the guru-disciple relationship that underpins the particular gharana (school) system. This system is based on the idea of a family of musicians, and is drawn from the model of 18th century court musicians. By establishing distinctions of style and repertoire, developing their musical technique and also the capabilities of the evolving sitar, the musicians were protecting their interests by ensuring that specialist skills and knowledge could be preserved within the family, with each new generation presumed to take responsibility for the role.

Taleem therefore covers many aspects of the non-verbal information imparted to a student by a guru. For example, much of the education received by students relates directly to the reality of performance contexts. One way in which this part of the schooling occurs is when the students are asked to play tanpura to accompany their guru during performances:

> *FIELDWORK JOURNAL, WEDNESDAY 24 NOVEMBER 2004*
>
> *[This evening I was told of] the instance of a young Arvindbai [Mr Parikh] assisting Khansab [Ustad Vilayat Khan, Mr Parikh's guru] during the early stages of Mr Parikh's performing career. Having tuned his teacher's instrument and played tanpura for the main part of a late-night concert at a private house in 1950s Bombay, Arvindbai was upset when Khansab turned to him and told him*

that it was time for him to leave. When he asked if he couldn't stay and assist his guru through to the end of the concert, Guruji told me that Khansab had said to him, "No. This is not for your ears, you are still learning. I must give the audience what they want to hear but this is not for you." Apparently, the audience wanted to hear lighter music that would be inappropriate for the vulnerable ears of a student of serious raga performance…

In this example, it becomes clear that a student might expect to continue a humble and attentive relationship with their teacher in situations away from simple lesson scenarios. Further, the guru typically offers teaching and guidance in other situations. This excerpt also demonstrates that, in 1950s Bombay, at least, performers and audiences have complex and two-way relationships with one another. Supporting this idea further is the following example from an interview, in which Khyal singer, Purvi Parikh (Mr Parikh's daughter) describes the way in which she adapts her performances during international tour performances (each interview is numbered according to the date on which it was collected - see Appendix A for full details in each case):

> *PP: My concerts are a little monitored a bit in the terms of their actual content for a foreign audience… Choice of rag, and length, and the type of phrases that you're expressing. It shouldn't be too complicated, you know.*

> Interview 4, with Purvi Parikh

The reception of their performance by audiences is a standard topic of conversation among the North Indian professional musicians to whom I have talked. Anecdotally, this appears to be a popular topic among many musicians, from North Indian classical to UK jazz performers. This appears to be due not only to the matter of the musicians' livelihood. Musicians - particularly those who improvise the music that they play - generally care very much that they have the opportunity to play to responsive, musically-educated audiences, and they intelligently adapt their delivery to suit their audience. This attitude was demonstrated during an interview with tabla player, Subrata Manna and sarod player, Tarun Nayak, during which Subrata explained

SM: If I want to be into the audience and if I want to transform my feeling to them. So I start building up with grooves, definitely. Then when they're attuned already with that groove, you know? Or when they're already into it, then I try to do something

NM: OK, so you stabilize them - you make it a shared understanding like you said it...

SM: Stabilize, yes...

NM: You make it like everyone can access this because we all understand it?

SM: Yeah, when I give them a long period of improvisation. In short periods you cannot do that. You need a little time to build up.

Interview 6, with Subrata Manna and Tarun Nayak

Finally, given the presence of this two-way relationship between musicians and audiences, it is perhaps not surprising that, sometimes, performers may also become weary and impatient of ignorant listeners:

FIELDWORK JOURNAL, THURSDAY 2 DECEMBER 2004

[Last night's lesson included] an edifying tale about a jeweller with a discerning client, picking up stone after gem after jewel and showing it off, talking about it. Then in comes an ignorant client, so he puts them all away...

In concluding this personal account, the two dominant themes highlighted here (the role of participation and trust in building and maintaining social relationships for musical interaction, and the relevance of physical, embodied participation to the process of musical performance education) can be seen to be important factors in the development of North Indian classical musicianship. Functioning, interactive relationships appear to be essential to both student-guru and also musician-audience situations, and this factor of musicianship is clearly relevant from an early stage in a musician's development, as demonstrated in the fieldwork journal excerpt of Tuesday 24 November describing Tariq's performance in the group lesson. Furthermore, both themes of social relationships and embodied participation have been shown as relevant factors not only to education situations but also to subsequent public performance situations.

3.5 Transforming the primary research questions into open interview themes

The key themes demonstrated in the previous section, which underpin the research questions given in section 3.3, demonstrated (a) the importance of the construction and maintenance of social relationships in order to facilitate the learning, appreciation and also the performance of North Indian music, and (b) the need for a highly embodied and participative approach to an understanding of this genre. Returning to the stated research intent for this project - to explore mechanisms of musically communicative behaviour that may be associated with social interaction - this chapter now addresses the way in which such knowledge might be used to develop the primary research questions into the most appropriate open interview themes.

From the discussion of construction and maintenance of the social relationships required for both learning and appreciating North Indian music - the development of good foundations for meaningful and reliable communication - it seems reasonable to ask, as sitarist, Pandit Budhaditya Mukherjee does here -

> *BM: All this music and the beauty in it - what exactly is it? It's something to make you feel very good. You may not be able to define that 'good'. I would find it rather difficult to define that 'good'.*

> Interview 5, with Budhaditya Mukherjee

What is it that the individual musicians of instrumental North Indian classical music do together that they can co-construct "all this music and the beauty in it" with immediacy and spontaneity? Music somehow *communicates*, it somehow *means,* and how else could we talk about this ineffable sense of connection without attempting to choose words that describe how it makes us *feel?*

In order to collect qualitative data which probed introspective matters of beliefs and feelings, a method of informal interviewing was developed to avoid presenting presupposed, pre-defined categories for the interviewee to respond through (Sommer & Sommer, 2002:61). Open questions were designed to tackle topics drawn from the primary research questions, which included: musicians' interpersonal relationships; the musicians' perception of similarity and difference between social and musical interaction; and their opinion of emotional expression in musical interaction.

These topics were raised with musicians from the author's position as either research student, or sitar student, or a combination of two. The following general topics were found to be useful, and were used as a base for informal discussions:

1. What makes a good pairing of soloist and accompanist?

2. What motivates improvised musical performance?

3. How are differences between individually-motivated and collectively-motivated behaviours negotiated in musical performance?

4. How do you share emotional expression in musical performance?

5. What are the similarities between the way musicians relate to each other musically, during performance, and the way they relate normally, away from a musical context?

With the angle of the open interview process established within a valid context of primary research questions, the remainder of the chapter presents the analysis which explored the qualitative data of the six interview transcripts and the fieldwork journal.

The informal interviews therefore broached the research questions in as valid and natural a manner as possible. The remainder of the chapter presents the qualitative analysis used to explore the ethnographic material in transcripts of the six informal interviews based on this open question style, and also the material of the fieldwork journal.

3.6   Coding and analysis

The qualitative analysis was carried out by a systematic and reflexive method, adapted from a Grounded Theory approach (Glaser & Strauss, 1967). This is conducted through the coding of the data - a process of reading, re-reading and labelling themes in the qualitative material that is described below in section 3.6.1. At the subsequent stage of analysis, these codes are grounded with reference to real circumstances (Strauss & Corbin, 1990). In the case of this particular research, this stage examines whether the emergent theory, regarding the ways in which the musicians communicate and interact, holds explanatory power across the different performance contexts of various musical events. To do so, the codes are cross-referenced against material which refers to such performance contexts. The final section examines how the core codes yielded by this

process might operate through the particular frame of a North Indian musical performance.

3.6.1   Open Coding

The qualitative analysis process begins with open coding. Strauss and Corbin define open coding as "a procedure by which the data is first conceptualized. A transcribed text can be analyzed in this way, through examining minutely every line, sentence, or paragraph." (Strauss & Corbin, 1997:144). These conceptual labels may then be compared to one another, and a list of conceptual categories can be generated from this process (Glaser & Strauss, 1967:106).

Initial themes

In the first stage of this process in this particular case, five themes were developed to label instances of a participant's reference to a particular concept which were used to produce three categories, described later in this section. The initial five themes included:

1. The source of creativity in musical performance

2. Musicians' social roles and responsibilities

3. Ideal musical partnerships for performers

4. Reference to participant's own education, individual development and gharana identity

5. Statements pertaining to the distinguishing nature of Indian music versus Western music, or one gharana versus another.

Of these themes, the first three were taken further, while two were not pursued in further analysis. The grounds for the decision to restrict the list of themes were particular for each item. The first, number four in the list above, appeared to relate to the participant's method of establishing an authentic voice as a spokesperson for their profession as a North Indian classical musician. In this way, the theme correlated with the culturally-specific rhetoric that is used to support the gharana system, a notion made explicit in Neuman's account (1980). The fifth theme was a topic that occurred in the interviews or journal in the context of discussions of the author's status as a visitor from the UK. Neither of these themes is related to the thesis developed here, and so these findings were not developed in the analysis.

The development of the three remaining themes, through a re-reading of the data in the light of all themes considered together, generated a list of conceptual categories (Glaser & Strauss, 1967:106). The three conceptual categories that were developed through this process are presented below.

Source of musical creativity

The first category is related to the source of musical creativity; particularly, the importance of this to the improvised form of North Indian classical music. When discussion with musicians reached the question of individualistic versus collective motives for musical interaction, the topic often turned to the source of creativity in musical improvisation.

Mr Parikh told me of a time during his own taleem when he felt depressed that he was not coming up with new ideas. His guru's response was that various factors contributed to creativity. Apart from practice of technique and what Mr Parikh himself terms the 'chiselling' effects of taleem, another factor should be considered -

> *FIELDWORK JOURNAL, MONDAY 15 NOVEMBER 2004*
>
> *[…] thirdly, of course, is your attitude to life itself, you see. I told Khansab [Ustad Vilayat Khan], 'I am a Bhakti-margi. I am not a Gyan-margi.' Like Khansab himself was a Gyan-margi. Gyan margi says, "I am the centre. All power emanates from me." But then the Gyan margi has to believe that he's* [gestures as if to another person in the room] *also a centre of power.* She's [another gesture, as if to a second person in the room] *also a centre of power. That's a very difficult position because […] it is difficult for him to accept that others are also centres of power. The Bhakti-margi says, "Oh God, I am nothing. I am surrendering to you". And as Khansab told me, "Arvindbai - play for him, and believe that he is playing through you."*

This account suggests that, for some, the source of musical creativity is God; the musician is a conduit for a greater power. For others, the power, or creativity, emanates from within themselves: they are the source, not the conduit. In the context of duo performance, the source of musical creativity and an individual's own expression might have implications on the musicians' interaction. Certainly, the data suggests that the relationship between the motive of individual expression and the motive of collective or social expression, or 'togetherness', in a musical performance is a matter of intellectual tension.

Sitarist Budhaditya Mukherjee, in particular, strongly defended his individualist stance in the interview that he gave: "Your musical imagination - anyone's musical imagination - is generated in his own mind. Obviously." He went on to state that

> *BM: …what you finally get to see [during performance] is the degree of achievement of that person to relate to what his imagination is demanding. […] Look, what I'm creating is from my subconscious.*
>
> Interview 5, with Budhaditya Mukherjee

However, when asked about an imaginary scenario in which "there was never an audience" he conceded that the "particular faculty [for skilled improvisation] would not grow". Pandit Mukherjee sets up a clear opposition between audience and performer, and describes his idealised scenario as one where not only is alap introspective and personal but "the entire performance is private", since "an artist [who] is so much involved in everything around him, he obviously is not going to reach that height of concentration".

In contrast, during an informal interview with Mr Parikh, I touched on the matter of individualistic expression of a person's emotion through rag improvisation:

> *NM: Do you ever play to express specifically a personal mood of, for example, love or anger?*
>
> *AP: This is a difficult question to answer. There is a story of Hanuman, who is a wonderful musician, a veena player. Hanuman becomes too sure of his musicianship, which has proven to be so powerful that all the notes of the music come alive in front of him. His ego grows to such as extent that one day he wants to play, but the force of his own ego has killed the notes of the music.*
>
> *There must be humility and affection for the notes of the rag. In a great performance, the performer can evoke the very presence of the rag: the rag stands before the performer.*
>
> *The rag form is built up from the grammar of the rag; the grammar of the rag is a vehicle. If a performer is involved closely enough with the rag he will identify himself through the rag. There is a loss of ego.*
>
> Interview 1, with Arvind Parikh

Mr Parikh is aligning an ideal of expressive performance with the conduit metaphor available in the Bhakti-marg concept. This gives rise to interesting questions about the artist's relationship with accompanists and audience, a topic to be addressed as the third theme in due course.

Whether the inspiration comes from a divine source or an exceptional level of concentration, both Mr Parikh and Budaditya Mukherjee suggest the presence of two contributory factors. Apart from the long hours of rehearsal cited by both as an integral element of fluent performance, both musicians also demand the full attention of their accompanist and audience, to support (not share) their improvisation. Mr Parikh offered an example, describing an instance where Zakir Hussein, an extremely skilled and famous tabla player, performed alongside the sitar master, Ustad Vilayat Khan. For this particular concert, Mr Parikh particularly praised the way in which Hussein performed an accompaniment - although only playing two or three extended solos throughout the long performance, "he was enjoying it, not feeling at all that he's not being given an opening for his own playing". After this approbation of Hussein, Mr Parikh noted that certain members of the audience who had attended the event were impatient to hear Hussein, and thus proved themselves to be lacking in their role as attentive listeners.

Social roles and responsibilities that musicians saw for themselves
This brings us to the second category, relating to the social roles and responsibilities that musicians envisioned for themselves and their colleagues. Alongside the views of Budhaditya Mukherjee and Mr Parikh, various views describe performers' responsibility towards the audience. Purvi Parikh suggested that audiences need to be considered; Subrata Manna suggested that they must be educated. In an alternative view presented earlier in the instance of Mr Parikh's taleem with Ustad Vilayat Khan (excerpt from Fieldwork Journal, 24 November 2004), it might be understood that audiences should, occasionally, be pandered to.

 Most explicitly voiced in the interview with Tarun Nayak and Subrata Manna were discussions of concert attendance and the responsibility of the artist versus the responsibility of the audience:

> *SM: ...nowadays, a lot of people are talking about our concerts are not well-attended.*
>
> *N: It's something I've heard.*
>
> *SM: Yeah. Well, I think you cannot blame them only. You have got to have some responsibility too...*
>
> Interview 6, with Tarun Nayak and Subrata Manna

Subrata Manna's statement reminds the reader that tabla players also have a contributory role in the expression of the rag, and that all performing artists may have a duty to maintain good relations with the attending public. Budhaditya Mukherjee's discourse also specifically refers to performer and audience responsibility:

> *BM: …the artist is there - he's the person responsible for creating the beauty, which is expected of him. But give him a chance! So for the first ten or fifteen minutes, it is the audience's most respectful duty to support the artist in whatever he's doing. If he can't grab the attention of the audience in those fifteen minutes initially, then they're free to talk or leave the place!*

> Interview 5, with Budhaditya Mukherjee

Budhaditya Mukherjee's ideal situation appears as one in which a sensitive, attentive and possibly hand-picked front-row audience only serve in a "psychologically helpful [manner] to him to reach that stage of peace" through which he can achieve perfect concentration, because he is more than aware of the potential for an inattentive audience's "distraction to reach the stage, then this will kill the artist's thought process".

There is a paradox in Pandit Mukherjee's account: if the faculty for spontaneous, skilled musical improvisation was redundant in the face of a reality without an audience ("without an audience, that particular faculty [for skilled improvisation] would not grow"), but if the performance is necessarily individualistic and personal, then what is it that the audience could do - or *not* do - that would distract the performer from his individually-motivated musical expression?

It could simply be that the noise level from a chattering audience might interfere with the attentional resources of a performer. However, this is not what the articulate Budhaditya Mukherjee says: it is the "distraction" itself that might somehow be conveyed to the stage and "kill the artist's thought process". Distraction could be described as a diversion of attention; a redirection of awareness from one main source of interest. The literature described in Chapter Two (section 2.7) offered the concept of *rapport* to explore social interaction, suggesting that *mutual attentiveness* plays a key role in the maintenance of communicative relationships, necessary for the creation of a "focused and cohesive interaction" (Tickle-Degnen & Rosenthal, 1990:286). It appears that, in the scenario of formal musical performance that Budhaditya Mukherjee describes, his role is in fact a highly social one that hinges on his presence as the source of novel, beautiful and creative

meaning. He cannot conceive of musical performance without an audience, but his audience must ideally be offering him their full attention.

This gives rise to the question: what precisely is it that the audience should be directing their attention to? Most important to Budhaditya Mukherjee are his personal "aesthetic visions", the imaginary, creative building materials through which he conveys continuity in the improvisation, for this is what gives his musical performance structure and meaning. When I ask about the importance of such structural features as rhythm and timbre, he specifically tells me that these "parameters only provide support to help focus the clarity" of his vision. For Budhaditya Mukherjee, the elements of musical structure which give a performance meaning issue from him alone - but having established that there could be no improvised performance without an audience, then the meaning must also rely on a two-way interaction: his voice cannot simply be heard, it must also be appreciated.

Ideal musical partnerships: loving and warm
In all the ethnographic material, there appears to be an implication that the tabla player has a responsibility to the soloist. According to Mr Parikh, the soloist needs to know that the tabla player "would definitely play within that disciplined circle [of the time structure]". Subrata Manna suggests that a tabla player has a particularly difficult role because of their responsibility to the soloist: "we have to get ready to answer. Because you won't get second chance on the stage. So in a way our job is a little bit more challenging or difficult than the main artist!" Budhaditya Mukherjee discussed the issue of a tabla player's responsibility most specifically: "I would like a warm, affectionate tone, patience and a little love for my music."

This brings us to the third and final category, emergent from the frequent use of social relationship terms such as "love" and "affection" to describe idealised accompanist-soloist musical relationships. A description that fits this category also exists in rapport studies in social interaction literature, where Tickle-Degnen and Rosenthal (1990) describe the apparent need for visible evidence of positive affect between individuals in dyadic interaction. In order that the quality of rapport can be created and sustained, the participants must experience "mutual friendliness and caring" towards one another, which is typically generated through non-verbal means (Tickle-Degen & Rosenthal, 1990:286).

Subrata Manna and Tarun Nayak commented on Pandit Mukherjee's quote, given during their interview; both musicians agreed that there must be affectionate feelings present in some way. Tarun responded with a metaphor:

> *TN: That is the accompaniment, when he's telling me some story I'm telling him some story, we are exchanging our deepest part of our hearts which is very abstract but very concentrated.*

> Interview 6, with Subrata Manna and Tarun Nayak

Mr Parikh's reference to his preferred tabla player was couched in affectionate terms, and hinted at the source of the connection between a good social relationship and a good accompanist:

> *AP: So he started with such a beautiful introduction which was in one to two tempo, and it gave a tremendous pleasure because it's - (now, this is where the answer to your question comes in). Because if the tabla player's musical enough, he's able to decipher and absorb what the musician's musical thinking at that particular moment is.*

> Interview 3, with Arvind Parikh

Soloists express strong preferences for one accompanist over another (Budhaditya Mukherjee described his attitude to accompanists: "I don't tend to stick with a very few, but then I do not also like to lay all the diamonds on the roads…") . Indeed, musicians in all genres tend towards certain partnerships and not others; some duos or groups work effectively and creatively while others fall out and fail to produce music together in a way that satisfies everyone involved.

Musicians who do not get on socially may find affinity during co-performance, and the reverse can also be true. Given this dichotomy, the use of social relationship terms to describe the qualities of an ideal musical partnership is interesting. Mr Parikh's own words in the interview excerpt given above appeared to give him new insight ("Now this is where the answer to your question comes in…"). To Mr Parikh, the best accompanist provided a particular density of musical sounds in accompaniment that demonstrated an understanding of Mr Parikh's own intentions. Tarun Nayak also offered the idea that musical partnerships required a great deal of empathy and mutual knowledge:

TN: It's related to all this - my knowledge, my thinking. Everything. And so this is true with him also, I think. What he thinks [...] that is expressed somewhere or other through music. There must be some common point between two individuals that we can converse.

Interview 6, with Subrata Manna and Tarun Nayak

Conceptual categories

In the final stage of the open coding process, the themes were considered in the light of one another, and this new interpretation was considered during the re-reading of the data. All three themes, of creative imagination; social roles in musical performance; and relationship qualities applied to musical interaction, share a commonality relating to the musicians wanting to know, or seeking some control over, one another's motivations and intentions when they perform together. With this commonality in mind, a list of three, mutually consistent categories relating to the operation of musical relationships were summarised. These included negotiated tempo, musical structure, and anticipation of others' intention as three elements of the way in which musicians appeared to manage one another's motivations and intentions during musical interaction.

The importance of a negotiated tempo appeared to have two functional effects: (a) its effect on inter-performer relationships. This can reveal either a "fit" or a "mismatch" between performers (Interview 3, with Arvind Parikh); and (b) expressivity in musical performance. Mr Parikh explains that "[a particular] emotion is [only] dominant in a particular area of the presentation. Because then it changes, you see, when the tempo changes" (Interview 3).

The second category described the musicians' reliance on predetermined aspects of musical structure. The musical structures must be known explicitly by the musicians involved in the interaction. Tarun Nayak's example, given in the interview after a performance with an unfamiliar musician: "…so we started with *vilambit* Teental. We know the basic structure, that framework is always there." (Interview 6, with Subrata Manna and Tarun Nayak). Musicians appear to use these structures to seek out the underlying intentions of other musicians - Budhaditya Mukherjee (Interview 5) suggested that "if my *sangatkar* [accompanist] is enjoying the music as well as giving me the *sangat* [accompaniment], he will realise that this is not the time to play his solo part."

The final category refers to musicians' anticipation of others' intention. In pragmatic terms, the musicians may try to predict an "expected kind of moment" (Interview 3, with

Arvind Parikh) regarding musical structure developed by or with other musicians, or they may try to read the audience response - "You can see that is a discerning person… you see people in the audience who you feel are receiving your communication" (Interview 4, with Purvi Parikh). All three categories help to articulate features of the active way in which performers communicatively engage with one another, and they also suggest that these acts of relationship-maintenance may occur between performers and audience members.

3.6.2   Reflecting on the context of musical interaction occasions

A further aspect of the systematic Grounded Theory method of qualitative data analysis suggests that theory which emerges from data coding should not just fit substantive data, but should also be generalisable across contexts (Glaser & Strauss, 1967:51). In order to examine the relationship of the codes to the theme of musical interaction as social interaction, the following discussion examines the data's reference to distinct occasions - events - of musical interaction.

During two of the interviews, I asked the musicians about what it is that differentiates contexts for musical behaviour in a North Indian classical music culture:

> *NM: So there is continuity in the study and performance of sitar between the taleem and riyaz and the performance - they're part of one thing?*
>
> *BM: You can understand it like this: it is input, assimilation and output.*
>
> Interview 5, with Budhaditya Mukherjee

During the interview, Budhaditya Mukherjee subsequently shows that there is a continuum in his mind between practice and stage performance when he defends the position of an individualist nature of performance by referring to the "tens of thousands of hours [we practice] without an audience". When the topic arose with Purvi Parikh, she described the combined role of composer, conductor and performer of the North Indian classical musician, suggesting a merging of several contexts for creation, rehearsal and performance of music.

To refer again to Brinner's (1995) account of the process of attaining complete musical apprenticeship, the inclusive definition of musical competence involves "all the types of knowledge and skills that a musician may need, […] an organic rendering of the "systematics" of a musical tradition" (Brinner, 1995:110-32). Through this process a

student learns complete sets of behaviour which, in composite, form the musical competence. At this level, the continuity between different musical activities is a given - all parts constitute the whole accomplishment of musicianship.

In Mumbai, lessons take place at Mr Parikh's home, and the beginnings and ends of this instance of musical interaction are determined at the teacher's discretion. The demonstration of this is most apparent in behaviour with a series of actions that mark the beginning and end of the event. For example, to begin the students might arrive and set out the instruments before the teacher comes into the room. The associated paraphernalia of sitar-playing - tools to tune, replace strings, grease fingers, clean the instruments - are laid out. Students prepare their own instruments and set up the electronic tanpura machine to begin tuning up. On the teacher's arrival, it is considered most respectful for the students to bend and touch his or her feet, and on doing this, the teacher will usually give the student their blessing. At any signal that the lesson is coming to a close, it is appropriate for male students to massage their guru's legs.

Beyond these signals and markers of the progress of the ceremony, certain social aspects of the contexts show resistance to relocation of room, building, country and props. For the lesson to be a lesson, the participants must share the motivation to be involved in a lesson. This hinges on a number of factors which must include certain features such as the status of the teacher in the eyes of the participants; the intention of the student to learn; and the intention of other people present to honour this lesson scenario. For example, rehearsals by the teacher with an accompanist before public recitals may also be integrated into a lesson. The opportunity to observe the skills and techniques of senior musicians in action is valued by students.

The difference between domestic and concert-hall performance settings again appears to be related largely to the behaviour of the participants, as Purvi Parikh describes: "If it's intimate audience you can see their faces but if it's a hall, then of course it's too much large mass" …However, while the very environment of a concert hall keeps the expert front row of the audience away from the main artist, extrovert behaviour from the front row of audience members - or even just one receptive listener - could potentially transform the feeling from the performer from distanced and formal to an informal concert. Purvi continues "…though it's many times that you can see that is a discerning person, you are almost addressing your entire concert to that person" (Interview 4, with Purvi Parikh).

In the course of fieldwork and recordings, it was typical to observe the context change in the course of one session of musical interaction. For example, as individuals arrived in the room where rehearsal was underway, the musical event could become showier - and develop into a type of informal performance; during lessons, the demonstration of a *tan* (fast phrase) might become part of some more substantial performance demonstration, then return abruptly to pedagogical context as a relevant interjection was voiced. The distinction between a lesson and a rehearsal, or a rehearsal and a performance, could be described as part of a sliding scale of extant contexts which accommodate musical behaviour.

3.6.3   Core Codes

To this point, three categories were shown to have been derived during the open coding stage (a) negotiated tempo; (b) musical structure; and (c) anticipation of others' musical intentions. With these categories, the qualitative material was read once again, on this occasion with a view to seeking out core, common codes in the light of the grounding of conceptual categories within the theoretical contexts of musical interaction.

The sliding scale of context for musical behaviour, from rehearsals to lessons to concert halls, suggested that a key distinction in the extant circumstances of these contexts may be the presence of people who witness the interaction, and the function of their social relationships. The physical co-presence of audience groups, as Purvi Parikh's quote at the end of the previous section described, might impact on the performance depending on whether or not the performer can see the individual faces. Budhaditya Mukherjee's performance may apparently be affected by audience presence ("If [a listener's distraction were to] reach the stage, then this will kill the artist's thought process"). The variation in one session of taleem between student demonstration and student performance, as given in the fieldwork journal excerpt of Tariq's playing during the busy sitar lesson (fieldwork journal excerpt, 23 November 2004), suggests that co-presence is a defining factor in the quality of many musical events.

Themes in the data pointed to the musicians' own consideration of the act of shared expression as something mediated without conversation or literal instruction ("There is some common point that we feel we're hitting on both sides. That is always happening with him and me also when we're playing" - Interview 6, with Subrata Manna and Tarun Nayak), and those processes of synchrony in ideal relations between the musicians ("If there is synergy between tabla and sitar then the whole level and success of the concert

will be enhanced because of the tabla player's contribution too" - Interview 3, with Arvind Parikh).

While tabla players' own personal expressive contribution is, according to the rhetoric surrounding North Indian classical music performance, considerably less than that of the soloist's, the actual experience of co-performance was a consistent feature in musicians' accounts of the communicatively salient aspects of musical interaction. The importance of co-performer communication was taken as given; questions of the channels of mediation for this "synergy" were often diverted to the existence of pre-existing musical structures, particularly rhythmic aspects

> AP: ...whilst the cycle is structured, and because of the fact that the tempo is live, the tabla player in many cases tends to alter that tempo to suit his own requirements. Because ...they are comfortable, they are in a position to express themselves much better. And if the sitar is ... not in control of the tempo which he wants, then he can be swept away...
>
> Interview 3, with Arvind Parikh

Or, alternatively, the mediation of co-performer interaction was attributed to physical gesture ("We use a lot of hand gestures because they help us express ourselves, to communicate, and to conduct, you know, while we're performing - it helps us to execute the ideas that we have inside our head." - Interview 4, with Purvi Parikh)

Common factors of both physical co-presence and of movement-in-time exist implicitly in all these categories; these are taken as core codes for the final stage of analysis, in which a grounded theoretical framework for the observation of musical duo interaction is set out.

3.6.4   Reality: contexts

Strauss and Corbin emphasise the need to focus analytically on the dynamic features of a research topic, to observe the aspects of the social phenomenon which change and show movement in time (Strauss & Corbin, 1990:96-115). In the case of musical interaction, their approach can be used to concentrate the study on those emergent aspects of communicative process which might underpin the event. As stated earlier, the subsequent analytical process in the development of a grounded theory requires the grounding of codes with reference to real circumstances. Borgatti (2005) states that this method of analysis can be carried out according to a basic frame of generic relationships, so that

categories found in the qualitative data can be examined with emphasis on their causal relationships in light of the phenomenon in question.

The framework given in Table 3.2 was useful in formulating a framework for a method of axial coding. The table given here, Table 3.3, presents an outline of Borgatti's generic framework and the adaptation for use with these data pertaining to communicative musical interaction, as explained below the table.

Table 3.3 - *Borgatti's (2005) generic frame for axial coding, after Strauss and Corbin (Strauss & Corbin, 1990:96-115), as applied to the case of North Indian duo performances.*

Basic frame of generic relationships for aspects of complex social phenomena (Borgatti, 2005)	As applied to the study of communicative musical interaction in North Indian classical music dyads
The phenomenon (concept of interest to researcher)	Event of communicative musical interaction
Causal conditions (the events which lead to the occurrence of the phenomenon)	A functioning relationship between at least two musicians
Context (specific values that influence actions related to the phenomena)	Moderating variables in the circumstances which accommodate the musicians' relationship (i.e. rehearsal, performance)
Intervening conditions (mediating variables which influence the occurrence of the phenomena)	Audience presence: how many people are involved (silently or as participants) in the interaction?
Action strategies (purposeful, goal-oriented activities that agents perform in response to the phenomenon and intervening conditions)	Co-ordinated, other-aware behaviours mediated without conversation
Consequences (the intentional or unintended consequences of the action strategies)	The 'dynamics' of the interaction

It is assumed from the codes and categories developed during the previous pages of analysis that any event of communicative musical interaction requires a functioning relationship between at least two musicians. The *moderating variables* that would be expected to influence the event of communicative musical interaction include the socio-musical contexts in which the musical interaction may take place. These include informal and pre-concert rehearsals, lessons, conversations, formal concerts and informal

performances. An observational analysis of the musicians' behaviour could consider such moderating variables as independent factors.

Intervening conditions which may affect the musical interaction include the presence of other people who witness the interaction, and the social roles of these people. The presence and behaviour of other individuals apart from the musicians may be influential, through the factors of physical co-presence and movement-in-time. These conditions could also be incorporated as independent variables during the video-analysis of the behaviour of the musicians.

The communicative, co-ordinated, other-aware behaviours - which the qualitative data have demonstrated to be important factors to the musicians - can be considered as *action strategies*. They all appear to contribute in some way to the dynamics of the musical interaction. The dynamics of a musical interaction could be defined by the qualities of performance that contribute to the musicians' own view and assessment of the event and their relationships. Such qualities may also contribute to the 'success' of the event as an act of audience-involved musical performance.

Through this chapter, the results of a method of qualitative data analysis have been set out, based on a grounded theory approach. The analysis asked how individuals co-construct musical interaction in improvised settings, and proposed a framework in which the components of musical interaction might be explored. Musical interaction, as explored in this chapter, appears to depend on the existence and continual maintenance of a relationship between least two individuals. In pragmatic terms, the interaction is constrained by aspects of what could be termed as the socio-musical context which house the social relationships that appear to be required for musical communication.

As Table 3.1 sets out, the research questions lend themselves to various methods of exploration, one of which -- also suggested in the ethological approach advocated in Chapter Two (section 2.10) -- includes video observation. A video analysis was conducted to see how the two key themes highlighted through this qualitative data reading - physical co-presence and movement-in-time - could be observed for their communicative function within particular instances of co-constructed musical interaction.The subsequent chapter describes the method devised for this analysis, which observes particular instances of musical interaction with reference to the qualitative categories derived here and considered to possess *emic* value.

4 VIDEO ANALYSIS FOR NORTH INDIAN DUO PERFORMANCES

4.1 Existing paradigms for behaviour observation

As Chapters One and Two argued, the research agenda for this thesis requires a focus on the physical aspects of musicians' interactions, calling for an analysis of movement as indicative of real-time communicative mechanisms. This chapter presents the development of a method for collecting such empirical data on musicians' potentially communicative behaviour during musical interactions, for use in a comparative study of communicative interaction in North Indian classical music duo performance.

As social interaction scholar, Cappella notes, the very concept of interpersonal interaction requires that we view the persons involved as capable of influencing one another's behaviour through their own behaviour (1996:353). The possible use of an ethological paradigm for the observation of musical interaction was first presented in Chapter Two, section 2.10, which described how the means and motives of ethologists who study the natural behaviour of animals under natural conditions appeared to be consonant with the aims of an embodied cognitive view of musical action. An ethological approach might therefore provide the methodological basis for an empirical study of musicians' social behaviour.

The application of the methodology in this case would be to measure the rate, duration and time-series qualities of particular behaviours exhibited by North Indian musicians in dyadic interaction. An analysis that deals in quantified evidence of communicative mechanisms can then explore the relationship of social and musical variables to the consequent data. Towards this end, videoed observations used in this study consist of real-time musical interactions whose ecological validity is maintained through a very low intervention method of data collection.

The classical behaviourist paradigm of animal observational studies has limitations; in observing only the external evidence of action, assuming no intention in the behaviour, the simple observation of movement could not possibly touch the "complex [and] collaborative" elements of musical interaction, which define such behaviour as a product of cultural cognition (Tomasello et al., 2005:675). However, post-behaviourist ethology attempts to include this missing cognitive aspect, incorporating an evolutionary perspective that considers the distinction of ultimate and proximate causation of

behaviour. A specifically cognitive approach, first proposed by Donald Griffin (1976), defines cognitive ethology as "the comparative, evolutionary, and ecological study of animal thought processes, beliefs, rationality, information processing, and consciousness" (Allen & Beckoff, 1997:ix).

While some ethologists have resisted this approach, suggesting that the reading of internal motivation from the observation of action must ultimately generate non-falsifiable hypotheses (Heyes & Dickinson, 1990), others have argued for the value of studies which target topics of communication and intention in animal behaviour (Allen & Beckoff, 1997). Beckoff proposes that mechanistic, stimulus-response explanations for animal behaviour are often "cumbersome", and suggests that both cognitive and noncognitive explanations might take the form of *just so* stories reliant on hypothetical constructs, and that "neither type applies in all situations" (1998:375).

Beckoff's suggestion, that recourse to a stimulus-response account of behaviour is sometimes appropriate but that other events "are best explained using a rich cognitive vocabulary" clearly applies to the instances of musical interaction explored here (1998:377). There are certain culturally-accepted and well-theorised tenets regarding the cognitive basis of musical interaction; it is not controversial to assume that musicians consciously intend for their behaviour during musical interaction to be meaningful on both a specifically and directive communicative and expressive level. As has been demonstrated through the preceding chapters, a crucial view taken by those who engage particularly with North Indian classical music is that the musicians are in a communicative, interactive social situation. Individual musicians act in a situation which requires that they reconcile their own personal intentions of sound production and musical structure with other the intentions of other musicians, in order to co-construct the musical event.

Furthermore, the social, participatory, and embodied processes involved in the event of musical interactions - revealed as emic categories of North Indian music performance through the qualitative analysis of Chapter Three - demonstrate that the physical involvement of the musicians in the whole event of musical interaction renders their expressive, non-verbal behaviour inextricable from the music-as-sound that they produce. In these terms, musicians certainly seek to entrain to one another's behaviour in order to play together in musical time, and appear to seek to influence one another's behaviour with their own behaviour towards this end (Himberg, 2006). It seems likely that the

reconciliation of other personal intentions regarding the emergent co-constructed musical event may also be negotiated through non-verbal action.

Chapter Two reviewed Owings and Morton's (1998) animal vocal communication motivational systems perspective. This framework focuses on the idea that it is the very regulation of self and others' behaviour that is key to communication processes. The appeal of this approach is its pragmatic focus on observable communicative outcome rather than abstract information. Instead of being something external and abstract awaiting interpretation through a process of representation and computation, information is defined as "useful shorthand to describe what [it is that] assessment produces. In strong contrast, management is focused on producing behavioural changes, not information." (Owings & Morton, 1998:54-5). The inter-related processes of production and perception of communicative behaviour are framed here as an interaction of assessment and management roles.

The observation of behavioural changes - and, crucially, the real dimension of timing in which these behaviours occur - is something that the ethological coding of empirical video data of interacting musicians might address by generating quantified data from the observation of these musicians' behaviours. The complex intentional motivations of the musicians' behaviour need not be denied, but - essentially - neither must these motivations be interpreted in order to carry out the analysis, since a framework that interprets communication through the notion of individuals' motivation to regulate themselves and others in their environment uses the resulting pragmatic outcomes of real-time behavioural changes as the grist for the analysis. The type of measurements collected from video recordings must therefore include observations about the movements of the musicians' bodies, but they do not need to account for the interpretation of the specific communicative intent of those behaviours. It is more relevant to consider their potential value and function as "behavioural changes" (Owings & Morton, 1998:55) brought about by the real-time process of management-assessment. Their interpretation in this light can be explored through a comparative analysis designed specifically for the case of duos of North Indian musicians.

This chapter accounts for the decisions that were made in the process of designing the video analysis, including the choices made in the description and classification of the infinitely varied movements of the performers, and those choices regarding data

collection procedure. The chapter concludes with descriptions of the musicians and events included in the recorded scenarios of interaction.

4.2   Descriptive classification of musicians' interactive behaviour

Existing studies that have used video analysis to explore musical performance primarily include research by the music psychologist Jane Davidson (2004; 2002; (in press); Williamon & Davidson, 2002), who has provided perhaps the largest body of work on the role of the body in music performance and musical communication. Studies such as Williamon and Davidson (2002) examined the importance of eye-contact in music rehearsal and stated the predominance of this over use of spoken language for inter-performer communication. This research, like much of Davidson's, uses video recordings as the basis for analysis of the frequency and duration of expressive behavioural events. A further influential paradigm for the video analysis of musical performance was developed by Regula Qureshi, whose *contextual input* model was designed to consider the processual aspect of music performance (Qureshi, 1987). Particular graphical effects were developed in order to present a performer's view of a Sufi musical event, using the visual alignment of musical transcription with video transcription of the participants' physical gestures. Other studies, such as Clayton (in press) make closer and time-coded analysis of specific events that occur during musical performance observing. In particular, Clayton observes the regularity of *tanpura* playing in the accompaniment to a North Indian classical vocal performance. This mode of video analysis uses the observation of fine motor movements and reveals that a form of emergent order - more complex than a one-to-one beating along with a pulse - exists between players' movement patterns.

For a video analysis methodology suitable to answer the research questions established for this thesis, the object of the observation should be the likely *action strategies* of co-ordinated, other-aware behaviour suggested by the analysis in Chapter Three (see Table 3.3). Exploratory description schemes and classifications of various behaviours were developed in the early stages of the video analysis design, consistent with a stage of exploratory observation that would yield the ethogram in a classical ethological approach. The most salient features of the specific case of the North Indian classical duo performances arising from these early stages were then used to guide the choices necessary for the description and classification of the musicians' movements.

The aim of the coding process is to log the most pertinent aspects of musicians' behaviour with a view to exploring the action strategies that may be used by interacting musicians to co-regulate their own and one another's musical behaviour, and to record these occurrences as time-series data in order to preserve the real-time, durational quality of the interaction. A parsimonious way to describe such non-verbal movements and gestures in this instance calls on the distinction set out by the ethologist, Hinde (1979) between the simple, objective labelling by *physical description*, and the style of *description by consequence*, through which patterns of behaviour are defined by their particular outcomes (Borgerhoff Mulder & Caro, 1985:327). The description by consequence approach was valuable in categorising the musicians' movements according to three broad, functional themes: evidence of visual attention, or availability for communicative purpose; expressive movement; and non-functional movement. The description of hand and arm movements necessary for sound production and instrumental technique was set aside as the analysis configuration developed here aims to focus on the aspect of social communication in the performers' behaviour. While accepting the premise that the musicians' sum body movements seem likely to contribute to the music-as-sound that they produce, musicians' movements that were associated solely with sound production on their instrument were not included in the descriptions.

Two existing, generic ethological measures for the description of behaviour were particularly useful in the descriptive classification system for the analysis. Martin and Bateson (1993) distinguish between two end-points on a continuum of duration qualities of movement. Behaviour patterns with a relatively short duration that can be described at points in time, such as discrete movements such as a nod, are usefully defined as behavioural *events*. Patterns of a relatively longer duration, such as a directed gaze or particular body posture, may be described by the description of behavioural *state* (Martin & Bateson, 1993:66). Tickle-Dengen and Rosenthal (1990:288-9) address the different levels at which participants' communicative movements may be integrated with one another. They propose a continuum on which to distinguish between the observational interpretation of individual behaviour, or integrated, dyadic interaction. This takes into account the measurement of discrete acts by participants (for example, direction of an individual's gaze); to the combination of these discrete acts by dyads (acts of mutual gaze); to discrete acts that together maintain interaction - for example, turn-taking behaviours; to larger scale behaviours with describable functions (such as expressive gestures conveying affective or pragmatic qualities).

The subsequent sections (4.2.1 to 4.2.3) provide an account of the classifications used to describe (code) the video recordings of the musicians in the light of behavioural *event* and *state* distinctions, and according to the continuum of interactive description offered by Tickle-Dengen and Rosenthal (1990:288-9). In the first instance, the analysis design observes behaviours as individualistic and isolated, noting simple features of duration and rate. At the subsequent stages, reported in Chapters Six and Seven, the co-performed and interactive nature of the behaviours is examined.

With the use of video analysis software, The Observer Video-Pro, the categories of behaviour summarised below were used as the basis of a coding configuration. The software allows the user to analyse digital video files at speeds ranging from frame-by-frame to eight-times real-time. This facility allows the user to identify and pinpoint particular behaviours, perhaps repetitive behaviours or larger scale events, and time-code these observations. While the software was originally designed for animal behaviour observation, the system is very versatile. Raw video material is collected by the researcher in the manner most suitable for their project, using whichever video recording equipment and camera set-up is appropriate to capture the behaviour that interests them.

In Chapter Three, certain difficulties associated with video analysis of musical interaction were set out (section 3.3, page 63); further potential difficulties with the method also exist. These include the manner in which people's bodies move in signature, individual ways, and also the way that musical instruments restrict how performers are able to use their bodies. For example, a sitar player always has more freedom of movement in their right foot than their left, and this freedom is greater than the amount of movement to be expected in the right foot of a tabla player. However, individuals tend to move with consistency and repetition to the extent that, for example, an individual's walking style can be enough for a friend to identify them from a great distance. A very strong familiarity with the video data, and the movements of the individuals involved, was gained over the period of data collection and analysis (see Appendix D for measures of reliability of coding). Similarly, the particular restrictions of instruments on the performers' movements were taken into consideration during the observational analysis. Such tactics to solve the problems associated with video analysis are described throughout this chapter.

4.2.1 Availability for communication - musicians' use of attention

The ethnographic study detailed in Chapter Three pointed towards the importance of the attention paid by and to musicians in interaction with one another (section 3.6.1) and, as was described in Chapter Two, both facial expressions and use of eye contact are known to be extremely important aspects of non-verbal human communication, and have been explored at great length in the research of, respectively, Paul Ekman (Ekman & Friesen, 1998) and Michael Argyle (1969; 1972; 1976). Recent research by Richardson and Dale (2005) and Richardson, Dale and Kirkham (in press), first cited in Chapter Two (section 2.6), points to the significance of attention patterns within the apparently simple act of one-to-one conversation, and also to the management of more complex social interactions. This approach has precursors in the cognitive ethology research that have considered aspects of attention related to communication through the study of animal patterns of vigilance (see Beckoff, 1996; Gerstner & Fazio, 1995).

Behaviour that is related to attention can be examined in the video recordings collected for this research by recording the direction in which the participants appear to be looking. This category of observation can be described as a behavioural state, for which four mutually exclusive conditions were defined: the musicians might be looking down towards their own hands, or at the other musician's hands, or at the other musician's face, or away from their partner. To supplement this information, the state of the individual's eyes - whether they might be open or closed - is also recorded. In the case of ambiguity, the state of the eyes might be described as 'downcast'.

Ambiguity typically occurs due to the limitations of video recording, where a frontal view of both musicians has the effect of limiting the perspective of the direction of eye gaze when the individual tilts their head forwards. In order to avoid ambiguity in this case, further video cameras would be required to record the view taken upwards from the floor in front of the performers to their faces. However, if the single camera perspective of the recordings has limitations, the compensation is that the audience-eye view recorded as natural a scenario as possible. Furthermore, the design of this aspect of the configuration is based on the notion that the interaction between musicians depends in part on the perspective of the musician being potentially looked *at* rather than the musician who is allegedly *looking*. The importance is the direction of the face, not the exact direction of the gaze. Whether the tabla player's eyes do or do not rest on the face of the soloist is not as relevant as whether or not the tabla player's face is presented towards the soloist, as it

may be that this is how the tabla player is making himself visible and available to the soloist.

The record of these events therefore gives an account of the direction in which participants present their face - either down towards their own hands (self); towards their partner's face (other's face); towards their partner's hands (other's hands); or away from their partner and themselves (away). Use of eye contact is also recorded (as open, closed or downcast), with a view to accounting for the individuals' management of their own and their partner's behaviour.

4.2.2   Whole-body involvement and availability for expressive behaviour

A second element of the configuration depends on the observation of the musicians' expressive upper-body movements. Certain gestures that musicians make can be thought of as expressive carriers for functional, attentional behaviour such as the direction in which participants appear to be facing at any one time. For musicians of stringed and percussion instruments, the upper torso, including head, neck and shoulders, is still available for movement when the hands are otherwise occupied.

Expressive gestures can be very hard to describe as human hands, arms, shoulders and heads tend to move with complex motion and with changing speeds. Also, there is a level at which these gestures are inherently communicative - they are expressive *of something* - and a socially-intelligent tendency is to 'read' them in order to account for the intention of the individual who is using them. As section 4.1 explained, in the case of this particular video analysis there is no need to attempt classify gestures with these descriptions. The aim of the video coding is to identify, more simplistically, the points of time in which the onset and retraction of expressive phrases begin.

Non-verbal communication research has supplied various techniques through which to describe such complex movements. Key to the identification of expressive gesture phrases, following work by Sacks, Schegloff and Kendon, is the assumption that there is a neutral position for the body to be in ("home position" (Sacks & Schegloff, 2002); "the position of rest or relaxation" (Kendon, 2004:111)). Naturally, this neutral position depends on the social context - for example, three people conversing together will position themselves so that all three can share a common space and offer each other a shared view of their body and face. This provides a spatial-orientational formation for the

interaction, a subject explored in such research as by Scheflen (1964) on the effects of posture and orientation to social interaction.

The neutral position is used here to describe a position in which individuals are not using their bodies 'effortfully' to express themselves, as part of a communicative act with another person. The concept of the neutral position also accommodates the material practicalities of any situation; for example, whether the participants are seated, and in what manner; whether they are standing, or carrying an object. To illustrate further, consider a situation in which an individual types at a keyboard while they talk to a friend. The hands-in-typing action could be read as the default, neutral position in this interaction situation. Although the individual's hands may be moving, the action is not related to the communicative situation. If the individual were to act expressively during the conversation, it is likely that either their hands would leave the typing occupation to gesture, or alternatively, they might substitute an expressive movement of their head or shoulders.

Expressive gestures emerge out of a resting position, and usually return to it - or to another, new resting position. Kendon uses the term *gesture unit* to describe this complete excursion from neutral position back to neutral position (2004:113). Within a single gesture unit, multiple shorter phrases of expressive gesture might occur. However, there are two clear points in time by which to code such a gesture phrase: (a) the onset of the gesture - the start of the effort that will take the gesturing body-part out of its current neutral position; and (b) the point at which the body-part that has been gesturing *begins* to return to the neutral position.

The event of the second point might sometimes be difficult to define; however, at other times is clearly perceptible because this is the moment at which the effort behind the gesture is removed - this action no longer holds the expressive intention that individuals are so well-primed to read. The retraction (Kendon uses the term *recovery* (2004:112)) is often very fast. The movement may begin a new phrase after this moment of retraction, before returning to a neutral position.

The occurrence of expressive gestures with the upper torso was observed in the case of every musician recorded in the video data corpus. Gesture phrases were identified from these movements as described above. An expressive gesture phrase has duration and is

therefore described as a behavioural *state*, occurring between the points-in-time of the onset and retraction *events*.

4.2.3 'Non-functional' movements

The third aspect of behaviour observed and coded in this study relates to apparently unconscious movements. Individual musicians tend to make quite a lot of adjustment to their own clothing or the positioning of their instruments during performance, and while this may take their hands to a different location than the position required for playing the instrument, the timing of the adjustment does not intrudes into the performance; rather, it is as if the two different layers of intention that separate the motivation of the movements prevent the musicians from missing a note, or playing too early or too late. Such self-adjustment behaviours are not included in the video analysis; their exclusion was typically a simple, unambiguous decision.

However, the video recordings also show examples of another type of unconscious and repetitive behaviour that does not appear to be related to the musical pulse of the music, and which has no apparent expressive qualities. Such movements were exhibited cross-modally, in head nods, finger taps and feet movements, for example. These movements possess little or none of the expressive dimensions that might be described by the dominant transcription system for dance movement, Laban notation, such as 'effort' and 'shape' (Dell, 1970). They are defined in the first instance as behavioural *events,* and coded by their occurrence as points-in-time. Chapter Five describes how such behaviours can then be classified as *bouts* which have duration, and may therefore be examined as a behavioural state with duration, onset and ending points in time. These movements tended to be individualistic, appearing in knees and feet tapping, but consistent by individual. While instances of this behaviour were noticeable in many different video recordings, they were not cited in the ethnographic data, unlike the cases of attention-related movements and expressive gesture. However, it seems likely that the musicians are peripherally aware of most of the movements that their duo partner make and so such movements may contribute to communicative mechanisms of the interaction.

4.2.4 Summary of the video coding configuration

To summarise, the final configuration for video coding focuses on three areas and provides a way to quantify (a) details of the direction in which individuals' are facing, and whether their eyes are open or closed. It also records (b) the occurrence of phrases of expressive gesture of the individuals' upper torsos. Thus, data are collected to describe

both the exhibited direction of individuals' attention at any one time, and also the parsing of the expressive movements that carry individuals' apparent attention from one place to another. Additionally, (c) simple body movements which count neither as expressive gestures nor appear to affect musical sound production, such as head nods, foot and knee lifts and finger tapping, are recorded.

4.3   Data collection considerations - parameters for comparison

The aim of the video analysis is to supply coherent and reliable empirical data about the non-verbal communicative behaviours of the musicians in real-time interaction, which can be used to compare these responses across dimensions of musical and non-musical organisation for the behaviour. The analysis in Chapter Three suggested that the circumstances that accommodate the musicians' relationships, and the factor of audience presence in the interaction, could be viewed as *moderating* and *intervening* variables respectively (see Table 3.3). Within the theoretical framework that was set out in Chapter Three, such variables seemed likely to elicit action strategies in the form of co-ordinated, other-aware behaviours.

In order to explore the thesis of a social regulation function for these behaviours, the empirical data must be drawn from comparable situations which can help to separate the musical and non-musical communicative behaviours. The system of data collection must support the aim of quantitative analysis of the musicians' behaviours with a view to making social regulation functions distinct from elements regarding the musical sound organisation.

4.3.1   Video recordings of various musical interaction contexts collected

To examine the concept that the context of the musical performance might affect the communicative behaviour of the musicians, video recordings were collected to include various scenarios. These included (a) the private rehearsal of musicians; (b) informal concerts, and (c) large auditorium performances. During the transition from rehearsal to performance, the musicians might go through a process of establishing shared intentions with regards the musical interaction, exploring aspects of the others' knowledge and how they behave as people would in any new social interaction in order to achieve rapport. By recording video material of players who were previously unknown to one another, and also instances including players who are familiar with one another, the potential for comparison of this factor is built into the design of the analysis.

A procedure was followed for recording musicians who were playing together for the first time. On the two occasions that such a recording was possible, the musicians were asked to use a short rehearsal to prepare an informal performance. During this time the soloist - either a sitarist or, in one case, a *sarod* (fretless lute) player - decided which rag to perform (section 4.4 includes photographs of the musicians and their instruments - see pages 108 - 115). The entire rehearsal was recorded so that the first moments during which the musicians played together could be collected. The rehearsal was followed by an informal performance to friends of the musicians and the researchers, which was also recorded. In order to compare this data to that of the formal, auditorium performances, the opportunity to record pre-performance rehearsal was taken on the one possible occasion that arose during the fieldwork period. Of the twelve video recordings made in the course of research, seven were selected to represent the best comparison of these social factors. These are described in the final section of this chapter, section 4.4.

4.3.2   Stratified sample taken from the data collection

Various aspects of the musical structure were considered for their potential impact on communicative dynamics. As described in Chapter Three, section 3.1, there are certain socio-musical constraints upon rag performance. These include typical performance structure and rhythmic time-frame, and the culturally-defined roles played by the respective instrumentalists.

In order to compare across these individual cases, excerpts of approximately one minute were taken from each recording session of rehearsal, informal performance or formal performance to create a form of stratified sample. This also served to reduce over three hours of video material to a total duration of twenty-five minutes, more appropriate to the demands of the level of coding and scale of this project. The criteria for these excerpts were as follows (the descriptive name given in parentheses is used throughout the analysis in Chapter Five):

1. Set A (*solo*) - to include the beginning of the performance or rehearsal. Due to the nature of North Indian classical music performance, this part of the musical activity is led by the soloist, who will be indicating the rag choice by playing a small portion of the alap section. During rehearsals, where less time is likely to be spent on the soloist's unaccompanied section, this early excerpt may also include part of a composition.

2. Set B (*tabla in*) - to include the point at which the tabla player joins in and starts to accompany the soloist. In the two recorded cases of rehearsals between unfamiliar musicians, this is the first time the musicians have ever co-performed.

3. Set C (*transition*) - to include a point during the musical activity where the musicians make a transition in the musical structure, for example, moving from one composition to another, or executing a tempo change as the performance progresses.

4. Set D (*flowing*) - to include a section where both musicians are playing throughout the excerpt, and appear to be relaxed. The performance could be described as flowing and the participants are likely to be smiling and showing relaxed faces during these periods, which usually occur towards the final part of the performances. Not to include any particular transition in tempo or gat.

As North Indian classical music performances vary considerably in duration and are quite flexible in their structure, the excerpts were taken from different points in time for each case. However, sets A and B covered objectively measured points in time. C and D, for transition and flowing excerpts, were generally taken from similar points in relation to the overall duration of each instance of musical activity, but D might have occurred before C in the real-time of the performance. Table 4.1 gives the details for the batch of video data exported from Final Cut Pro 3, the video editing software used to format the recordings from Mini-DV format to the appropriate file for use with the Observer Video-Pro coding software.

Table 4.1 - *Batch list for excerpts sampled from recorded video data in Sets A - D.*

Mehboob Nadeem w. Subrata Manna	Duration	Media Start	Media End	Reel*
rehearsal (A)	00:32.16	05:11.06	05:43.21	1of 2
rehearsal (B)	01:00.00	06:23.00	07:23.00	1of 2
rehearsal (C)	01:00.00	00:12.19	01:12.19	1of 2
rehearsal (D)	01:00.00	14:25.00	15:25.00	1of 2
informal performance (A)	00:55.19	08:19.12	09:14.31	2 of 2
informal performance (B)	00:58.24	25:04.09	26:02.33	2 of 2
informal performance (C)	01:00.00	36:21.20	37:21.20	2 of 2
informal performance (D)	00:57.08	31:29.21	32:26.29	2 of 2
Arvind Parikh w. Dilshad Ahmed				
rehearsal (B)	01:00.00	01:11.24	02:11.24	1 of 1
formal performance (A)	01:00.00	06:33.21	07:33.21	1 of 1
formal performance (B)	01:00.00	39:05.24	40:05.24	1 of 1
formal performance (C)	01:00.00	50:38.17	51:38.17	1 of 1
formal performance (D)	01:00.00	46:01.02	47:01.02	1 of 1
Nayan Ghosh w. Abhijeet Banerjee				
formal performance (A)	01:00.00	08:32.12	09:32.12	3 of 4
formal performance (B)	01:00.00	00:29.24	01:29.24	4 of 4
formal performance (C)	01:00.00	24:41.02	25:41.02	4 of 4
formal performance (D)	01:00.00	17:50.03	18:50.03	4 of 4
Tarun Nayak w. Subrata Manna [1]				
rehearsal (A)	01:00.00	05:07.03	06:07.03	1 of 2
rehearsal (B)	01:00.00	09:47.02	10:47.02	1 of 2
rehearsal (D)	01:00.00	12:52.09	13:52.09	1 of 2
informal performance (A)	01:00.00	07:21.12	08:21.12	2 of 2
informal performance (B)	01:00.00	13:25.11	14:25.11	2 of 2
informal performance (C)	01:00.00	26:07.21	27:07.21	2 of 2
informal performance (D)	01:00.00	29:36.12	30:36.12	2 of 2

Total excerpts = 24

In summary, various considerations were included in the design of the data collection, and a careful stratified sample procedure was used to extract the raw video recordings used in the analysis. This overall design produced five independent variables to be used to probe the consequent, coded duration, rate and time-series responses for patterns of variance and correlation, across all three different classes of behaviour described in sections 4.2.1 to 4.2.3.

---

[1] No Set B (transition point) excerpt from the Rehearsal recording session with Tarun Nayak and Subrata Manna was satisfactorily comparable to the other sessions; during their rehearsal, the musicians did not change pace or composition.

Table 4.2 - *Independent variables and their descriptions*

Independent Variable	Description
ROLE	The role of the musician as a soloist or supporting accompanist
CONTEXT	The socio-musical context in which the recording was made, either as a rehearsal situation without a specifically attending audience, with an informal audience of friends and researchers, and in a formal performance with a large and discerning audience
FAMILIARITY	The familiarity of the musicians with one another
SET	Points during the musical interactions were identified so that musical constraints that might define certain behaviour patterns could be given some separation
LAY	The tal cycle duration (*lay*), a measure representing musical time structure, is either *vilambit* (slow) or *drut* (fast), or the excerpt is unmetred

In the collection of comparable video recordings, and in their deployment through statistical methods of analysis (described in Chapter Five), the factors shown in Table 4.2 were used as measures against which the behaviour of the musicians could be examined.

4.4   Details of the recordings

The following section summarises the details of each of the video recordings collected for use in the analysis, and presents an outline of events as they were initially perceived by the author.

4.4.1   Mehboob Nadeem and Subrata Manna

Total rehearsal recording duration: 30 minutes
Total performance recording duration: 40 minutes

The video data in this case were extracted from a recording made in April 2004 in Cambridge. The scenario featured the first musical introduction of these two musicians to be recorded. The informal audience were mixed in experience, from students and

Indian music novices to experienced performers of the genre. The musicians introduced themselves to one another very briefly, and discussed various topics including the problem of obtaining visas to travel abroad.

Figure 4.1 *- Mehboob Nadeem (sitar) with Subrata Manna (tabla), during informal performance.*

During the rehearsal, Mehboob began to play while Subrata was tuning; Subrata acknowledged this by facing Mehboob's direction with a nod. The act of tuning and re-tuning typically interleaved the first fifteen to 20 minutes of their playing together, and other preparations in the room to set up the recording equipment also disturbed, quite naturally, the very first moments of musical interaction. The two gats selected by Mehboob were both in Teental; he selected a slow composition and a fast composition.

The recording session resulted in two apparently happy and relaxed musicians, and the performance of Rag Yaman had some exciting moments. Unfortunately, the entire performance had to be cut short. During the exposition of the rag in tal, the soloist played structured improvisations which, taking their course, would have exceeded the allotted recording time. However, the excerpts used in the analysis are taken prior to the point at which a time-warning caused some disturbance.
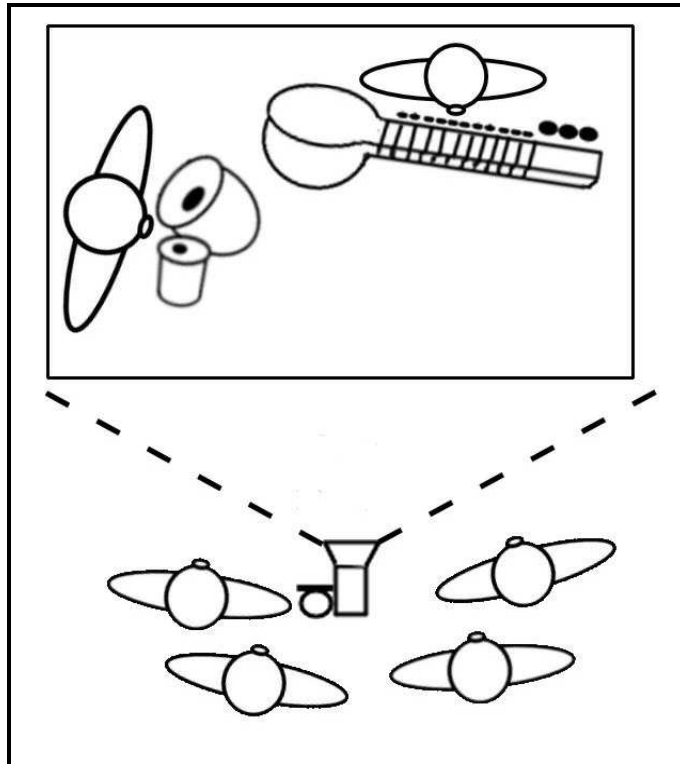
Figure 4.2 - *Room layout for recordings of informal performance. Rehearsal took place to the same layout without small audience.*

4.4.2   Arvind Parikh and Dilshad Ahmed

Total rehearsal recording duration: 2.5 minutes
Total performance recording duration: 52 minutes

Pandit Arvind Parikh and his accompanist, tabla master Dilshad Ahmed, feature in recordings made at a concert in Chembur, India on 21 November 2004. The musicians also rehearsed in a room backstage before the concert, and a very short excerpt of this was successfully video-recorded. As is clear from Figure 4.3 and Figure 4.4, the sitarist and tabla player are not unattended; Arvind Parikh's student, Tariq, is observing and treating the occasion as taleem, in the manner of his musical apprenticeship. He is slightly self-conscious in front of the camera, and exhibits his devotion to his guru as enthusiastically as always - he scrutinises every moment of the rehearsal and gives appreciative signals after interesting tans. He follows the tal, which is Jhaptal, by keeping time on his fingers. Just out of the right-hand side of the frame, Tariq's brother, a tabla player, is also sitting in on the rehearsal.

Figure 4.3 - *Arvind Parikh (sitar) with Dilshad Ahmed (tabla) during pre-concert rehearsal in green room. Also in room, students Tariq (right hand side of frame) and Raj (just off right hand side of frame).*
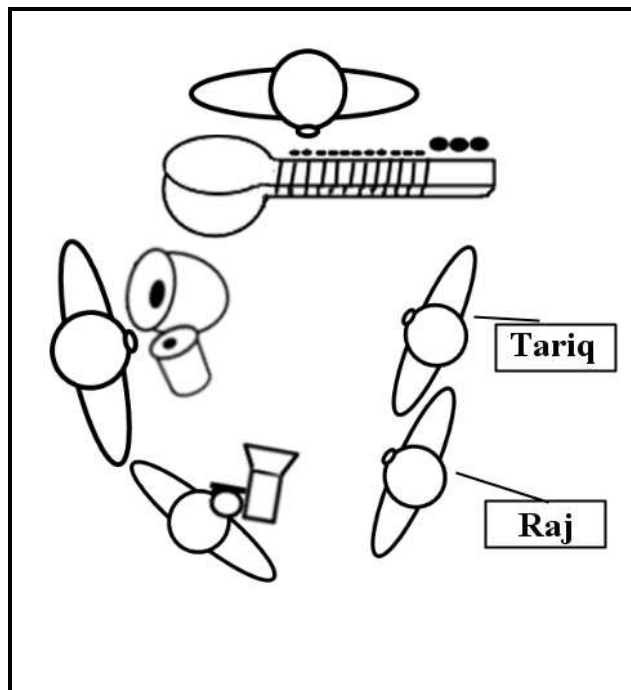
Figure 4.4 - *Chembur, Green room rehearsal recording layout. Camera moved during recording, capturing a varying field including sitarist, student (Tariq) and either tabla player or second student (Raj).*

Another element of Tariq's apprenticeship is his presence on-stage during the performance. Perhaps encouraged by this, also possibly by the presence of several of his students - including myself - in the audience, and perhaps also by the nature of the concert which was organised to showcase North and South Indian music alongside one another, Arvind Parikh takes a pedagogical approach to the development of Rag Yaman in this performance. He addresses the audience with a few words about the performance's structure during the concert and, after the first composition (in Teental) ends, he speaks again during the performance to flag up the idiosyncrasies of next composition, which is in Jhaptal.

The auditorium seating area was quite dark, while the stage was well-lit. The audience seating was also set at quite a distance from the high stage. The structure of the alap's development was particularly clear and thorough.

Figure 4.5 - *Arvind Parikh (sitar) with Dishad Ahmed (tabla) during formal performance in large auditorium. Student Tariq is sitting behind Arvind Parikh. In the far left of the frame, a musician for a subsequent performance sits on the stage.*

112
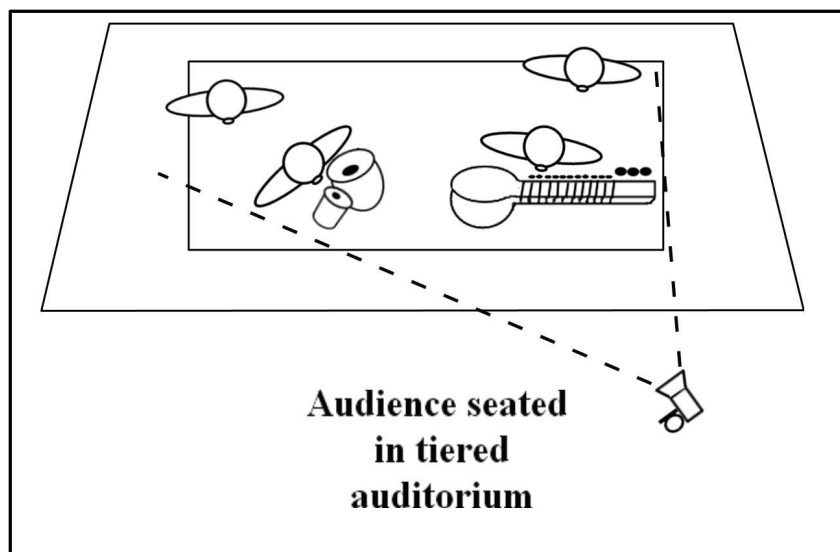
Figure 4.6 - *Chembur formal performance, recording field layout includes tabla player (Dilshad Ahmed) and sitarist (Arvind Parikh). Also partly visible: student (Tariq) behind sitarist, and a musician waiting to play in the second half of concert (left and behind tabla player).*

4.4.3   Tarun Nayak and Subrata Manna

Total rehearsal recording duration: 14 minutes
Total performance recording duration: 25 minutes

In a follow-up to the Cambridge recording made in April 2004, this session was recorded in December, in Kolkata. The same tabla player, Subrata, who had performed with Mehboob Nadeem in April, was introduced to another soloist with whom he had never played before.

The musician dyads were asked to rehearse together and then to perform a short recital according to the procedure set out in section 4.3.1, page 104. The resulting performance of Bairagi Todi was performed to a small, mixed audience ranging from professional musicians to American and British ears less familiar with the genre. The room was also much smaller than the venue for April's recording, and after the recording gear was set up there was less room, and a greater sense of informality.

Figure 4.7 - *Tarun Nayak (sarod) with Subrata Manna (tabla), during rehearsal for informal performance (same room set-up).*
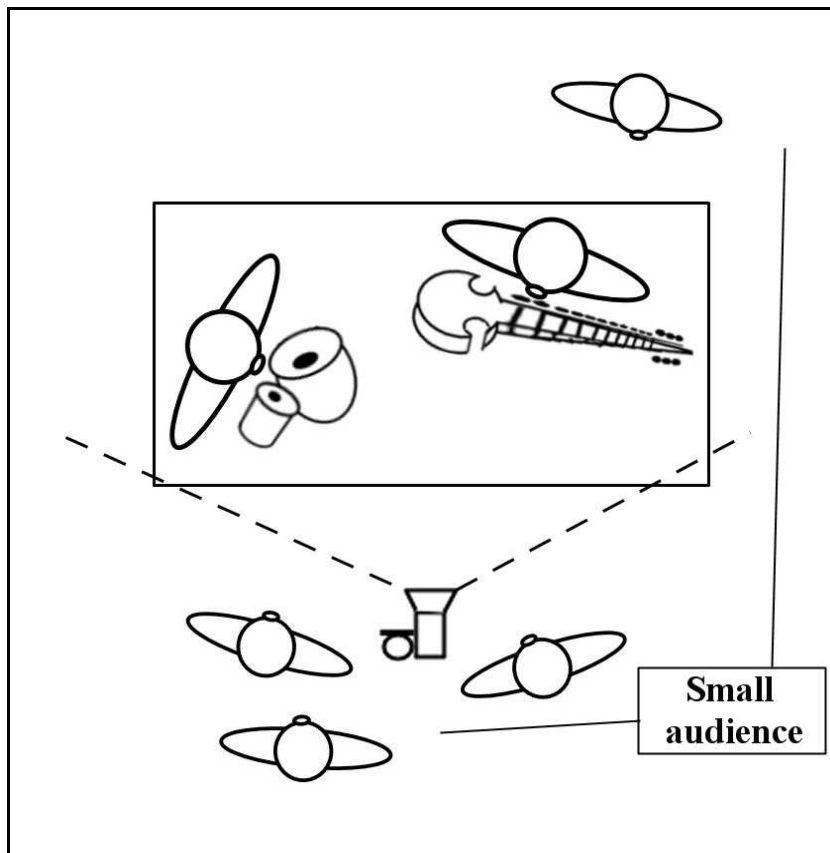
Figure 4.8 - *layout for recording both rehearsal and informal performance.*

The musicians rehearsed together very briefly, and during this time Tarun played a more extended section of alap than Mehboob had done in April. The rehearsal included one composition in Teental. It was Subrata who took the initiative to end the rehearsal period and move on to the main recording.

The performance was of a good standard, and included two different compositions in Teental (one slow, one fast). The performance included moments of uncertainty, and sometimes there were hints of a lack of direction.

4.4.4   Nayan Ghosh and Abhijeet Banerjee

Total rehearsal recording duration: No rehearsal recorded for this concert
Total performance recording duration: 20 minutes

During the fieldwork period of this research, the author attended two performances by sitarist, Nayan Ghosh. The first took place at the Bharatiya Vidhya Bhavan, Mumbai on 26 November, the second in Kolkata on 7 December 2004 where this data was recorded. During the first concert, the audience were a drum-frenzied crowd who were delighted by the finesse of the tabla player, Yogesh Samshi. The second concert, whose recording is used in this study, took place with the superb tabla player, Abhijeet Banerjee, and was a better showcase for Nayan Ghosh's sitar playing. At the time of recording, this performance stood out as the best of those collected during the fieldwork.

Figure 4.9 *- Nayan Ghosh (sitar) with Abhijeet Banerjee (tabla)*
during formal performance in large auditorium.
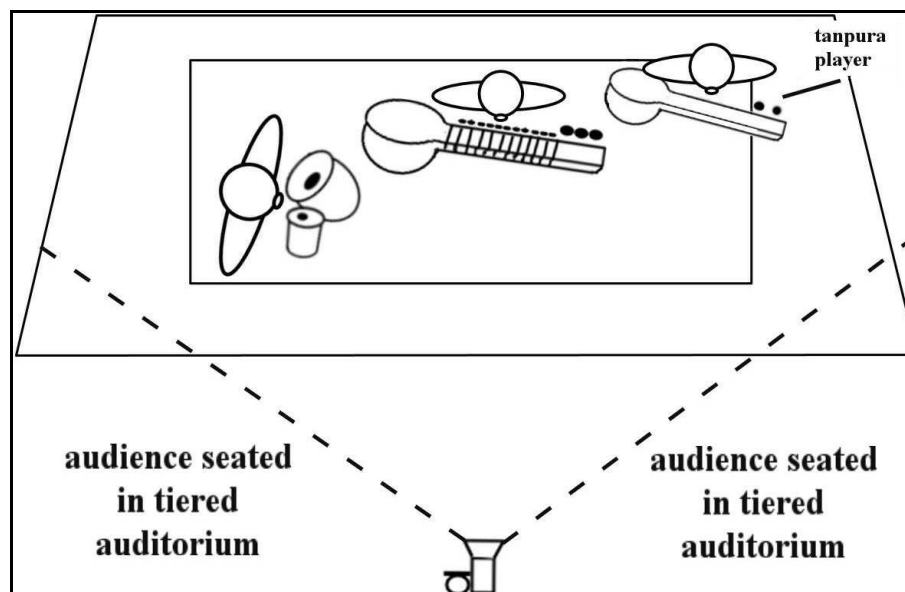
Figure 4.10 - *Recording layout for formal performance.*

The venue was a purpose built auditorium, with a large, experienced and enthusiastic audience. The lighting remained bright on audience as well as the stage for the entire concert, so the first few rows of the audience were clearly visible to those on stage, who actively interacted with them.

The musicians performed Rag Jhinjhoti, in which Nayan Ghosh played several different compositions after a substantial alap, jor and jhala. The responsive audience appeared to be very happy, and the musicians also appeared satisfied with the performance during the moments after the concert.

In the following chapter, the coding configuration and data collection methods presented in this chapter are applied to the video data described above. The results of the preliminary stage of the video analysis, discussed in Chapter Six, are developed and explored further in Chapter Seven.

5 VIDEO CODING ANALYSIS: I

5.1 Introduction

As described in the previous chapter, the video analysis component of this research is based on a management-assessment model of communication (Owings and Morton, 1998), and aims to explore pragmatically the behaviour of interacting musicians, observing communicative behaviour as real-time managing and assessing strategies by which the individuals construct the musical event together. The observations made of the video data are based on evidence of behaviour related to attention, expressive gesture, and unconscious repetitive movement.

The coding configurations used to yield data from the observations are applied to a stratified sample of video excerpts taken from the video data corpus. Initially, the data is explored using a simple, ethologically-grounded methodology in which behaviours are examined by considering the rate and duration of their occurrence. For the purposes of studying communication between interacting humans, this approach may appear over-simplistic. However, the strength of the analysis at this stage lies in the epistemologically well-founded basis of ethology and its observation of what is there: while the presumed frame for the interaction is that of a meaningful, musically-structured interaction, the coding configuration does not have to engage with the complexities of interactive behaviour as it observes the behaviour of each individual separately. In short, the analysis in this first section asks, "Who does what, and when?"

In this chapter, the preliminary stage of analysis reveals variation in the data signifying possible patterns in the observed behaviour that could be based on musical, social or other psychological mechanisms of organisation. The first stage of the analysis is designed to draw out factors of strongest influence on the behaviour. In order to unpick the effects of these various musical and non-musical factors, variation is examined in relation to a number of independent variables. With the use of exploratory factor analysis to examine the structure of the multivariate responses, and statistical tests to examine the effect of independent variables, this first stage of analysis draws conclusions about the strongest factors which may affect the observed behaviours.

5.2 Coding configuration summary

As described in Chapter Four, section 4.2, behaviours were classified according to three broad, functional themes: evidence of attention; expressive movements; and apparently

non-functional movements. Behaviour related to attention is examined by observation of the direction in which the participants appear to be looking through a coding system that accounts for the direction in which participants present their face, and their use of eye contact. The expressive movement aspect of the coding observes the musicians' expressive gestures of the upper torso, including head, neck and shoulders. The third aspect of behaviour coded in this study relates to repetitive movements, such as knee and foot taps.

5.3 General Method

5.3.1 Participants

Participants comprised seven musicians, all trained to a professional level in North Indian classical music performance. These musicians were video-recorded while they played together in four different duo pairings. For each case, the duos consisted of one soloist, either sitar (n=3) or sarod (n=1) with tabla accompaniment. Hence the participants fall into two groups by their position in the musical interaction as either soloist or tabla player (Role).

Of these four cases, in two instances the musicians were known to each other and had played together before on many occasions, and in two they were not known to one another - a variable of level of acquaintance (Familiarity). In the two instances where musicians were unknown to one another prior to the recording, the data includes both a rehearsal and a performance. The performance in both cases was of an informal nature, to small audiences consisting of friends of the musicians and the research team.

Where the musicians were previously known to each other, the data included formal performances in front of a larger audience of classical Indian music aficionados. One of these cases also included a short green room rehearsal. Hence the cases fall into three categories regarding their situation (Context): Rehearsal (n=3), Informal Performance (n=2), Formal Performance (n=2).

5.3.2 Selection of excerpts

In order to compare across the individual sessions that together comprise the video data, four excerpts of approximately one minute were taken from each of the seven sessions to create a form of stratified sample. The criteria for these excerpts were given in section 4.3.2 of the previous chapter.

5.3.3 Coding procedure

Each of the resulting 25 excerpts was coded according to the configuration summarised in section 5.2. This resulted in raw data that included the description of mutually-exclusive, communicative states, and non-durational, point-in-time events (see Table 5.1).

Table 5.1 - *Descriptions of communicative states and non-durational events coded from the video data.*

CODING GROUPS	DESCRIPTION	BEHAVIOUR
COMMUNICATIVE STATES	**Participant looking in direction of…**	self
		other's face
		other's hands
		away
	Participant's eyes are…	eyes-open
		eyes-downcast
	Expressive gesture	onset
		retraction
NON-DURATIONAL EVENTS	**Beating behaviour**	tap
	Musical structure	sam
		khali

Communicative states

The various aspects of communicative state coding were carried out from the video without sound. For each case of communicative state coding, the physical positions of the musicians were taken into account to define the categories of face direction and expressive gesture onset and retraction.

The code other's face was used where musicians appeared to be directing their face in their co-performer's direction in a way that gave their co-performer view of their own facial expression. Where the gaze appeared to be directed specifically towards their co-performer's hands, other's hands was coded. The category away refers to the state when the participant's face is presented in a direction beyond the interaction zone that exists between the two musicians. The musician is looking at neither self, nor other's hands, nor other's face. Away therefore includes the state of looking out at an audience but can also include instances of looking to the side or behind the stage area.

Five examples of such decisions are demonstrated with reference to illustrative figures in Chapter Four.

1. Figure 4.1, p.109, shows soloist Mehboob Nadeem (sitar) with Subrata Manna (tabla). Sitarist looking in direction: <u>other's face</u>. Tabla player looking in direction: <u>away</u>

2. Figure 4.3, p.111 shows soloist Arvind Parikh (sitar) with Dilshad Ahmed (tabla). Soloist looking in direction: <u>self</u>. Tabla player looking in direction: <u>other's face</u>

3. Figure 4.5, p.112 shows Arvind Parikh (sitar) with Dishad Ahmed (tabla). Soloist looking in direction: <u>self</u>. Tabla, looking in direction: <u>away</u>

4. Figure 4.7, p.114 shows soloist Tarun Nayak (sarod) with Subrata Manna (tabla). Soloist looking in direction: <u>other's face</u>. Tabla player looking in direction: <u>other's face</u>

5. Figure 4.9, p.115 shows soloist Nayan Ghosh (sitar) with Abhijeet Banerjee (tabla). Soloist looking in direction: <u>self</u>. Tabla player looking in direction: <u>other's face</u>

As described in more detail in Chapter Four, section 4.2.2, the notion of expressive gesture phrase relies on the observation of physical effort as an individual moves out from, and retracts to, a neutral, non-expressive position. The coder made decisions about what constituted the neutral position of 'no effort' depending on the circumstances of each expressive gesture. For example, due to the involvement of the head and neck in the attentional patterns of the musicians, the gesture onset might begin while the musician looked at the audience (<u>away</u>), and retract after the musician's neutral looking position had shifted to his own lap (<u>self</u>).

Determining the specific direction in which the participant's eyes are focused cannot be an accurate decision from two-dimensional video data. Therefore, the eyes are coded as eyes-open when it is clear that this is so, and eyes-downcast in other cases. At times, the participant's eyes are not visible to the camera, and this is also coded as eyes-downcast and the category considered to include periods of ambiguity for the partipant's eyes.

Non-durational events

The repetitive beating behaviour is coded at each occurrence of a non-expressive, tapping movement. These occur multi-modally, in head, finger, knee and foot tapping, and are coded to video without sound in the first instance.

The musical events of sam and *khali* (a fixed point in the time cycle) are coded with a combination of video and sound. Such music structural points are identified through the audio track, then the video is replayed while the coder 'plays along', coding by tapping the computer key in time with the music.

5.4   Who does what, and when do they do it? (Method)

As the video data consists of ethologically-valid socio-musical interactions, there are complex social and music aspects to consider. A multitude of factors are likely to contribute to variation in the pattern of communicative looking and gesturing behaviours. This first part of the analysis incorporates a combination of exploratory and inferential statistics to determine the extent to which certain types of musical and social constraints on the interaction setting might have an effect on the communicative behaviour.

5.4.1   Dependent variables

Of all the occurrences that were coded (see Table 5.1), a total of seven behaviours constitute the dependent variables examined in the first part of the analysis. These consist of four looking behaviours (away, self, other's hands, other's face), and expressive gesture. Also, the dependent variables included responses derived from the observation of co-occurrences between individual, creating instances of mutual gaze, and the repeated occurrence of tapping events that produced the state of a beating bout. These dependent variables are all explained below.

Communicative behaviour

The four 'looking' behaviours, along with the expressive gesture data, together describe the direction of attention and an expressive carrier aspect of this direction of attention. The participants physically move in their interaction space to exhibit their attention or, in other words, to attend to one another. The methods of these observations are described in the previous chapter, sections 4.2.1 and 4.2.2.

Mutual gaze

A further attention-related behaviour was identified from the coded occurrences given in Table 5.1. The category of mutual gaze describes combination responses by both participants, as both must be looking in the direction of other's face as well and displaying the condition of eyes-open. The response of mutual gaze is therefore coded as a state that begins when all criteria are fulfilled, and ends when any single criterion ceases. The plot in Figure 5.1 is taken from the video observation software, Observer Video-Pro, and shows how mutual gaze occurrences were identified in each excerpt. Accurate onset and ending times were drawn from the tabulated data after the occurrences were identified. The subsequent tabulated data was summarised by regression analysis, to explore the relationship of the responses to possible predictors (known as independent variables - see section 5.4.2 below).

Subject	Behavioral Class
soloist	facing: other's face
soloist	eyes-open
tabla	facing: other's face
tabla	eyes-open
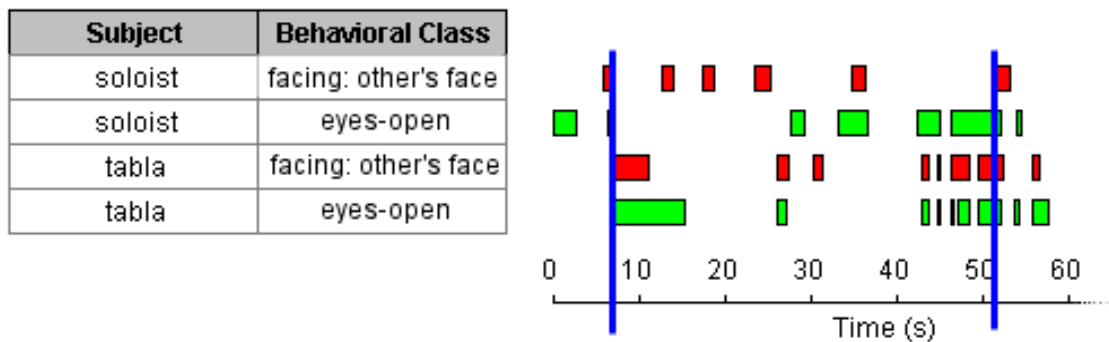
Figure 5.1 - *Results plot from Observer Video-Pro, showing coincidence of musicians' behaviours for mutual gaze (marked by blue bars).*

Beating bouts

In the first instance, the apparently non-functional, beating movements that individuals made with feet, head or knees were coded as individual taps according to the visual image, without sound. Such tapping behaviour might be considered to have an obvious function for a performing musician -- namely, to keep time with the music. However, such tapping behaviours did not appear to be clearly associated with a musical pulse during the exploratory data observation period on which the movement classification, presented in Chapter Four, was based. After coding without sound in the first instance, the coded taps were reviewed alongside the video data with sound. At this point, one complete excerpt and two further periods of tapping in two more excerpts were seen to be clearly 'in time' with the musical pulse. As the associated tapping movements possessed a

clear metrical function they were excluded from the classification of non-functional behaviours, and these data points were discarded from the series of coded taps.

Martin and Bateson (1993) note that "behaviour patterns sometimes occur in temporal clusters, referred to as *bouts*, in which the same, relatively brief act is repeated several times in succession (a bout of events)" (Martin & Bateson, 1993:67). Certain criteria can be used to assess the occurrence of bouts of beating behaviour in the first instance. Firstly, they are uni-dimensional in movement quality, moving only one body part in one manner. Secondly, they do not move the body part used for tapping from point A to point B, as gesture phrases may do when an expressive movement of the shoulders and neck occurs at the same time as the musician re-directs their attention from their own hands to their partner's face, for example. These movements do not appear to have describable expressive qualities, but are simply one aspect of a body that may be involved in a musical interaction.

In order to be counted as apparently non-functional, beatingbehaviour, the coded occurrences of taps were then classified as bouts of behaviour according to certain criteria, defined as follows:

1. A bout must consist of three or more consecutive events which occur at regular intervals AND

2. In order to be considered to be a bout, the two consecutive interval durations must be less than 1.5 s (a summary of the initial coding data indicated that all values greater than 1.5 s could be considered as outliers, falling between 1.5 and three times away from the middle 50% of the data) AND

3. The two consecutive regular interval durations must be of values within ± 0.12s of one another. (The boundary for determining a suitable interval duration cut-off for the bout must be to some extent arbitrary. The summary of initial coding indicated that the median inter-tap interval was 0.68 s with a first quartile of 0.52 s, and a third quartile of 1.2 s.)

These criteria were applied to the time-series data for each individual in each excerpt, yielding 28 beating bouts.

5.4.2 Independent variables

In order to look for patterns of variance and correlation in the consequent data, the design of the video coding took into account various factors which could be controlled without disturbing the validity of the musical interactions. These factors, first given in Table 4.2, include (a) Role, (b) Context, (c) Familiarity, (d) Set and (e) Lay.

While the independent variables (a) - (d) are self-explanatory, (e) requires further explanation, as it would be expected that the tempo of the tal cycle - the lay - might exist on a continuous scale. However, two distinct groups of preferred cycle duration occur in the data. Figure 5.2 shows a histogram summarising all the tal cycle duration data, which suggests that the cycle durations in the sample have a bimodal distribution.
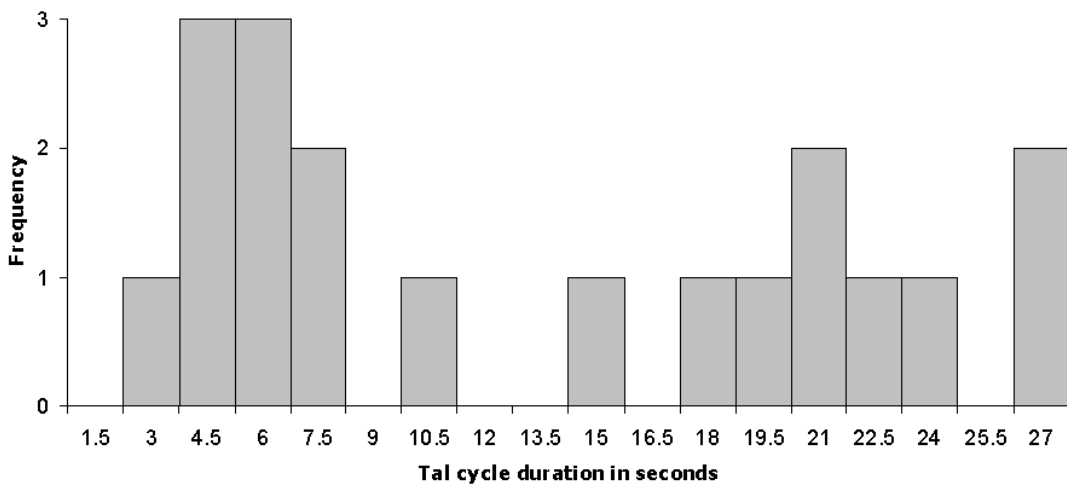
Figure 5.2 - *Preferred tal (musical time cycle) durations in 19 excerpts of metred performance, showing two groups of durations with ranges of approximately 3 to 12 s, and 18 - 25 s. Histogram has tal cycle durations grouped in 1.5 s bins.*

The variation in the cycle duration is a factor which may have an effect on the behaviour of musicians, as the act of playing quickly may require different interpersonal dynamics between two musicians than the act of playing slowly, for example. Not only this, but the inclusion of three categories of musical time structure (fast, slow, not in time - or alap) in the independent variables provides a means of examining the effect of musical structure on the organisation of the musicians' behaviour.

5.4.3 Quantitative measures

The data on communicative states, including looking direction and gesture phrase, were examined through four measures:

1. Rate of occurrence per minute (n = 50)

2. Rate of occurrence per cycle (n = 38)

3. Total duration of events per minute (n = 50)

4. Mean duration of events per minute (n = 50)

Rate - events per minute, events per cycle

Rate of occurrence of looking events can be described for all the data by considering the number of events per minute. In a small number of the excerpts a one-minute duration was not available according to the criteria for each Set - for example, where the musicians stopped playing and began talking to other individuals. In these instances the rate of events per minute was found by scaling the available results (see Table 4.1, page 107 for exact excerpt duration times).

In addition to events per minute, the rate of events can also be calculated according to their number per complete tal cycle. For this measurement, the onset times recorded by the coding for each sam were treated as a single time-series for each excerpt. The mean inter-onset interval between sam occurrences in each excerpt was used to scale the rate of events, to give a rate for the number of looking events per cycle.

One excerpt from Set C included more than one time cycle, as it featured a transition between two different compositions. In this case, the inter-onset interval values fell into two distinct groups. The mean inter-onset intervals of these groups were calculated separately to give two values. This produced two new excerpts of approximately 30 s each, used in place of the original one-minute excerpt. The two new excerpts created in the Set C instance described above were scaled in the same way to give results on rate and duration of events per cycle.

Duration of events - total duration and mean duration

The duration of behaviours is calculated by the *total* duration in each one-minute excerpt (scaled where necessary, as described for the rate data in the previous section). This data supplements the rate of occurrence per minute data. In addition to this, the *mean* duration of each occurrence is calculated across each excerpt so that total duration responses give an indication of the proportion of time spent by individuals on each behaviour, while the mean duration data shows the typical occurrence time of each event.

Mutual gaze and beating bouts

While the behaviours categorised as *communicative behaviour* in section 5.4.1 are common to every excerpt, the occurrences of mutual gaze and beating bouts are less frequent. The analysis groups for rate of occurrence per minute, rate of occurrence per cycle, total duration and mean duration are therefore calculated for the appropriate excerpts and summarised separately.

5.4.4 Statistical Methods

Multivariate summary by principal component analysis

The groups were initially summarised by factor analysis methods, using Principal Components Analysis (PCA) to establish a smaller number of factors that offered the most parsimonious account of variation in the communicative behaviour. The use of PCA for behavioural observation data has been discussed by Frey and Pimental (1978), who describe the value of PCA as a method that gives "every indication of being robust", and seems likely to be valid "for most if not all data analysis" (Frey & Pimental, 1978:225). The potential applications of PCA coincide well with the interests of this analysis. It is principally a method of transforming a set of variables into a smaller set, reducing the complexity of managing multivariate data (Dunteman, 1994:157). It can also help to generate new hypotheses concerning behavioural phenomenon (Frey & Pimental, 1978:224). Frey suggests that the features of PCA that might be seen as limitations when compared to a scientific, hypothesis-driven paradigm, in fact provide a good fit for use in behavioural observation research. Unlike some other methods of factor analysis, PCA is not hypothesis-guided and does not presume that an underlying structure is present in the responses, but uses mathematical functions to explain as much of the variance as possible (Kim & Mueller, 1994a:85) leaving the interpretation and subsequent analysis open to the investigator. Frey comments that this "fishing" technique in fact makes "good biological sense" where such complex factors in ecologically-valid settings are involved (Frey & Pimental, 1978:245). It is important to note that the subsequent testing of hypotheses generated through such an open design would not validly confirm any strong argument for evidence of that particular hypothesis. The approach is heuristic, and its use in the development of this thesis is considered as such; the aim is to reduce complex data by seeking a small number of underlying factors that might govern the complex relationships between large numbers of variables.

MINITAB statistical analysis software was used to carry out the three stages of PCA. In the first instance, the software prepares a co-variance matrix according to the raw data,

whose loading structure is analysed to give Eigenvalues. These are scores, or weightings, that equal the variances of the principal components. Secondly, orthogonal (uncorrelated) components are extracted. Components may be considered of value to an investigation where the Eigenvalue is approximately one - this is equivalent to an account of approximately 20% of the total variance. When the loadings of the PCA correlation matrix are plotted with the chosen components representing x- and y-axes, the length and direction of the resulting lines demonstrate the strength of each response's association with the axes. Weightings closest to zero show the least association with a component.

Finally, the extracted components may be simplified through a form of orthogonal rotation as this allows the investigator to interpret the factors more easily (Kim & Mueller, 1994a:78). Varimax is the most widely used rotation method. By maximising the variance of the squared weightings within the components, Varimax rotation effectively simplifies the loadings by making the large larger, and the small smaller. Factor analysis approaches are based on fundamental uncertainties because, although systematic, the approach infers causal structures from correlational structures (Kim & Mueller, 1994b:2). The Varimax rotation, which adjusts the axes on which grouping variables are based, aims to produce a simple factor solution but it is up to the investigator to interpret the factors in the light of what they know of the data.

In every case to which PCA was applied here, the first two components accounted for more than half of the total variation. In this case, the distribution of the observations in the variable space can be approximated by plotting the principal component scores as a two-dimensional, scatterplot representation, so that the investigator can examine the visual clustering of the observations (Dunteman, 1994:225). For the multivariate data explored here, the principal component scores of the observations were grouped according to the categories for the five independent variables Role, Context, Familiarity, Set and Lay. Where the visual effect suggested that the independent variables had an apparent association with the dispersal of variance shown through the principal component scores - the groups showing clear divergences with strong weightings, or whose dispersal lie in close association to the trajectories of the loading plots - such patterns were investigated with non-parametric tests.

Investigation of trends in PCA summary
The results of the principal component analysis are followed by a summary of each independent variable's likely effect on rate and duration of communicative behaviour

occurrences, using the PCA summary to guide the exploration of apparent patterns and associations between the independent variables and responses with non-parametric tests. The results of the initial analysis on mutual gaze and beating bouts are subsequently presented.

The responses of the dependent variables showed a mix of normally- and non-normally-distributed data, and therefore non-parametric tests were applied where the PCA results suggested that an independent variable might provide an explanation for the account of variance given by the principal components. Where dependent variables showed a strong visual association in the PCA results, a test for Spearman's rank-order correlation established the significance of apparent associations between pairs of variables. In the instances where a statistically high degree of correlation was established between the dependent variables in one factor, this knowledge could be used to simplify the data further. This test statistic is shown as r_s.

The Mann-Whitney U test is a non-parametric procedure that compares two sets of data to examine whether the groups show significant differences. Its use here, for example, might be to explore whether the variation in observations of the rate per minute at which musicians looked at one another's face showed significant differences between (a) soloists and (b) accompanists. The Mann-Whitney U test is very robust, and is based on neither an assumption of normal distribution of the responses, nor of a homogeneous variance (Dytham, 1999:92-3). The test statistic is shown in this chapter as w.

In some cases, there were more than two possible categories for the independent variables and for this scenario the Mann-Whitney U test is not appropriate. In such instances, the Kruskal Wallis test - a non-parametric equivalent to ANOVA (analysis of variance) - can be used to explore statistical similarity between groups where the variables include more than two categories. For example, an apparent association between the rate per cycle at which musicians look away from one another may appear as a feature of the principal component summary given for the independent variable, Context, which has three categories. Where the overall result of a Kruskal Wallis test suggests that there may indeed be a statistically significant difference between groups in this independent variable, the inspection of the summary statistics for this test can reveal interaction between variables (Dytham, 1999:106-8). In our example, this may show that the significant effect could be attributable to the category of Formal Performance. The statistic for this test is shown as h.

In some cases, a large number of outlier observations may render Kruskal-Wallis less powerful; in these circumstances, Mood's median test is applied. This is another non-parametric alternative to a one-way analysis of variance test. Mood's median test compares the equality of median values of groups, and is more robust against outliers than the Kruskal-Wallis test. The test statistic is given as follows: Mood χ^2.

Investigation of mutual gaze and beating bout data variation

In the investigation of mutual gaze and beating bout behaviours, stepwise regression is used to examine the possible effects of the independent variables on responses. This technique explores linear relationships between the continuous response data and the independent variables Context, Familiarity, Set and Lay, and is helpful in identifying variables that are most likely to be impacting on the responses where multiple variables are considered (Dytham, 1999:175). The regression coefficient is shown here as *t*.

5.5   Who does what, and when do they do it? (Results)

This section presents the results of the first stage of analysis. First, the summary of data as explored by principal component analysis and factor analysis is presented for all communicative behaviour data as described in section 5.4.1.

5.5.1 Rate

Occurrence of behaviours per minute
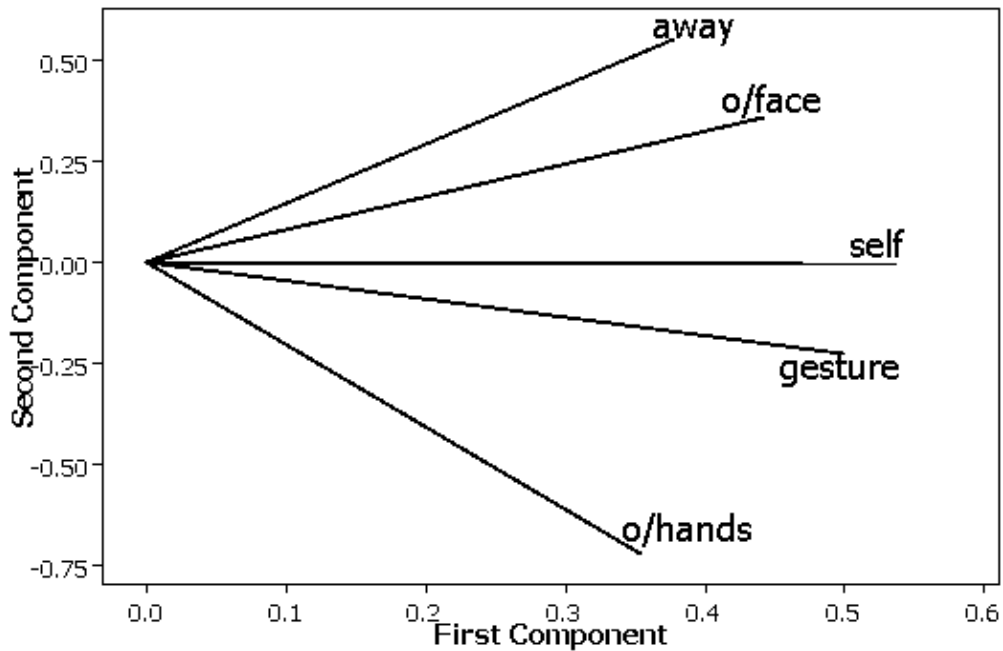
Figure 5.3 - *PCA loading plot: occurrence of communicative behaviours per minute. PC1 (x-axis) describes 47.6% of variation. PC2 (y-axis) describes a further 20.5%.*

The results of principal component analysis of the variation across dependent variables for communicative behaviour describe the data as predominantly explained by means of the first two components, whose Eigenvalues are 2.38 and 1.02 respectively. This signifies that, together, these two components account for 68% of the variation. As displayed in the loading plot in Figure 5.3, PC1 (x-axis) describes more than 46% of the variation, and is associated most strongly with occurrences of self (weighting of 0.54), and also with gesture (weighting of 0.50) (see Table 5.2). These two occurrences are very strongly correlated ($r_s = 0.6$, $p < 0.001$).

Table 5.2 - *First two principal components' scores*
for rate of communicative behaviours per minute.

Variable	PC1	PC2
away	0.378	0.551
self	0.536	-0.003
o/face	0.442	0.361
o/hands	0.354	-0.718
gesture	0.499	-0.224

PC2 (y-axis) accounts for a further 20.5% of the variation, and indicates that, as for PC1, the variables <u>away</u> and <u>other's face</u> appear to be associated; the statistical significance of this association is confirmed ($r_s = 0.374$, p = 0.007).

To explore further the associations between the mutually exclusive looking states and the occurrence of the gesture phrases with these, principal component factor analysis with Varimax rotation was carried out. The results from this, shown in Table 5.3 and displayed as a loading plot in Figure 5.4, suggest that three factors might contribute to the explanation of variance in the responses, respectively accounting for 20.4%, 20.3% and 20.3% of the variation.

Table 5.3 - *PCA factor analysis summary with Varimax*
rotation for rate of occurrence of communicative
behaviours per minute.

Variable	Factor 1 (20.4%)	Factor 2 (20.3%)	Factor 3 (20.3%)
away	-0.006	0.149	-0.969
self	0.177	0.260	-0.156
o/face	0.051	0.954	-0.155
o/hands	0.969	0.049	0.006
gesture	0.215	0.121	-0.165
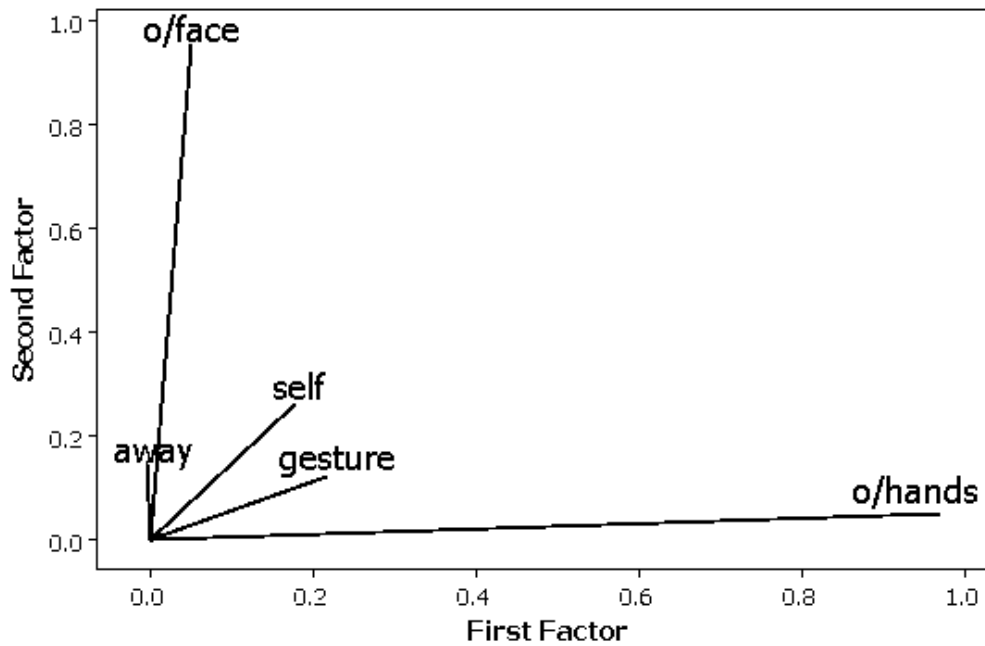
Figure 5.4 -*Loading plot for PCA factor analysis: rate of occurrence per minute. First factor accounts for 20.4% variation, second factor accounts for further 20.3%, third factor accounts for 20.3%.*

The first 20.4% of variation is most strongly associated with attention to <u>other's hands</u>, the second 20.3% is associated with attention <u>other's face</u> from the interaction zone, and the third factor, accounting for 20.3%, summarises the data by responses indicating attention to <u>away</u>; this may be imagined by the loading plot for <u>away</u> extending in a third dimension. The response <u>self</u> (with <u>gesture</u>) is also present in the first two factors but has a weaker weighting, therefore <u>self</u> is associated with both <u>other's hands</u> and <u>other's face</u>.

In the context of the musical interaction, these factors might be described as:

1. Within interaction zone; participant directly attending to other musician with indirect interaction (other's hands and self)

2. Within interaction zone; participant directly attending to other musician with direct interaction (other's face and self)

3. Beyond interaction zone (away)
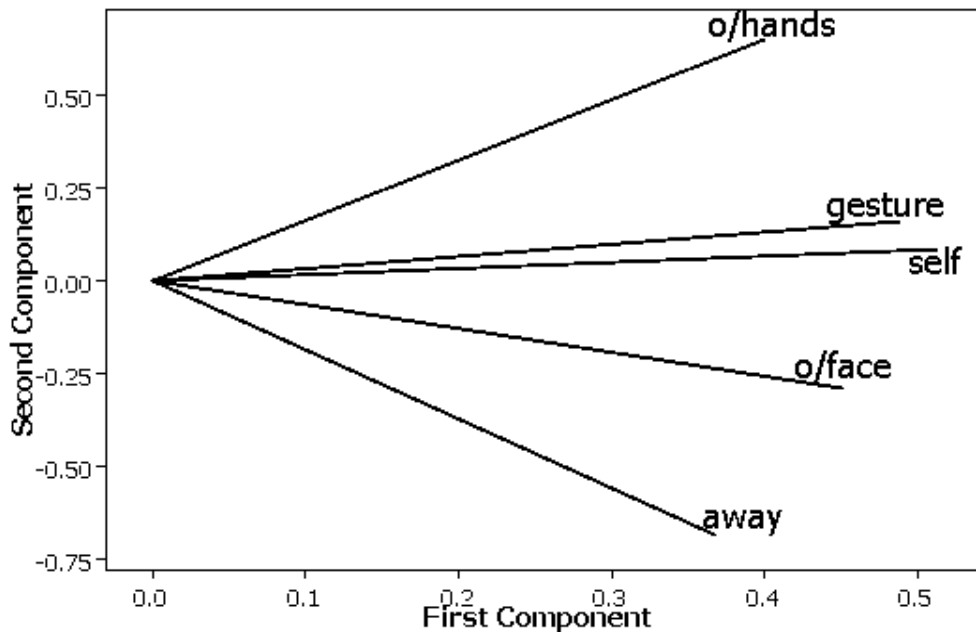
Figure 5.5 - *PCA loading plot: occurrence of communicative behaviours per musical time cycle. PC1 (x-axis) describes 62.8% of variation. PC2 (y-axis) describes a further 17%.*

As shown in Figure 5.5, the principal component analysis for variation in the data as a rate of occurrence per cycle gives rise to a very large first component with an Eigenvalue of 3.14, equivalent to an explanation of 62.8% of the variation. This suggests that responses with high scores on this first axis summarise the majority of the variation in the data. Again, <u>self</u> scores highly on PC1 (0.51), followed by other's face (0.45) and other's hands (0.4). Once again, <u>gesture</u> is highly correlated with <u>self</u> ($r_s = 0.61$, p < 0.001); indeed, <u>self</u> is also correlated so highly with <u>other's face</u> ($r_s = 0.738$, p < 0.001) and <u>other's hands</u> ($r_s = 0.381$, p = 0.018) that <u>self</u> may be used to summarise all four responses.

Table 5.4 - *First two principal components' scores for rate of communicative behaviours per musical time cycle.*

Variable	PC1	PC2
away	0.368	-0.680
self	0.513	0.084
o/face	0.451	-0.288
o/hands	0.400	0.650
gesture	0.488	0.159

The smaller second component, with an Eigenvalue of 0.85 (equivalent to an account of 17% of the variation), shows a strong negative weighting for <u>away</u>. This aspect of the summary distinguishes <u>away</u> from the closely associated factors <u>self</u>, <u>other's face</u>, <u>other's hands</u> and <u>gesture</u>.

Table 5.5 - *PCA factor analysis summary with Varimax rotation for rate of occurrence of communicative behaviours per musical time cycle.*

Variable	Factor 1 (22.7%)	Factor 2 (21.5%)	Factor 3 (21.4%)
away	0.059	0.214	-0.949
self	0.346	0.363	-0.239
o/face	0.142	0.903	-0.245
o/hands	0.936	0.131	-0.056
gesture	0.317	0.253	-0.217

Differences between the PCA summaries of rate of occurrences per minute and rate per cycle indicate that the musical time structure has an effect on the patterns of communicative behaviour. Similarities suggest that the behaviour is also affected by other interaction dynamics. The differences between Figure 5.3 and Figure 5.5 indicate that the effect of scaling the occurrences to the musical time cycle causes the responses to be more closely aligned with one another on the first axis, contributing similarly to the amount of variation in the data.

Further exploration with factor analysis (see Table 5.5 and Figure 5.6) clarifies the summary by PCA, suggesting the presence of three factors underlying the correlational

structure of the responses, accounting for 22.7%, 21.5% and 21.4% of the variation respectively.
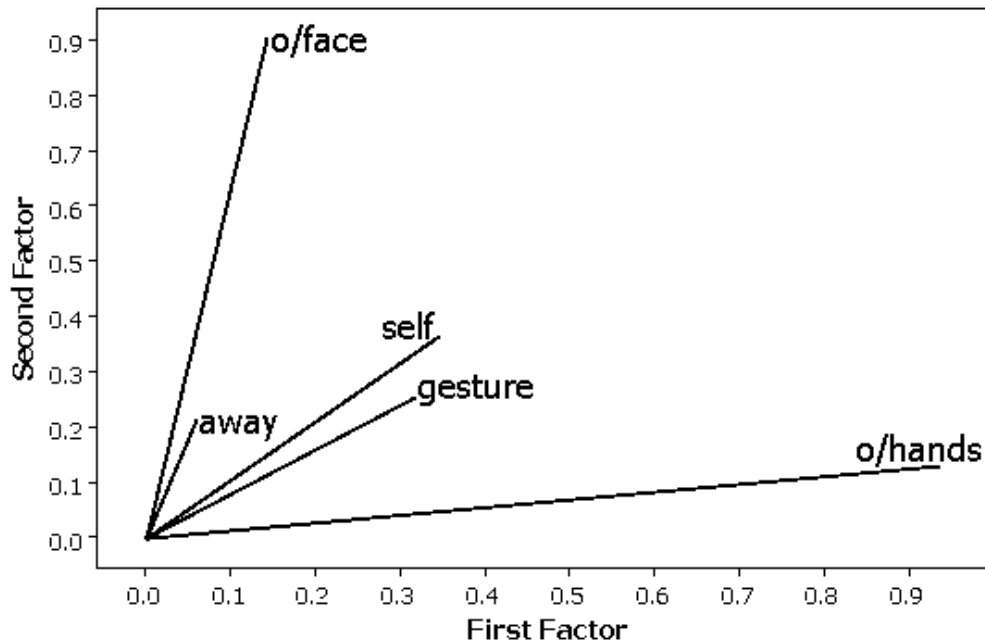
Figure 5.6 - *Loading plot for PCA factor analysis: rate of occurrence per musical cycle. First factor accounts for 22.7% variation, second factor accounts for further 21.5%.*

The first factor is defined by strong factor loadings for <u>other's hands</u>, the second by <u>other's face</u> and the third by <u>away</u>. Given the context of the musical interactions from which this data is drawn, three factors might be proposed from this summary:

1. Within interaction zone; participant directly attending to other musician with indirect interaction (other's hands and self)

2. Within interaction zone; participant directly attending to other musician with direct interaction (other's face and self)

3. Beyond interaction zone; participant not directly attending to other musician (away)

The very close association between <u>self</u>, <u>other's face</u> and <u>other's hands</u> suggests that Factors 1 and 2 may also be combined, summarising the variation across two, simpler factors: (a) within interaction zone, and (b) beyond interaction zone.

5.5.2 Duration

Total duration of occurrences per one-minute excerpt

Figure 5.7 - *PCA loading plot: total durations of communicative behaviours per minute. PC1 (x-axis) describes 39.3% of variation. PC2 (y-axis) describes a further 25.9%.*

Table 5.6 - *First two principal components' scores for total durations of communicative behaviours per one-minute excerpt.*

Variable	PC1	PC2
away	0.342	-0.559
self	-0.688	0.080
o/face	0.525	0.512
o/hands	0.123	-0.628
gesture	-0.344	-0.156

The principal component analysis for total duration of communicative behaviour occurrences, displayed as a loading plot in Figure 5.7, shows strong weightings for self (-0.70), other's face (0.54) and away (0.31) (see Table 5.6) on the first two principal components with Eigenvalues of 1.95 and 1.28, accounting for 39% and 26% respectively. The opposing signs of these strongest weightings suggest that PC1's explanation of variance may be related to the consistently different total duration times in

each excerpt of <u>other's face</u> or <u>away</u>, and <u>self</u> looking behaviours. These negative correlations are both statistically significant (<u>other's face</u> with <u>self</u>: r_s = -0.774, p < 0.001; <u>away</u> with <u>self</u>: r_s = -0.435, p = 0.001).

Scores for PC2 indicate that a further quarter of all the variation in the data is also partly summarised by variation in the response <u>other's face</u>. A fairly strong positive weighting of <u>other's face</u> against the stronger negative weightings of <u>other's hand</u> and <u>away</u> is the defining feature of the axis, but these negative correlations are not statistically significant (<u>other's face</u> and <u>other's hands</u>: r_s = 0.037, p = n.s.; <u>other's face</u> and <u>away</u>: r_s = 0.010, p = n.s.). The loading plot also suggests a possible association between <u>other's hands</u> and <u>away</u> (see Figure 5.7), but there is no significant correlation (r_s = 0.206, p = n.s.)

The relationship between the responses is explored further with factor analysis (see Figure 5.8). This simplifies the indications given by the PCA; the dominant factor accounting for 34% of the variation in looking behaviour duration data is the opposition of <u>self</u> with <u>other's face</u>.
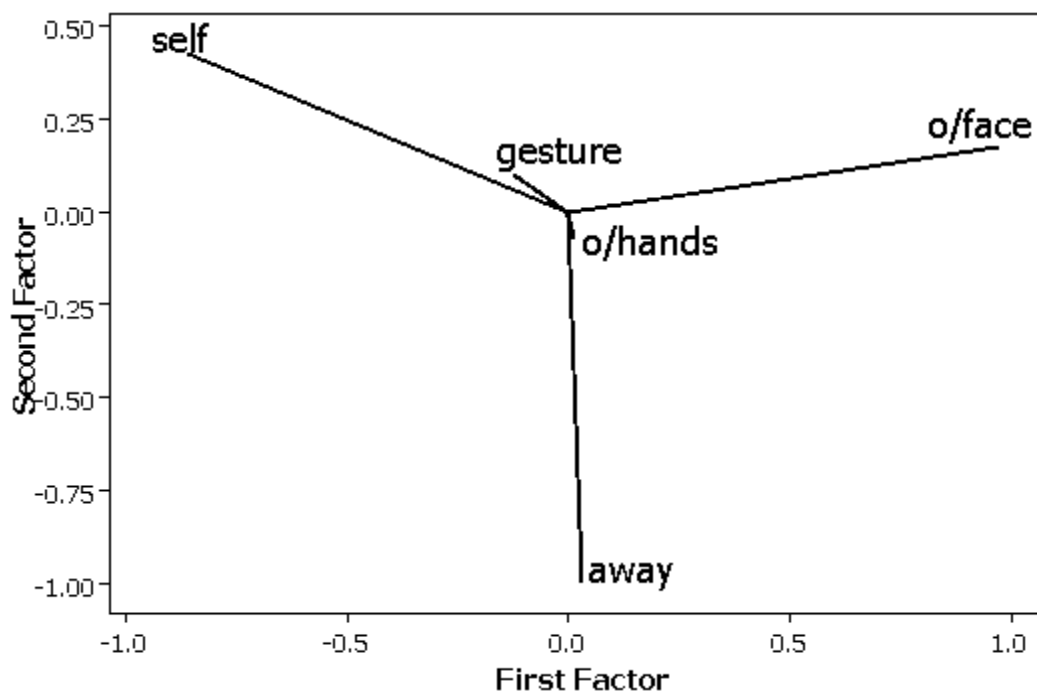
Figure 5.8 - *Loading plot for PCA factor analysis: total duration of communicative behaviours per one-minute excerpt. First factor accounts for 33.9% variation, second factor accounts for further 24.3%.*

Examination of the factor analysis scores in Table 5.7 shows that <u>away</u> behaviour, which marks that the participant's attention is not actively focused on the other musician, has a

very strong score as the second factor and accounts for nearly a quarter of the variation in the duration data (24.3%).

Table 5.7 - *PCA factor analysis summary with Varimax rotation for total durations of communicative behaviours per one-minute excerpt.*

Variable	Factor 1 (33.9%)	Factor 2 (24.3%)	Factor 3 (20.6%)
<u>away</u>	0.028	-0.993	-0.064
<u>self</u>	-0.862	0.427	-0.243
<u>o/face</u>	0.968	0.179	-0.139
<u>o/hands</u>	0.010	-0.069	0.996
<u>gesture</u>	-0.124	0.099	0.056

The factor loadings in Table 5.7 also suggest that the variation in the duration values of the behaviours is small enough to show distinctive patterns when examined as summarised data. Responses with wide variation would show lower PCA scores and could be summarised less meaningfully.

The factor analysis results summarise that data for <u>self</u> durations are distinct from the looking, interactive behaviours.

Mean duration of occurrences per one-minute excerpt
The data for mean duration of an occurrence of communicative behaviour reflect both the rate of occurrence data and the total duration per excerpt data. The data are also interesting for the study of units of time in which the behaviours tend to take place. If there is very wide variation in all of the data, and no particular discrimination between occurrence-type, the PCA summary would reflect this with low scores for the responses. In part, this is what the first principal component (Eigenvalue 1.7, equivalent to an account of 34% of the variation) suggests -- of all the looking behaviours, three out of four have weightings of less than 0.2 from the zero score (see Table 5.8).

Table 5.8 - *First two principal components' scores for mean durations of communicative behaviours per one-minute excerpt.*

Variable	PC1	PC2
away	0.110	-0.444
self	-0.870	-0.068
o/face	0.176	0.643
o/hands	0.155	-0.620
gesture	-0.679	0.022

This implies that PC1 summarises 34% of the variation with very little discrimination between the looking behaviour responses <u>away</u>, <u>other's hand</u> and <u>other's face</u>. However, the mean duration data for <u>self</u> (and <u>gesture</u>) do have strong weightings on PC1 (see Figure 5.9 and Table 5.8), and appear to show a correlation. However, this association is not statistically significant ($r_s = 0.52$, n.s.). The opposition in weightings of <u>other's face</u> versus <u>self</u> has a statistically significant negative correlation ($r_s = -0.496$, p < 0.001).
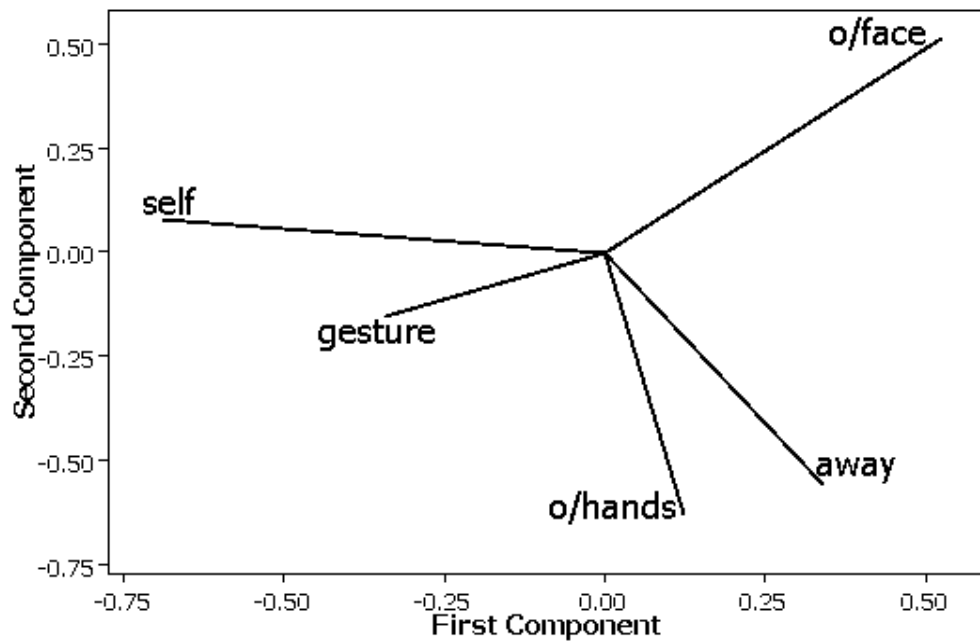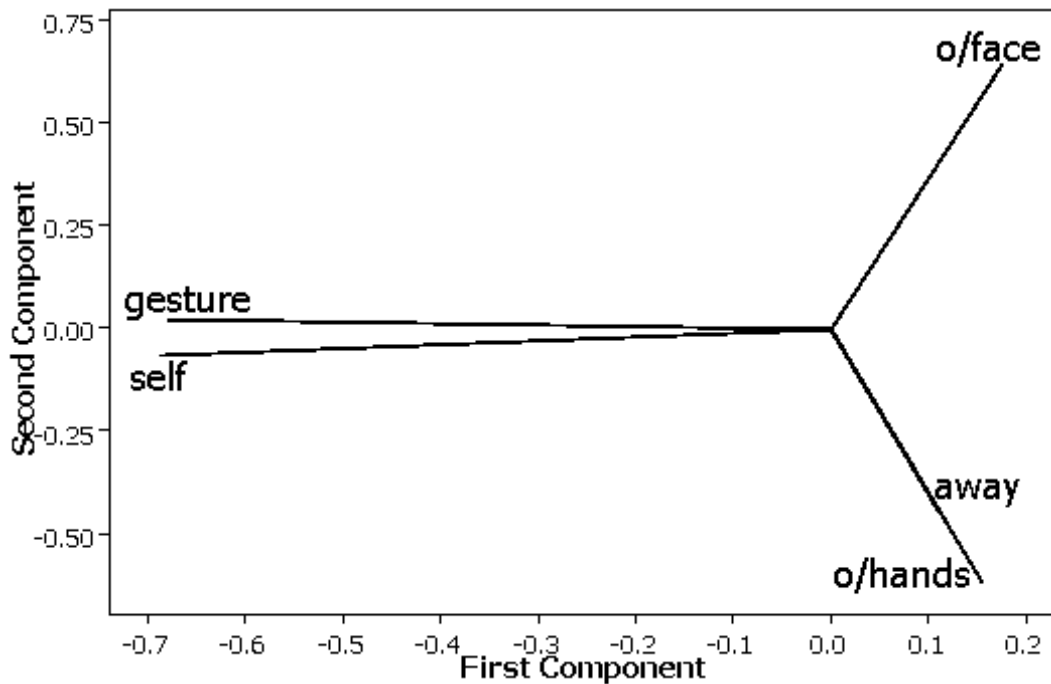

Figure 5.9 - *PCA loading plot: mean durations of communicative behaviours per minute. PC1 (x-axis) describes 34% of variation. PC2 (y-axis) describes a further 23%.*

The second principal component (Eigenvalue 1.18, equivalent to an account of 23.6% of the variation) shows a similar pattern to the data for total duration per one-minute

excerpt; the responses <u>away</u> and <u>other's hands</u> appear to be associated, but this is not statistically significant ($r_s = 0.197$, p = n.s.).

The apparent associations and differences of the summary shown in principal component analysis are explored further with Varimax rotation, presented in the loading plot in Figure 5.10.
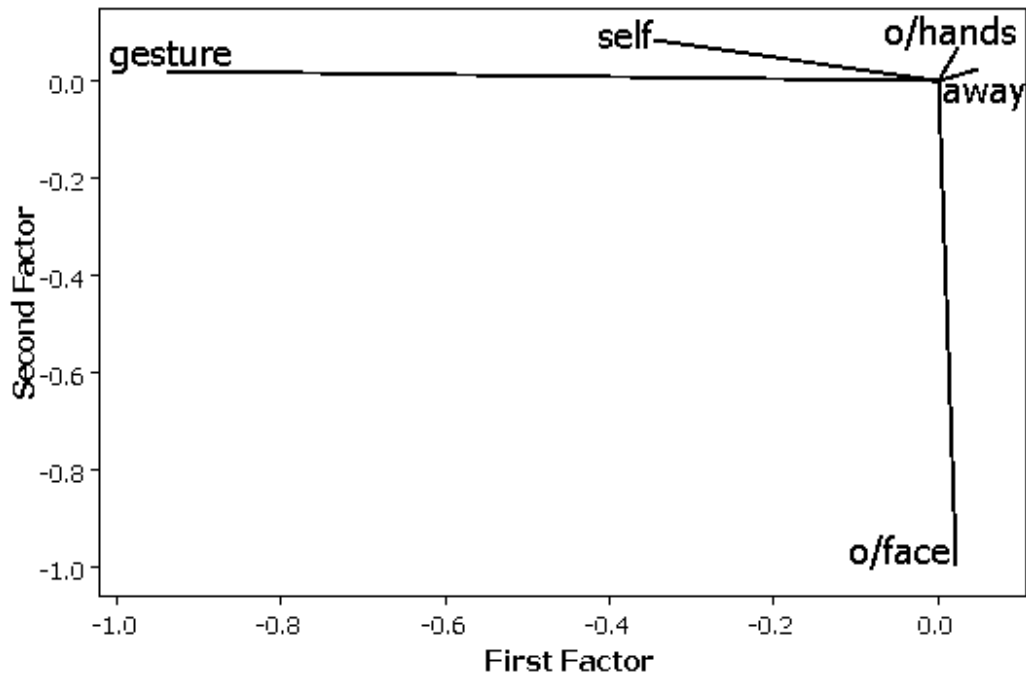
Figure 5.**10** - *Loading plot for PCA factor analysis: mean duration of communicative behaviours per minute. First factor accounts for 34% variation, second factor accounts for further 23%.*

The rotated factor loadings in Table 5.9 emphasise an alternative possible causational structure to the likely trends apparent in the initial PCA, suggesting that all five dependent variables relate to distinct responses, as there are five, similarly proportioned loadings with strong weightings in each variable (see Table 5.9). <u>Other's face</u> and <u>self</u> show potential negative correlation in Factor 2; this is confirmed ($r_s = -0.496$, p < 0.001). <u>Self</u> and <u>gesture</u> show similarities, but this is not statistically significant ($r_s = -0.277$, p = n.s.).

Table 5.9 - *PCA factor analysis summary with Varimax rotation for mean durations of communicative behaviours per one-minute excerpt.*

Variable	Factor 1 (20.1%)	Factor 2 (20%)	Factor 3 (20%)	Factor 4 (20%)	Factor 5 (19.9%)
away	0.049	0.026	-0.034	-0.095	0.059
self	-0.345	0.084	0.061	-0.080	-0.413
o/face	0.023	-0.995	0.069	-0.636	-0.062
o/hands	0.026	0.069	-0.995	-0.591	-0.047
gesture	-0.939	0.023	0.028	-0.235	-0.401

5.5.3 Rate of occurrences - results

In this section, scatterplot representations of observations of rate of behaviour according to their principal component scores are used to examine visually the clustering of the observations and their relationship to component axes.

Role
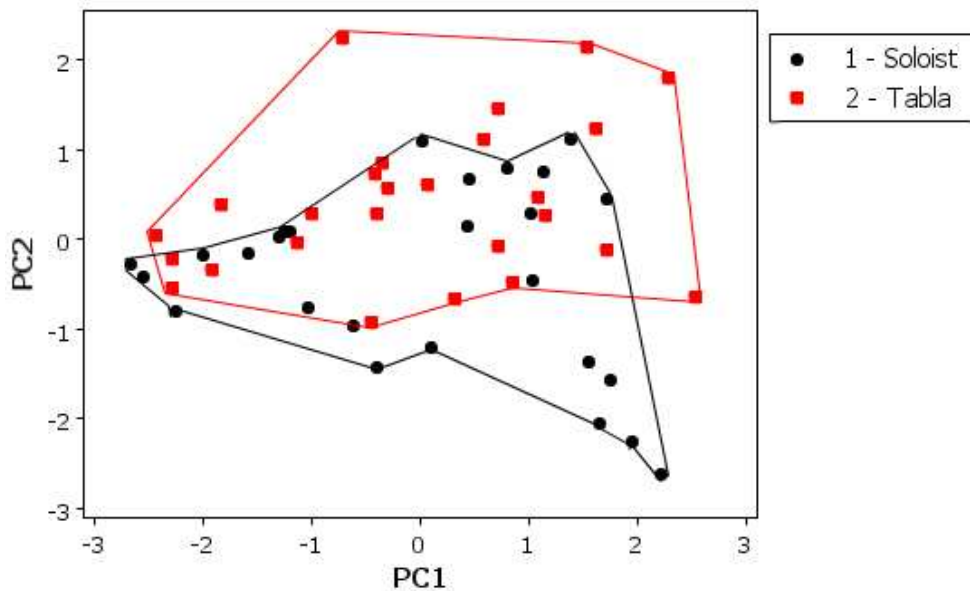
Figure 5.11 - *Scatterplot: variation in rate of behaviour per minute by PC1 and PC2 scores for Role.*

The weightings of the dependent variables on PC1 and PC2 are plotted as the two groups in the independent variable Role (see Figure 5.11). The resulting scatterplot shows no apparent divergence between Role 1 (soloist) and Role 2 (accompanist) according to the first principal component. However, there appears to be some divergence on PC2, which summarises 21.2% of the variation by strong positive scores in other's face (and away), and strong negative scores in other's hands. Testing whether the response for other's face (and away) is associated with Role confirms a significant difference between categories (n = 50, w = 493, p < 0.001), suggesting that the Role of the individual affects the rate per minute that the musicians look at each other's face and away from their own interaction zone.
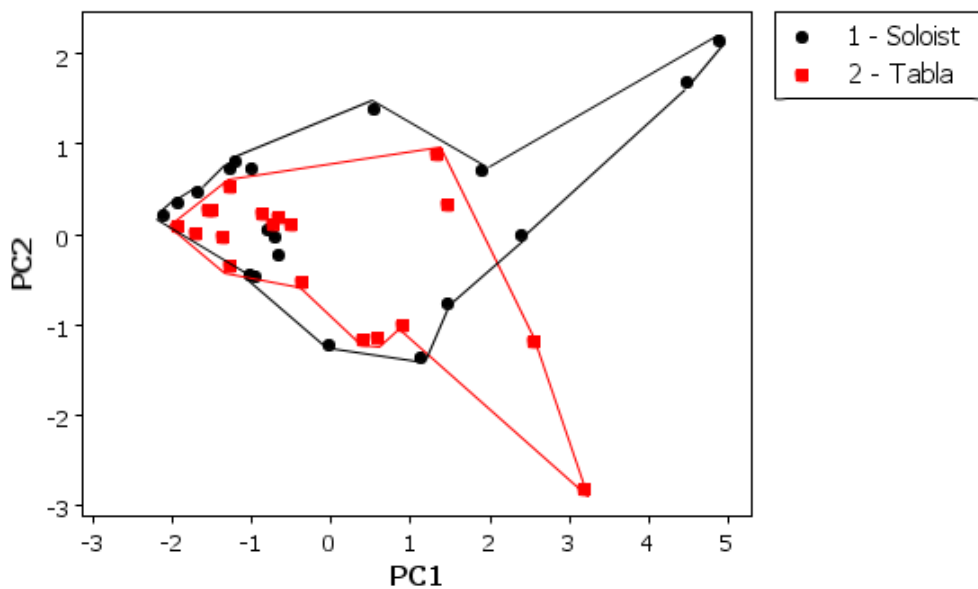
Figure 5.12 - *Scatterplot: variation in rate of behaviour per musical cycle by PC1 and PC2 scores for Role.*

When the time base is changed from one minute to one complete musical time cycle, the majority of the explanation of variance summarised in the PCA was seen to lie with the first principal component (see Figure 5.5), which gives similar strong, positive weightings to all dependent variables. When rate is examined as occurrence per musical time cycle, a plot of the PCA weightings grouped by Role shows that there may be an association between PC2's summary of the factors away versus the cluster other's hands, other's face, self and gesture (see Figure 5.12). This may summarise the variation associated with

Role 2 (tabla player) and Role 1 (soloist) respectively; however, the association is not statistically significant (n = 50, *w* = 360, p = n.s.)

Context
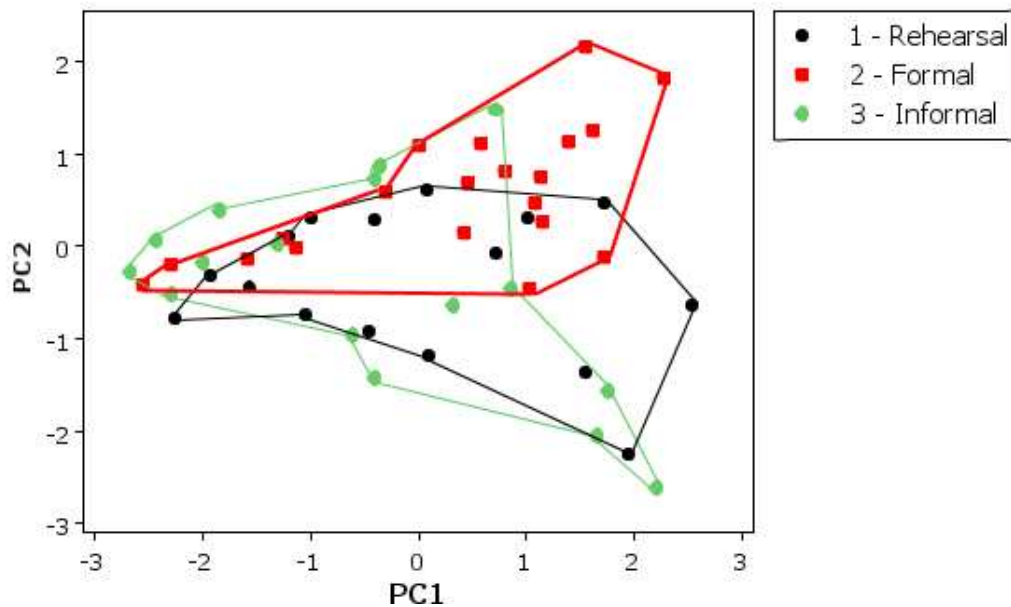
Figure 5.13 - *Scatterplot: variation in rate of behaviour per minute by PC1 and PC2 scores for Context.*

When the PCA scores for rate of occurrence per minute are plotted by category of the independent variable Context, there does not appear to be any clear association between the categories and the first two principal component axes (see Figure 5.13). Strong positive weightings on PC1 might indicate association by Context category with <u>self</u> (and <u>gesture</u>) behaviours; strong positive weightings on PC2 might similarly indicate <u>other's face</u> (or <u>away</u>), and strong negative weightings might indicate <u>other's hands</u>. While Context 3 (Informal Performance) is dispersed across the whole plot, there is some suggestion in the plot that Context 2 (Formal Performance) may be associated with <u>other's face</u> (or <u>away</u>), and Context 1 (Rehearsal) may be associated with <u>other's hands</u>.

These hypothetical correlations were examined, confirming that there is no significant association between Context categories with <u>other's face</u> (*h* = 0.37, d.f. = 2, p = n.s.), but that statistically significant differences do exist between the categories with <u>other's hands</u> (*h* = 6.37, d.f. = 2, p = 0.041) and <u>away</u> (*h* = 9.28, d.f. = 2, p = 0.010). Post hoc analysis revealed that Context 1 (Rehearsal) has the greatest median value for the rate of occurrence of <u>other's hands</u> (2.5 occurrences per minute) while Context 2 (Formal

Performance) has the lowest rate of zero per minute; the difference between these categories is significant (n = 36, w = 351.5, p = 0.0115). The difference between Formal Performance and Informal Performance (median rate of occurrence of 1.02 per minute) is not significant (n = 34, w = 276, p = n.s.).

For the response <u>away,</u> Context 2 (Formal Performance) has the highest median value of nine occurrences per minute, and Context 3 (Informal Performance) has the lowest (2.6 occurrences per minute); there is a significant difference between these categories (n = 34, w = 394.5, p = 0.0064). The post hoc analysis reveals that there is also a significant difference between the categories of Rehearsal (median value of 5 occurrences per minute) and Formal Performance for the response <u>away</u> (n = 34, w = 215, p = 0.027).

Figure 5.14 - *Scatterplot: variation in rate of behaviour per musical cycle by PC1 and PC2 scores for Context.*

The equivalent scatterplot of PCA scores by Context group were then studied for rate of occurrence per cycle. As discussed in section 5.5.1, the first principal component for rate of events per cycle gave similar, strong weightings to all dependent variables, but distinguished <u>away</u> from <u>other's hands</u> on the second axis. As Figure 5.14 shows, the scores for Context 1 (Rehearsal) on the second component axis are all positive but do not have particularly large weightings. Scores for Context 2 (Formal Performance) do, however, appear to follow the same pattern as the rate of event per minute data, showing large negative weightings, and Context 3 appears to show association with positive weightings on this axis.

This association between Context with <u>away</u> was tested and the results confirmed a significant difference between the three Context categories with <u>away</u> ($h = 9.55$, d.f. $= 2$, p $= 0.008$); Context with <u>other's hands</u> showed no significant difference between categories ($h = 4.86$, d.f. $= 2$, p $=$ n.s.). Post hoc analysis showed that Formal Performance has the highest median value for rate of occurrence of <u>away</u> per minute, and Informal Performance the lowest; there is a significant difference between both Rehearsal with Formal Performance (n $= 26$, $w = 118$, p $= 0.0252$), and Formal with Informal Performance (n $= 26$, $w = 244$, p $= 0.0051$); however, there is no significant difference between Contexts 1 (Rehearsal) and 3 (Informal Performance) for <u>away</u> (n $= 24$, $w = 165$, p $=$ n.s.).

Familiarity
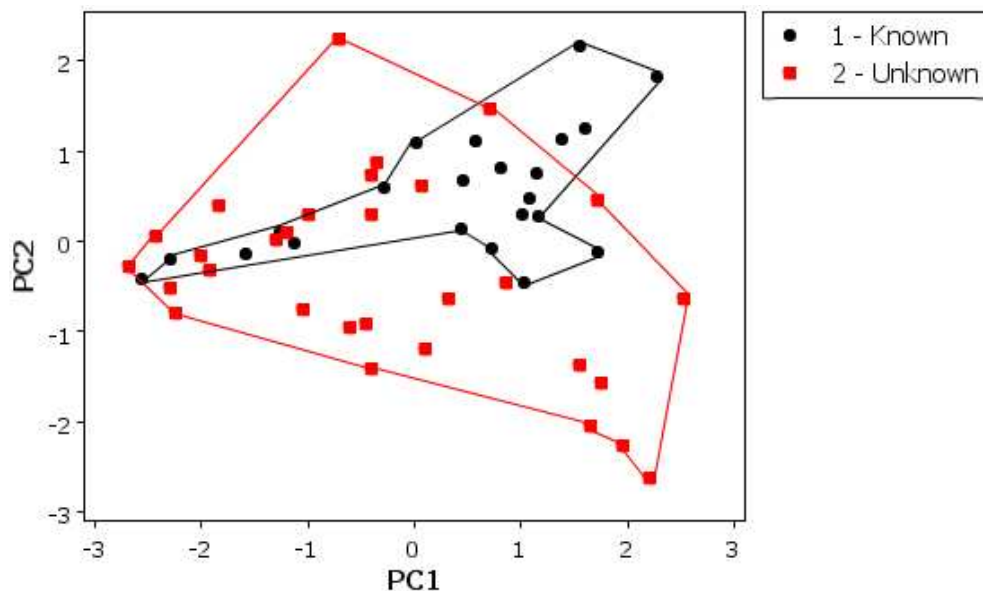
Figure 5.15 - *Scatterplot: variation in rate of behaviour per minute by PC1 and PC2 scores for Familiarity.*

The categories for the independent variable Familiarity appear to show some association with the second principal component. The individual data points for Known largely lie across wide values on PC1. The stronger negative weightings on PC2 are represented by data points in the Unknown category (see Figure 5.15). As PC2 summarises the opposition of <u>other's face</u> (and <u>away</u>) against <u>other's hands</u>, these three dependent variables were tested for their association with both categories of Familiarity. The results show no significant difference across the two categories for <u>other's face</u> (n $= 50$, $w = 541$,

p = n.s.) but significant responses for <u>other's hands</u> (n = 50, *w* = 415.5, p = 0.05) and
<u>away</u> (n = 50, *w* = 659, p = 0.0032).

Category 1, Known, was seen to have a significantly higher incidence of <u>away</u> (and
<u>other's face</u>) behaviour per minute (median value of nine occurrences) than category 2,
Unknown (median value of 3.43 occurrences). The reverse is true of the behaviour
<u>other's hands</u>, for which the significantly greater median value lies with category 2,
Unknown (median value of 1.93) over Known (median value of 0.5).
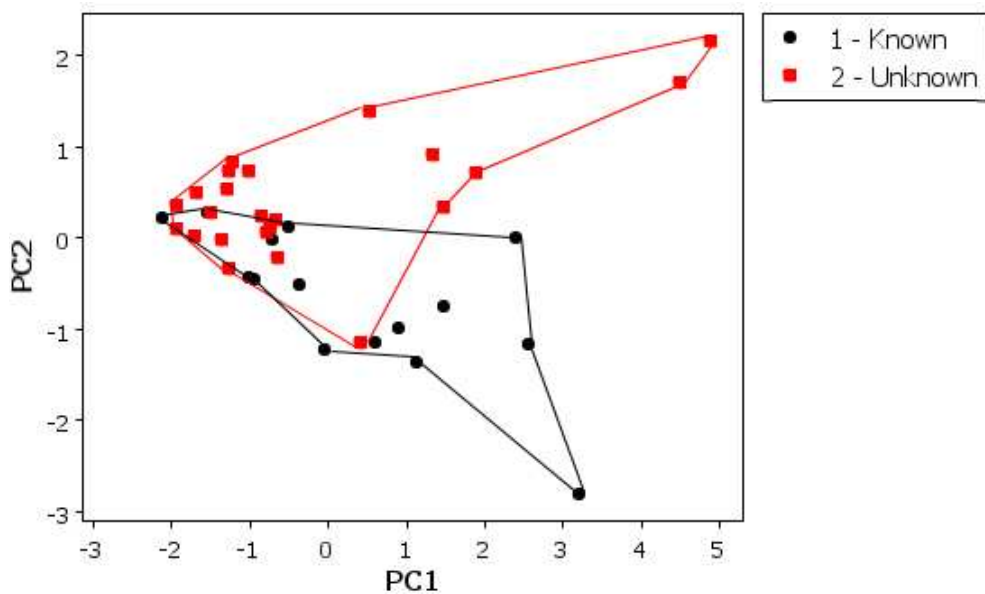
Figure 5.16 - *Scatterplot: variation in rate of behaviour per musical
cycle by PC1 and PC2 scores for Familiarity.*

This trend continues when the results for rate of event occurrence per cycle are
considered. As shown in Figure 5.16, the two categories for Familiarity both show
dispersal across both positive and negative weightings on PC1, while association with the
second principal component shows a clearer opposition of <u>other's hands</u> and <u>away</u>
between the two categories than the PCA results for rate of events per minute. Again, the
results show a significant associations between category 1, Known, with <u>away</u> (n = 38, *w*
= 388, p = 0.0045) and 2, Unknown, with <u>other's hands</u> (n = 38, *w* = 217.5, p = 0.0243).

146
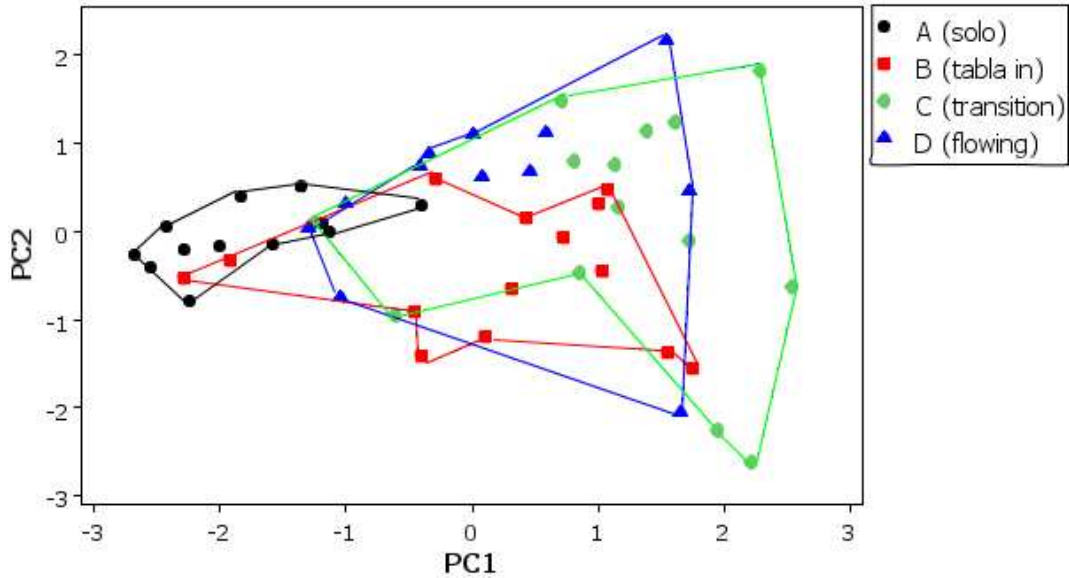
Figure 5.17 - *Scatterplot: variation in rate of behaviour per minute by PC1 and PC2 scores for Set.*

Figure 5.17 demonstrates that Set A, the excerpt during which the soloist begins to play the unaccompanied, free-time alap, appears to be heavily weighted to negative scores on PC1, while Set C, the excerpt during which the duo negotiate some form of musical transition, appears to be more strongly weighted to positive scores on this axis. PC1 was seen in section 5.5.1 to represent a summary based on strong positive weightings of <u>self</u> (positively correlated with <u>gesture</u>).

On the second axis, Set B shows some tendency for negative scores while Set D shows a wide dispersal across the axis (see Figure 5.17). This suggests that Set B, the excerpt featuring the point at which the tabla player begins to play, might be associated with <u>other's hands</u> while Set D, the 'flowing' excerpt, may be associated with either <u>away</u> (or <u>other's face</u>).

The results showed that the dependent variables <u>self</u> (and <u>gesture</u>), <u>away</u> and <u>other's hands</u> all show a statistically significant association with categories of Set (<u>self</u>: $h = 19.49$, d.f.= 3, $p < 0.001$; <u>away</u>: $h = 15.63$, d.f. = 3, $p = 0.001$; <u>other's hands</u>: $h = 10.8$; d.f.= 3, $p = 0.013$. Set A (solo) shows a very low median rate of occurrence of <u>self</u> (and <u>gesture</u>) (median value of two occurrences per minute), in comparison to Set C (10.33 occurrences per minute), and the difference is highly significant (n = 24, $w = 83$, p = 0.0001). This pattern is repeated with the response <u>away</u> (n = 24, $w = 96$, p = 0.0020).

These results are referred to again in section 5.5.4 below, where the duration of the events is discussed.

The occurrence of other's hands has a substantially higher median value for Set B, representing the tabla entry (median value of three occurrences per minute) than for any other category. Set A (solo) in particular has the lowest median value of zero occurrences per minute. Post hoc analysis suggests that the interaction of these categories with Sets C (transition) and D (flowing) may be factors relating to the significant association between the independent variable Set with the variation in responses (Set A (solo) with Set B (tabla in): n = 26, w = 107, p = 0.0035).

These results are now compared to the responses as rate of events per cycle. As excerpts in Set A have no cycle duration, only Sets B to D are discussed.
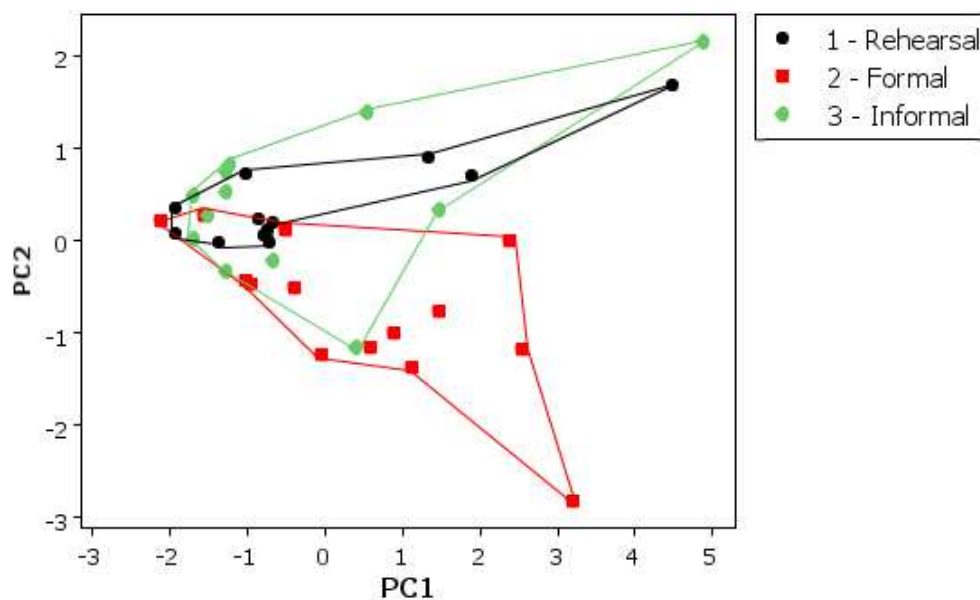

Figure 5.18 - *Scatterplot: variation in rate of behaviour per musical cycle by PC1 and PC2 scores for Set.*

The scatterplot in Figure 5.18 displays the first two principal component weightings for rate of event per cycle by Set. The PCA showed similar strong, positive weightings for all the responses on the first axis, and an opposition of other's hands (positive) versus away (negative) on the second axis. While the data points for Sets B (tabla in) and D (flowing) are widely dispersed across both positive and negative values of both axes, there is some tendency in B (tabla in) towards strong positive weightings on both axes, and some tendency in Set D (flowing) towards negative weightings, particularly on the second axis. Set C (transition) shows only negative weightings on the first axis.

148

Self responses (representative of self, gesture, other's hands and other's face in this instance) are examined for the effect of these Set categories on the summary given by the first axis. A further test for away explores the association between the negative weightings of D (flowing) and the summary given by the second axis.

The results of significant differences between Set categories with self (h = 10.82, d.f. = 2, p = 0.004) suggest that high median values for rate of occurrence per cycle in B (2.7 occurrences per cycle) and low median values for C (0.79 occurrences per cycle) significantly differ from the overall average rank; post hoc analysis confirms a significant difference between these variables (n = 26, w = 248.5, p = 0.0024). The test for similarity between Set categories and responses in away showed no significant similarity between categories (h = 3.51, d.f. 2, p = n.s.).

Lay
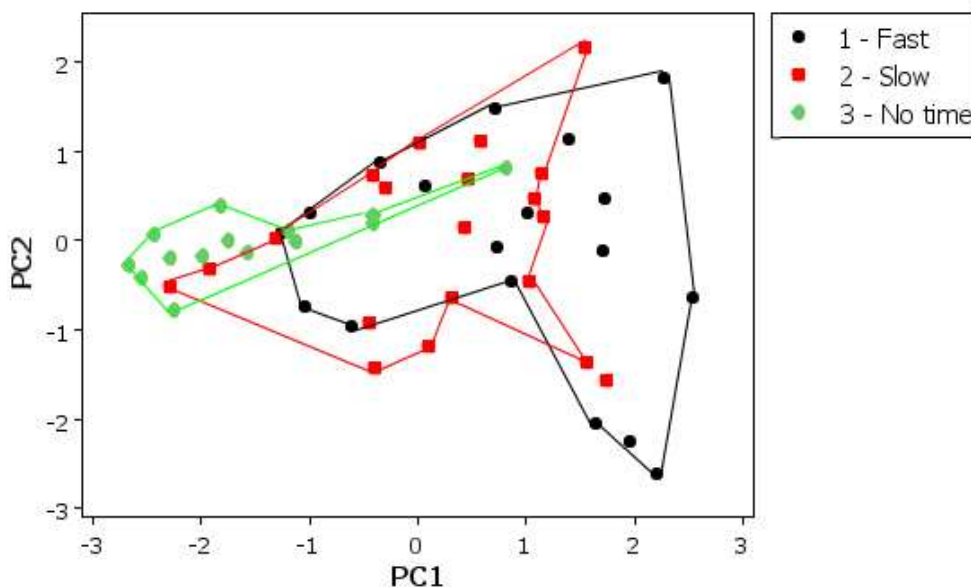
Figure 5.19 - *Scatterplot: variation in rate of behaviour per minute by PC1 and PC2 scores for Lay.*

The plot of PC1 and PC2 weightings of the independent variable Lay suggests that Lay 3 (music not in time) could be well summarised by PC1 as many of the data points show strong negative values on the x-axis (see Figure 5.19). Categories 1 and 2 (fast and slow musical time cycles) appear to show wide dispersal across both axes, implying that neither principal component summarises the variation in the data well. The collection of responses represented by self (and gesture) is associated here with the summary of the variation given by PC1, and these responses showed statistically significant differences

between Lay categories ($h = 10.52$, d.f. = 2, p < 0.001). Lay 1 (fast) and Lay 3 (no time cycle) differed most greatly from the overall average rank, with the median value of two occurrences per minute for Lay 3 substantially smaller than the equivalent median values for Lay 1 (10.33) or Lay 2 (slow) (8.5). Post hoc analysis confirmed no statistical difference between Lay 1 and 2 (n = 38, $w = 395$, p = n.s.), but significant differences between Lay 1 and 3 (n = 30, $w = 378.5$, p = 0.0001), and Lay 2 and 3 (n = 32, $w = 417$, p = 0.007).

Figure 5.20 - *Scatterplot: variation in rate of behaviour per musical cycle by PC1 and PC2 scores for Lay.*

When the same responses are examined as rate of event per cycle, there is a clear separation between the two categories of fast cycle and slow cycle (see Figure 5.20). Fast cycles, with a shorter time cycle duration, are tightly grouped with negative weightings on PC1, and near zero on PC2. Slow cycles show a wider dispersal across PC2, with both positive and negative weightings, and with a wide range of positive weightings on PC1. The variation in the responses given by PC1 can be summarised by the close association between self, gesture, other's hands and other's face. PC2 summarises variation through the opposition of other's hands and away. Significant differences were confirmed between the two Lay categories with self (n = 38, $w = 239$, p = 0.0011) and away (n = 36, $w = 208.5$, p = 0.001). The shorter, faster time cycle category, Lay 1, yielded fewer events per cycle than the longer, slower cycle in Lay 2.

5.5.4 Duration of occurrences - results

In the previous section, scatterplot representations of observations of rate of behaviour according to their principal component scores are used to examine the visual clustering of the observations and their relationship to component axes. However, a similar comparison of mean durations of the data would be meaningless if the data was very widely varied. In this case, the summary sought by principal component analysis would be expected to return similar weightings for all responses and little pattern would be explicable in the data. The initial task of data summary in this case is therefore to examine the distribution of the responses.
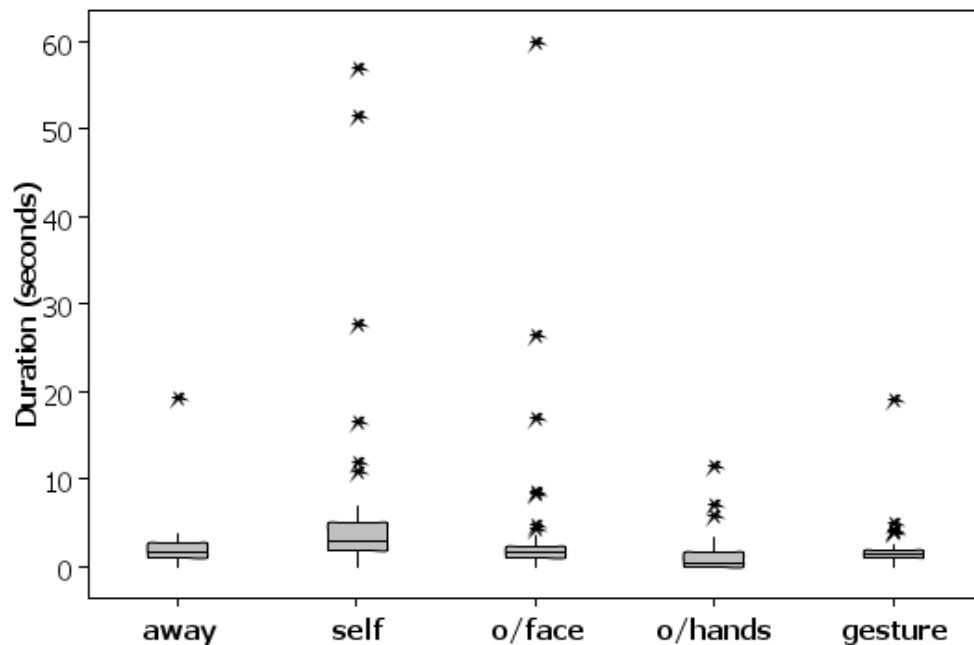
Figure 5.21 - *Mean event durations for all communicative behaviours across entire data set. The use of boxplots shows the spread of the observations - median values are represented by the horizontal line across the shaded boxes, which show the interquartile values. Vertical lines on either side of the box show the data range; asterisks show outlying observations.*

All five of the responses have normal distributions[1]. However, there are many outliers in the data, as the asterisks in the plots in Figure 5.21 show. Inspection of the tabulated observations revealed that many of the behaviours with the longest durations occurred in excerpts when the tabla player was not playing, during the alap. The data were studied again with Set A excluded to observe the mean durations of communicative behaviours between musicians who are both engaged in musical performance activity.

The resulting mean values are illustrated in Figure 5.22; the mean duration values of the behaviours before and after this transformation (given below in Figure 5.22) indicate that the removal of Set A observations eliminates a large number of the outlying values, and accordingly reduces the variation in the mean values of all the behaviours.

Table 5.10 - *Mean duration in seconds of behaviours, showing the effect of removing Set A observations on the range of values across all five variables.*

Variable	Mean duration (s)	
	All occurrences (a)	Excluding Set A (b)
away	2.21	2.20
self	6.15	3.17
o/face	3.87	3.18
o/hands	1.20	1.37
gesture	1.99	1.56

By using robust non-parametric tests, the entire data set can be handled together and the possibility of Type I error, where no real difference between categories may mistakenly show as a significant result, is very low. The data for Set A (solo) may therefore be included in the analysis to and results considered in the light of the preceding discussion, with the application of statistical techniques suitable for handling large numbers of outlying observations.

---

[1] In all cases, an Anderson-Darling Normality test (test statistic a^2) showed a statistically significant response (n = 50 away: $a^2 = 6.38$, p < 0.005; self: $a^2 = 9.91$, p < 0.005; other's face $a^2 = 11.61$, p < 0.005; other's hands: $a^2 = 5.98$, p < 0.005; gesture: $a^2 = 8.71$, p < 0.005).
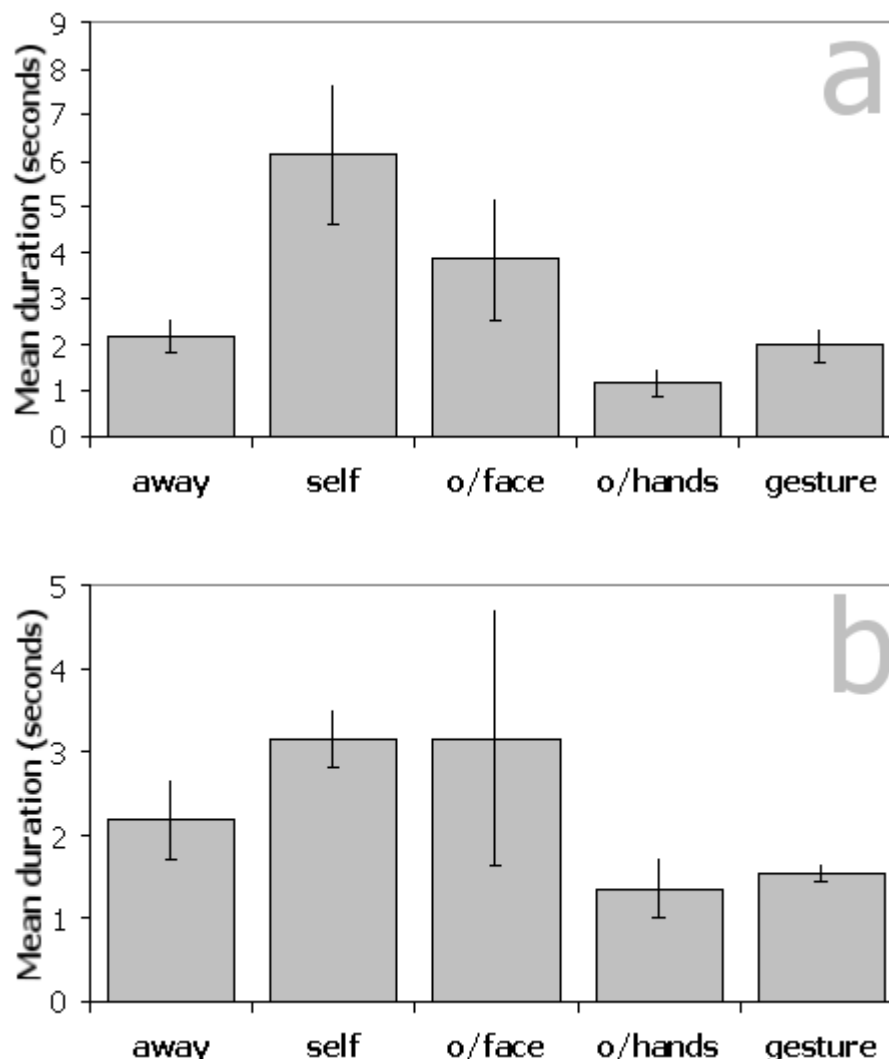
Figure 5.22 - *(a) Mean event durations for all communicative behaviours across entire data set, and (b) for excerpts from Sets B, C and D only, excluding data where soloist is unaccompanied by tabla in excerpts of alap performance, which has no musical time cycle. Vertical bars demonstrate the standard error of the mean values for each case.*

Role

The PCA scores for total duration per one-minute excerpt showed that PC1 summarised variation in a way that showed a negative correlation between self (strong negative weightings) and other's face (strong positive weightings). Other's face was also associated with variation summarised by the second principal component, and this axis is also defined by strong negative scores for both other's hands and away.
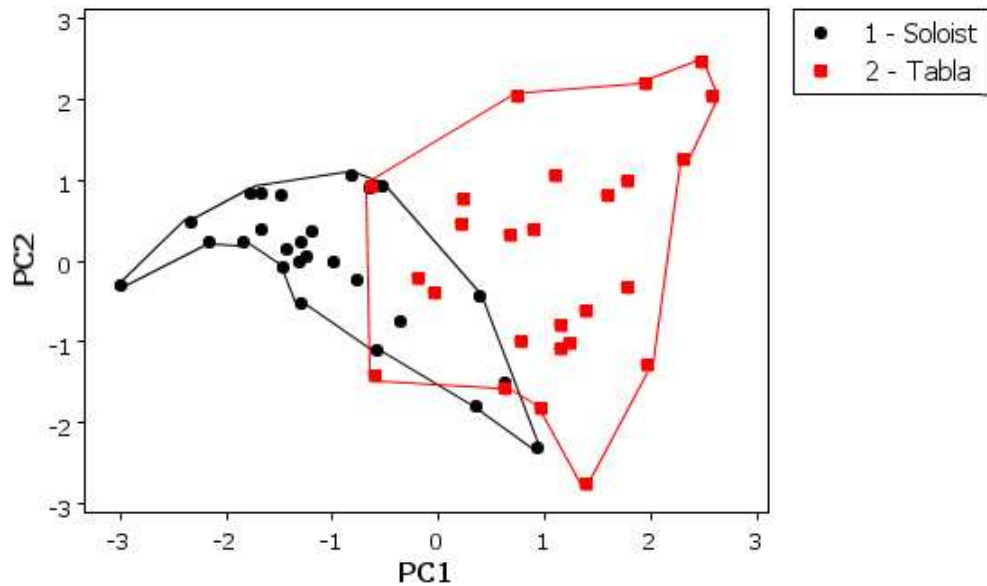
Figure 5.23 - *Scatterplot: variation in total duration of behaviours per one-minute excerpt by PC1 and PC2 for Role.*

As Figure 5.23 shows, the two categories for Role are clearly divided on the x-axis; Role 1 appears to be associated with negatively-weighted principal component scores and Role 2 shows association with positively-weighted scores. The negative correlation of <u>self</u> and <u>other's face</u> is statistically significantly related to the independent variable of Role (<u>other's face</u>: n = 50, *w* = 374, p < 0.001; <u>self</u>: n = 50, *w* = 912, p < 0.001). For the response <u>self</u>, the median total duration value is greater for Soloist (median total duration of 45.3 s) than for Tabla player (median total duration of 14.4 s). For <u>other's face</u>, the trend is reversed with the median total duration for Soloist (3.34 s) much less than that of the Tabla player (18.03 s).

The PCA summary of variation across the mean durations of the dependent variables in each excerpt suggested a summary by the strong negative weightings of both <u>self</u> and <u>gesture</u> on the first principal component, summarising 34% of the variation across all the mean duration data. PC2 summarises a further 23.6% of the variation, and on this axis the responses for <u>other's face</u> show a particularly strong positive weighting.

154
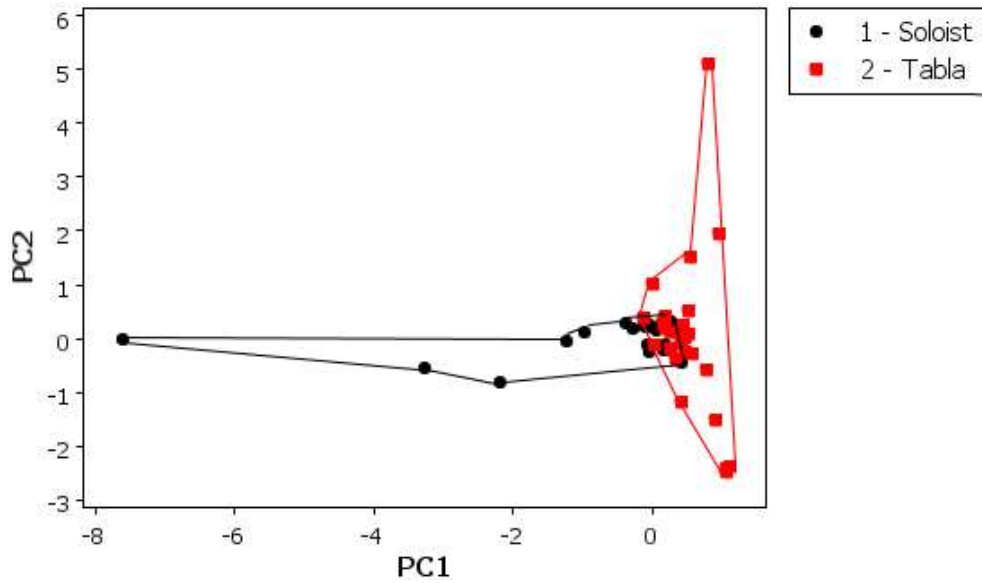
Figure 5.24 - *Scatterplot: variation in mean duration of behaviours per one-minute excerpt by PC1 and PC2 for Role.*

Figure 5.24 demonstrates that Role may be associated with PC1; category 1 (Soloist) includes several data points which have strong negative weightings. Test results showed a highly significant difference between Soloist and Tabla player in mean durations of responses for both <u>self</u> (n = 50, w = 836.5, p = 0.0001) and <u>gesture</u> (n = 50, w = 746, p = 0.0361). Consistent with the results for total duration per one-minute excerpt of the same event, Soloist shows a greater mean duration of behaviour than Tabla player.

The variation in mean durations of behaviours for Role 2, Tabla player, appear to show an association with PC2's summary, which included strong positive weightings for <u>other's face</u>. Role 2 shows a higher median value for this response than Role 1, and the association of Role with this response is statistically significant (n = 50, w = 402, p < 0.001).

Figure 5.25 *- Scatterplot: variation in total duration of behaviours*
per one-minute excerpt by PC1 and PC2 for Context.

The independent variable Context appears to show no grouping according to the three categories in either PC1 or PC2, for either total (see Figure 5.25) or mean duration of events per excerpt Figure 5.26).
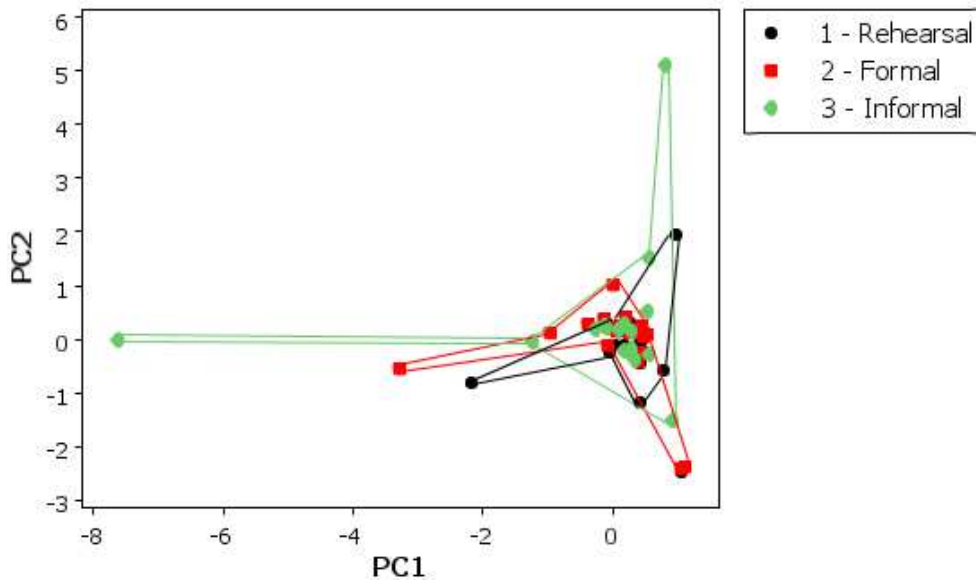
Figure 5.26 *- Scatterplot: variation in mean duration of behaviours*
per one-minute excerpt by PC1 and PC2 for Context.

While the effect of possible outlier observations in Context category 3, Informal Performance, for mean duration of behaviours illustrates some possible tendency towards strong negative values on PC1 and positive values on PC2 (see Figure 5.26), the results of a test for association with the responses strongly correlated with these axes show that there is no statistical significance (<u>self</u>: Mood $\chi^2 = 0.5$, d.f. = 2, p = n.s.; <u>other's face</u>: Mood $\chi^2 = 1.47$, d.f. = 2, p = n.s.).

Familiarity
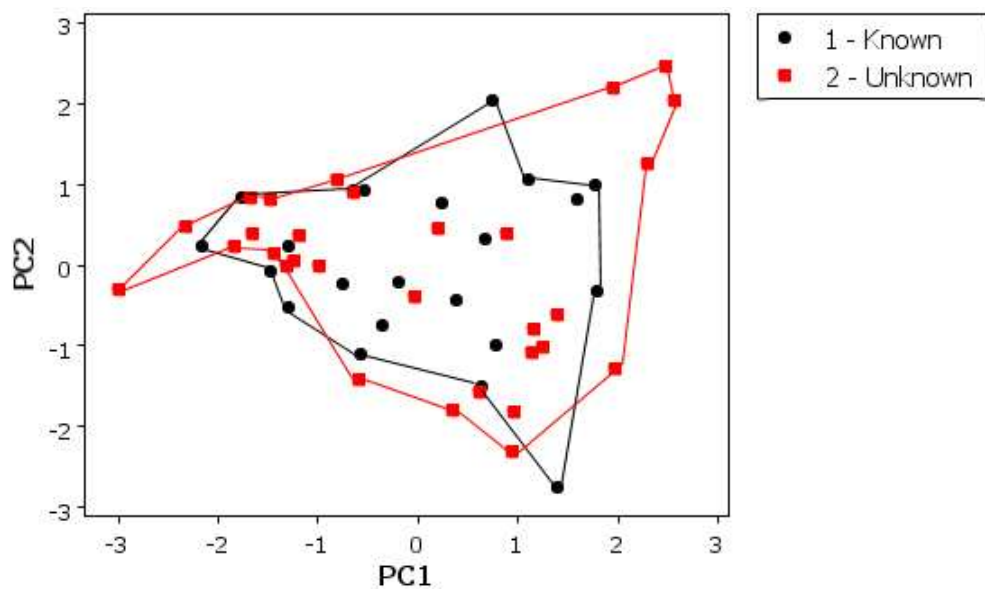
Figure 5.27 - *Scatterplot: variation in total duration of behaviours per one-minute excerpt by PC1 and PC2 for Familiarity.*

The two categories for Familiarity appear to have no association with either PC1 or PC2 for total duration (see Figure 5.27). As shown in Figure 5.28 below, however, there appears to be some trend for category 2 (Unknown) to be associated with negative scores on the first principal component, and this category also has strong weightings on PC2 when responses are measured as mean duration of events.
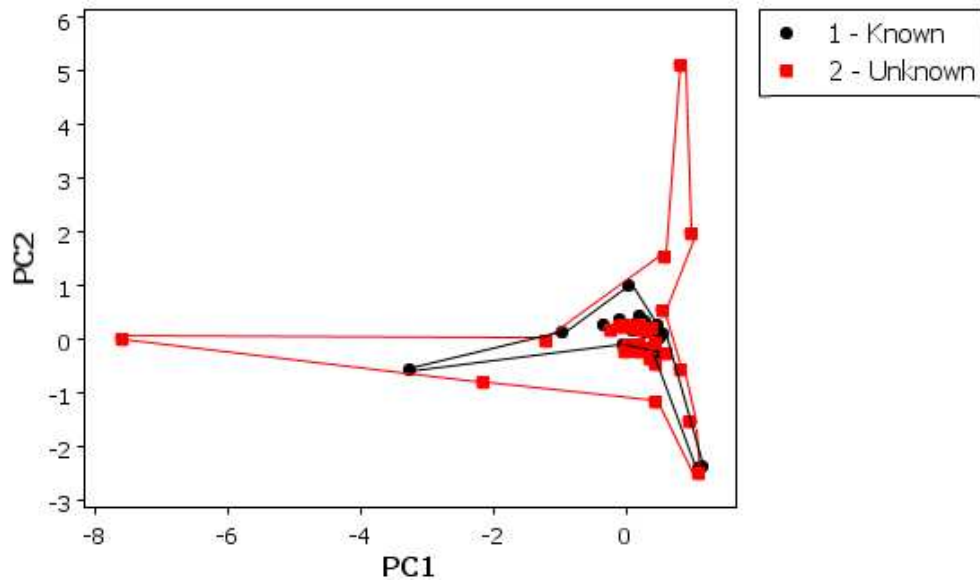
Figure 5.28 - *Scatterplot: variation in mean duration of behaviours per one-minute excerpt by PC1 and PC2 for Familiarity.*

The PCA for mean duration of behaviour drew attention to the negative correlation between self and other's face, which could describe the summary given by the two first components. Familiarity was tested for association with the response self; there was no statistically significant difference between the two categories of Known and Unknown (n = 50, w = 484.5, p = n.s.).

Strong negative weightings with PC2's summary of 23.6% of the variation across mean duration responses are associated with both of the dependent variables away and other's hands. However, the difference between Familiarity categories with both of these responses is not statistically significant (away: n = 50, w = 446.5, p = n.s.; other's hands: n = 50, w = 455, p = n.s.).
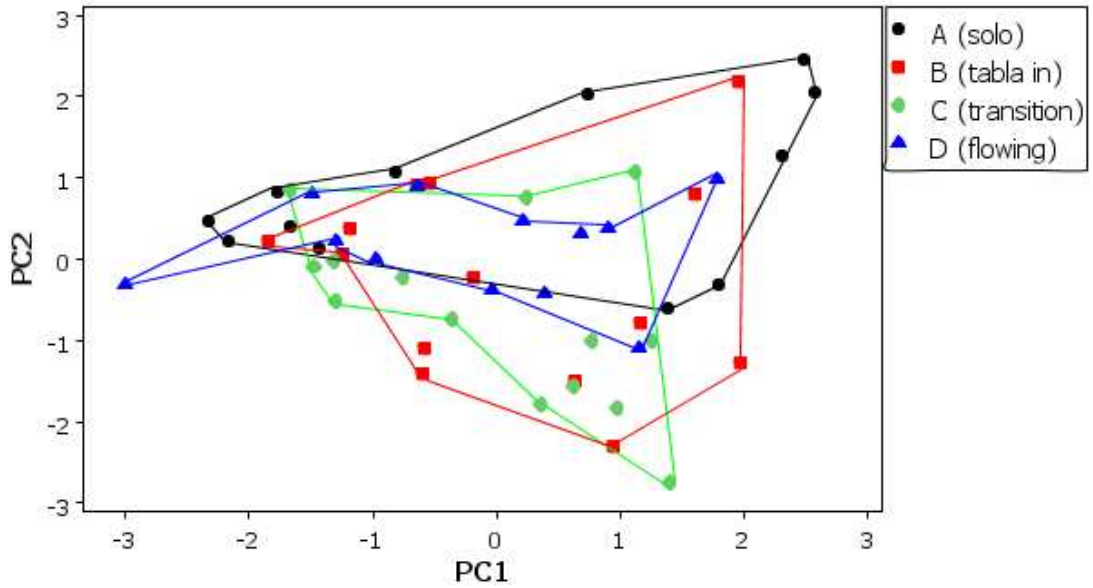
Figure 5.29 - *Scatterplot: variation in total duration of behaviours per one-minute excerpt by PC1 and PC2 for Set.*

The distribution of the four Set categories across both PC1 and PC2 suggest that there the independent variable offers no explanation for variation in the results for total duration of events per excerpt.
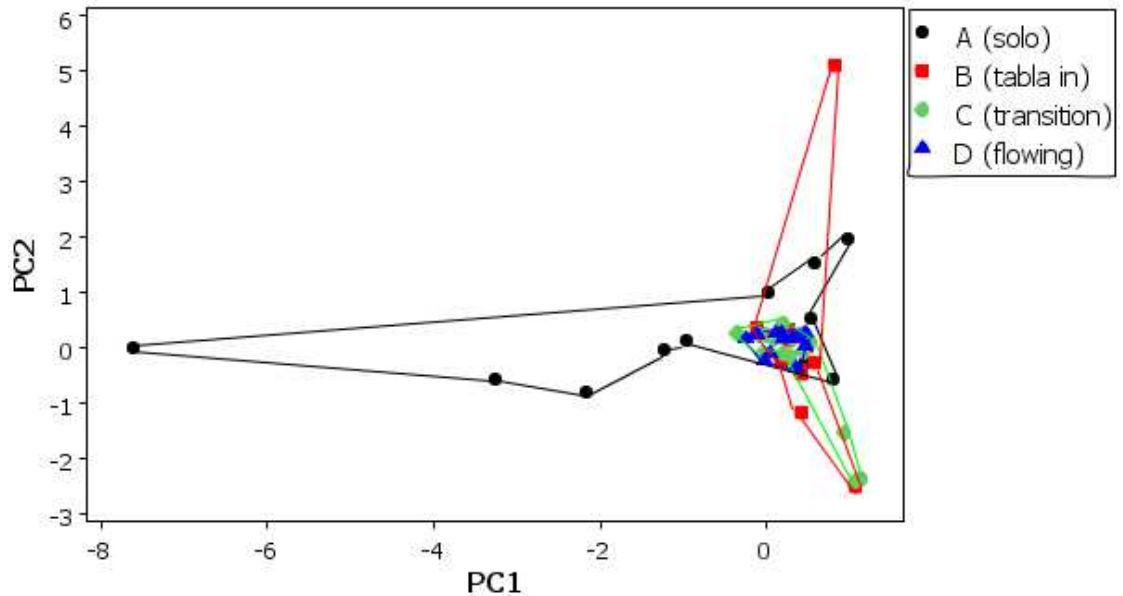
Figure 5.30 - *Scatterplot: variation in mean duration of behaviours per one-minute excerpt by PC1 and PC2 for Set.*

With the exception of A and B, the majority of responses for mean duration of event across all categories of Set appear to lie at zero on the axes of both PC1 and PC2. The data variation was explored for a possible association between independent variable, Set with <u>self</u> and <u>gesture</u> responses as category A appears primarily associated with strong negative scores on PC1. These associations are not statistically significant (<u>self</u>: Mood χ^2 = 3.29, d.f. = 3, p = n.s.; <u>gesture</u>: Mood χ^2 = 1.29, d.f. = 3, p = n.s.).
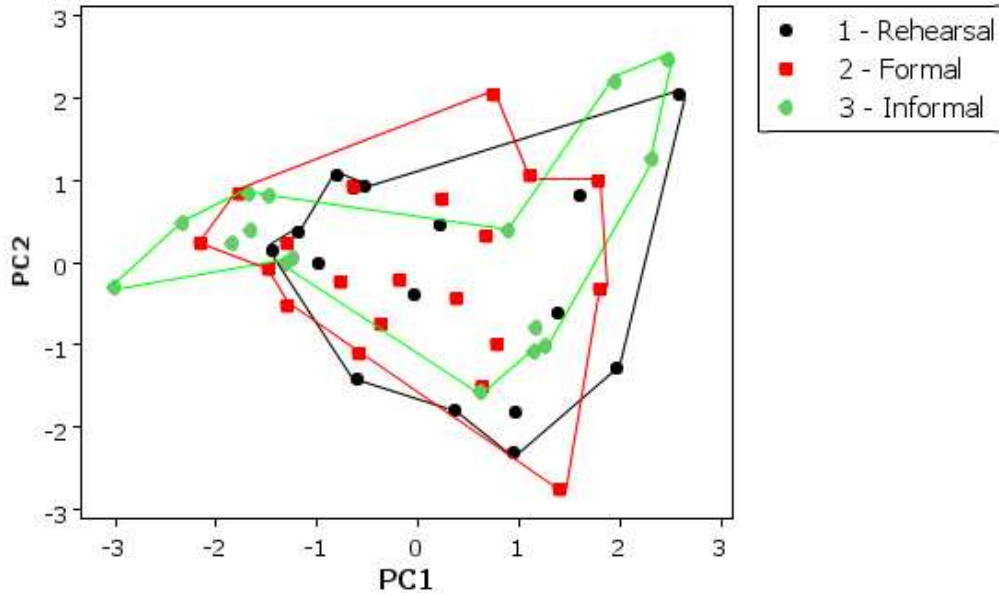
Lay
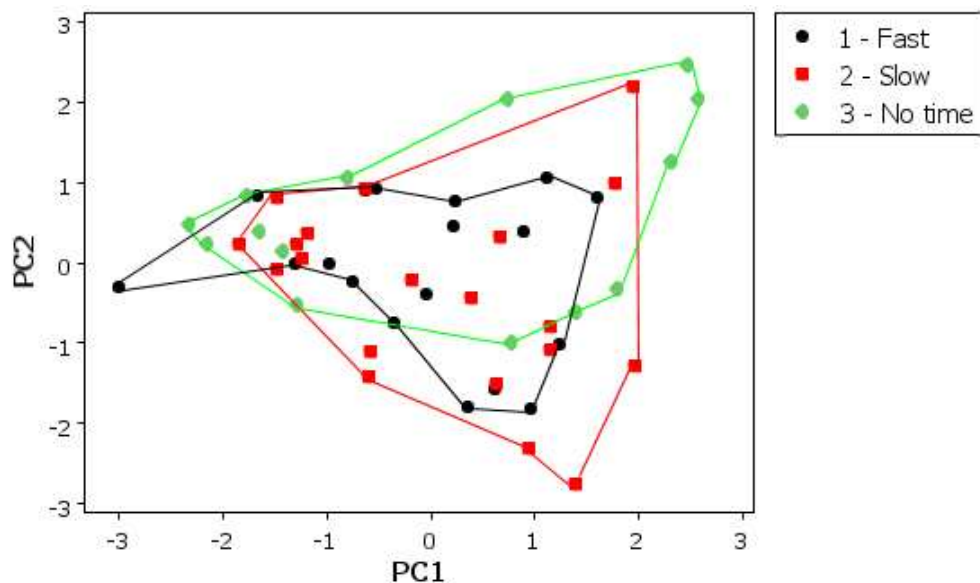
Figure 5.31 - *Scatterplot: variation in total duration of behaviours per one-minute excerpt by PC1 and PC2 for Lay.*

As for the independent variables Context, Familiarity and Set, the categories for Lay appear to have no association with the explanation of variation in total duration of events per excerpt that is given by either of the first two principal components.

Regarding the mean duration data (see Figure 5.32), there appears to be some association between category 3 (no time cycle) and PC1, as category 3 alone shows dispersal along the negative values of the axis. However, the response <u>self</u>, whose PC1 weightings showed strong negative values, showed no statistically significant difference between categories (Mood χ^2 = 2.22, d.f. = 2, p = n.s.).
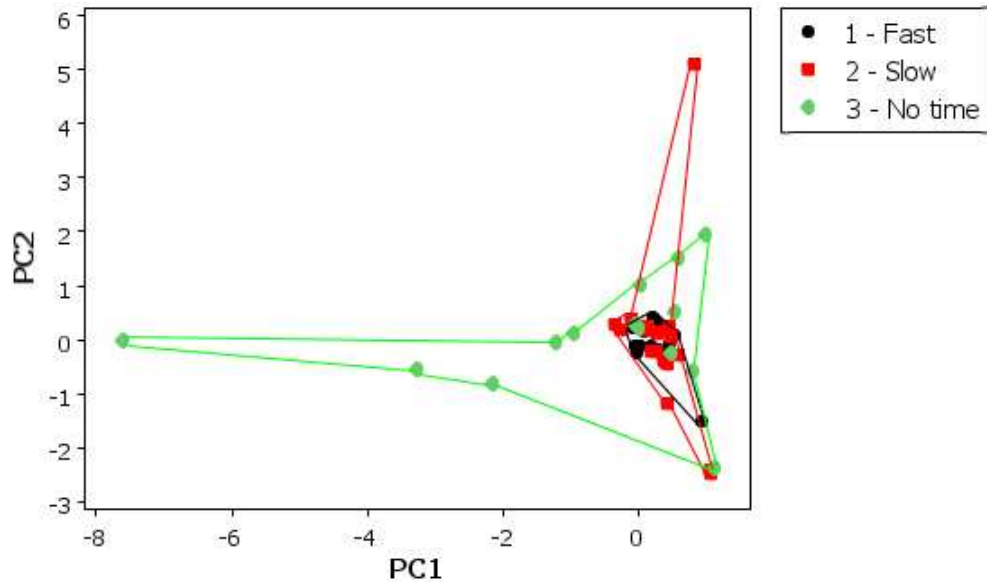
Figure 5.32 - *Scatterplot: variation in mean duration of behaviours per one-minute excerpt by PC1 and PC2 for Lay.*

5.5.5   Mutual gaze - results

Using the method described in section 5.4.1, recorded occurrences of mutual gaze were tabulated by their rate of occurrence and duration.

Rate of Mutual Gaze occurrence

There were 23 occurrences of mutually-held gaze in the sampled data, which were counted in 13 of the 24 excerpts (see Figure 5.33). The greatest rate was of four occurrences in one excerpt, but the modal value was zero, or no recorded incidence of mutual gaze.

The relationship of the independent variables with the variation in rate of mutual gaze occurrence was explored with a stepwise regression analysis to identify which, if any, of the four independent variables Context, Familiarity, Set or Lay might be a significant predictor for mutual gaze occurrence. This was carried out for both rate of occurrence per minute and rate of occurrence per cycle.
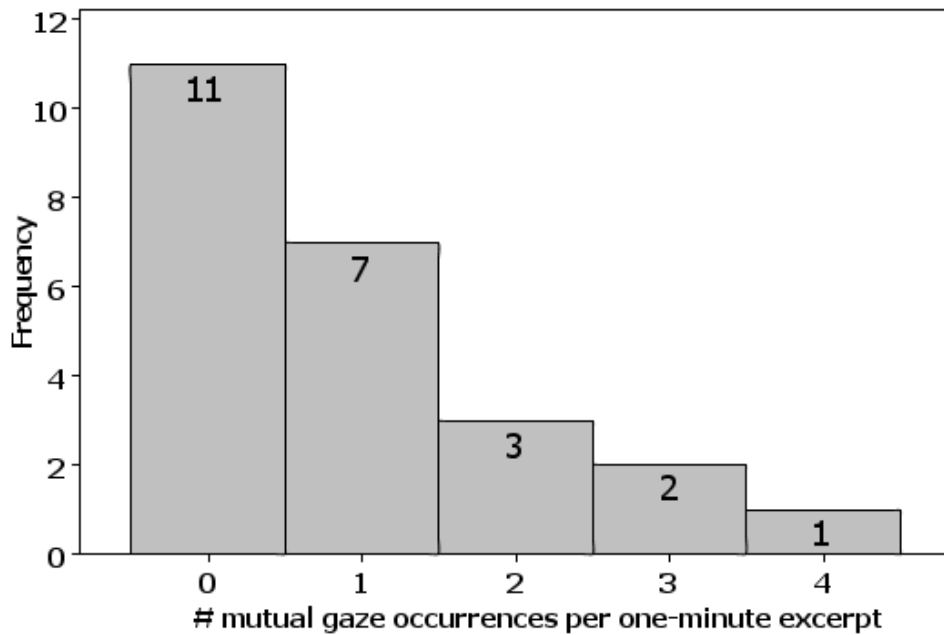
Figure 5.33 - *Occurrence of mutual gaze across video data sample of 24 excerpts.*

For rate of mutual gaze occurrence per minute, the variable with the closest association with the responses is Context, potentially accounting for just 7.82% of the variation. However, this is not statistically significant (n = 23, t = -1.68, p = n.s.). For rate of occurrence per musical time cycle, the best fit response is Familiarity, which may account for nearly 10% of the variation in the data; however, the association is not statistically significant (n = 23, t = -1.77, p = n.s.).

Duration of Mutual Gaze occurrence

The duration of recorded mutual gaze occurrences have a non-normal distribution, with a median duration value of 0.66 seconds (see Figure 5.34). The interquartile range of the data is 0.76 s from the first quartile value of 0.4 s to the third quartile value of 1.16 s.

The values of duration for each instance of mutual gaze were investigated with stepwise regression analysis. The results indicate that two of the four independent variables may be predictors for the duration responses. These are Lay and Context; both show a statistically significant association with variation in the response data. The independent variable, Lay may account for 14.4% of the variation (n = 23, t = 2.17, p = 0.42); Lay and Context together may account for nearly a third (31.31%) of the total variation (n = 23, t = -2.48, p = 0.022).
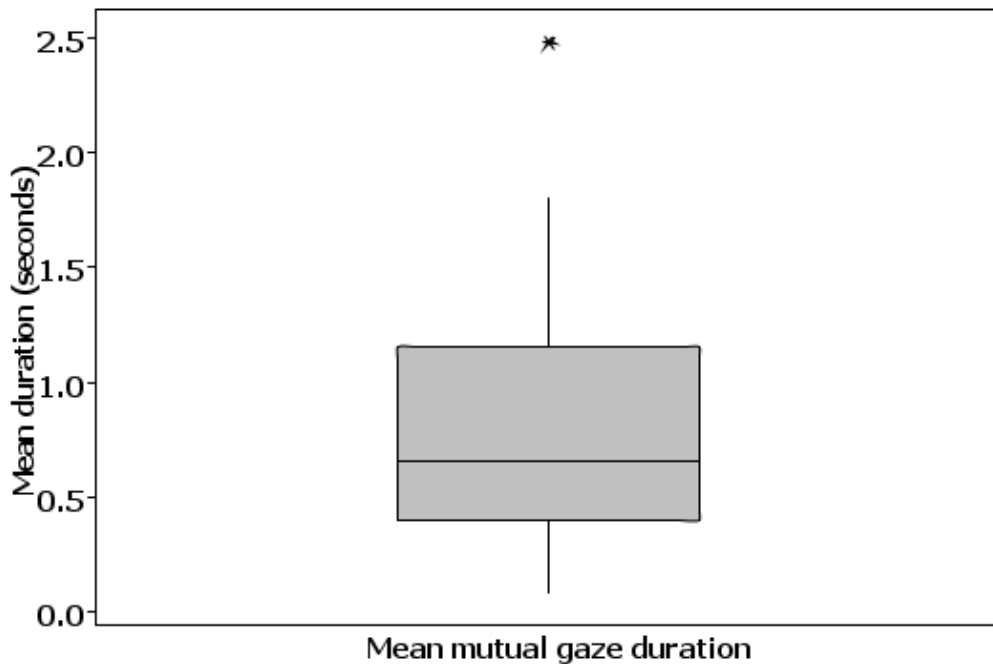
Figure 5.34 - *Mutual gaze mean duration in 23 occurrences. The median value is 0.66 s, shown by the horizontal line. The asterisk marks one single outlying duration value.*

To explore the possible reasons for significance of Lay in the regression analysis results, the robust Kruskal-Wallis test was used to examine the distribution of median values of mutual gaze event duration with Lay and Context. For Lay, the association with mutual gaze duration response is not statistically significant ($h = 4.8$, d.f. = 2, p = n.s.), although the effect of small sample sizes here should be considered when inspecting the result of the test. A study of the summary statistics for the test reveal that the median duration of mutual gaze events for Lay category 3 (music that is not in time) has a higher average rank score than categories 1 and 2. The results of the test for the effect of Context indicates a statistically significant association ($h = 6.27$, d.f. = 2, p = 0.044). The average rank scores for Context category 3, Informal Performance, differ substantially from the scores for Rehearsal and Formal Performance categories. Informal Performance shows the lowest median duration value of 0.34 s in comparison to Rehearsal (0.98 s) and Formal Performance (0.51 s). Post hoc analysis confirms a statistically significant difference between Rehearsal and Informal Performance contexts (n = 17, $w = 132$, p < 0.0132), but not between Rehearsal and Formal Performance contexts (n = 18, $w = 132$, p = n.s.) or between Informal and Formal Performance contexts (n = 11, $w = 42.5$, p = n.s.)

5.5.6 Beating bouts - results

Observed tap events were recorded as bouts of beating behaviour according to the method described in section 5.4.1. Data for the inter-tap interval - or the tapping rate - of the beating bouts follow a normal distribution. The mean value is 0.73 s with a standard error of mean of 0.023 s, as shown in Figure 5.35.
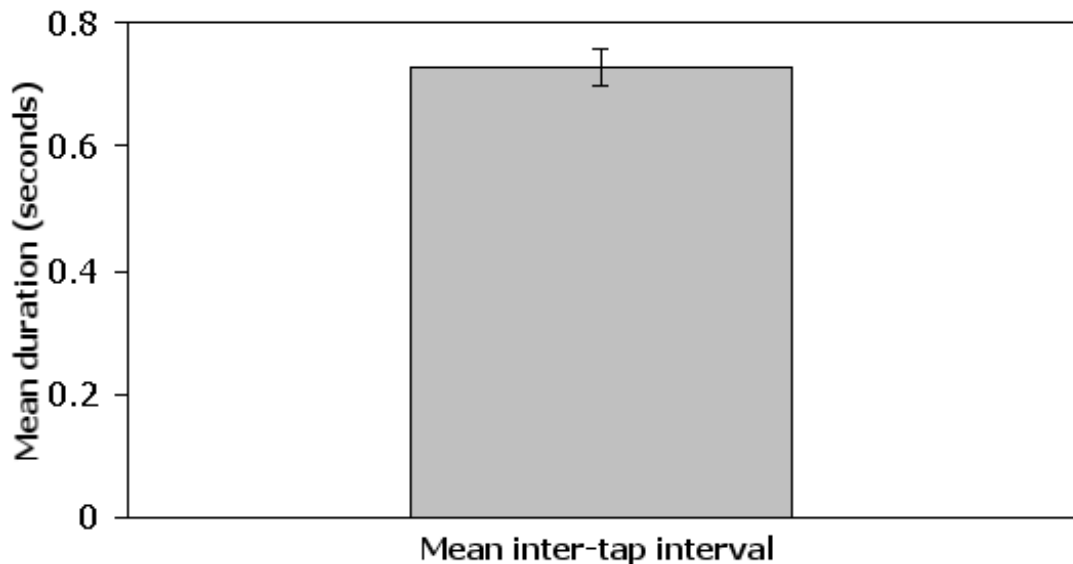
Figure 5.35 - *The mean value for inter-tap interval is 0.73 s, taken from all tabulated bouts and including 79 inter-tap intervals. The vertical bar represents the standard error of the mean of 0.023 s.*

The recorded beating bouts were tabulated by their rate of occurrence and duration.

Rate of occurrence of beating bouts

A total of 28 bouts of beating were recorded from individuals' behaviour in 14 different excerpts (n = 48).[1] There were no instances of beating behaviour in the majority of cases, and the bouts were exhibited by three out of seven individuals. Figure 5.36 illustrates the distribution of beating bouts within excerpts by individuals.

As for the mutual gaze data, stepwise regression analysis was performed on both rate of occurrence per minute and per cycle for the beating bouts. The results indicated that, for rate of occurrence per minute, Set has a statistically significant effect on a total of 10.53% of the variation in the responses (n = 48, $t = 2.56$, p = 0.014). For rate of occurrence per musical time cycle, the analysis showed that none of the variables should be considered

---

[1] Complete set of 24 excerpts, data coded for both individuals in each excerpt, therefore n = 48.

as predictor factors. Given the extremely small size of this sample, results of the data summary are further presented here in an informal data inspection.
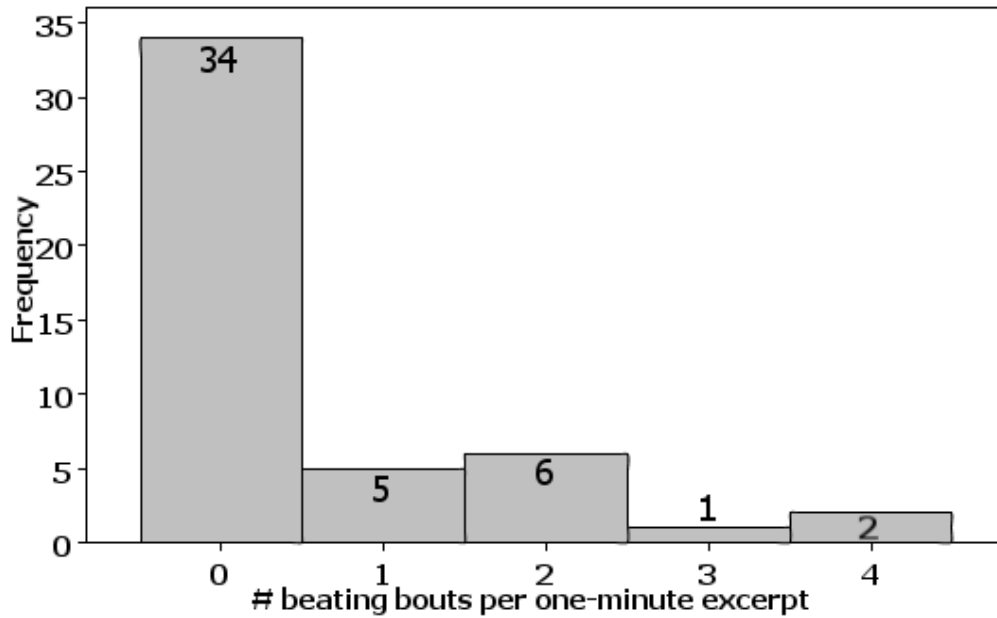
Figure 5.36 - *Recorded beating bouts in the video data sample, showing distribution of bouts by individuals across all the excerpts.*

No beating bouts occurred in Lay category 3, or in Set category A, for which the common factor is the lack of musical time cycle. As the behaviour appeared more specific to individual preference than other behaviours included in the study, it may be appropriate to disregard non-beating individuals in an informal consideration of the behaviour and its possible predictor variables, leaving three individuals in the trial. Two out of three individuals exhibiting beating behaviour were previously unknown to one another; this constituted 12 out of the 14 excerpts featuring beating bouts.

Duration of beating bouts
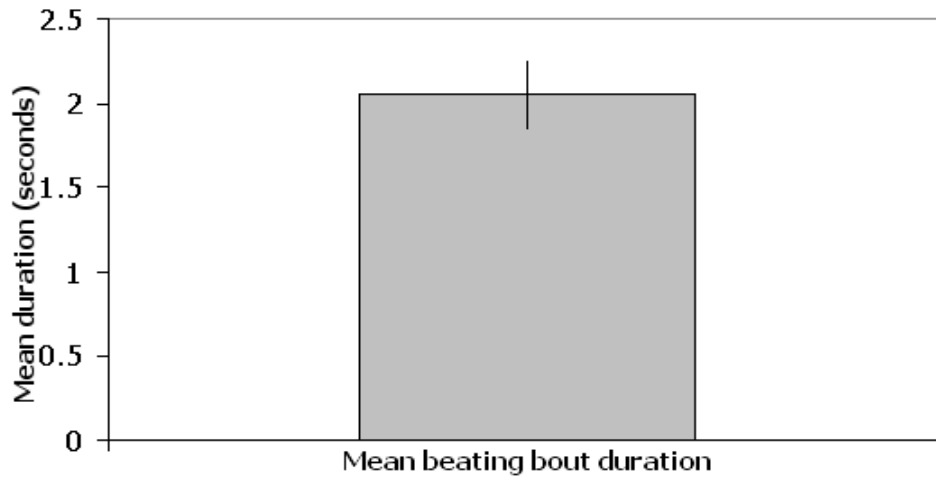
Figure 5.37 - *Mean beating bout duration is 2.05 s, with a standard error of the mean of 0.204 s, represented by the vertical bar.*

The 28 bout durations were examined with stepwise regression analysis across all independent variables; this revealed that both Lay and Familiarity may be predictors for a total of 19.98% of the variation in beating bout duration (for Lay, n = 48, t = -2.97, p = 0.005; for Familiarity, n = 48, t = 2.07, p = 0.044). The association between Lay and duration of beating bout was confirmed as statistically significant (h = 9.08, d.f. = 2, p = 0.011). Post hoc analysis, in the light of the statement in section 5.5.6 regarding the occurrence of beating bouts only in excerpts where musicians were performing within a musical time cycle, showed that there was no statistically significant difference between the categories of fast and slow time cycles (n = 48, w = 309, p = n.s.). Therefore, the effect can be accounted for by the difference between performance with a musical time cycle and unmetred performance.

The two categories for Familiarity were shown to have statistically significant effects on beating bout duration (n = 48, w = 356, p = 0.025). The small number of beating-bout-exhibiting individuals might be taken into account as the median for both categories appears as zero and no clear difference between these two categories supports the test result.

This concludes the initial exploratory data analysis. The subsequent chapter discusses these results, addressing the most likely influences on behaviour that have been indicated so far, and exploring the effect of musical and non-musical organisation on elements of non-verbal communication between interacting musicians.

6 DISCUSSION OF VIDEO CODING ANALYSIS RESULTS: I

6.1 Introduction

This chapter discusses the findings of the first stage of data analysis, which examined some basic ethological measures of the musicians' behaviour. The rates at which behaviours occurred per minute and also per musical cycle were measured. The movements that were assessed as part of this study included attention direction (looking behaviours); mutual gaze; gesture phrases; and beating behaviour events. In addition to the measurement of the rate at which these behaviours occurred, both the total and mean durations of the behaviours were calculated for each one-minute excerpt.

The approach is based on a view of communication as a dynamic process of continual, interlinked management and assessment by individuals of one another. This view guided an analysis that aims to infer information about the behaviour of the musicians by measuring aspects of individuals' behaviour as independent occurrences. The discussion focuses on these indications of likely organising factors in the patterns of behaviour; these observations then form the basis of further analysis in the subsequent chapter.

Preceding the main discussion, the first section of this chapter addresses the results of the tal cycle duration survey, whose findings were used to define the independent variable, Lay in Chapter Five, section 5.4.2.

6.1.1 Tal cycle duration results discussion

The data in the sample included performances in the time cycles Teental (16 beats) and Jhaptal (10 beats - refer to Chapter Three's brief introduction to North Indian musical systems, section 3.2, for a description of these time cycles; see Chapter Four, section 4.4, for description of the time cycles included in each recording session). The clear bi-modality of the results was note-worthy, as the tal cycles here could take any duration and yet they appeared to cluster in two groups with cycle duration values of approximately (a) 3 to 12 seconds, and (b) 18 to 25 seconds (see Figure 5.2, page 124).

A simple musicological explanation could refer to the three main tempi class of North Indian music performance - vilambit (slow), madhya (medium) and drut (fast); it seems that the sample data happened to include only vilambit and drut gats (compositions). In the cases included in the sample, the musicians apparently chose to perform no medium

tempo composition. The apparent preference for two groups of tempi out of an array of continuous possibilities for tal duration is an interesting topic, given the significance attributed to tempo by the musicians themselves in discussion about the interaction between musicians in performance:

> *AP: In India, we call the tempo [...] when there are two humans interacting together, a sitar player and a tabla player, the tempo between them is described in Hindi language as zindalay. It's the tempo which is life. It's the tempo which is vibrant.*
>
> Interview 3, with Arvind Parikh

An ecological approach to the study of musical time perception might offer further discussion to the ethnomusicological account. At a cognitive level, the culturally-specific interpretation of groupings and descriptions of the metrical structures could be seen to apply. But the musicians are also likely to respond to the immediate demands of musical activity by entraining to a pulse in the most efficient manner available. Large and Jones (1999) have proposed that such entrainment could be interpreted through a dynamic model of attentional processes. In this model, a regular pulse of attentional neurological activity is 'captured' by periodic stimuli in auditory events, giving rise to temporal expectations within active, online action-perception mechanisms.

The tendency to entrain to a particular level of pulse, from which an individual may then infer other temporal expectations, seems likely to be related to an effect described by music psychologists such as Fraisse (1982), London (2004), and Repp (2006) as a human propensity to *subjective rhythmicization*. The earliest description of this phenomenon comes from late nineteenth-century psychology (London, 2004:14). Subjective rhythmicisation is a way to describe how individuals may perceptually group periodically-recurring auditory events into imagined units of, for example, two, or three. London suggests that *subjective metricization* may be a more accurate description of this phenomenon since it is this tendency to group periodically occurring events which gives rise to the concept of musical metre (London, 2004:15).

Inherent in an account of subjective rhythmicization is the notion that recurring auditory events at a particular periodicity may be comfortably anticipated with minimal cognitive load; at a particular rate of occurrence, certain periodic events can be comfortably anticipated, and individuals may co-participate within the emergent structure of these events. The limits of such a time-frame appear to extend to an upper region of

approximately three to five seconds (Pöppel & Wittmann, 1999). The lower region has been cited variously depending on factors. Two of these include the proprioceptive training of the participant (as trained instrumental musicians in general have consistently lower thresholds than untrained participants), and the action by which the participant demonstrates their participation in a periodic event (since fine motor movements may be acted out faster than gross movements). Repp (2006) found the mean synchronization threshold for tapping along to auditory stimuli to be approximately 125 ms (0.125 s), while Pöppel and Wittman (1999) have proposed a 0.6 s boundary for a typical time period in which movements for steady, periodic performance can remain under voluntary control. Within thresholds of these regions, individuals appear to 'feel' a pulse reliably without undertaking cognitive acts of attentional effort, such as the mental subdivision of a slow pulse into a greater number of units, or the reverse where auditory events occur at a very fast rate.

Such feats of musical time accountancy are known and rehearsed by North Indian classical musicians. In the context of a performance in a fast Teental or in Jhaptal, musicians may mentally pare the cycles down to metric structures of, for example, 4 + 4 + 4 + 4 in Teental, or 2 + 3 + 2 + 3 in Jhaptal. The act of perceptually grouping events may therefore give rise to the experience of an alternative metre which has four equal or unequal units. Where a cycle is very slow, with a long duration, musicians may mentally subdivide the tal further, to give the sense of a regular, basic pulse of which there may be 32 events in Teental, or 20 in Jhaptal.

The first band of preferred tal cycle durations seen in these data include values from approximately 3 to 11 seconds. The individual 'counts' in these instances would have intervals of approximately 180 ms to 1.2 s. Hierarchically-grouped into four units, the approximate durations of 750 ms to 3 s might be experienced as a comfortable pulse. The second band of preferred tal cycle durations has a mean of approximately 22 s, from 18 to 25 seconds. At the pulse level of the counts of the tal this would give intervals of approximately 1.3 s to 2.5 s, which are comfortably within the boundaries for subjective rhythmicization described in the music rhythm perception literature.

It has also been suggested that small integer ratios exist in the preferred tempi demonstrated by participants asked to tap rhythmically; Fraisse (1982) described the typical bimodal distribution of 1:1 and 2:1 intertap intervals produced by subjects on such tapping tasks. In the small number of cases outlined here, it may be that the experienced

pulse of these two distributions could be related through their common capacity to offer a vibrant, intuitive and comfortable tempo within which the musicians can perform together. They could be seen to have an approximate 1:1 ratio, as a mean of 1.5 s may be inferred from the grouping of individual counts of the 6 s mean tal duration into four units for the first band of preferred tal cycle durations. The individual counts of the second band of preferred tal cycle durations (mean duration of 22 s) are calculated as approximately 1.4 s for Teental, or 2.2 s for Jhaptal.

While this short survey can only offer an extremely limited view of the preferred durations of tal that likely exist in a wider pool of music performance, the discussion points towards universal mechanisms of time perception that might underlie negotiated tempo judgements between musicians (further discussion of this topic is included in Chapter Seven).

6.2 Looking behaviours

6.2.1 Principal Components Analysis and factor analysis summary

As described in section 5.4.4, the principal component analysis (PCA) and factor analysis summaries were used to study variation in rate of occurrence and duration data on communicative behaviour as outlined in Table 5.1. In the first part of this chapter's discussion, the attention patterns exhibited in looking behaviour are investigated.

Rate

Looking first to the broad picture presented by the factor analysis with Varimax rotation, the results for rate of looking behaviour occurrences suggest that variation in the responses can be summarised by factors that make a distinction between rates of events for interaction *within* and interaction *beyond* the duo's own physical frame of reference. When examined at the base rate of musical time cycle duration, the occurrence of looking behaviour <u>self</u> may be seen as part of a referencing, checking action when combined with both <u>other's face</u> and <u>other's hands</u> looking behaviour. These may be described as factors that summarise within duo interaction *self-interest* versus *other-interest*. <u>Away</u> behaviour constitutes a separate factor to explain variation in the responses, and describes communication that occurs *beyond* the duo's interaction zone.

Duration

The total duration responses give an indication of the proportion of time spent by individuals on each behaviour, while the mean duration data shows the typical occurrence time of each event. In contrast to the data on rate of occurrence, there is no obvious summary for the duration data in the dependent variables.

In the total duration summary, the variation may be reducible to a description of two factors – those behaviours related to interactive, communicative behaviour on the one hand, and non-interactive behaviour on the other. In particular, the PCA for both total and mean duration data variation demonstrated a negative correlation between self (non-interactive) and other's face, which could be described as a maximally interactive type of looking behaviour. The descriptive factor summary of mean duration, however, showed that the variation tended to occur according to the specific response. For example, looking at other's hands showed consistently different patterns in duration variation to looking away. These observations support the notion that the aspect of attention which is exhibited in duration of looking events varies consistently according to the function of the looking behaviour, and in particular they indicate an opposition between the behaviour least related to social interaction (looking at self) and the behaviour of maximum social interaction (looking at other's face).

6.2.2   Musical and non-musical organisation factors in looking behaviours

Rate

The significant associations between the variation in rate of both Role and Set occurrences per minute are lost when the time base is altered and the same occurrences examined according to their respective musical time cycle durations. This implies that the effect of both Role and Set variables on the rate of looking events may be influenced by the musical time structure. The effect of Role on rate of events is weaker than the effect of musical structure, as Role's predictor value disappears when the time base by which rate is measured is changed from one minute to one time cycle.

While the effect of musical performance constraints measured in the variable, Set - whether it is first entry of the tabla player, transition by the two players to a new gat or tempo, or a flowing section featuring extemporised bursts around a pre-composed structure - has a significant effect on the rate of self looking behaviours regardless of the time base, away looking behaviour per cycle loses the associative value it held when measured as a rate of behaviour per minute. Therefore the factor analysis summary that

distinguished the effect of behaviour *within* interaction zone from behaviour targeted *beyond* interaction zone appears less compelling. Such an account appears to have less power than musical time structure in accounting for variation in the data.

There is a significant difference between the rate per minute at which <u>self</u> events occur when the music is unmetred with no time cycle, and when the music has a fixed time structure. However, there is no significant difference between the rate of responses per minute in fast and slow musical time cycles. When the time base is scaled to the musical cycle, this difference becomes statistically significant, confirming that musical time structure does indeed impact the variation in the rate of certain looking events.

However, certain factors appear to contribute to the variation in responses regardless of musical time structure. The independent variable Context is related to the behaviour of musicians looking <u>away</u>; when examined as both occurrence per minute and occurrence per cycle, the variation can be accounted for with the explanation that musicians look <u>away</u> far less during Rehearsal than during Formal Performance. Informal Performances appear to show a middle-ground for this behaviour, with less looking <u>away</u> than Formal Performance but more than a Rehearsal.

Familiarity between musicians also proved to be a consistent factor in accounting for variation in the same behaviour, as familiar musicians look <u>away</u> from the duo's interaction zone more frequently than do unfamiliar musicians. Additionally, the results suggest that musicians who have known each other for longer look at each <u>other's hands</u> significantly less than do unfamiliar musicians. A possible explanation for this might be that the interaction dynamics are more secure, and musicians require less communicative maintenance within the interaction. An account in which dyadic, interactive behaviour alters according to the level of familiarity in a social relationship is well substantiated by literature on interpersonal relationship development, as summarised by Tickle-Degnen and Rosenthal (1990). While early encounters are "rigidly circumscribed by culturally acceptable and stereotypical behaviour", later interactions may "show more diversity in the ways they [participants] communicate thoughts to one another. There should be an increase in communication efficiency and coordination and fewer misunderstandings of communication meaning" (Tickle-Degnen & Rosenthal, 1990:279). In this case, stereotypical behaviour might include deliberate and obvious other-attending activity such as looking at a partner's hands. Musicians in more familiar pairings seem likely to have developed alternative communicative mechanisms, permitting a departure from the

early, rigorous maintenance of basic dyadic communication channels within the dyad's zone of interaction.

Duration

Role is the only independent variable whose association with the variation in duration measurements is consistent across both total duration and mean duration data. The association between Role 1 (soloist) with high values in looking at <u>self</u> in both mean and total duration values indicates that soloists look down at themselves for longer than tabla players look at themselves. Total and mean duration data showed that tabla players also look for longer at the soloists' faces than soloists look at tabla player's faces. No other independent variables account for any variation in the duration data; the variables Context, Familiarity and Group show no association with variation in the duration data.

Given the lack of explanation for mean duration data variation by the socio-musical predictors given as independent variables, it would seem that a different organisational mechanism may be involved. One possible account is supported by research on non-musical human behaviour patterns. Through observation of the filmed behaviour of four different groups (Europeans, Tobriand Islanders, Yanomami Indians and Kalahari Bushmen), Schleidt (1988) reports a three-second universal duration in repetitive movement patterns in everyday human behaviour. Criteria for the identification of movement patterns were based on the occurrence of identifiable units which must recur at least three times, with the beginning and end of the action visible on film. Other selection criteria excluded movements associated with self-adjustors (such as scratching), work-related movements or ritual behaviour; therefore Schleidt's observations would not focus on any behaviour associated with musical performance.

Gerstner and Fazio (1995), summarising research by Gerstner and Goldberg (1994), Schleidt, Pöppel and Eibl-Eibesfeldt, (1987), and Schleidt (1988), propose that the 1 - 4 second time constant for human perceptual segmentation (and its association with non-perceptual motor actions) can be explored in both human and non-human mammalian species through observation of vigilance postures. Vigilance, as described earlier in Chapters Two and Four, sections 2.6 and 4.2.1, is considered to be a perceptual phenomenon that is evidenced in such behaviour as looking up while eating, for example. Gerstner and Fazio (1995) suggest that the mean duration of these looking behaviours matches the 1 - 4 second "universal" duration of movement pattern; furthermore, they propose that these results indicate an evolutionarily conserved mechanism for behaviour.

Such cognitive ethological research offers an alternative account of the organisational mechanism that might underlie the variation in communicative behaviour duration data, as it is possible that evolutionarily-conserved mechanisms for temporal constraints of action-perception units may well operate throughout musical, as well as non-musical, interaction. The mean duration data of looking behaviour during excerpts of musical interaction indicates that the median values for duration of units in all types of behaviour fall well within the 1 - 4 second boundary (see Figure 5.24).

Schleidt (1988) proposes two inter-related functions of the universal time constant. Firstly, the relation of the action unit to the perceptual present could be imagined to contribute to the sensation of *now* first discussed in Chapter Two, section 2.6. Secondly, Schleidt offers the suggestion that "communication and synchronisation between people might be facilitated by a mechanism which creates a common time beyond the content of a behaviour pattern" (Schleidt, 1988:74). While the specifics of such a mechanism are ultimately inaccessible through observation, the notion that dynamic social interaction processes might be the foundation for the experience of shared time is extremely relevant to this thesis' discussion of the functions of human musical behaviour. It seems likely that while the rate of occurrence of behaviour is affected by socio-musical factors, the duration of these events is associated with possible universal mechanisms which might underlie social behaviour.

6.3   Expressive gesture events

To recap section 4.2.2, musicians have been seen to exhibit complexes of expressive movement, using predominantly head and shoulders as their hands are occupied. These complexes of expressive movements are, in a way, the carriers of the attentional behaviour that have been coded as patterns of looking behaviour. Phrases of expressive gesture can be measured from their onset to retraction from and to a neutral position, where no expressive effort appears to be exhibited.

6.3.1   PCA and factor analysis

Expressive gestures occurred in every excerpt and related to the physical delivery of the looking behaviours themselves. Expressive gesture events were included in the PCA and factor analysis summaries for the same categories as all looking behaviours. The gesture phrase data shows a highly statistically significant positive correlation with <u>self</u> in every case apart from the summaries for total duration data per excerpt. In this case, the total

duration of expressive gesture behaviour did not have a strong score on either the first or second principal component, suggesting that its occurrence was not well summarised by either axis.

6.3.2   Organisation factors in expressive gesture behaviour

The association of gesture phrases with looking at <u>self</u> in both cases of rate of occurrence per minute and rate per cycle implies that expressive gesture behaviour is affected by similar socio-musical factors as the looking behaviour, and, like the looking behaviour, is particularly affected by the musical structure. The rate of <u>self</u> looking behaviour responses show significantly low values for both Set A (solo) and Lay 3, where the music is not in time, indicating that the musicians move to direct their attention towards themselves during the alap significantly less often than during other parts of the performance.

The rate of gesture phrases scaled per cycle confirmed the most obvious outcome, that faster cycles with shorter durations featured fewer events than slower cycles with long durations. This further confirms that communicative behaviour within the musicians' interaction zone, including looking events of <u>self</u>, o<u>ther's hands</u> and <u>other's face</u>, and expressive gesture phrases, are strongly associated with the musical time structure.

Considering only the data where the music is performed in time, when the responses were scaled by rate of occurrence per cycle the results showed that Set B (tabla in) has a greater median value of gesture occurrence than C (transition) or D (flowing). The excerpts included in Set B are taken during the first part of tabla accompaniment, when the tabla player joins the soloist in tal. When expressive gestures are considered as behaviours that the duo may be able to use to entrain to one other's movements, this result could be corroborated by the factor analysis summary that offered a distinction between behaviour directed *within* the interacting duo and behaviour directed *beyond* the interaction zone.

However, such gestures may also be accounted for by the ostentatious arrival of a tabla player announcing his presence to the audience, in which case the behaviour would be a communication intended to be conveyed *beyond* the interaction zone. This is certainly a concept supported by the qualitative data, where showy and flamboyant entries by tabla players are frowned upon by some soloists, as "boisterous" acts of theft of the audience attention which is owed to the soloist (Interview 3, with Arvind Parikh).

The mean duration of gesture phrases show the same pattern as mean duration of looking behaviours; the only independent variable to have an effect is Role, and again it is the soloist who displays significantly longer gestures. The gesture phrase duration data for the musicians who are playing together featured consistently short phrase durations with a normal distribution.

In conclusion, while both musical time structure and socio-musical factors such as Context and Familiarity may partly govern the onset of gesture phrases, their duration does not appear to be associated with these factors. Given this evidence, Schleidt's theory of a mechanism for duration constraint on perceptual-action behaviour for the purposes of "communication and synchronisation" appears to be supported by the gesture phrase duration results (Schleidt, 1988:74).

6.3.3   Summary for individually-observed communicative state behaviours

1. Rate of occurrence variation may be summarised by two factors: within interaction duo and beyond interaction duo

2. Duration of occurrence variation may, to some extent, be summarised in two factors by communicative function: interacting and not interacting

3. The rate of expressive gesture communicative movements appears to be associated with self-directed attention patterns

4. Musical time structure strongly affects the variation in the responses for communicative behaviour

5. The part of the music performance underway affects the rate at which musicians look down at themselves and avoid interactive attention patterns

6. Musicians look away from the interaction zone (includes looking events towards the audience) significantly more during formal performance than other contexts

7. Familiar musicians look at one another's hands significantly less than unfamiliar musicians look at one another's hands.

8. Familiar musicians look out towards an audience more than unfamiliar musicians

9. Soloists look down at themselves for longer than tabla players do so

10. Tabla players look at soloists' faces more often than soloists check tabla players' faces, but these are brief checks rather than long gazes - regardless of familiarity

11. Socio-musical factors explain variation in rate of the behavioural occurrences better than they explain the variation in duration of the occurrences

12. Physiological action-perception mechanisms with universal time constraints may offer a better explanation than socio-musical factors for variation in duration

6.4   Mutual gaze

The results for mutual gaze event show a surprisingly low occurrence; of the twenty-four recorded minutes in which instances of mutual gaze were sought, only twenty-three instances were recorded and these events lasted less than a second on average (see Figure 5.34).

Work by Davidson, (2004), Davidson and Good (2002) and Williamon (2002) suggests that, in Western classical, jazz and popular music, eye contact between musicians is frequent and essential. The incidence of mutual gaze recorded here is lower than would be expected in the light of this research, and also in view of the qualitative data; when asked to talk about their non-verbal communication, the musicians typically referred to mutual gaze as a primary source of contact ("…it's like when you're talking to somebody and you want to express an idea, and put the emphasis on that - so we're using the hand gestures or your shoulder, your eyes, or the expressions in your face…" Interview 4, with Purvi Parikh). A shared gaze seems to express mutual intention, as evident in the behaviour of both parties is the dual notion, "I am attending to you. You are attending to me".

An explanation for the discrepancy between expected and observed incidence of mutual gaze is that musicians and audiences may believe they witness a greater incidence than is actually the case. One suggestion to account for this is that the musicians are entraining to one another - and the audience to them - in a manner that triggers an experience similar to that rendered by the shared gaze. While the rate of occurrence of mutual gaze does not

appear to be significantly associated with any independent variable, certain observations made during the coding of the event suggest that the association might in part be related to the musical structure.   Where the music was in time, occurrences of mutual gaze appeared to occur at the sam. This feature is illustrated in Figure 6.1, which shows a time-line for the excerpt of Mehboob Nadeem and Subrata Manna during the rehearsal before their informal performance (Set C), during which two occurrences co-occur with the sam.

In the rhetoric of performers and aficionados, the sam would be a typical incidence of eye contact that musicians are aware of using. As singer, Purvi Parikh said, with reference to non-verbal communication including eye contact and hand gesture, "You're saying to the tabla player that you come to the sam, or, you know, like - a very spontaneous… that you've done an improvisation and so has he, and it comes together and you're doing things together" (Interview 4).
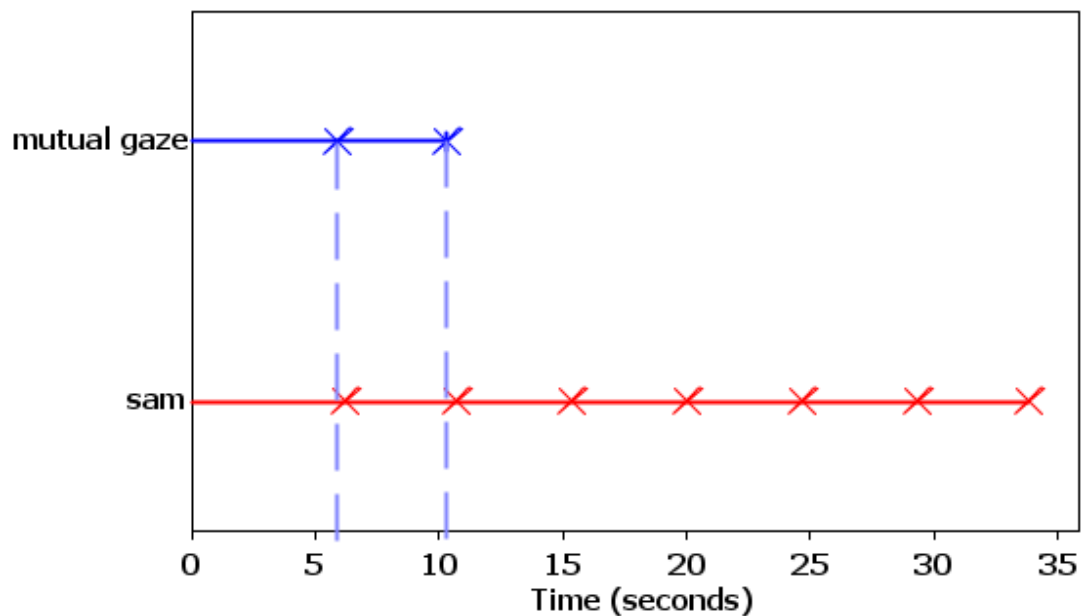
Figure 6.1 - *Example of mutual gaze association with the sam in one example of the thirteen excerpts featuring mutual gaze occurrence. Showing the first 35 seconds of Set C excerpt of Mehboob Nadeem and Subrata Manna during Rehearsal context.*

The quotation from Purvi's interview also supports the notion of a mutual-intention quality of mutual gaze, as the interviewee appears to suggest that the aspect of spontaneous co-creation is strongly associated with an expressive affirmation. Purvi goes on to state that, "When it's like a dialogue between people, then the audience is almost shut off because there's a sense that you and me are improvising together". This would

further support the summary of communicative behaviour into the factors *within* interaction zone and *beyond* interaction zone.

The duration of the mutual gaze events showed a non-normal distribution (n = 23, a^2 = 0.69, p = n.s.). The interquartile range of 0.76 s about a median duration value of 0.66 s indicates a shorter behavioural unit than that of the other communicative behaviours. While mutual gaze events occurring in Lay category 3 (not in musical time) appeared to have a longer duration, this association was tested and found not to return a statistically significant result (n = 23, h = 4.8, p = n.s.).

However, the duration of mutual gaze occurrence was seen to be significantly longer during Rehearsal than Informal Performance. In conclusion, while mutual gaze occurrence was not associated with any particular independent variable, the duration appeared to be typically longest during Rehearsal, and an apparent alignment in some cases with the sam is supported by the qualitative data. These results are followed up at the second stage of analysis in Chapter Seven. The typical duration was shorter than other communicative behaviours for which greater physical movement is required, and shorter than rhetoric and literature on the importance of eye-contact between musicians might suggest.

6.5   Beating bouts

As discussed in section 5.5.6, periods of beating behaviour were observed and coded. These behaviours appear as tapping or beating motions in various parts of the body. They could be described as uni-dimensional in the sense that these movements do not have the carrier quality in three-dimensional space that expressive gesture phrases possess. Although they may occur as head-nods, knee taps, foot taps or finger taps, the do not serve to move an individual's face, leg, foot or hand from position A to position B; they may be described simply as one aspect of motion in a body that is involved in a musical interaction. However, movements of this sort can also be observed in non-musical interactions; a similar description of the type of body movement is defined by the class of stereotypic movement used by psychologists to describe repetitive behaviour apparently related to cognitive stress caused by learning difficulties and pathologies.

Schleidt (1988) refers to observation of stereotypic movements recorded during the cross-cultural study of human movement patterns. These are not the focus of the study, which compares the mean duration of short, complete behaviours, but "patterns built up of

simple movements of short duration (period lengths less than approx one second) which are repeated again and again, having therefore a somewhat stereotyped character (episode lengths between approximately five and 55 seconds). These behaviour patterns may have a regulatory biophysiological function, either stimulating the system or calming it down" (1988:73).

It seems most likely that beating or tapping behaviour, when exhibited during a musical interaction, might be expected to occur "in time" with the music. At times, musicians and audiences do certainly participate in musical events by tapping purposely in time (on the beat, off the beat, every three or four beats) - these are all very common methods of inferring and enjoying a meter in music when presented with a regularity of pulse (London, 2004:12-3). However, observations made during the study of specifically non-verbal communicative behaviour in the video data indicated that the pulse inferred from bouts of tapping were not always related to the musical pulse in any readily apparent manner.

The strongest predictor for beating bout was the time structure of the music, as the beating behaviour did not occur with Set A when soloist played unaccompanied alap. While the initial analysis returned no significant association with independent variables, there is some evidence of association with the socio-musical factor, Familiarity, as 12 out of 14 of the beating bouts occurred in duos where the musicians were unfamiliar with one another. The mean duration of beating bouts, at 2.05 s, is much shorter than the stereotypic behaviour described by Schleidt (1988), and the variation within this summary does not show any association with any independent variable. However, the duration does fit within the 1 - 4 second perceptual-action present timescale. Furthermore, the inter-tap interval, shown in Figure 5.35, shows a mean value of 0.73 s that is similar to the preferred tapping tempo found by music psychologist, Fraisse, of approximately 0.6 s (Fraisse, 1982).

The possibility that these behaviours occur as a form of stereotypic behaviour, perhaps employed by musicians for their biophysiological regulatory function, is pursued in the second stage of the analysis in Chapter Seven. Given the association with music in time, this second stage of analysis also goes on to examine the type of musical action in progress when the beating bouts occur, and to explore further the relationship of the beating rate with the musical pulse.

7   VIDEO CODING ANALYSIS: II

7.1   Introduction

The subsequent stages of analysis described in this chapter draw on the findings of the first part of analysis, discussed in Chapter Six. Where behaviour appears to be most affected by musical factors, the time-series data is examined in relation to the musical time-cycle or specific musical action (such as the performance of a gat, solo alap, or an improvised section). Where behaviour appears to be related to social, or socio-musical, factors such as the degree of familiarity between the two musicians, or the context in which the musical interaction takes place, the analysis considers the behaviour of the musicians in relation to one another in the light of an interpretation of communication as a continual, mutual process of intention-shaping by and between individuals.

The focus of analysis in this chapter moves from the observational interpretation of individual behaviour to that of integrated, dyadic interaction. This change of perspective is consonant with the continuum of approaches to observing interaction clarified by Tickle-Degnen and Rosenthal (1990:288-9), which was discussed in Chapter Four, section 4.2. For the final section of the chapter, the analysis focuses on mutual interaction processes as they take place in time during performances.

Looking behaviours and expressive gesture, when considered together, may be thought of as forming ensembles of complex movements that could constitute at least part of the individuals' attention-giving and attention-receiving behaviour. In instances where the interacting behaviour of two individuals appears to be affected by social factors and not by musical time organising principles, the time-series data are analysed by a form of cross-correlation, as a way to unpick the interaction-in-time aspect of the behaviour which contributes to the individuals' co-construction of a musical performance. The data variation is subsequently tested with appropriate statistical methods to summarise and investigate association between the processes of musicians' behaviours and the observable outcome of their interaction.

7.2   Behaviour associated with musical organisation

This section looks at the significant results from the analysis in Chapter Five, which suggested that musical structure contributes to the organisation of musicians' behaviour. These include the communicative behaviours of looking events and expressive gesture phrase; the possible association between mutual gaze and the occurrence of sam; and the occurrence of beating bouts.

7.2.1 Communicative behaviour summary

Musical structure was shown to have an effect on some looking behaviours. When the data was examined with music time structure as the time base for rate of occurrence, highly significant associations between the responses for looking at <u>self</u>, at <u>other's face</u> and at <u>other's hands</u> indicated that these behaviours could be considered as a cluster. The descriptive factor analysis was suggestive of a first factor to account for behaviour that takes place *within* the interaction zone of the musicians, and a second factor, related to the occurrence of looking <u>away</u>, that might describe behaviour directed *beyond* the interaction zone.

While the occurrence of <u>away</u> looking behaviour is apparently related to the socio-musical variables of Context and Familiarity, *within* interaction zone looking behaviours were most affected by musical structure. These looking behaviours are also very closely associated with expressive gesture occurrence, as discussed in section 6.3.

Method

To examine the effect of musical time structure on these communicative behaviours, excerpts were chosen in which both players perform and no transition, either in instrumentation, composition or tempo, takes place. Set D excerpts (n = 12) meet these criteria. These excerpts were all found to be based on Teental, the 16-beat musical time cycle.

The onset of expressive gesture of the musicians was used as the focus for the analysis. The gesture phrase duration data for these twelve cases showed a normal distribution, with a mean value of 1.31 s and a standard error of 0.14 s from the mean (see figure 7.1). The absence of outliers, which may distort the value of the mean and standard deviation, suggests that the simple analytical focus on onset times is more meaningful in this case than for the onsets of a behaviour with more varied duration values.

Figure 7.1 - *Mean duration of the twelve Set D gestures is 1.31 s, with a standard error of the mean of 0.14 s, represented by the vertical bar.*

Figure 7.2 - *Boxplot summarising the rate of gesture phrase onset by cycle for all 12 Set D excerpts. The median value - represented by the horizontal line across the box - is 1.2 s, with an interquartile range of 1.75 s, shown by the limits of the box.*

The general onset rates per musical time cycle of the Set D gesture phrases is shown in Figure 7.3. This summary demonstrates that a fairly constant rate of expressive gesture phrases - typically one or two - occur in each cycle. However, for this analysis the actual onset time of the gesture phrase within the cycle is of particular interest.

To explore this further, the data were represented through sine and cosine transformations whose base unit was an equivalent time value to the respective tal cycles.   These points were plotted along concentric circles, corresponding to successive time cycles so that the centre of each diagram represents zero seconds, and the outer circle shows the final cycle of the 60-second duration of the excerpt. The onset times of the gestures were plotted in relation to a fixed position for sam, at a 3 o'clock position on the graph (see Figure 7.3).

The Set D (flowing) excerpts are identified as follows by the numbers given in Figure 7.3:

1.   Tarun Nayak (sarod) and Subrata Manna (tabla), Rehearsal

2.   Tarun Nayak (sarod) and Subrata Manna (tabla), Informal Performance

3.   Nayan Ghosh (sitar) and Abhijeet Banerjee (tabla), Formal Performance

4.   Mehboob Nadeem (sitar) and Subrata Manna (tabla), Rehearsal

5.   Mehboob Nadeem (sitar) and Subrata Manna (tabla), Informal Performance

6.   Arvind Parikh (sitar) and Dilshad Ahmed (tabla), Formal Performance
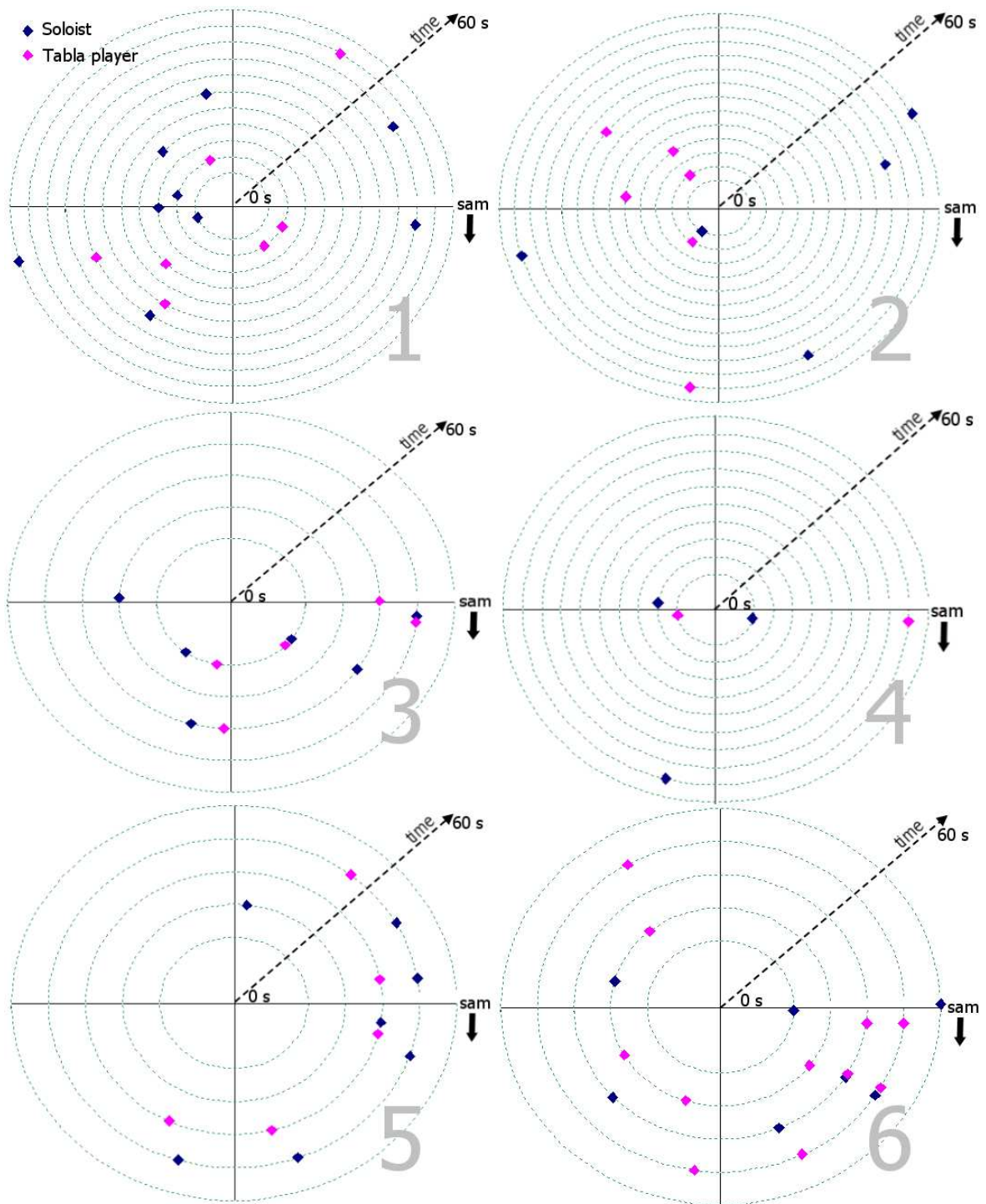
Figure 7.3 - *Gesture frequency during Set D (flowing) excerpts. Each dotted circle represents one complete cycle, showing the successive cycles within each 60 s excerpt. The innermost circle represents the first cycle in the excerpt, and the outermost represents the last of the excerpt. The time cycles begin at the right-hand side of the circles (3 o'clock) and progress clockwise. Each excerpt is identified by the number given in the bottom right corner.*

185

Results and discussion

The depiction of rates of gesture event given in Figure 7.3 suggest that there might be variation between the quadrants of tal cycle. In particular, the first and second quadrants appear more densely populated than the third and fourth. This was explored further with use of a histogram to summarise general trends in the gesture phrase occurrence (see Figure 7.4). While there is variation within each instance, it appears that there is some general trend for expressive gesture to occur predominantly in the first and second quadrants.

The third quadrant is the khali, which means *empty*. In contemporary North Indian music cheironometric practice, the use of a hand wave for the empty (silent) beat provides orientation in symmetrical tals such as Teental. Without this opposition to the sounded claps at the start of the first, second and fourth quadrants the time structure could be mistaken for a shorter four-beat cycle. The musicians here are, of course, playing and not clapping. In performance, the khali is typically evident through the tabla player's use of closed-sound drum strokes, which produce less resonant, low frequencies than the open sounds. An interesting observation of this limited survey is that the third and fourth quadrants show a lower incidence of expressive gesture - however, there is no discrimination between the third and fourth quadrants.
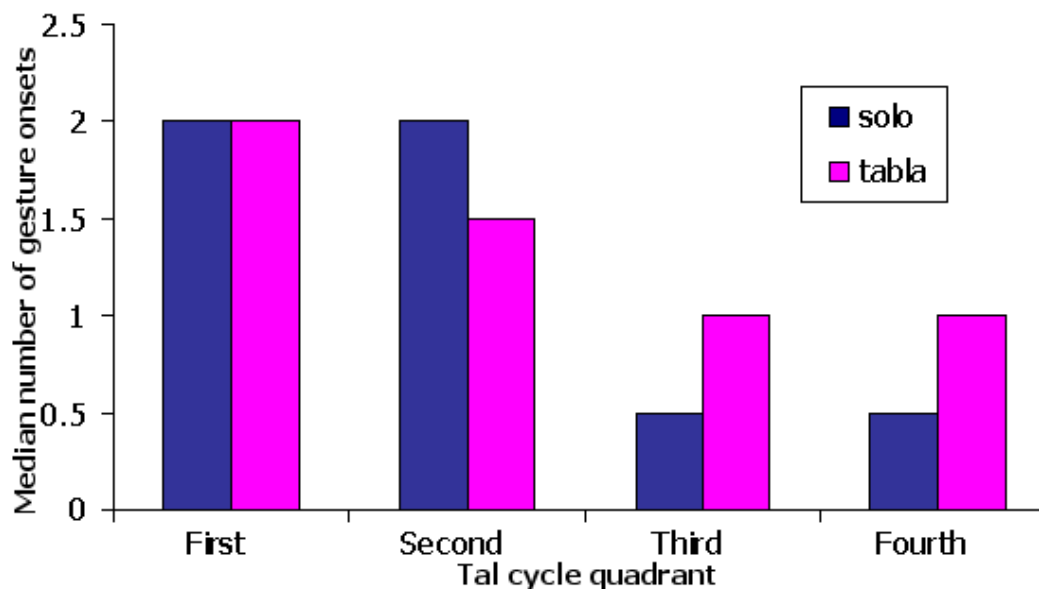
Figure 7.4 - *Median values for number of gesture phrase onsets in each quarter of Teental cycle for Set D excerpts.*

The results for the excerpt shown as Number 5 in Figure 7.3 - with Mehboob Nadeem on sitar and Subrata Manna on tabla during their informal performance - appears to follow a different pattern to the others, as there is considerably more activity in the last quadrant than the second

or third. The data were referred back to the original context to investigate this pattern, and it was noted that, during this excerpt, Mehboob plays a nine-beat tihai in two of the cycles. Musically, this means that there is complex rhythmic activity between the musicians which builds tension through the second half of the cycle until it is resolved on the sam. The cycle in the excerpt is slow, taking 17.6 s to complete. One explanation for the gesture phrase onset pattern in this excerpt might relate to a way in which the musicians may be using their bodies to help subdivide the metrical structure, to enhance their entrainment to the long metrical cycle.

A further observation of these data is that, while Role was shown to have no effect on the rate of occurrence per cycle or duration of gesture phrases (see Figure 5.12, section 5.5.3), and while the trend applies for greater expressive gesture in the first and second quadrants and fewer in the third and fourth quadrants, the two Roles do show slightly different patterns in the onset of their gesture phrases. The element of dynamic interaction for responsive behaviour between musicians is addressed in the final section in this chapter.

7.2.2   Mutual gaze and time cycles

The discussion in Chapter Six concluded that the rate of mutual gaze occurrence was not associated with any particular independent variable. However, the suggestion that mutual gaze might occur in relation to the sam, a music structural feature, was supported in the qualitative data and apparent in certain cases (see Figure 6.1).

Method

This possible association between mutual gaze and sam was explored further by a Chi-Square Goodness-of-Fit test. The test was used to compare the likelihood of mutual gaze events happening contemporaneously with the sam by chance against the rate at which they were actually observed.

The time period of 2 s was chosen for the resolution at which the events were considered to be contemporaneous. This arbitrary value was based on consideration of the range of mutual gaze occurrence durations (median value of 0.66 s), and a degree of leeway about which the two events might be considered to be related in experience. Therefore a *hit* was scored when a mutual gaze occurred at sam onset ± 2 s. The *expected* counts which would bear out the null hypothesis (H°) for this test - that the mutual gaze events were occurring by chance - was generated by applying the following logical statement to each excerpt:

S = sam onset (in seconds)

T(S) = total number of sam occurrences per excerpt

R = 2 s resolution)

$H°$ (mutual gaze events occur by chance within 2 s of sam) = S/60 * T(S) * 2(R)

Results and discussion

The results suggested that the occurrence of mutual gaze with sam appears significantly more often than chance (n = 23, χ^2 = 4.56, p = 0.033). This result would bear out the informal observations and qualitative data reports on the use of mutual gaze by musicians to affirm the mutual experience of structurally-salient moments during music performance, or, alternatively, to direct and support the audience's attention and interest in those moments of when "it comes together and you're doing things together" (Interview 4, with Purvi Parikh). But since mutual gaze events did not occur exclusively with sam - indeed, four of the 23 occurrences were recorded from periods during which the music was not in time - the explicit time marker of the sam cannot be the only instigator of a mutual gaze.

During alap, a structural feature called a *mohra* is often used to underpin the free-time solo improvisation with a music grammatical framework. The mohra could be described as a motif, and can be identified as a short melodic phrase set to a specific pattern of melody and chikari string strokes. The mohra's function is analogous to that of a full-stop or semi-colon in written language; it is a means of constructing a coherent musical narrative through meaningful sections. The following Fieldwork Journal extract includes the author's notes on a sitar lesson during which the function of the mohra was discussed:

> *FIELDWORK JOURNAL, WEDNESDAY 24 NOVEMBER*
>
> *[Mr Parikh explained aspects of alap improvisation:] "Make a subject - for instance, Sa is the subject ("Let's call it the King. Say, for example, 'The King has a beautiful kingdom. He has a handsome son who serves him well. He wears a long cloak...' etc") by using a phrase, "Ni Re Sa". Create a paragraph about the subject, but stick to that subject within the paragraph. End with mohra."*

While this explicit structure provides an obvious framework with a function that is comparable to the sam, the four cases of mutual gaze which occur in Set A (solo) do not show a continutation of the trend. To illustrate, the data were examined with reference to the original context in the video excerpts.

One instance of a Set A mutual gaze data point occurs in the informal performance by Mehboob Nadeem and Subrata Manna, shortly before Mehboob begins the alap proper. He formally salutes the other musicians in the room, nodding to the Subrata, who receives the acknowledgement in mutual gaze and then makes a small bow. The remaining three mutual gaze events from Set A occur during a single excerpt of Tarun Nayak and Subrata. This excerpt records a rehearsal by these two unfamiliar musicians, and therefore the very first notes played by the Tarun constitute his introduction, in musical terms, to Subrata. Tarun keenly seeks Subrata's gaze, perhaps looking for recognition of the rag he is introducing, or approval from Subrata. The mutual gazes occur during sustained notes, but these notes are midway through the long, slow phrases which Tarun uses to establish the rag (Bairagi Todi) - they are not structurally-salient markers as a mohra would be.

However, certain aspects of performance style of alap indicate that the occurrence of mutual gaze should not be expected, even at a mohra. As discussed in Chapter Six, mutual gaze could be thought of as the outward expression, whether for the benefit of performers or audience or both, of the success of a musical process based on shared intention - a co-constructed occasion of musical "coming together". Alap is defined by a very different approach to performance in tal: "Because alap is an introvert […], it's a journey inward and the gat portion is a journey […] outward, you know…" (Interview 7, with Nayan Ghosh); "…many times when you're doing alap, both musicians have their eyes closed because it's very introspective…" (Interview 4, with Purvi Parikh).

It is possible that the acknowledgement of structure and progress marked by mutual gaze when the music is in tal might also be an important feature of musicians' interaction during alap. A soloists' ideal tabla player appears to be one who not only accompanies them through audible tal but also provides creative companionship: "It very important that the accompanist involves himself as deeply as the main artist into the alap making." (Interview 7, with Nayan Ghosh); "…it's possible he has [no interest in my music]. I would not like to play with an accompanist like that, however good he may be..." (Interview 5, with Budhaditya Mukherjee).

An informal review of the video data showed that the salient phrase-endings of an alap, typically marked by a mohra, are indeed acknowledged by the accompanists in most cases - but not with an intrusive mutual gaze. Instead, the tabla players typically demonstrate their appreciation through an expressive gesture of the head and shoulders, and verbal utterances of approbation ("Wah"). The apparent socio-interaction value in the use of mutual gaze demonstrated by Tarun and Subrata leads to a further line of inquiry which is be examined in

the second part of this chapter, investigating in greater detail the possible non-musical organisation aspects of musicians' mutual gaze behaviour.

7.2.3 Beating bouts

The indications in the first analysis of beating bouts suggested that, while these behaviours were strongly associated with duo performance in metred music, the behaviour does not have a readily apparent relationship to the musical pulse. In the following development of the analysis, beating bout occurrences are explored according to their tapping rate in relation to the musical pulse, or *matra* (the musical beat that is counted to make the correct number of divisions of a particular tal - for example, Teental has 16 matra; Jhaptal has 10 matra). They are also examined in relation to the cognitive demands of musical performance on the individual who is exhibiting the behaviour at the time of the bout.

Occurrence of bouts with performance content

The discussion in Chapter Six mentioned the possible relevance of non-musical behaviour literature documenting stereotypic actions that occur in relation to cognitive stress and appear to have a self-regulatory function. Developmental psychologist, Thelen, suggests that the broad term *stereotypic movement* can be used to describe repetitive, rhythmic body movement for which it is "difficult to ascribe goal or purpose" (1979:699). Some empirical evidence seems to suggest that the onset of such actions may be linked to states of high arousal (particularly in cases of autism), and their occurrence productive of a soothing effect (Mason, 1991:1022), lowering levels of 'tension' or arousal (Soussignan & Koch, 1985:165). This section examines the relationship of bouts of beating behaviour in relation to periods of musical extemporisation, where performers call upon generative processes in skilled improvisation, typically using complex rhythms.

Method

The beating data give results for three individuals out of the total eight involved in the recordings. The data were coded without sound initially; cases were then removed from the total set if a relationship to the musical pulse (1:1, 2:1, 1:2) was immediately apparent.

Two new categories for description of musical behaviour were applied in Observer Video-Pro to code the musicians' playing for the entire relevant excerpts as either *improvising* or *NOT improvising*. *Improvising* implies a high degree of the musician's own personal expressivity - a broad definition that includes expressive paraphrasing of the gat as well as the most open, extemporized elements and also tans and *tihais* (rhythmic cadence). While tans and tihais could

be considered as pre-composed to a certain degree, their performance during co-performance is versatile; constraints regarding the repetitive form and end-point within the overall time-cycle govern tihai and tan use, but the decisions regarding their deployment are left to the discretion of the performer within the real-time of the performance.

The class *NOT improvising* is therefore more prescriptive, and is used to describe the following types of musical behaviour:

      1.   tabla player playing the plain theka

      2.   soloist is playing straight gat (pre-composed element)

      3.   soloist between passages of active melodic performance (i.e. chikari string (drone) strumming alone)

The instances of beating behaviour were then tabulated as two groups; those occurring during improvisatory performance, and those occurring during non-improvisatory performance. The proportion of *improvised* versus *NOT improvised* performance according to each individual during each excerpt was then used to predict chance levels of beating bout occurrence. The expected number of beating bouts that this method generated for each class were compared to the actual, observed number.

Results

The results of the test indicated that the null hypothesis could be rejected in this instance, as the observed rate of occurrence for beating bouts during improvisation was highly statistically significantly unlikely to occur by chance (n = 28, χ^2 = 10.16, p = 0.001).

Rate of tapping as a proportion of musical pulse

The association of the beating bouts with instances of metred performance, and the known use of tapping behaviour to engage with metre in music, suggests that the relationship of these beating behaviours to musical pulse may be of particular interest.

Method

The inter-tap intervals of beating bouts were tabulated to explore a relationship with the prevailing musical pulse. The rate of tapping for each bout as a proportion of the musical pulse was calculated for each case. These data are presented in Figure 7.5's scatterplot, showing the bouts for each of the three individuals who exhibited the behaviour.
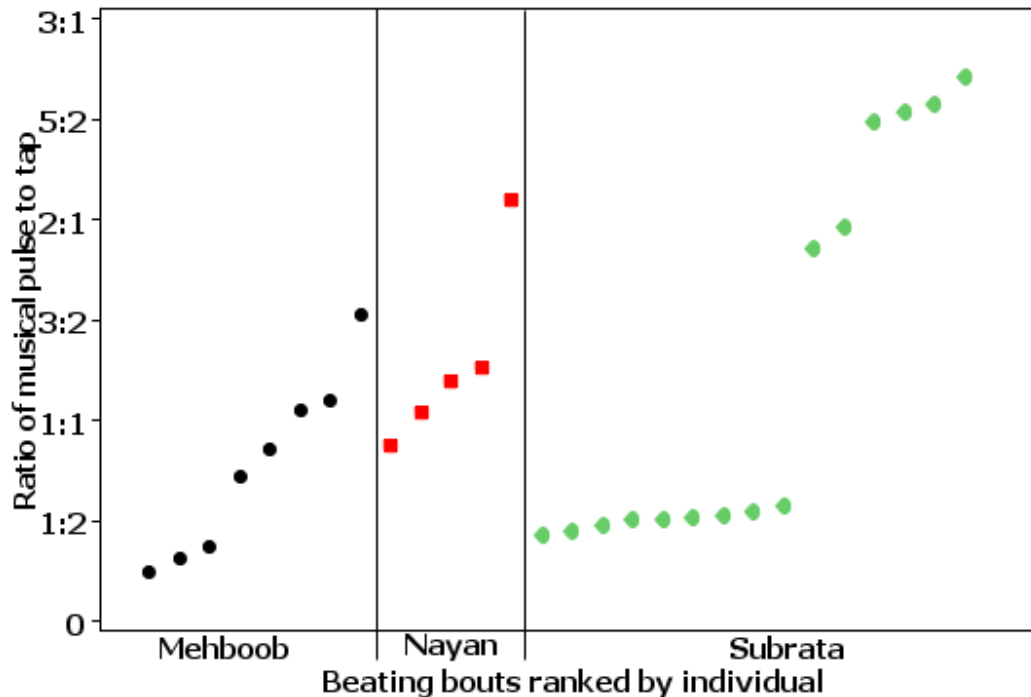
Figure 7.5 - *Beating bout data with inter-tap rate as a proportion of music pulse.*

Results

When the rate of beating is examined in relation to the prevailing musical pulse there seems to be some grouping around the ratios of 1:2, 2:1 and 5:2. While the most obvious cases of relationships between the beating rate and the musical pulse had already been excluded (see section 5.4.1), the beating bouts recorded here do show some clustering at these points. This is particularly clear in the case of Subrata, whose beating bouts most typically occur with an inter-tap interval rate of approximately two taps per matra. The other beating bouts for Subrata also show a tendency to cluster at particular ratios; a further two bouts occur at a rate of 1:2 taps to musical pulse divisions, and the final group show beating bouts with an inter-tap interval of 2:5 taps to musical pulse.

The data for the other individuals, Nayan and Mehboob, is not distributed in such discrete groups. The beating bouts tabulated for Mehboob are normally distributed, with a spread of tapping rates that approximate a 1:5 taps to pulse ratio, to a 3:1 ratio. The beating bouts recorded for Nayan - fewer than were recorded for either Subrata or Mehboob - loosely approximate a 1:1 ratio, with one bout loosely approximating a 2:1 ratio of taps to musical pulse.

Discussion

Given the prior exclusion of beating bouts that were readily interpretable as inference of metric structure, it is possible that the beating bouts displayed in Figure 7.5 show the least accurate occurrences of behaviour that were intended to entrain to the pulse in order to demonstrate - or use - an inferred metre.

In the case of Subrata's performance, an interpretation of the function of beating behaviour as inference of metric structure is, in fact, supported by the unusual 5:2 ratio. Of these four beating bouts, three occurred during the performance of by Tarun and Subrata. These were drawn from the recording of their Informal Performance, from the end of Set A and the beginning of Set B excerpts. The fourth beating bout, with a rate of tapping which best approximates the ratio 5:2, occurs at Subrata's first tabla entry during his rehearsal with Mehboob - the event of his musical introduction to the soloist. In all of these cases, Subrata is performing complex rhythmic improvisation which he talked about in an interview following his performance with Tarun:

> SM: *First he was doing five* - khandajati [see glossary]. *So I answered him also in khandajati. And then he switched over to cheghun - triplet. So actually I followed him also - I answered him also in that way. But I learned how to do the mathematics - also I learned - but it's also improvisation, how you apply...*
>
> Interview 6, with Subrata Manna and Tarun Nayak

The use of complex ratios between shared musical pulse and inferred metric grouping underpin the construction of rhythmic variation used as the basis for improvisation in Indian music[1]. It seems possible that Subrata's apparent bodily entrainment may somehow demonstrate a physical manifestation of the cognitive work of his "mathematics".

While an intuitive explanation for the function of these beating bouts relates somehow to a musician's reaction to a heavy cognitive load - participating with their whole bodies in order to attend fully to the "problem" of improvisation in performance - the matter of the beating bouts is an interesting one when considering that the two musicians are playing together. These beating bouts appear to align at certain ratios with the musical pulse, but they are not simply "in time". The majority of the bouts plotted in Figure 7.5 have an inter-tap interval which differs by more than 50 ms from the pulse (or simple ratio with the pulse), and as audible taps many would therefore be beyond the perception threshold within which two events sound 'together' (London,

---

[1] For a detailed discussion of laykari, or "rhythmic variation techniques", see Clayton (2000), Chapter 10 (pp.157-78).

2001:279). While these behaviours seem to be to do with musicians' entrainment to one another - and these pairs of musicians are, together, the very source of the musical pulse - each individual's beating bout behaviour would not appear to be useful to the other in pursuit of that goal.

If the behaviour is more related to the musicians' own personal cognitive processes in that instant, rather than a co-constructed musical performance, the beating behaviours may yet have as much to do with a human behaviour mechanism in response to a stressful situation as to do with keeping musical time. Factors such as complex generative improvisation techniques, in addition to the socio-musical variable of familiarity or unfamiliarity between performers, also appear to be related to the occurrence of these beating behaviours. In studies which do not look to musical interaction scenarios, stereotypic behaviour has been associated with both self-regulation and a lowered awareness of external stimuli (Mason, 1991:1023). It may be that these beating bouts, while fully integrated into the act of musical performance in shared musical time, show evidence of cognitive stress and that their exhibition has parallels with stereotypic behaviour in non-musical situations.

7.3   Behaviour associated with non-musical organisation

7.3.1   Looking at other's face behaviour

The social interaction value of the non-verbal communicative tool of mutual eye-gaze is well documented for non-musical interaction (for example, see Argyle, 1976; Bavelas, Coates, & Johnson, 2002; Tomasello et al., 2005). In particular, the value of mutual gaze lies in its capacity to manage other people's attention. Section 7.2.2 discussed Tarun and Subrata's use of mutual gaze. While other instances of mutual gaze appeared to be related to the organisation of the musical time structure (specifically, the occurrence of the sam), Tarun and Subrata used a considerable amount of eye-contact during Tarun's solo alap. This section considers the social interaction organisational value of non-verbal facial communication events.

Arising from the view of the mutually-held gaze as a technique for real-time attentional behaviour management between interacting individuals, the data were examined to explore the events which act as a precursor to mutual gaze events. In cases where no apparent external (musical) structure provides a stimulus for the act of a musician looking at their colleague's face, mutual gaze may well happen through the instigation of attention from one musician to the other's face. In the video data included in this study, the participants were seated in a manner that gave them full view of each others' face with the exception of one case. (The exception is

shown in Figure 4.5, of the Formal Performance by Pandit Arvind Parikh accompanied by Dilshad Ahmed. In this case, the soloist was seated further forward than the accompanist, with the effect that the accompanist was usually facing towards the soloist, but could only view the soloist's face properly when it was turned towards him.) In most circumstances, the participant being gazed at may choose to reciprocate the action or not at any time.

Thus, mutual gaze events can be thought of as occurring in three stages:

1. Instigation, or opening, effected by the creation of a mutual gaze opportunity when one individual looks at the other's face

2. Start, effected by the individual who is being gazed at choosing to return the gaze

3. End, effected when either individual turns away from the gaze

The following analysis examined the attention patterns that musicians used in order to negotiate the moments of mutual gaze that occurred.

Method

The time-series data for the communicative behaviours of looking at the other's face and the mutual gaze data were tabulated in order to look for a pattern in the behaviour where mutual gazes arose. From the data, the act of looking at the other's face in the build-up to a mutual gaze, and any looking act which ended the mutual gaze (looking at other's hands, at self or away) were recorded for each individual. The data were coded according to the individual who initiated the mutual gaze by responding to an opening gaze from the other, and then according to the individual who broke off the mutual gaze event first.

In order to look at the relationship between mutual gaze, personal interaction and resulting musical behaviour, the excerpts featuring the tabla player, Subrata were also explored separately to compare his behaviour with soloist Mehboob to his behaviour with soloist Tarun. In both of these cases, the musicians were unfamiliar with one another. In addition to the new mutual gaze initiating and ending data, the rate per excerpt of mutual gaze events for Subrata with the two different soloists was examined. The data were tested for statistically significant difference to compare the variation in data for Subrata and Mehboob with that of Subrata with Tarun.

Results

As illustrated in Figure 7.6, soloists appear to choose when to start mutual gazes more than three times as often as tabla players. This implies that the tabla player is three times more likely to

give the opening gaze at the soloist's face, who then chooses when (or whether) to establish a mutual gaze event. While soloists ended the mutual gaze slightly more often than tabla players in the data in this sample, the results show a more balanced responsibility for the act of ending the event. This data can be used for comparison with Figure 7.7.
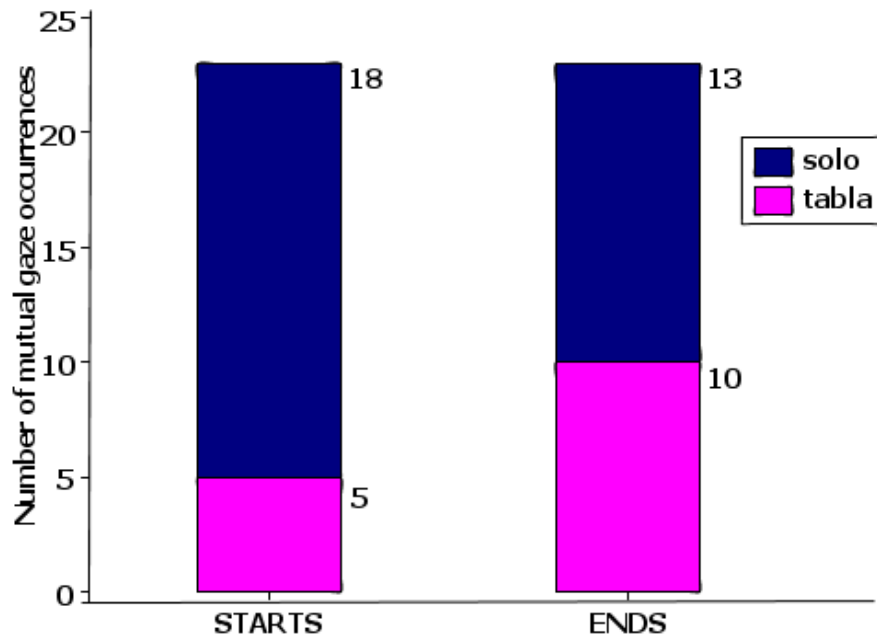
Figure 7.6 - *All data for mutual gaze occurrence, showing which Role is more likely to initiate and end the mutual gaze.*
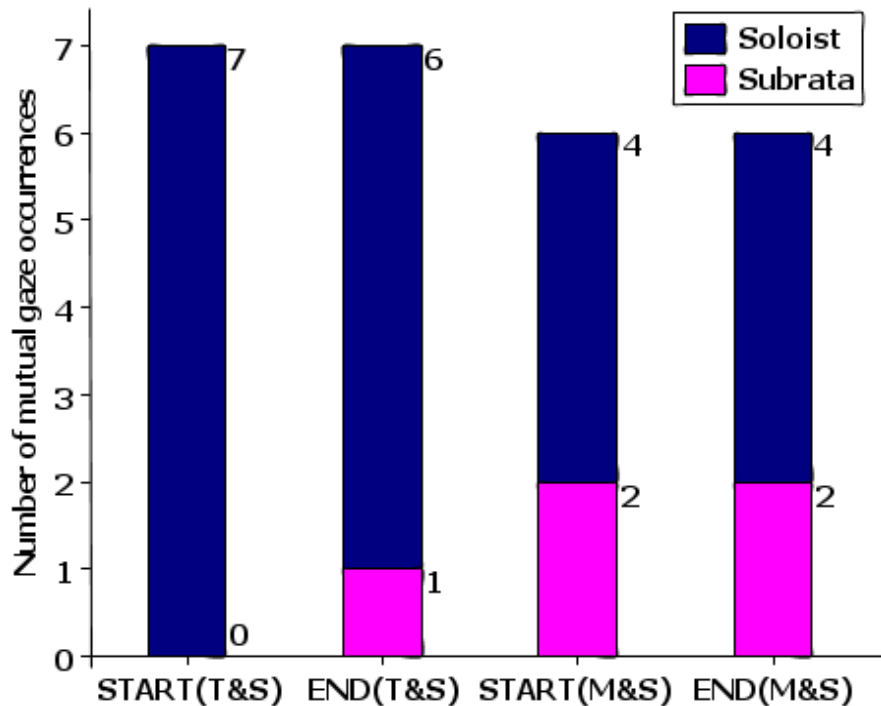
Figure 7.7 - *Data showing mutual gaze occurrence for Subrata with two different soloists. Includes six occurrences between Subrata with Mehboob, and seven occurrences between Subrata with Tarun.*

Figure 7.7 shows that Subrata participates in a total of thirteen mutual gaze occurrences with soloists Tarun and Mehboob. Of these, he starts two and ends three. Where Tarun is the main soloist, Subrata prepares each of the seven mutual gazes and ends one - allowing Tarun to start all seven and end six of these. Where Mehboob is the main soloist, Subrata prepares two-thirds of the mutual gaze events, allowing Mehboob to start four of the six occurrences. Mehboob then ends four, and Subrata ends two. Thus, the behaviour of Subrata and Mehboob shows a slightly closer match to the overall trend suggested by Figure 7.6, although with such a small number of cases, this can only be a limited, descriptive appraisal of the outcome.

This appearance of difference in the behaviour of the two pairs of musicians is investigated for statistically significant difference between the rate of looking at other's face and the total duration of looking at other's face. Tarun shows a significantly higher rate per minute than Mehboob for looking at Subrata's face -- Tarun has a median rate of six events per minute, Mehboob has a rate of two events per minute ($n = 15$, $w = 74.5$, $p = 0.0362$). Tarun also shows a significantly higher total duration for looking at Subrata's face than does Mehboob, with a median value 8.4 s per minute excerpt rather than Mehboob's value of 3 s ($n = 15$, $w = 74$, $p = 0.0428$). Interestingly, Subrata demonstrates a similar rate with both soloists, showing no significant difference between the two cases ($n = 15$, $w = 66$, $p = n.s.$).

Discussion

Across all the mutual gaze data, tabla players are more likely to be looking first at the soloist's face – instigating a mutual gaze – and the soloists are most likely to terminate the eye contact by being the first to look away.

The two pairs of musicians showed statistically significant differences in their uses of mutual gaze to one another, with Tarun Nayak and Subrata Manna showing the most apparent divergence from the general trend of the complete sample. These musicians were interviewed after their performances. A particular feature which arose in the interview with Tarun and Subrata may represent an underlying dynamic of the performance. While Tarun, as the soloist, was expected to perform as the 'main artist', Subrata mentioned that he had, in fact, accompanied Tarun's guru on tour. This implied an aspect of seniority on Subrata's part which could not be expressed in explicit terms, due to the conventions of the soloist and accompanist relationship.

The significantly high level of attention that Tarun pays Subrata's face, commented on informally in section 7.2.2, offers a counterpart to the notion of instigation, opening and ending of mutual gaze events. Given that Subrata's behaviour with both soloists does not significantly differ, it seems likely that it is Tarun's unusually strong use of gaze towards Subrata's face during alap sections of both rehearsal and performance that could be demanding a reciprocity of gaze from Subrata, which then provides the means for Tarun to start and end the mutual gazes.

Introduced to two unfamiliar musicians, Subrata's behaviour in looking at the others' faces does not appear significantly different, but Mehboob and Tarun behave differently to one another towards Subrata. As discussed in Chapter Four, the resulting performances with these two pairings were different in many ways. While the scenarios of rehearsal followed by informal performance and the meeting of two musicians previously unknown to each other were stably maintained, factors such as the choice of rag, the time of day, and even the country in which the recordings were made are likely to have affected the dynamic of the performance. It also seems likely that this change in dynamic might be related to the interpersonal dynamics between the pair, and in the central case of non-verbal facial communication and eye-gaze, the dynamic between musicians is proven to be observably different.

Literature on interaction from non-musical interaction studies offers a supporting perspective on this topic. Conformity to conventional systems of interactive behaviour during early encounters with unfamiliar individuals was noted in Chapter Six, section 6.2.2. Tickle-Degnen and

Rosenthal further propose that three interrelating components together define the quality of rapport in interpersonal interaction, suggesting that (a) mutual attentiveness, (b) positivity and (c) co-ordination are all essential factors of successful rapport-building (Tickle-Degnen & Rosenthal, 1990). Crucially, the authors note that while evidence of all three components is required to maintain rapport longitudinally over the course of a dyad's relationship, the weightings and particular qualities of each component would be expected to alter over time; for instance, "initial attentiveness may signal interest...whereas later attentiveness would signal the unity of the dyad members" (1990:279). It seems likely that such a strong attentiveness as demonstrated by Tarun's attention to Subrata's face with its consequent non-verbal demands of reciprocity might be a factor of the individual's aim to establish rapport with his accompanist.

During later interactions, Tickle-Degnen and Rosenthal propose that participants are likely to be "less constrained by impression management concerns"; at this stage they are likely to demand "more interaction coordination relative to the positivity" in order to maintain the rapport (1990:279). A descriptive comparison of the two resulting performances by Subrata with Mehboob and Subrata with Tarun might emphasize the effectiveness of certain qualities of the first pair's performance which contributed to an engaging performance, such as broad dynamic and rhythmic variation, and specific occasions of particular co-ordination between the players which caused both to smile and appear pleased during the performance. It might be suggested that the first pairing moved quickly from the early form of attentiveness (signalling interest) to the later version (signalling unity). It was proposed earlier that certain ensembles of behaviour might stand in for explicit, mutual gaze where acknowledgement of a salient event was necessary, but where the use of eye contact was less appropriate, such as during alap (see section 7.2.2). The various forms of attentiveness that familiar and experienced musicians may use to signal unity are also likely to include more diverse and sophisticated techniques than those applied in the early stages of their relationships.

7.3.2   Interaction in time

In this final section of the chapter, the complexes of communicative behaviour by the pairs of musicians are considered in the light of the previous analyses, which have shown that the organisation of behaviour is affected not only by musical structure, but also by the musicians' management of each others' behaviour, and regulation of their own. Musicians' looking behaviour and expressive gesture show the anticipated evidence of individuality, but also of trends through which the musicians might predict and order their own and their partners' interactive behaviour. The type of communicative, co-ordinated, other-aware behaviours indicated by the qualitative data analysis of Chapter Three suggested that musicians employ

action-strategies to negotiate the co-production of musical performance. It seems likely that the conjunction of the various attentional and expressive movements at the musicians' disposal are indeed used in strategic ways, and responded to strategically also.

As suggested through observation of the mutual gaze scenarios for Tarun and Subrata in the previous section, the attention-receiving and attention-giving behaviour is demonstrably more interlinked than that which might be described by simple, turn-taking acts. The approach outlined below takes the view that such communicative process is evidenced in complexes of behaviour that include both looking behaviours and expressive gesture phrases.

If this is taken to be the case, certain of the music-interactional processes, which can be thought of as contributing to the performers' shared construction of a musical performance event within the constraints of the musical temporal and formal structure, might be observable in the video data. This would open the way to asking certain questions of the real-time interaction of the duos regarding the effect of audience presence, the use of expressive gesture, and management of attention to each other's faces in cases where this is *not* reciprocated with a mutual gaze. The following section outlines such questions.

For example, the analyses so far have pointed to the socio-musical outcomes of physical co-presence, with variation in data clustering into two factors of within interaction zone and beyond interaction zone, and performance contexts - where audience members are present - demonstrating a significant effect on the attentional behaviour of the musicians. What might be the effect within the interaction zone when members of the performing duo look beyond it? The implications of non-verbal facial communication can potentially manipulate and direct the attention of the audience to a specific aspect of the musical event: is there evidence in the ensembles of complex behaviour acted out by the performers which suggests that this management strategy is used?

While the expressive gesture phrases employed by the musicians have been shown to correlate very strongly with aspects of the musicians' attentional behaviour, it seems possible that the behaviours also operate as an exclusive mode of communication between players. In the example given in Figure 7.3, the use of expressive gesture by the two players is constrained by the time structure, and yet the patterns of density of expressive gesture use appear to show varying configurations. It may be that an element of turn-taking in the density of expressive gesture occurrence could play a role in the sustained and flowing effect of these particular excerpts.

Eye-contact receives considerable popular attention as a means by which musicians negotiate their improvised performances (see Chapter Six, section 6.4). This study has shown that mutual gaze events may be less common than might be expected. One reason for this may be that a cueing framework of instigation, opening and ending may be necessary for a mutual gaze occurrence to arise when there is no prompt from an external organising structure. Cases in which the instigation of one musician looking to the other's face is not reciprocated - which could possibly be described as a failed mutual gaze attempt - may be resolved in a different fashion and with different consequences to the mutual gaze, and seem a valid case for further investigation. If the communicative behaviour is seen to include both attention through looking behaviour and also expressive carriers of attention in the form of expressive gesture, may the resulting behavioural ensemble play a part in the management of interpersonal dynamics?

Method

The data consist of all twenty-four of the one-minute excerpts, which include four different pairs of musicians playing together. The data give onset times for communicative behavioural events, including looking behaviours and expressive gesture phrases, by both the soloist and tabla player who feature in every excerpt. Four questions drawn from the issues described in the preceding section, regarding the ways in which the musicians might manage each other's non-verbal communicative behaviour, were composed as logical statements in the form: "If S does A, does T do B within 3 seconds?". (In this case, the three-second resolution was chosen to reflect the range of behaviour durations with mean values from approximately 1.5 to 3 s (see Figure 5.22) and a degree of leeway about which the two events might be considered to be related in experience.)

The questions were as follows:

  1. If the soloist looks at <u>other's face</u>, does the tabla player <u>gesture</u>?

  2. If the soloist makes a <u>gesture</u>, does the tabla player make a <u>gesture</u>?

  3. If the tabla player looks at <u>other's face</u>, does the soloist <u>gesture</u>?

  4. If the soloist looks <u>away</u>, does the tabla player <u>gesture</u>?

A null hypothesis was generated in order to compare the likelihood of event B following A within three seconds by chance. This was calculated as follows:

  p (HITS by chance) = (total B HITS per 3 second period) * (total A HITS)

Hits were scored when the difference between onset (B) and onset (A) gave a value of less than three seconds. MISS was scored where no event B occurred within three seconds of A. Therefore, the sum of HIT and MISS scores equals the total number of occurrences of event A.

The total number of B events was capped so that this could not be greater than the total number of A events; where an excessive number of B events occurred in clear isolation from A events, these events were not included. The likelihood of a MISS is therefore: Total A - p (HITS by chance).

A Chi-Square Goodness-of-Fit test was used to compare the observed HITS with predicted Hits generated by the null hypothesis.

Results

Of the four statements, two had significant results across all the data:

For question one - *if the soloist looks at the tabla player's face, does the tabla player gesture?* - the result showed that these events co-occurred with significant frequency (n = 97, χ^2 = 6.49, p = 0.011). Question four - *if the soloist looks away from the tabla player, does the tabla player gesture?* - also showed a significant level of co-occurrence (n = 122, χ^2 = 26.20, p < 0.001).

The results for question two - *if the soloist gestures, does the tabla player gesture?* - showed that there was no apparent correlation between the occurrence of the two behaviours (n = 200, χ^2 = 2.78, p = n.s.).

The results for question three - *if the tabla player looks at the soloist's face, does the soloist gesture?* - showed an overall lack of association between the composite behaviours (n = 162, χ^2 = 1.5, p = n.s.). However, further investigation of data showed that two of the four cases showed statistically significant association between the two behaviours, and two did not. The cases in which Tarun performed with Subrata, and in which Arvind Parikh performed with Dilshad Ahmed showed no association (respectively, n = 36, χ^2 = 0.66, p = n.s. and n = 53, χ^2 = 0.47, p = n.s.) However, where Mehboob performed with Subrata (n = 36, χ^2 = 4.14, p = 0.042), and Nayan Ghosh performed with Abhijeet Bannerjee (n = 37, χ^2 = 7.96, p = 0.005), the occurrence of these behaviours showed a statistically significant association.

Discussion

Certain of the complexes of behaviour appear to show evidence of action-strategy function in the negotiation of real-time co-performance. It appears that the act of a soloist looking at the

other's face may instigate an expressive gesture by the tabla player. This non-obtrusive use of non-verbal communication may be an acknowledgement of another's use of attentional behaviour; it does not convey knowledge of a mutually-created experience so much as it might convey recognition of the soloist's actions. Such an action may possibly provide elements of the 'love' and 'warmth' that soloists described as particularly good qualities of an accompanist (see section 3.6.1).

The highly significant result for the question, *if the soloist looks away, does the tabla player gesture?* suggests that there is a powerful association between the soloist's attentional behaviour and the tabla player's subsequent action. This could be accounted for in two different interactional scenarios. On one hand, a dominant role could be played at these points by the tabla player; if the soloist's attention is taken beyond the interaction zone, a physically interesting act of gestural expression by the tabla player could recall the soloist's attention back within the interaction zone. Alternatively, where an audience is present, the soloist might be looking out towards them. In this case, the tabla player might be seen as taking an intermediary role between the soloist and audience by publicly appreciating the soloist's actions, as a guide to the audience that they should do the same. This could be interpreted in a similar manner to the tabla player's own ostentatious arrival into the duo performance after the alap, a possibility which was discussed in Chapter Six, section 6.3.2. The qualitative data analysis revealed a theme of performer responsibility to the audience (see section 3.6.1); the tabla player's potential education of the audience, by guiding their attention and appreciation in response to the soloist, would fit well with the second explanation.

The results for the third question - *if the tabla player looks at the soloist's face, does the soloist gesture?* - give a more ambiguous response. Initially, the result appeared to show that there was no relationship between the composite event of the tabla player looking at the other's face and soloist then gesturing. In part, this would support the account of the reverse to the event described above; where tabla players are expected to act out a slightly subservient role to the main artist, a variation on the seen-but-not-heard approach serves to maintain the musical interaction without upsetting the ostensible 'manager' (soloist) and 'managed' (tabla player) positions.

This approach to the partnership might be useful in the interpretation of Tarun and Subrata's relationship. While Subrata's accomplishments as a performer arguably outweighed those of Tarun, the roles that were acted out during the recorded rehearsal and performance, evident in the eye contact and mutual gaze behaviour discussed in sections 7.2.2 and 7.3.1, firmly placed

Tarun as the manager of non-verbal behaviour, and Subrata as the managed accompanist. An element of this attitude might also have been expressed through the stage positioning and seating arrangements in the performance by Arvind Parikh and Dilshad Ahmed described earlier (see page 194).

While these two of the four performances demonstrated what could be termed as the *Main Artist (with tabla accompaniment)* approach, power relations between the remaining duos appeared to be balanced differently, or were perhaps less transparent. It is interesting that the video data featuring Mehboob with Subrata, and Nayan Ghosh with Abhijeet Bannerjee did not follow the same responses for question three as did the recordings by Tarun with Subrata, or Arvind Parikh with Dilshad Ahmed. The example of the soloist gesturing in apparent response to the tabla player looking to their face might suggest a sophisticated form of the other-attentiveness that Tickle-Degnen and Rosenthal describe as signalling "the unity of the dyad members" (1990:279), through which better co-ordination and "positivity" may arise in later stages of interpersonal relationship.

These results imply that behavioural ensembles, which include reciprocal, frequently overlapping, multi-modal actions by two individuals, might be vital to the functioning of embodied musical interaction. They appear to play a part in the management of social interaction dynamics; while these dynamics are ultimately unique according to each musical event with its varying music structural constraints, context, musicians' relationships, and so many other factors, the results indicate that certain behavioural ensembles obtain across these data.

This concludes the analysis and discussion of results. The following, final chapter draws on discussions included throughout this work and elaborates the thesis that musical interaction is a form of social interaction and that accounts of musical behaviour should include reference to the real-time, embodied act of unscripted interaction.

8 CONCLUSIONS AND FUTURE DIRECTIONS

8.1 Summary of the argument and findings

It has been suggested that the dynamic qualities of bodies in musical interaction have been under-examined in studies of musical communication and meaning construction. This work contributes to a recent turn towards embodied and physical approaches in the humanities and the social sciences that seeks to redress this imbalance. The research expounds the thesis that the dynamic, interactional qualities of musicians' movements can be explored through a study of the way that participants in musical interactions act together in time. The author initially set out three inter-related considerations to tackle the subject of interpersonal musical engagement: thinking about music at the level of social interaction; thinking about how music's meaningful nature may be conceived as an emergent property of the interaction; and thinking about ways in which musical meaning could be mediated through embodied action.

The first two chapters explored the relationship between musical communication and social interaction in order to consider how these three main considerations are treated in existing literature. The interdisciplinary review examines the specific study of musical communication in a broad perspective of intellectual trends and developments, in order to identify obstacles in the way of a study of interpersonal musical engagement, and the strengths of current methodologies that could be used to examine embodied and dynamic aspects of musicians' interaction.

Chapter One addressed the relationship between music and human communication in the fields of musicology, ethnomusicology and music cognition studies. It was suggested that the dominant interpretive methods of musicology are epistemologically grounded in a particular philosophical perspective that evokes an individual's isolated and abstracted encounter with the world. This encounter is seen as something that must be both validated by and explored through rational processes of thought-as-language logic. The literature review of this chapter noted that the increasing awareness of cultural context has arisen in arts and humanities scholarship since the mid to late twentieth century provided terms for the discussion of shared, socially-grounded knowledge (cf. Clayton, Herbert, & Middleton, 2003). Scholarship privileging this social level of interpretation brought insight and raised new questions on the subject of musical meaning, employing various methodological paradigms from such disciplines as anthropology (Merriam, 1964), semiotics (Nattiez, 1990), hermeneutics (Kramer, 1993;, 2002) and critical theory (Adorno, 1983).

However, with the exception of the anthropological influence the emphasis in these views often lies in speculation on the individual's negotiation of musical meaning, albeit within the larger social context. Through this implicit continuation of the prevailing rationalist epistemology, music's meaningful nature has often been examined through passive and individualistic responses to musical works. The impact of a similar perspective on the study of social interaction in general is taken up in Chapter Two, where the strongest trends in the field of communication studies as a whole are considered for their likely impact on the shape of musical communication studies.

Chapter One noted the extent of ethnomusicological approaches, which encompass the most socially-oriented perspective on the nature of music's communicative properties. The material concern of ethnomusicology is typically musical *action* rather musical *work*, and methods of analysis tend towards transcription of sound organisation and ethnography with the aim of understanding the role of musical action in a society. In general terms, an ethnomusicological approach treats each culture's musical activity as something that is deeply embedded in specific social occasions. These studies therefore offer interpretations of the immediate social interaction level, but the anthropological ethos also discourages any form of generalisation that could compromise the music's difference from Western musical constructs. This tends to restrict the possibilities for studies of musical interaction that look to the behavioural level.

Technologies for empirical, scientific research have also provided tools for musical enquiry. Meyer's influential work, *Emotion and Meaning in Music* (1956) set a precedent in its focus - the convergence of musicological and psychological explanation - while psychological studies from Helmholtz (1862 (1954)) and Seashore (1967 (1938)) to the present day have contributed to the question from the perspective of how and why people respond as they do to musical stimuli. Broadly speaking, music research based on experimental psychology methods uses a natural science paradigm to seek now-and-forever explanations of acoustic phenomena, and instantiated descriptions of biological causation for skills of musicianship. This type of research lies in contrast to the various ethnomusicological and culturally-aware studies reported since the 1990s, which locate their enquiries within academically-defined terms of place and people.

It was suggested that much existing research on musical meaning approaches music as a time-neutral phenomenon; whether the focus is on musical meaning as transcendental or immanent, many such modes of analysis cannot encompass the study of musical activity at an action-in-time level that seems necessary to consider the emergent properties of musical interaction. Additionally, the perspective of existing musicological frameworks is inclined towards an

individual-centred interpretation of music meaning, even where the individual is acknowledged to be a member of a larger, complex group of individuals.

Chapter Two surveyed general trends and intellectual forces implicated in the creation of the abstract, passive individual evoked in Chaper One. It is suggested that throughout the twentieth century, pragmatic approaches to communication that have focused on the context of social interaction - which would be most pertinent to the study of the emergent, performative aspects of meaning in musical interaction - may have been sidelined. This is attributed in part to the effect of the mind-body dualism prevalent in Western philosophical epistemology, which underpinned the powerful effects of early cognitive scientific paradigms. The related dominance of structural linguistics benefited from the capacity for computational modelling that advanced dramatically at this time, strengthening the impression that the mind-as-processor interpretation of human communication mechanisms were true to real, biological systems.

These factors may have contributed to the conceptual boundaries - and resulting methodologies - which forced a gulf between the study of social interaction at an individual level and at a broader, social level of interaction (McDermott & Roth, 1978:322). For example, the work of interaction scholars, such as Goffman (1974), Condon (1974) and Kendon (1990) was concerned with the study of the function of language as communicative behaviour, following the early pragmatics vein begun by C S Peirce and Malinowski. But the emerging individualistic, case-by-case approach to communication studies was not methodologically consistent with the concerns of those who discuss the consequences of such social communicative action (Attewell, 1974). In a move to shore up the pragmatist vein of linguistics, linguist Herb Clark clarified a distinction between language *structure* and language *use* (Clark, 1996), emphasising the difference between the fascinating and complex patterns that can be perceived in human speech systems and their textual representation, and the essentially improvised and non-literary implementation of human acts of communication. This perspective is consonant with increasingly powerful accounts of embodied cognition such as those developed by Lakoff and Johnson (Lakoff & Johnson, 1999; Reybrouck, 2005), and developmental psychologists, such as Thelen (Smith, 2006) and Trevarthen and Aitken (2001).

Developmental psychology research that focuses on pre-verbal communication applies non-verbal communication research methods, and employs an action-first view of human communication. This perspective is valuable to the interpretation of music as communicative action, and reveals continuities between language and music systems that can be hidden in the dominant Western musicological interpretation of the musical *work*. Developmental psychology

research on communication always factors in the presence of at least two individuals in the event. This assumption of other-directed behaviour in human communication is an important position for this thesis. Musical interaction depends on the processes of attention by which people manage to play together, and so musical action necessarily demands other-directed behaviour. In order to actively attend to one another's musical behaviour, individuals must listen dynamically, continuously adjusting and adapting to their ever-changing socio-musical environment. Embodied cognition studies have established action-perception mechanisms that provide an appropriate framework to consider the processes involved in music perception. Interpreting behaviour ecologically with this framework includes a social interaction aspect; in contrast to the individualistic expression model of musical meaning, this view embraces a social-management view of behaviour.

Chapter One cited the most promising studies for music interaction in light of the thesis as those which have taken a music cognition approach. Such studies, including theories and analysis of embodied performance by scholars including Baily (1977), Qureshi (1987), Stobart and Cross (2000), Keil (1995b) and Davidson (2002), have focused on music outside of the Western canon. The study of the rhythmic, time-embedded processes of interaction between individuals is seen in these studies to be a key topic for the discussion of emergent aspects of interpersonal musical engagement. The notion of *entrainment* between interacting musicians, describing the mechanisms used by individuals who are behaving in coordination with one another, was highlighted in Chapter Two as a process that is just as valid for social interaction as for specifically musical time-keeping. Social interaction studies have identified qualities of interpersonal relationships, such as rapport and responsiveness, which are primarily dependent on acts of physical synchrony and other communicative mechanisms independent of language structure. Such co-constructive aspects of interpersonal interaction can be seen as emergent properties of the communication event. An appropriate research agenda for the thesis points therefore towards a focus on the analysis of movement as indicative of real-time communicative interaction. This focus is consonant with a cognitive ethological agenda. Existing ethological frameworks include methodologies for systematic observation, and current cognitive ethological approaches support the use of these for the study of social interaction phenomena.

In conclusion, the literature review suggested that in order to examine the live, emergent aspects of music performance, it is necessary to resist the concept of music as a disembodied *work*; to embrace the embodied cognition view of action-perception; and also to consider the durational quality of musical action in a social context. Together, Chapters One and Two suggested that the sociality of music, as a performed event, entails co-ordinated action by agents. Essentially,

this must require motion of bodies in space and time, and suggests that the construction or interpretation of musical meaning may best be examined as a property of action and interaction.

Chapters Three and Four set out the boundaries and scope of the current research to observe specific cases of such interactions at an appropriate level of analysis. The role of the author's particular interest in and experience of North Indian classical music performance was cited for its contribution to the formulation of the original thesis. Features of the duo configuration dominant in this improvisational music, also its clarity of performance structure, and the value placed on relationships between musicians with one another and also with their audience were described in Chapter Three. The chapter included a summary explanation of some of the most salient features of the music and vital terminology.

Drawing on an ethnomusicological approach, the author's involvement in the project as a participant-observer was explained, and her role in the collection of qualitative research materials, including informal interviews, fieldwork journal entries, and audio and video recordings, was accounted for. The inclusion of a qualitative research component in the project established the most viable framework for an observational analysis of North Indian duo performance, to avoid the reduction of complex cultural phenomena.

A primary set of research questions were posed, which asked:

1. During real-time musical interaction, what types of non-verbal communication do the musicians appear to use?

2. How do the participants in a musical event feel that communication occurs?

3. What functions might the non-verbal, physical movements of musicians serve during musical interaction?

The complete set of qualitative data used in this research (see Appendix A) provided the material for qualitative analysis using Grounded Theory technique. The method included thorough, contextualised readings and re-readings of the material in light of the research questions, which essentially asked how individuals might be co-constructing musical interactions in the improvised settings of the genre. The qualitative analysis yielded a framework for exploring the components of musical interaction - the results of the grounded theory analysis suggested that the scenario of North Indian classical music duo interaction is constrained by aspects of the socio-musical context that housed the social relationships, which appeared to be required for musical communication. The core codes of *physical co-presence*

and *movement-in-time* suggested a view of musical interaction in which individuals act together in their immediate physical and temporal environment to manage one another's actions and negotiate their continued relationship.

The development of a methodology for the observation of musical interaction, based on the well-tested paradigm of a cognitive ethological framework, was set out in Chapter Four. In particular, the methodology was designed to fit the specific case of North Indian classical music duos on the back of the emic framework of musical interaction established in Chapter Three, which had suggested that the musicians must use particular action strategies to negotiate their own and one another's interactive behaviour. Video recordings were collected during the course of the research project, specifically for their empirical evidence of musicians' potentially communicative behaviour during musical interactions. The recordings were made with the least interference in the natural course of the musical interactions. Chapter Four outlined the development of the method of behavioural observation designed for this case. This aimed to log the most pertinent aspects of musicians' behaviour with a view to exploring the strategies used by interacting musicians to co-regulate their own and one another's musical behaviour, and to record these occurrences as time-series data in order to preserve the real-time, durational quality of the interaction.

The configuration was designed to focus on three areas of behaviour, providing a way to quantify details of the visible attention patterns of the musicians; the occurrence and timing of their expressive gestures of the upper torso; and simple body movements which counted neither as expressive gestures nor appeared to affect musical sound production. Certain factors that the qualitative analysis of Chapter Three had indicated as relevant variables of communication in musical interaction - features of socio-musical context and of musical organisation - were considered. Stratified excerpts of the video recordings were sampled from the corpus of recordings so that the empirical observations could be considered with the best possible comparison. Specialist behavioural observation software was used to code the video samples, and the consequent data were investigated with statistical techniques for the relationship between the resulting variation of responses and the proposed independent variables.

Chapter Five gave an account of the exact methods and results of the first part of the analysis, which used a classic ethological paradigm to observe the musicians' behaviour as independent events and to record simple rate and duration of occurrence information. This first part of the analysis compared the patterns of variation in all the responses for rate and duration, and then according to each of the three areas of behaviour that the coding configuration had identified.

The particular case of mutual gaze, in which musicians both looked at one another simultaneously, was also examined. The results of this part of the analysis were discussed in Chapter Six, and the findings were used to tease apart distinctions in the possible organisation of the musicians' behaviour, separating specifically musical structure factors from social interaction factors. Chapter Seven described the methods used in follow-up analyses to Chapter Six, and also set out the results and their discussion. The findings of the analysis and discussion are set out below; general points of discussion derived from the study of the results are presented in *italics*, and followed by an account of specific points that contribute to that conclusion.

The observable distinction between behaviour related to the frameworks of social and musical structures reinforces the concept of the social interaction context as something which is implicated in the experience of musical meaning.

Exploratory factor analysis was used to examine the overall trends of rate and duration of behaviour occurrence. This suggested that the rate of occurrence of the musicians' attention patterns could be summarised as whether the musicians are interacting with one another *within* their local physical space (or F-formation, formed by the general positioning of the musicians' bodies) or *beyond* this two-person zone. Meanwhile, the duration of the behavioural occurrences could be summarised by two factors that suggested a dependence on the apparent function of the behaviour -- specifically, the variation of other-directed attentional behaviour was different to self-directed attentional behaviour.

A key finding of the first part of the analysis was that expressive gesture patterns were thoroughly integrated into the holistic patterns of the musicians' general behaviour. The initial observations that contributed to the design of the coding configuration had suggested that the expressive gestures of the upper torsos, which all the musicians made in every recording, could be seen to carry the attentional apparatus of the face and head from one position to another, or as an excursion from and to the same position. Gesture phrases might begin or end at any point in relation to the attentional behaviour. It was seen that the rate of expressive gesture excursions correlated very highly with the occurrence of self-directed attentional behaviour, but that the mean duration of gesture phrases showed an independent pattern of variation. The parsing of these expressive gestures could therefore act as possible phrases of expression, with a separate level of behaviour organisation to the attention patterns.

The musical time structure, when explored through the system of time-cycle duration, was seen to affect the rate at which certain behaviours were performed by the musicians, but did not appear to affect the duration of these behaviours (this is discussed in more detail below).

The music-structural conventions of performance at a global level of performance structure - such as the inclusion of introductory, unaccompanied and unmetered solo performance, followed by a period of extemporisation around a pre-composed melodic and rhythmic structure, for example - appeared to affect the rate at which musicians looked at themselves and each other. The musicians' communicative behaviour was also seen to alter according to socio-musical features such as the function, or context, of the interaction itself. For example, musicians widened their patterns of attention outwards beyond their own local interaction zone during formal performances.

Familiar musicians behaved in observably different ways to unfamiliar musicians in the study: they looked at one another's hands less frequently and away from their local F-formation more. While the demands of musical performance structural aspects could contribute to the challenges faced by musicians who are unfamiliar with one another, the matter also appears to be strongly implicated in social interaction negotiations; for example, the continued study of a musician partner's hands is not in itself revealing of another's musical intentions (a factor that emerged as important to the musicians according to their own accounts of musical interaction during the qualitative analysis presented in Chapter Three), or particularly useful for the purposes of musical communication. The evidence of this correlation might be better explained by the possibility that looking at another musician's hands is an ostentatious and conventional signal of attention-giving. Non-musical interaction studies that have focused on relationship quality concepts like *rapport* propose that such stereotypical or conventional behaviours are typically carried out in early stages of interpersonal relationships.

The role of the musician in the musical performance affects the way in which they display attention to one another; for example, soloists look towards tabla players less than tabla players look towards soloists. This observation supports North Indian classical music rhetoric surrounding the roles of the soloist and accompanist, and was further supported by the observations that when the soloist does look at his accompanist's face, the accompanist typically performs an expressive gesture; also, when the soloist looks out beyond the local interaction zone, the tabla player typically performs an expressive gesture. These results might indicate that the tabla player uses the expressive gesture behaviour to support the soloist's actions by demonstrating his continued attention to him with an expressive acknowledgement.

However, the continuation of this commonly-held view would extend to the notion that soloists are dominant in the management of the duo's behaviour; but this is not supported in every case. In two performances, certain behaviour patterns were observed that could signify more subtle levels of attention-giving and -receiving in the interaction patterns. In these cases, the act of a tabla player looking at the soloist's face was typically followed by an expressive gesture by the soloist -- a reverse situation to the parallel response of the soloist looking to the tabla player's face and the tabla player acknowledging with a gesture. Also, the use of expressive gesture in itself by a soloist did not typically incur a replication of this behaviour by the tabla player, even though studies of relationships in social interaction, discussed in Chapter Two, section 2.7, suggest that mimicry is a predictable behaviour where the aim of the participants is to generate positive affect. In the words of the musicians whose opinions contributed to the qualitative analysis presented in Chapter Three, this quality of positivity emerged as a desirable feature of musical partnerships. Given this, the replication of a soloist's expressive gesture might have been expected of the tabla player with the view of the two musicians' roles as simple leader (soloist) and follower (accompanist).

The duration of communicative behaviours within music performance seems to have more to do with universal mechanisms (possibly related to interaction processes) than factors of musical time organisation.

The trends in the different observed behaviours showed that each has different patterns of duration variation. These patterns do not appear to be affected by the musical time cycle, or by social interaction factors to do with the musicians' relationship or the circumstances in which they are playing music together. The duration data did show some distinction between attentional behaviours in specifically communicative acts, and individuals' self-directed attention. Self-directed attentional behaviours had a typically longer duration than other-directed behaviours. These results were discussed in Chapter Six, and it was suggested that the patterns were consonant with the notion of an evolutionarily-conserved mechanism for the temporal constraint of action-perception units, proposed by cognitive anthropologists. Research was cited by Schleidt (1988), in which two inter-related functions of the universal time constant are proposed. The idea that a 1 - 4 second action unit may contribute to the experience of the perceptual present was considered; this is not refuted by the variations found in these data. Secondly, Schleidt's suggestion that the mechanism of a constant unit of action duration could serve a means of synchronisation between individuals in acts of communication by creating a sense of "common time beyond the content of a behaviour pattern" (Schleidt, 1988:74) was examined. The idea that dynamic social interaction processes may serve as the foundations for

the experience of shared time is well-supported by the view of human musical behaviour presented in this research.

Evidence of behaviour related to musical time-keeping appears to support the concept of subjective rhythmisization

The observational analysis included an informal survey of tal cycle durations, and associated data regarding the variation in the pulse of the musical performances. This survey suggested that although the recordings included ten-beat and sixteen-beat tal cycles that ranged from very fast (3 s per cycle) to very slow (25 s per cycle), the musicians had tended not to perform in the middle of this range; the results appeared to be distributed in two groups. The discussion of these results in Chapter Six speculated that the two groups may have a close relationship in terms of the actual sense of pulse that the musicians in each case might experience, and drew on the notion of subjective rhythmicization.

Subjective rhythmicisation, or subjective metricization (London, 2004:15), describes how individuals perceptually group periodically-recurring auditory events into larger imagined units. This grouping tendency gives rise to the experience of musical metre. The way in which individuals can entrain to a particular level of pulse allows them to infer other temporal expectations. The case for subjective rhythmicization suggests that particular periodicities of recurring auditory events could be most comfortably anticipated with minimal cognitive effort -- at a particular rate, certain periodic events can be best anticipated so therefore individuals could co-participate with most stability within the emergent structure of these events. In the unrelated investigation into Subrata's beating bout occurrences, one possible explanation suggested that the tapping behaviour demonstrated Subrata's cognitive effort required for the complex cross-rhythms he was playing.

The small number of cases outlined in the informal survey suggested that the subjective pulse of the two preferred distributions of tal duration could be related to one another in their common capacity to offer a vibrant, intuitive and comfortable tempo for the musicians to perform together. They were seen to have an approximate 1:1 ratio, where a mean pulse of 1.5 s could be inferred from the grouping of individual counts of the 6 s mean tal duration into four units in the first band of preferred tal cycle durations. In the second band, the individual counts of the preferred tal cycle durations, which had a mean duration of 22 s, were calculated as approximately 1.4 s for cases of Teental, or 2.2 s for Jhaptal.

This discussion points towards universal mechanisms of time perception that could underlie negotiated tempo judgements between musicians -- a factor in musicians' perceptions of the quality of their relationship with one another that arose in the qualitative analysis of Chapter Three. While the survey could only offer a limited view of the vast possibilities of this type of music performance, the results suggest that further research on interactive negotiation of expressive timing, and also perception and performance studies, could be developed through the study of this particular genre. The results also fit well with views from current music evolution studies, which are focusing on the social and biological entrainment processes of rhythmic, interactive behaviour (see, for example, Bispham, 2006).

Joint attention appears to be a complex factor in the construction of musical meaning; this supports the notion that the study of communication process should include consider the expressive and non-linguistic dimension of intentionality.

Mutual gaze was seen, through the analysis and discussion in Chapters Six and Seven, as a method of interpersonal attentional management. Its deployment in musical interaction is complex, and it is not as routinely or heavily used as the author anticipated in the light of notions of musicians' non-verbal communication in rhetoric surrounding co-performer communication.

The duration of mutual gaze was seen to have some relationship with the context of musical interaction, suggesting that musicians are likely to use longer acts of mutual gaze during rehearsals and in formal performance, although the rate of occurrence appears to be unaffected by the independent variables discussed in the previous three chapters. Mutual gazes are most likely to occur at the key point of a time-cycle, the sam. A possible account of this pattern could be in the function of mutual gaze as evidence of both parties' shared intention in the moment in which they occur, allowing an individual to convey such a complex notion as, 'I am aware of what you do and the intention you are expressing and I adapt my behaviour according to you'. This type of function gives a good explanation for their occurrence at the sam, and is well-supported in the ethnographic literature.

Such an explanation also fits well when the larger-scale circumstances in which mutual gazes occur is taken into account. For a mutual gaze act to happen between two participants, a sequence of attentional patterns must coincide, and sometimes the sequence begins but does not reach a perfect mutual gaze conclusion. Social relationship factors such as familiarity and rapport may strongly affect the consequences of individuals' attempted and successful use of

mutual gaze. If a function of mutual gaze may be to signify shared intention, possibly enhancing the entrainment of two musicians, the co-occurrence of the gazes with the sam may have as much to do with social relationship factors as the musical time-structure.

Musicians also have to act as self-focused (self-monitoring) individuals within musical interactions.

The results of the study on musicians' apparently non-functional tapping movements revealed that some individuals demonstrated bouts of beating behaviour that did not appear to be in time with the dyad's mutually negotiated tempo. An investigation of the results showed that in many cases, the beating behaviour did in fact cluster around simple ratios of the pulse -- although it was not particularly well timed as such. The small number of cases in which the behaviour occurred seemed to suggest that the tendency might be related to stess factors such as the demands of creative extemporisation and a lack of familiarity with their musician partner.

In studies of non-musical interaction scenarios, stereotypic behaviour - defined as repetitive, rhythmic body movement for which it is "difficult to ascribe goal or purpose" (Thelen, 1979:699) - has been associated with both self-regulation and a lowered awareness of external stimuli (Mason, 1991:1023). Although beating bouts are integrated into the act of musical performance in shared musical time, their occurrence hints at the type of self-focused mechanisms that individuals must also carry out in order to participate in musical interactions. The idea that individuals must balance self-focused behaviour with interactive, expressly communicative behaviour within the duo could also be suggested in the evidence that self-directed attention demonstrated the longest typical duration of all the attentional behaviours.

8.2   Reflecting on strengths and weaknesses

A key strength of the research presented here may lie in the level of success with which the methods of analysis have deciphered social and musical structural factors. The thesis required that no single organisational factor should be considered in priority to the other, and sought an approach that recognised the rich, cultural and social complexity of these particular musical interactions. The consideration of music structural aspects of the performances did not require the analytical separation of a sound trace from the generative, embodied source of the musical event. Furthermore, where the embodied basis of the interaction was acknowledged, the presence of more than one individual - consequently, the interaction of the dyad - was a natural feature of the study.

A second strength of the study is its bridging role between between social and individual studies of the mechanisms humans use for interpersonal interaction. Such studies were seen to be lacking in the musical communication literature reviewed in Chapter One. The importance of finding an interface between the levels of analysis at an individual level and at a broader, social level may be paramount to the future of research on music cognition that already recognizes the value of music as a social, collaborative phenomenon. The relationship between cultural phenomena and the biological systems of the humans who create them is a vast and fascinating territory. New technologies are providing greater access to research tools for the measurement and observation of external behaviour at ever-improving quality and resolution with digital recording media -- and also for the measurement of cognitive processes, in neuroimaging technology, for example. The power of empirical observation can be its potential to probe fascinating, complex and unknown territory in a systematic manner; this project contributes by highlighting the value of musical interaction as a rich source for future research in this area.

The research draws on current notions of embodied cognition, in order to push human movement towards the centre of discussions about communication and meaning. In this way, the thesis supports the epistemological shift described in Chapter Two, most evident in the relinquishing of mind-as-processor models of human cognition and also in the increasingly socially aware ideas of human language development. The level of practical involvement by the author in the research project has also strengthened the research, and is partly related to the thesis' contribution to the repositioning of non-linguistic knowledge within discussions of communication and meaning. The systematic approach of a behavioural observation study is most valuable for its capacity to measure objective evidence of verifiable events, but the demands of a rationalist paradigm of scientific endeavour do not necessarily fit with social and creative acts such as musical performance. The results of musical interaction in performance can change patterns of human behaviour at an immediate time-scale. This investigation does not attempt to define or analyse the *feelings* of the people involved in the musical interaction so much as identify the fact that musical interaction does produce behavioural and socially-relevant changes -- and that this may be the case for all participants, performers and audience members alike. The author carried out a practical level of participant-observation as a sitar student and maintained active music performance throughout the duration of the research in order that the practice, action-based knowledge -- better expressed in the act than in discussion about the act -- could remain at the forefront of the development of the thesis; this was a vital aspect in the development of the coding configuration.

Coding configurations that include the interpretation of expressive behaviours are always open to the criticism of subjectivity. Indeed, such qualifications must, by their nature, involve a degree of subjective assessment. As Appendix D illustrates, the main coder's capacity to replicate judgements on the best description of the video-recorded musicians' behaviour showed a very good level of reliability with the coding configuration on both attention behaviours and expressive gesture behaviours. The coding scores of an independent rater showed that the attentional behaviour elements of the coding configuration could be objectively rated, to a resolution of one single frame of the digital video-recording sequence. Although a reasonable degree of concordance occurred between the results of the new coder and the original coder, the results for expressive gesture observation were, predictably, replicated far less accurately than attentional behaviour, with a lower concordance and with less resolution.

As with any other quantitative method of social research, the analysis described here required the simplification of highly complex, fluctuating systems. However, the combined methods of ethnographic research and ecologically-valid video observation were designed to be used in such a way as to minimize the reductive effect. However, two particular aspects of the project could be better accounted for should the research project be repeated: the identification of looking behaviour in the coding configuration should include more specific detail on the looking patterns, noting whether musicians looking <u>away</u> turn to the audience or to the back of the room, for example. Also, in earlier stages of development of the configuration, expressive gestures were identified and described more accurately. Certain evidence suggested that some expressive gestures possessed a relationship with the melodic contour of the musical phrase, although this was much more apparent in the gestures of singers, who did not have their hands occupied, than any of the instrumentalists whose video recordings were used in this project. A replication of the observational research in this thesis could determine the degree to which the quality of some expressive gesture contours are contiguous with melodic contour, and if this proved to be the case, these gestures should be flagged as such and their function in relation to other gestures considered.

8.3   Implications for different fields of research

As might be expected by the interdisciplinary nature of the project, this thesis may have implications for various fields of research. In terms of the methods developed for the study of a non-Western genre by a British researcher, the project contributes to the versatile and various approaches that can be called upon for cross-cultural music cognition studies. The publication

of parts of this thesis will also contribute to a continual broadening of the musical repertory included in musicological scholarship.

The thesis also holds conceptual implications for general musicology; an approach that positions body knowledge, with all the immediacy and embodiedness of musical interaction, at the forefront of a discussion of musical communication and meaning highlights the invisible restrictions on musicology that wishes to look towards the emergent, performative aspects of music meaning but fails to acknowledge the human body's role in the act of producing and attending to musical interaction. The type of analytical approach described through this research is compatible with -- not exclusive to -- existing approaches, such as transcription.

The domain of gesture studies particularly and social interaction studies in general could benefit by admitting the study of musical interaction to their field - although it seems likely that the dearth of studies has most to do with the lack of attention to the topic by music specialists than by an exclusion of the topic by social interaction experts. In Chapter Two, section 2.10, several uses of musical analogy were mentioned, in which social interaction researchers and ethologists described elements of their study with reference to music's meaningful nature, but these references do not appear to have been developed beyond these analogies. Similarly, the topic of musical interaction also seems to be a prime, unmined source for social cognition studies. While developmental psychologists have long known of the communicative functions of musical elements in pre-verbal interaction, the mature manifestations of culturally-specific musical interactions could provide a wealth of material that might further knowledge and understanding of the mechanisms of social cognition. The notion of human development of the capacity for shared intentionality given by Tomasello, Carpenter, Cal, Behne and Moll (2005) heavily emphasised the potential importance of such a concept in human cognitive evolution. With the social, functional definition of musical interaction that has been applied in this dissertation, the social interaction element of musical behaviour can be seen to have an important relation to the human capacity for communication. Particularly, the value of music interaction studies to social and evolutionary cognition studies may be in the way that its non-linguistic capacity for engendering social entrainment can be examined, through such methods as those highlighted in this dissertation.

8.4   Future directions

Many projects offer themselves as continuations of the work of this thesis, including the development of purpose-designed studies to explore the phenomena such as beating bouts, mutual gaze sequences and the relationships of expressive gesture and melodic contour.

Various elements of this project were begun and then set aside in the scaling of the final project. One key area that was reluctantly put to one side included the study of individuals involved in a musical lesson scenario. The context of a music lesson includes fascinating transitions between natural, spoken language and musical forms of communication. An obvious future project is to return to this topic and explore the management of teacher-student relationships in music lessons. The number of participants in typical sitar lessons could also lead to a further challenge to be addressed in a continutation of this research, which must be to develop methods for studying a greater number of participants in an interaction.

In other related research directions, the author intends to explore further the notion of embodied apprenticeship in musical interactions, linking the whole-body and interactive cultural contexts of learning to the distinctive, culturally-mature musical genres that arise in human society. Also, the approach to the study of musical rhythm and behavioural timing that is included in this work will be developed towards a contribution to the evolutionary approaches to the capacity for rhythmic entrainment. The operation of meaningful gesture and entrainment processes must happen in time; without processes of subtly-timed behaviour, the interaction could not occur. An individual's environment includes other individuals, as the way that we judge and assess our place in the world is inseparable from the other people who inhabit it. We are motivated to empathise with and to anticipate other people's intentions because they are our world and they change our environment from moment to moment. In this sense, individuals' movements and gestures have describable qualities beyond direction and speed as they are motivated by an individual's impulse to move and react in some manner to their environment and are always 'read' as such when witnessed by other people.

In musical performance, particularly improvised musical performance, we act within self-imposed constraints and structures that allow us to express something with our own voice that has meaning to others through its relationship to a preordained structure. Our expressiveness depends on our bodies, and the essential human sharing of intentions can only be done by seeking out others' perspectives to a single situation or their attitude to life; seeking out their motivations and attempting to empathise by a continual judgement of other people's intentions. Certain aspects of North Indian musical performance behaviour are essential to acts of co-performance and may regard inter-performer communication, but these do not exclude the audience but rather draw them in.

This thesis has tried to locate body movement - an holistic, integrated view of the way individuals occupy space in their physically-social world - at the forefront of a discussion about

human acts of relating and communicating. This view has taken the notion that meaning may be *in* the movement -- in the changes that we make to our local, interactional environment and right between the words that we speak. In this sense, meaning might be found in the pauses and hesitations and the prosody of our *use* of language, evident in our patterns of attention and our intention to direct others' attention. Meaning may start in all of these changing, moving 'places'.

Participating in musical interaction, we participate in events whose duration, and the place they occupy in time, are important. Rules for behaviour, and guidelines for action, apply differently to non-musical interaction, and they are often based on the creation of novelty within a stable structure. It may be that the use of recurrent, predictable (and enjoyably unpredictable) events in time allows us a framework for the location of our social selves in space and time. Musical interaction may perhaps be defined in particular by its mode of delivery through human bodies and their organisation in response to a dynamic, people-populated world. However, we have to co-construct and improvise in order to communicate in any sphere of human interaction. Where musical performance and interaction is constantly referred to through instantiated scores and recordings, the meaningful, affective nature of music remains perceived as an inexplicable gift to those with the intellect and education to perceive it. Meanwhile the dynamic, in-time, social reality of musical behaviour as embodied process is deemed a topic outside the realms of music scholarship. The greatest value of taking a social interactive and relationship view on the study of musical interaction could be that it encourages a reciprocal perspective - that if we can examine musical interaction as a form of social interaction, we could also see what everyday social interaction situations can learn from musical ones.

APPENDIX A - Interviews and video recordings

Date	Material
21/04/04	Informal performance by Mehboob Nadeem (sitar) and Subrata Manna (tabla) (recital room, Cambridge). [1][6]
21/11/04	Concert by Pandit Arvind Parikh (sitar) with Dilshad Ahmed (tabla). Also includes Green Room rehearsal (Auditorium, Chembur). [2][4]
15/12/04	Informal performance with rehearsal by Tarun Nayak (sarod) and Subrata Manna (tabla) (private apartment, Kolkata). [2][6]
07/12/04	Concert by Pandit Nayan Ghosh (sitar) with Abhijeet Banerjee (tabla) (Auditorium, Kolkata). [2][6]
26/02/04	Interview 1, with Arvind Parikh by Nikki Moran (private apartment, Chelsea London). [3][4]
21/04/04	Interview 2, with Mehboob Nadeem and Subrata Manna by Nikki Moran and Martin Clayton (recital room, Cambridge). [5][6]
26/11/04	Interview 3, with Arvind Parikh by Nikki Moran (private apartment, Mumbai) [3][4]
01/12/04	Interview 4, with Purvi Parikh (Khyal singer) by Nikki Moran (private apartment, Mumbai). [2][4]
10/12/04	Interview 5, with Pandit Budhaditya Mukherjee (sitarist) by Nikki Moran (private residence, Kolkata). [3][4]
15/12/04	Interview 6, with Tarun Nayak and Subrata Manna by Nikki Moran and Martin Clayton (private apartment, Kolkata). [2][5][6]
23/05/05	Interview 7, with Pandit Nayan Ghosh by Martin Clayton and Laura Leante (Sangeet Mahabharati, Mumbai). [7]

---

[1] Video and audio recording to MiniDV by Hi 8 video recorder with stereo pair of AKG microphones
[2] Video and audio recording to MiniDV by MiniDV camcorder with in-built microphone
[3] Audio recording to Minidisk stereo recorder, transcribed by Nikki Moran
[4] Recorded by Nikki Moran
[5] Transcription from MiniDV audio by Nikki Moran
[6] Recorded by Martin Clayton, Laura Leante and Nikki Moran
[7] Audio recording direct to audio file, transcribed (from CD copy of recording) by Adrian Poole

APPENDIX B - Observer Video-Pro configuration

Configuration 1 - ATTENTION

Program type and version: Observer 5.0

Computer model: x86 Family 6 Model 9 Stepping 5 Genuine Intel Intel(R) Pentium(R) M processor 1400MHz; 502 MB memory. Installed operating system: Windows XP Professional Edition Service Pack 2.

Settings

Setting	Value
Recording method	Continuous
Automatically generate key codes	No
Case sensitive	Yes
Duration of Observation	Open Ended

Independent Variables

Number of Independent Variables: 3

Independent Variable Name	Type	Values
Context	Nominal	rehearsal
		informal performance
		formal performance
Soloist	Nominal	mn sitar
		tn sarod
		ap sitar
		ng sitar
Accompanist	Nominal	sm tabla
		da tabla
		ib tabla

Participants

Number of Participants: 5

Name	Code	Name	Description
soloist	s	soloist	solo instrumentalists
tabla	t	tabla	tabla accompanist
extra 1	1	extra 1	non-player
extra 2	2	extra 2	non-player

Behaviours

Number of behavioural classes: 3

Behavioural Class 1: Head move goal

Type: Nominal

Number of Elements: 3

Behaviour Name	Code	Type	Modifier
Other	o	State	Face;Hands
Away	a	State	(None)
Self	s	State	(None)

Element Descriptions:

Behaviour Name	Description
Other	Towards other person, at face or hands
Away	Not at other person or self
Self	At own hands or lap

Behavioural Class 2: Musical events

Type: Nominal

Number of Elements: 2

Behaviour Name	Code	Type	Modifier Class 1
Khali	0	Event	(None)
Sam	x	Event	(None)

Element Descriptions:

Behaviour Name	Description
Khali	Khali
Sam	Sam

Behavioural Class 3: Eyes

Type: Nominal

Number of Elements: 2

Behaviour Name	Code	Type	Modifier Class 1
Open	8	State	(None)
Downcast	%	State	(None)

Element Descriptions:

Behaviour Name	Description
Open	Eyes open
Downcast	Eyes downcast

Configuration 2 - EXPRESSIVE & NON-FUNCTIONAL MOVEMENT

Specifications: see ATTENTION configuration.

Settings

(As for ATTENTION configuration)

Independent Variables

(As for ATTENTION configuration)

Participants

(As for ATTENTION configuration)

Behaviours

Number of behavioural classes: 1

Behavioural Class 1: Gesture

Type: Nominal

Number of Elements: 3

Behaviour Name	Code	Type
Onset	o	Event
Retraction	e	Event
Tap	t	Event

Element Descriptions:

Behaviour Name	Description
Onset	Onset of gesture movement
Retraction	Gesture begins to retract
Tap	Iterative, uni-dimensional movements

APPENDIX C - Table showing dates of coding

Excerpts are identified by the surname of the soloist followed by Set group (A-D), followed by scenario - formal (f) or informal (i) performance, or rehearsal (r). Excerpts re-coded for coder reliability assessment 27-29 March 2007 (see Appendix D) are **emboldened**.

Configuration 1		Configuration 2	
Observation	**Date**	**Observation**	**Date**
NADEEM_Ar	**18-04-2006**	NAYAK_Dr	06-06-2006
NADEEM_Br	**18-04-2006**	**NAYAK_Di**	**06-06-2006**
NADEEM_Dr	18-04-2006	GHOSH_Df	06-06-2006
NADEEM_Cr	18-04-2006	NADEEM_Dr	06-06-2006
NADEEM_Ai	18-04-2006	NADEEM_Di	06-06-2006
NADEEM_Bi	18-04-2006	PARIKH_Df	06-06-2006
NADEEM_Ci	18-04-2006	**NADEEM_Br**	**26-06-2006**
NADEEM_Di	19-04-2006	**NADEEM_Ar**	**26-06-2006**
PARIKH_Br	19-04-2006	NADEEM_Ai	26-06-2006
PARIKH_Af	19-04-2006	NADEEM_Bi	26-06-2006
PARIKH_Bf	19-04-2006	NADEEM_Ci	27-06-2006
PARIKH_Cf	**19-04-2006**	NAYAK_Bi	11-07-2006
PARIKH_Df	20-04-2006	NAYAK_Ar	11-07-2006
GHOSH_Af	20-04-2006	NAYAK_Ai	11-07-2006
GHOSH_Bf	**20-04-2006**	NAYAK_Bi	11-07-2006
GHOSH_Cf	20-04-2006	NAYAK_Ci	11-07-2006
GHOSH_Df	20-04-2006	GHOSH_Af	11-07-2006
NAYAK_Ar	21-04-2006	**GHOSH_Bf**	**11-07-2006**
NAYAK_Br	21-04-2006	GHOSH_Cf	11-07-2006
NAYAK_Dr	21-04-2006	PARIKH_Br	11-07-2006
NAYAK_Ai	21-04-2006	PARIKH_Af	11-07-2006
NAYAK_Bi	21-04-2006	PARIKH_Bf	11-07-2006
NAYAK_Ci	22-04-2006	**PARIKH_Cf**	**11-07-2006**
NAYAK_Di	**22-04-2006**	NADEEM_Cr	11-07-2006

APPENDIX D - Video coding rater reliability

The effectiveness of an analysis approach that records time-coded data points by observation of video-recorded instances of behaviour was assessed. Available measures include the reliability of an individual coder's performance over time (coder reliability), and the potential for the observations to be replicated with a good degree of success by other coders (inter-coder reliability). Good performance across these two measures demonstrates a well-designed coding configuration that can capture and describe real phenomena.

Observer Video-Pro software includes a statistical analysis component for assessing coder reliability. Data records for comparison cases are directly linked so that the correspondence of two observation groups that have been scored for the same behaviours can be assessed. State behaviours which have duration can be tallied by their sequence and duration, and all behaviours can be tallied by their sequence and rate of occurrence. The degree of tolerance that defines how closely in time two observations must be recorded in order to be deemed a *match* may be altered - its use here ranges from 0.04 s (one single frame in the PAL video encoding format, which captures 25 frames per second) for configuration one, to 3 s in configuration two. The agreement of the two observation groups is graded by an index of concordance, where zero represents a total lack of concordance and 1 represents perfect concordance.

The main coder in this study is the author, whose knowledge of the subject matter and practice with the software mean that she might be considered an expert coder in this case. The expert coder's reliability was tested with a replication task after a period of eight months, during which time she did not use the software, and a shorter-term replication task comparing coding across an interval of two days. The level of inter-coder reliability was tested by a task in which a non-expert, who was familiar with the use of various software interface designs similar to The Observer Video-Pro, was asked to apply elements of both configurations (looking direction, eyes-state and expressive gesture phrases) to code random excerpts. The non-expert was given minimal, generic instruction to avoid influencing his judgement on the task.

Coder reliability

An excerpt was randomly selected for re-coding from each recording session, making a set of four excerpts for the re-coding, which took place on 27 to 29 March 2007 after a period of at least eight months had elapsed (see Appendix C). A further complete, randomly selected excerpt was re-coded twice within two days in order to test short-term reliability. The

concordance results show good and very good levels of reliability (see Table D1 and Figure D1).

Table D1 - concordance values showing good levels of coder reliability over a minimum of eight-months (Long period) and very good reliability on a replication task within two days (Short period).

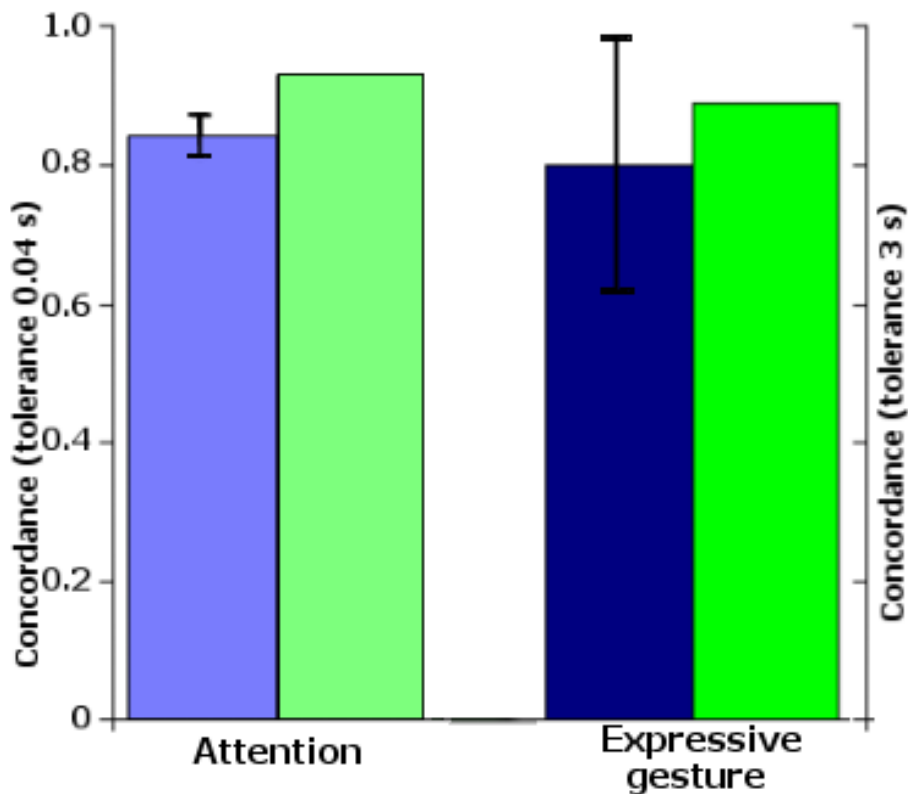| Configuration	Analysis	Index of concordance	
		Long period	Short period
1 - Attention (looking-direction AND eyes-state for soloist AND tabla player)	Duration and sequence	0.84	0.92
	Rate and sequence (0.04 s tolerance)	0.84	0.93
2 - Expressive gesture phrases by soloist	Rate and sequence (3 s tolerance)	0.79	0.89

Figure *D1 - Main coder reliability from Long period (blue) and Short period (green) replication tasks on attentional behaviour and expressive gesture behaviour, assessed by rate and sequence concordance. The results of the 4-excerpt trial for Long period are collapsed to a mean value, and the standard deviation of the concordance scores represented by the vertical bars.*

Inter-coder reliability

A complete, 60 s excerpt was randomly selected for the inter-coder reliability task. This assessed concordance between this new coder's observations and the original series produced by the expert coder. Tolerance levels were set to match the first coder reliability task (see Table D2 for results).

Table D2 - concordance values describing inter-coder reliability on coding tasks in both configurations.

Configuration	Analysis	Index of concordance
#1 - Attention (looking-direction AND eyes-state for soloist AND tabla player)	Duration and sequence	0.84
	Rate and sequence (0.04 s tolerance)	0.77
#2 - Expressive gesture phrases by soloist	Rate and sequence (3 s tolerance)	0.67

While the inter-coder reliability task for the attentional behaviours clearly demonstrates a robust configuration, the gesture phrase coding task in configuration two shows a lower degree of concordance.

A comparison of the actual results is shown in Figure D2 below, demonstrating that many of the gesture phrases appear to have been accurately identified (for example, see events at approximately 12, 20, 26, 37, 46 and 48 seconds). Given the deliberately short and non-prescriptive briefing given to the inexperienced coder, and the complexity of this subtle task, the results represent a reasonable level of reliability.
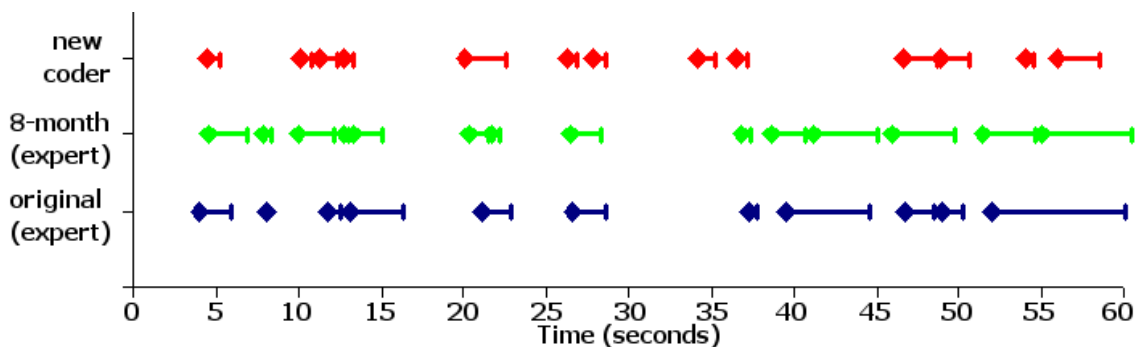

Figure D2 - Gesture phrase coding reliability - correspondence between original coding, replication after eight months, and inter-coder trial. The onsets of the gesture are marked with the blue, green and red diamonds, and the duration of each gesture represented by the horizontal tail to the right of the diamonds.

GLOSSARY

TRANSLITERATION (IAST)	TERM	DEFINITION
ālāp	alap	Introductory section of North Indian classical performance. Soloist presents the essential melodic features by which an individual rag can be identified, and develops these through systematic, un-metered improvisation. (See **rag**)
antarā	antara	The second part of a gat (composition), usually uses pitches in the upper part of the octave. (See **gat**)
aṅg	ang	Style.
āroh	aroh	Ascending melodic pattern characteristic of a particular rag. (See **rag**)
avaroh	avroh	Descending melodic pattern characteristic of a particular rag. (See **rag**)
Bageshrī	Bageshree	The name of a heptatonic rag with flattened third and seventh degrees (komal Ga and Ni). The first and fourth degrees (Sa and Ma) are both strong notes; the fifth degree (Pa) is used rarely. (See **komal**)
bandiś	bandish	Vocal composition.
bhajan	bhajan	Devotional song.
bhakti	bhakti	Devotion.
bol	bol	Onomatopoeically descriptive syllable used to describe individual drum sounds. Set sequences of bols are used to play the theka for a particular tal. (See **theka; tal**)
caugun	chaugun	Quadruple.
calan	chalan	Way of moving.
chand	chhand	Metre.

chegun	chegun	Sextuple.
cikārī	chikari	Strings on a sitar that are tuned to fixed pitches, sounded by downward strikes of the right hand. They are used for rhythmic effect, punctuating long phrases during the alap and producing a backwash of sound against the melody stream during jhala.
dhrupad	dhrupad	Style of vocal music, often devotional.
drut	drut	Tempo: fast.
Ektāl(a)	Ektal	12-beat time cycle.
gamak	gamak	Style of melodic ornamentation, a 'shake'.
gat	gat	Pre-composed melody, used as basis for extended improvisation during instrumental performance.
gāyakī	gayaki	Vocal (gayaki ang = vocal style).
gharānā	gharana	School, or style, of music performance.
jhālā	jhala	Fast, rhythmic section of instrumental performance where a melody is sustained against a backdrop of drone-string strokes.
Jhaptāl(a)	Jhaptal	10-beat time cycle.
joṛ	jod	Rhythmic, but unmetered, section of performance.
khālī	khali	"Empty" beat of a time cycle, marked by a wave in the system of claps and waves that musicians and audiences use to demonstrate the tal. The khali occurs at a fixed point in the time cycle. For example, in Tintal the khali falls on the ninth beat; in Jhaptal the khali falls on the sixth beat.
khaṇḍajāti	khandajati	Quintuplets.
khyāl	khyal	Genre of vocal music on which much classical instrumental music performance is based. Khyal is lighter in style than devotional dhrupad, with a typically shorter alap and more elaborate ornamentation. However, khyal adheres more strictly to the form of a particular rag than does

the lighter vocal form, thumri. (See **dhrupad**; **thumri**)

komal	komal	Pitch: flattened (♭).
lay(a)	lay	1. Tempo; 2. Rhythm.
laykārī	laykari	Rhythmic patterns.
madhya	madhya	Middle.
mandra saptak	mandra saptak	Lower octave.
Marwa	Marwa	The name of a hexatonic rag in which the fifth degree (Pa) is excluded, and the tonic (Sa) infrequent.
mātrā	matra	Beat, or musical time-unit.
mī̃d	meend	A type of glissando. On sitar, the string is pulled across the fret (laterally to the neck of the instrument) in order to bend the pitch.
mizrāb	mizrab	Metal finger-pick used to strike sitar strings. It is fitted over right-hand index fingertip.
mohra	mohra	Fixed-pattern phrase used in the structuring of an alap improvisation; a form of cadence.
mukhṛā	mukhra	Cadential figure which gives structure to the unmetered alap.
murkī	murki	A type of melodic ornamentation
palṭā	palta	Melodic patterns based on generative principles specifically learnt for the purpose of developing instrumental technique. (See **vistar; prastar**)
Paṇḍit	Pandit	(Hindu) master. (See **Ustad**)
prastār	prastar	Systematic development of musical material by permutations of an original melodic or rhythmic unit.
rāg(a)	rag	1. Modality - the selection of notes deployed in a performance; particularly, the relationship of these notes to one another. A rag can be defined by the pitch hierarchies produced by patterns of

		ascent and descent; emphasis of certain pitches by repetition and ornamentation; and choice of octave (tessitura). 2. A literal translation from Sanskrit might describe the act of colouring or dyeing the mind, engendering certain emotions and passions (Bor, 1999:1). In this sense, rag can be portrayed in poetry and paintings as well as music.
ras(a)	ras	Sentiment; emotion or feeling.
Rūpak tāl(a)	Rupak tal	7-beat time cycle.
riaz	riyaz	Dedicated musical practice.
sam	sam	First beat of a time cycle; also the end point of cadential figures. This distinguishes the concept of tal from the notion of musical time associated with the visual imagery of a bar in Western music notation, where musical duration is segmented into discrete units - one unit of time ends at the barline and the next begins after it.
samvādī	samvadi	The (perceptually and/or rhetorically) second strongest note in a rag. (See **vadi**)
sangat	sangat	Accompaniment.
sangatkar	sangatkar	Musician accompanist.
saptak	saptak	Octave. The Indian system divides the octave into seven chroma with the note-names Sa, Re, Ga, Ma, Pa, Dha, Ni. Re, Ga, Dha and Ni also have flattened forms while Ma may be sharpened - in this way, the complete chroma includes twelve tones. (See **komal; tivra**)
sargam	sargam	Oral notation system (solfège) in which pitches are referred to by name. The pitches of the notes are not fixed in their frequency as the system uses a moveable tonic. (See **saptak**)
sarod	sarod	Short-necked, fretless lute with a steel fretless finger board and skin sound board.
sitār(a)	sitar	Long-necked, fretted lute with typically 11-14 strings. Of these, two or three are used as melody strings stopped by the fingers of the left hand. Other strings are played with the right hand at

		fixed pitches; others are tuned to vibrate in harmonic resonance. (See **chikari; tarab**)
śruti	shruti	Microtonal pitch interval.
sthāyī	sthayi	The first part of a gat (composition), usually uses pitches in the lower part of the octave.
śuddh	shuddh	Pitch: natural (♮).
surbahār	surbahar	A large, low-register lute; like a type of bass sitar.
svara	swara	Musical note.
tablā	tabla	Pair of tuned drums used to accompany much classical North Indian instrumental music.
tāl(a)	tal	Rhythmic cycle. (See **sam; khali**)
tān	tan	Fast phrase rehearsed in practice and incorporated into performance.
tālīm	taleem	The learning situation in which a student of Hindustani music performance sits with his or her guru.
tānpūrā	tanpura	Long-necked lute with no frets; produces drone.
tār saptak	tar saptak	Upper octave.
tarab	tarab	Strings on a sitar which are tuned to vibrate in harmonic sympathy without being touched or struck themselves, giving the instrument its characteristic halo of sound.
tihāī	tihai	Rhythmic cadence, where a rhythmic figure of a particular duration is repeated three times to end with the first beat of the cycle. Example: a tihai beginning on the ninth beat of a 16-beat cycle would be required to cover a total of nine beats in order to end with the sam. This could be produced by a figure with five notes such as: ♪♪♪♪♩ Repeated three times, this forms a nine-beat tihai. (See **sam**)
Tīntāl(a)	Teental	16-beat rhythmic cycle.

tīvra	teevra	Pitch: sharpened (♯).
ṭhāṭ	thaat	A classification system of modal categories (or, scale-types), describing the finite selection of pitch chroma from the possible set of twelve. According to Bhatkande (1860-1936), every rag can be classified as belonging to one of ten thaats, according to the selection of pitches which it deploys (Bor, 1999:3).
ṭhekā	theka	A specific rhythm pattern that defines a particular time cycle unambiguously. During an instrumental performance by sitar and tabla, the tabla player typically embellishes the basic theka. (See **bol**)
thumrī	thumri	Light classical song style of vocal or instrumental music.
Ustād	Ustad	(Muslim) master. (See **Pandit**)
vādī	vadi	The (perceptually and/or rhetorically) strongest note in a rag. (See **rag**)
vilambit	vilambit	Tempo: slow.
vistār	vistar	Systematic development of musical material by expanding the kernel of a melodic or rhythmic unit.
Yaman	Yaman	The name of a heptatonic rag in which the fourth degree (Ma) is sharpened. (Similar in melodic content to Phrygian mode.)
ziṇḍālay(a)	zindalay	Tempo: vibrant, alive.

REFERENCES

Abbate, C. (2004). Music - Drastic or Gnostic? *Critical Inquiry, 30*(3).

Adorno, T. W. (1983). *Prisms* (S. a. S. Weber, Trans.). Cambridge, Mass: MIT Press.

Adorno, T. W. (1984). *Aesthetic Theory* (C. Lenhardt, Trans.). London: Routledge and Kegan Paul.

Adorno, T. W. (2002). Culture, Technology and Listening - The Radio Symphony (S. Gillespie, Trans.). In R. Leppert (Ed.), *Essays on Music* (pp. 251-69). Berkeley: University of California Press.

Alibali, M., Kita, S., & Young, A. (2000). Gesture and the process of speech production: We think, therefore we gesture. *Language and cognitive processes, 15*, 593-613.

Allen, C., & Beckoff, M. (1997). *Species of Mind. The Philosophy and Biology of Cognitive Ethology*. London: MIT Press.

Argyle, M. (1969). *Social Interaction*. London and New York: Methuen & Co.

Argyle, M. (1972). Non-verbal communication in human social interaction. In R. A. Hinde (Ed.), *Non-verbal Communication*. Cambridge: Cambridge University Press.

Argyle, M. (1976). *Gaze and mutual gaze.* Cambridge: Cambridge University Press.

Ashley, R., Mader, R., & Hasty, R. (2002). *Musical expressivity within ensembles.* Paper presented at the 7th International Conference on Music Perception and Cognition, Sydney.

Atkinson, J. M., & Heritage, J. (Eds.). (1984). *Structures of Social Action:studies in conversation analysis*. Cambridge: Cambridge University Press.

Attewell, P. (1974). Ethnomethodology since Garfinkel. *Theory and Society, 1*(2), 179-210.

Baaren, R. B. v., Chartrand, T. L., Maddux, W. W., Bouter, C. d., & Knippenberg, A. v. (2003). It Takes Two to Mimic: Behavioral Consequences of Self-Construals. *Journal of Personality and Social Psychology, 84*(5), 1093-102.

Bailey, D. (1992). *Improvisation: its nature and practice* (2nd ed.). Dorchester: The Dorset Press.

Baily, J. (1977). Movement Patterns in Playing the Herati Dutar. In J. Blacking (Ed.), *The Anthropology of the Body* (Vol. 15, pp. 275-330). London: Academic Press.

Baily, J. (1985). Musical Structure and Human Movement. In P. Howell, I. Cross & R. West (Eds.), *Musical Structure and Cognition*. London: Academic Press.

Baily, J. (1988). Anthropological and Psychological Approaches to the Study of Music-Theory and Musical-Cognition. *Yearbook for Traditional Music, 20*, 114-24.

Baily, J. (1991). Some Cognitive Aspects of Motor Planning in Musical Performance. *Psychologica Belgica, 31*(2), 147-62.

Baily, J. (1992). Music Performance, Motor Structure, and Cognitive Models. In M. P. Baumann, A. Simon & U. Wegner (Eds.), *European Studies in Ethnomusicology: Historical Developments and Recent Trends* (pp. 142-58). Wilhelmshaven: Florian Noetzel Verlag.

Bally, C., Sechehaye, A., & Reidlinger, A. (Eds.). (1974). *Course in General Linguistics by Ferdinand de Saussure* (Revised ed.). London: Fontana.

Bates, E., & Dick, F. (2002). Language, Gesture and the Developing Brain. *Developmental Psychobiology, 40*, 293-310.

Bavelas, J. B., Coates, L., & Johnson, T. (2002). Listener responses as a collaborative process: The role of gaze. *Journal of Communication, 52*(3), 566- 80.

Beattie, G., & Coughlan, J. (1999). An experimental investigation of the role of iconic gestures in lexical access using the tip-of-the tongue phenomenon. *British Journal of Psychology, 90*, 35-56.

Bechtel, W., & Zawidzki, T. (1998). Selective biographies of major contributors to cognitive science. In W. Bechtel & G. Graham (Eds.), *A Companion to Cognitive Science* (pp. 750-76). Malden, Mass and Oxford: Blackwell.

Beckoff, M. (1996). Cognitive ethology, vigilance, information gathering, and representation: Who might know what and why? *Behavioural Processes, 35*, 225-323.

Beckoff, M. (1998). Cognitive Ethology. In W. Bechtel & G. Graham (Eds.), *A Companion to Cognitive Science* (pp. 371-9). Malden, Mass and Oxford: Blackwell.

Beebe, B., Sorter, D., Rustin, J., & Knoblauch, S. (2003). A Comparison of Meltzoff, Trevarthen, and Stern. *Psychoanalytic dialogues, 13*(6), 777-804.

Beebe, B., Stern, D., & Jaffe, J. (1979). The Kinesic Rhythm of Mother-Infant Interactions. In A. Siegman & S. Feldstein (Eds.), *Of Speech and Time* (pp. 23-4). Hillsdale, New Jersey: Erlbaum.

Benzon, W. L. (2001). *Beethoven's Anvil: Music in mind and culture*. Oxford: Oxford University Press.

Berliner, P. (1978). *The Soul of MBira: music and traditions of the Shona people of Zimbabwe* (Vol. 26). Berkeley and London: University of California Press.

Bernieri, F., Davis, J. M., Rosenthal, R., & Knee, C. R. (1994). Interactional Synchrony and Rapport: Measuring Synchrony in Displays Devoid of Sound and Facial Affect. *Personality and Social Psychology Bulletin, 20*(3), 303-11.

Bernieri, F., Reznick, J. S., & Rosenthal, R. (1988). Coordinated movement and rapport in teacher-student interactions. *Journal of Nonverbal Behavior, 12*(2), 120-38.

Bernieri, F., & Rosenthal, R. (1991). Interpersonal coordination: behaviour matching and interactional synchrony. In R. S. Feldman & B. Rimé (Eds.), *Fundamentals of nonverbal behavior* (pp. 401-32). New York: Cambridge University Press.

Bickerton, D. (2000). Can Biomusicology Learn from Language Evolution Studies? In N. L. B. M. S. B. Wallin (Ed.), *The Origins of Music* (pp. 153-63). Cambridge, MA: MIT Press.

Birdwhistell, R. (1952). *Introduction to Kinesics: An Annotation System for the Analysis of Body Motion and Gesture*. Washington, DC: Foreign Service Institute, US Department of State.

Bispham, J. (2006). Rhythm and Music: What is it, who has it and why? *Music Perception, 24*(2), 125-34.

Blackburn, S. (1996). Intentionality. In *The Oxford Dictionary of Philosophy*. Open University: Oxford University Press. Oxford Reference Online.<HTTP://WWW.OXFORDREFERENCE.COM/VIEWS/ENTRY.HTML?SUB VIEW=MAIN&ENTRY=T98.E1261> 21 February 2007.

Blacking, J. (1971). Deep and Surface Structures in Venda Music. *Yearbook of the International Fold Music Council, 3*, 91-108.

Blacking, J. (1974). *How Musical Is Man?* USA: Washington Press.

Blacking, J. (1977). Towards An Anthropology of the Body. In J. Blacking (Ed.), *Towards An Anthropology of the Body* (Vol. 15, pp. 1-28). London: Academic Press.

Boal, I. (2001, 2001). *Language*. Retrieved 16 October, 2006, from <HTTP://WWW.OXFORDREFERENCE.COM/VIEWS/ENTRY.HTML?SUBVIEW= MAIN&ENTRY=T128.E569> Open University

Bor, J. (Ed.). (1999). *The Raga Guide*. The Netherlands and UK: Nimbus Records.

Borgatti, S. (2005, 17 September 06). *Introduction to Grounded Theory*. Retrieved 20 January 2005, 2005, 2006, from HTTP://WWW.ANALYTICTECH.COM/MB870/INTROTOGT.HTM

Borgerhoff Mulder, M., & Caro, T. M. (1985). The Use of Quantitative Observational Techniques in Anthropology. *Current Anthropology, 26*(3), 323-35.

Born, G., & Hesmondhalgh, D. (Eds.). (2000). *Western Music and Its Others: Difference, Representation, and Appropriation in Music*. Berkeley and London: University of California Press.

Brett, P., Wood, E., & Thomas, G. C. (Eds.). (1994). *Queering the Pitch: The New Gay and Lesbian Musicology*. New York: Routledge.

Brewer, & Gardner. (1996).

Brinner, B. (1995). *Knowing music, making music: Javanese gamelan and the theory of musical competence and interaction*. Chicago: University of Chicago Press.

Brown, S. (2000). The 'Musilanguage' Model of Music Evolution. In N. L. B. M. S. B. Wallin (Ed.), *The Origins of Music* (pp. 271-300). Cambridge, MA: MIT Press.

Camurri, A., Coletta, P., Ricchetti, M., & Volpe, G. (2000). Expressiveness and physicality in interaction. *Journal of New Music Research, 29*(3), 187-98.

Camurri, A., Lagerlöf, I., & Volte, G. (2003). Recognising emotion from dance movement: comparison of spectator recognition and automated techniques. *Internation Journal of Human-Computer studies, 59*, 213-25.

Cappella, J. N. (1984). The Relevance of the Microstructure of Interaction to Relationship Change. *Journal of Social and Personal Relationships, 1*, 239-64.

Cappella, J. N. (1996). Dynamic Coordination of Vocal and Kinesic behavior in Dyadic Interaction: Methods, Problems and Interpersonal Outcomes. In J. H. Watt & C. A. VanLear (Eds.), *Dynamic Patterns in Communication Processes* (pp. 353-86). Thousand Oaks, California: Sage.

Cappella, J. N., & Green, J. O. (1982). The effects of distance and individual differences in arousability on nonverbal involvement: a test of descrepancy-arousal theory. *Journal of Nonverbal Behavior, 8*(4), 259-86.

Chomsky, N. (1957). *Syntactic Structures*. The Hague: Mouton.

Chomsky, N. (1968). *Language and mind*. New York: Harcourt, Brace & World.

Clark, H. (1996). *Using Language*. Cambridge: Cambridge University Press.

Clarke, E. F. (2005a). Creativity in performance. *Musicae Scientiae, XIX*(1), 157-82.

Clarke, E. F. (2005b). *Ways of Listening: An Ecological Approach to the Perception of Musical Meaning*. Oxford: Oxford University Press.

Clayton, M. (2000). *Time in Indian Music: Rhythm, Metre and Form in North Indian Râg Performance*. Oxford: Oxford University Press.

Clayton, M. (2001). Introduction: towards a theory of musical meaning (in India and elsewhere). *British Journal of Ethnomusicology, 10*(i), 1-17.

Clayton, M. (in press). Observing entrainment in Indian music performance: Video-based observational analysis of tanpura playing and beat marking. *Musicae Scientiae*.

Clayton, M., Herbert, T., & Middleton, R. (Eds.). (2003). *The cultural study of music: a critical introduction*. New York and London: Routledge.

Clayton, M., Sager, R., & Will, U. (2004). In time with the music: the concept of entrainment and its significance for ethnomusicology. *ESEM CounterPoint, 1*, 3-45.

Clynes, M. (1979). Sentics: Communication and generation of emotion through dynamic expression. In S. Weitz (Ed.), *Nonverbal communication: Readings with commentary* (2nd ed.). New York: Oxford University Press.

Condon, W. S. (1975). Multiple Response to Sound in Dysfunctional Children. *Journal of Autism and Childhood Schizophrenia, 5*(1).

Condon, W. S. (1985). Sound-Film Microanalysis: a means for correlating brain and behaviour. In F. Duffy & N. Geschwind (Eds.), *Dyslexia: a neuroscienctific approach to clinical evaluation* (pp. 123-56). Boston: Toronto.

Condon, W. S., & Sander, L. S. (1974). Neonate movement is synchronized with adult speech: Interactional participation and language acquisition. *Science, 83*, 99-101.

Cook, N. (1990). *Music, imagination and culture*. Oxford: Clarendon.

Cook, N. (2001). Theorizing Musical Meaning. *Music Theory Spectrum, 23*(2), 170-95.

Cottrell, S. (2004). *Professional Music-making in London: ethnography and experience*.

Crane, T. (2005). Intentionality. In *The Oxford Companion to Philosophy*. Open University: Oxford University Press. Oxford Reference Online. <HTTP://WWW.OXFORDREFERENCE.COM/VIEWS/ENTRY.HTML?SUBVIEW= MAIN&ENTRY=T116.E1243> 21 February 2007.

Cross, I. (1998). Music Analysis and Music Perception. *Music Analysis, 17*(1), 3-20.

Cross, I. (1999). Is music the most important thing we ever did? Music, Development and Evolution. In S. W. Yi (Ed.), *Music, mind and science* (pp. 10-39). Seoul: Seoul National University Press.

Cross, I. (2001a). Music, cognition, culture and evolution. *Annals of the New York Academy of Sciences, 930*, 28-42.

Cross, I. (2001b). Music, Science and Post-Positivist Pluralities. *Intégral, 14/15*, 20-6.

Cross, I. (2003). Music and biocultural evolution. In M. Clayton, T. Herbert & R. Middleton (Eds.), *The Cultural Study of Music: A Critical Introduction* (pp. 19-30). London: Routledge.

Cross, I. (2005). Music and meaning, ambiguity and evolution. In D. E. Miell, D. J. Hargreaves & R. MacDonald (Eds.), *Musical Communication* (pp. 27-43). Oxford: Oxford University Press.

Cross, I. ((in press)). Music and Cognitive Evolution. In L. Barrett & R. Dunbar (Eds.), *OUP Handbook of Evolutionary Psychology*. Oxford: Oxford University.

Cross, I., & Morley, I. (2002). *Music and Evolution: the nature of the evidence.* Paper presented at the 7th International Conference on Music Perception and Cognition, Sydney.

Dahlhaus, C. (1979). Was heisst Improvisation? In R. Brinkmann (Ed.), *Improvisation und neue Musik: Acht Kongreßreferate* (pp. 42-54). Mainz: Schott.

Dahlhaus, C. (1982). *Esthetics of music* (W. W. Austin, Trans.). Cambridge: Cambridge University Press.

Dahlhaus, C. (1989). *The Idea of Absolute Music* (R. Lustig, Trans.). Chicago: University of Chicago Press.

Daly, A. (1988). Movement Analysis: Piecing Together the Puzzle. *TDR, 32*(4), 40-52.

Davidson, J. W. (2004). Bodily communication in musical performance. In D. E. Miell, D. J. Hargreaves & R. MacDonald (Eds.), *Musical Communication* (pp. 215-37). Oxford: Oxford University Press.

Davidson, J. W., & Good, J. M. (2002). Social and Musical Co-ordination Between Members of a String Quartet: An Exploratory Study. *Psychology of Music, 30*, 186-201.

Davidson, J. W., & Malloch, S. ((in press)). Expressive body movement in performance as communicative musicality. In C. Trevarthen & S. Malloch (Eds.), *Communicative Musicality*. Oxford: Oxford University Press.

Davies, S. (1994). *Musical Meaning and Expression*. Ithica and London: Cornell University Press.

Davies, S. (2001). Philosophy of music, §IV: Anglo-American philosophy of music, 1960–2000, 'Expressiveness'. In S. Sadie & J. Tyrrell (Eds.), *The New Grove Dictionary of Music and Musicians* (Vol. 19, pp. 622-3). London: Macmillan.

Dell, C. (1970). *A primer for movement description: Using effort-shape and supplementary concepts.* New York: Dance Notation Bureau.

Dennett, D. C., & Haugeland, J. C. (1987). Intentionality. In R. L. Gregory (Ed.), *The Oxford Companion to the Mindq*. Open University: Oxford Reference Online <HTTP://WWW.OXFORDREFERENCE.COM/VIEWS/ENTRY.HTML?SUBVIEW=MAIN&ENTRY=T159.E462> 21 February 2007.

DeNora, T. (1986). How is Extra-Musical Meaning Possible? Music as a Place and Space for "Work". *Sociological Theory, 4*(1), 84-94.

Dittrich, W. H. (1998). Review of Allen and Bekoff, "Species of Mind. The Philosophy and Biology of Cognitive Ethology". Colin Allen & Marc Bekoff. London: MIT Press (1997). *Animal Behaviour, 56*, 1305-7.

Downey, G. (2002). Listening to Capoeira: Phenomenology, embodiment, and the materiality of music. *Ethnomusicology, 46*(3), 487-509.

Dunteman, G. H. (1994). Principal Components Analysis. In M. S. Lewis-Beck (Ed.), *Factor Analysis and Related Techniques* (Vol. 5, pp. 157-245). London: Sage.

Dytham, C. (1999). *Choosing and Using Statistics: A Biologist's Guide*. Oxford: Blackwell Science.

Eibl-Eibesfeldt, I. (1972). Similarities and Differences Between Cultures in Expressive Movements. In R. A. Hinde (Ed.), *Nonverbal Communication* (pp. 297-311). Cambridge: Cambridge University Press.

Ekman, P., & Friesen, W. V. (1998). Constants across Culture in the Face and Emotions. In J. M. Jenkins, K. Oatley & N. L. Stein (Eds.), *Human Emotions: A reader* (pp. 63-72). Oxford: Blackwell.

Evans, V. (2003). *The Structure of Time: Language, Meaning, and Temporal Cognition*. Amsterdam: John Benjamins.

Exline, R., & Winters, L. C. (1965). Affective relations and mutual glances in dyads. In S. S. Tomkins & C. E. Izard (Eds.), *Affect, cognition and personality* (pp. 319-50). New York: Springer.

Fassnacht, G. (1982). *Theory and Practice of Observing Behaviour* (C. Bryant, Trans.). London: Academic Press.

Feld, S. (1974). Linguistic Models in Ethnomusicology. *Ethnomusicology, 18*(2), 197-217.

Feld, S. (1992). *Sound and sentiment: birds, weeping, poetics and song in Kaluli expression* (2nd ed.). Philadelphia: University of Pennsylvania Press.

Feld, S., & Fox, A. A. (1994). Music and Language. *Annual Review of Athropology, 23*, 25-53.

Feldhütter, I., Schleidt, M., & Eibl-Eibesfeldt, I. (1990). Moving in the beat of seconds: analysis of the time structure of human action. *Ethology and Sociobiology, 11*, 511-20.

Fernald, A. (1989). Intonation and communicative interest in mother's speech to infants: Is the melody the message? *Child Development, 6*, 1497-510.

Feyereisen, P. (1991). *Gestures and Speech: psychological investigations*. Cambridge/Paris: Cambridge University Press/Editions de La Maison des Sciences de l'Homme.

Fogel, A. (1993). *Developing Through Relationships: origins of communication, self and culture*. New York and London: Harvester Wheatsheaf.

Fraisse, P. (1982). Rhythm and Timing. In D. Deutsch (Ed.), *The Psychology of Music* (1st ed., pp. 149-80). New York: Academic Press.

Freeman, W. J. (2000). Emotion is Essential to All Intentional Behaviours. In M. D. Lewis & I. Granic (Eds.), *Emotion, Development, and Self-Organisation: dynamic systems approaches to emotional development* (pp. 209-35). Cambridge, UK: Cambridge University Press.

Freeman, W. J., & Núnez, R. (1999). Restoring to Cognition the Forgotten Primacy of Action, Intention and Emotion. *Journal of Consciousness Studies, 6*(11-12), ix-xix.

Freksa, C. (1991). Qualitative Spatial Reasoning. In D. M. Mark & A. U. Frank (Eds.), *Cognitive and Linguistic Aspects of Geographic Space* (pp. 361-72). Dordrecht and London: Kluwer Academic Publishers.

Frey, D., & Pimental, R. A. (1978). Principal Component Analysis and Factor Analysis. In P. Colgan (Ed.), *Quantitative Ethology* (pp. 219-45). New York: Wiley.

Garfinkel, H. (1967). *Studies in Ethnomethodology*.

Gerstner, G. E., & Fazio, V. A. (1995). Evidence of a universal perceptual unit in mammals. *Ethology, 101*, 89-100.

Gerstner, G. E., & Goldberg, L. J. (1994). Evidence of a time constant associated with movement patterns in six mammalian species. *Ethology and Sociobiology, 15*(4), 181-205.

Gibson, J. (1950). *The Perception of the Visual World.*

Glaser, B. G., & Strauss, A. L. (1967). *The discovery of grounded theory : strategies for qualitative research*. Hawthorne, New York: Aldine de Gruyter.

Goffman, E. (1974). *Frame Analysis: an essay on the organisation of experience*. Boston: Northeastern University Press.

Goffman, E. (2000). Footing (from Forms of Talk, Oxford, Blackwell, Chapter 3). In M. Wetherell, S. Taylor & S. J. Yates (Eds.), *Discourse Theory and Practice* (pp. 93-110). London: Sage.

Goodman, E. (2000). *Analysing the Ensemble in Music Rehearsal and Performance: The Nature and Effects of Interaction in Cello-Piano Duos.* Unpublished PhD, Royal Holloway, University of London, London.

Goodwin, C. (1981). *Conversational Organisation: Interaction between Speakers and Hearers*. California: Academic Press.

Goodwin, C., & Duranti, A. (Eds.). (1992). *Rethinking Context: Language as an Interactive Phenomenon* (Vol. 11). Cambridge: Cambridge University Press.

Griffin, D. R. (1976). *The question of animal awareness*. New York: The Rockefeller Press.

Harrigan, J. A., & Rosenthal, R. (1986). Nonverbal aspects of empathy and rapport in physician-patient interaction. In P. D. Blanck, R. Buck & R. Rosenthal (Eds.), *Nonverbal communication in the clinical context* (pp. 36-73). University Park: Pennsylvania State University Press.

Harwood, D. (1995). Responses to Keil, Prögler, Alén. *Ethnomusicology*, 74-7.

Heijden, A. H. C. v. d. (1998). Attention. In W. Bechtel & G. Graham (Eds.), *A Companion to Cognitive Science* (pp. 121-39). Malden, Mass and Oxford: Blackwell.

Heritage, J. C. (1987). Ethnomethodology. In A. Giddens & J. H. Turner (Eds.), *Social Theory Today* (pp. 224-72). Cambridge: Polity Press.

Heritage, J. C. (2001). Goffman, Garfinkel and Conversation Analysis. In M. Wetherell, S. Taylor & S. J. Yates (Eds.), *Discourse Theory and Practice: a reader*. London: Sage.

Hesmondhalgh, D. (2000). International Times: Fusions, Exoticism, and Antiracism in Electronic Dance Music. In G. Born & D. Hesmondhalgh (Eds.), *Western Music and its Others* (pp. 281-304). Berkeley, California: University of California Press.

Heyes, C., & Dickinson, A. (1990). The intentionality of animal action. *Mind Language, 5*, 87-104.

Himberg, T. (2006). *Co-operative Tapping and Collective Time-keeping: Differences of timing accuracy in duet performance with human or computer partner.* Paper presented at the ICMPC 9, Bologna, Italy.

Hinde, R. A. (1979). *Towards Understanding Relationships*. London: Academic Press for the European Association of Experimental Social Psychology.

Hinde, R. A. (1982). *Ethology: Its Nature and Relations with Other Sciences*. New York & Oxford: Oxford University Press.

Hood, M. (1971). *The ethnomusicologist*. New York: McGraw Hill Book Co.

Hoopes, J. (Ed.). (1991). *Peirce on signs : writings on semiotic*. Chapel Hill: University of North Carolina Press.

Hutt, S. J., & Hutt, C. (1978). Heart-rate variability: the adaptive consequences of individual differences and state changes. In V. Reynolds & N. Blurton-Jones (Eds.), *Human Behaviour and Adaptation* (pp. 171-89). London: Talyor and Francis.

Hymes, D. H., & Gumpertz, J. J. (1964). The Ethnography of Communication. *American Anthropologist - Special Issue, 66*(6), Part 2.

Jairazbhoy, N. A. (1982). Review: The Life of Music in North India: The Organisation of an Artistic Tradition (Neuman). *The Journal of Asian Studies, 42*(1), 194-5.

James, W. (1890). *Principles of Psychology*.

Janata, P., & Grafton, S. T. (2003). Swinging in the brain: shared neural substrates for behaviors related to sequencing and music. *Nature Neuroscience, 6*(7), 682-7.

Johnson, M. (2005). The philosophical significance of image schemas. In B. Hampe & J. E. Grady (Eds.), *From Perception to Meaning: Image Schemas in Cognitive Linguistics*. Berlin: Mouton de Gruyter.

Keil, C. (1995a). Forum Comments: Participation Si! Alienation No! *The Journal of American Folklore, 108*(429), 316-9.

Keil, C. (1995b). Participatory Discrepancies. *Ethnomusicology, Special Edition*, p.1: "Music is about process, not product[…] it's not about composers bringing forms from on high for mere mortals to realize or approximate, it's about getting down and into the groove, everyone creating socially from the bottom up".

Keil, C., & Feld, S. (1994). *Music Grooves: essays and dialogues*. Chicago: University of Chicago Press.

Keltner, D., & Gross, J. J. (1999). Functional Accounts of Emotions. *Cognition and Emotion, 13*(5), 467-80.

Kendon, A. (1981a). Some functions of the face in a kissing round. In A. Kendon (Ed.), *Nonverbal communication, interaction, and gesture: selections from Semiotica (Vol. 41)* (pp. 321-55). The Hague: Mouton.

Kendon, A. (1990). *Conducting Interaction: Patterns of behaviour in focused encounters* (Vol. 7). Cambridge: Cambridge University Press.

Kendon, A. (2004). *Gesture: visible action as utterance*. Cambridge: Cambridge University Press.

Kendon, A. (Ed.). (1981b). *Nonverbal communication, interaction, and gesture: selections from Semiotica* (Vol. 41). The Hague: Mouton.

Kim, J.-O., & Mueller, C. W. (1994a). Factor Analysis: Statistical Methods and Practical Issues. In M. S. Lewis-Beck (Ed.), *Factor Analysis and Related Techniques* (Vol. 5, pp. 75-155). London: Sage.

Kim, J.-O., & Mueller, C. W. (1994b). Introduction to Factor Analysis: What It Is and How to Do It. In M. S. Lewis-Beck (Ed.), *Factor Analysis and Related Techniques* (pp. 1-73). London: Sage.

King, E. (2006). The roles of student musicians in quartet rehearsals. *Psychology of Music, 34*(2), 262-82.

Kivy, P. (1989). *Sound Sentiment: an essay on the musical emotions*. Philadelphia: Temple University Press.

Kramer, L. (1993). *Music as Cultural Practice*. California: University of California Press.

Kramer, L. (2002). *Musical Meaning: Toward a Critical History*. California: University of California Press.

Kress, G. (2001). From Saussure to Critical Sociolinguistics: The Turn Towards a Social View of Language. In M. Wetherell, S. Taylor & S. J. Yates (Eds.), *Discourse Theory and Practice: a reader*. London: Sage.

Kubik, G. (1987). Malawian Music: a Framework for Analysis. In M. Strumpf (Ed.). Zomba: Department of Fine and Performing Arts.

Kubik, G. (2000). Interconnectedness in Ethnomusicology. *Ethnomusicology, 44*(1), 1-14.

Lakoff, G. (1987). *Women, Fire and Dangerous Things: What Categories Reveal about the Mind*. London: University of Chicago Press.

Lakoff, G., & Johnson, M. (1999). *Philosophy in the Flesh: The embodied mind and its challenge to Western thought*. New York: Basic Books.

Langer, S. (1942). *Philosophy in a New Key*. Cambridge, Mass: Harvard University Press.

Large, E. W., & Jones, M. R. (1999). The dynamics of attending: How people track time-varying events. *Psychological Review, 106*(1), 119-59.

Lazarus, R. S. (1991). *Emotion and adaptation*. New York, Oxford: Oxford University Press.

Leeuwen, C. v. (1998). Perception. In W. Bechtel & G. Graham (Eds.), *A Companion to Cognitive Science* (pp. 265-81). Malden, Mass and Oxford: Blackwell.

Lemke, M. R., Koethe, N. H., & Schleidt, M. (1999). Timing of movements in depressed patients and healthy controls. *Journal of Affective Disorders, 56*, 209-14.

Lerdahl, F., & Jackendoff, R. (1983). *A generative theory of tonal music*. Cambridge, Mass: MIT Press.

Levenson, R. W. (1994). Human Emotions: A Functional View. In P. Ekman & R. J. Davidson (Eds.), *The Nature of Emotion: Fundamental Questions* (pp. 123-6). New York: Oxford University Press.

Lewis, G. E. (1996). Improvised music after 1950: Afrological and Eurological Perspectives. *Black Music Research Journal, 16*(1), 91-122.

Lewis, J. L. (1995). Genre and Embodiment - from Brazilian Capoeira to the Ethnology of Human Movement. *Cultural Anthropology, 10*(2), 221-43.

Lewis, M. D., & Todd, R. M. (2005). Getting emotional: A neural perspective on emotion, intentionality and consciousness. *Journal of Consciousness Studies, 12*(8-10), 210-35.

Lidov, D. (1999). *Elements of Semiotics*. New York: St Martin's Press.

Locke, J. L. (1993). *The Child's Path to Spoken Language*. Cambridge, Mass: Harvard University Press.

London, J. (2001). Rhythm, '2. Perception of duration and succession'. In S. Sadie & J. Tyrrell (Eds.), *The New Grove Dictionary of Music and Musicians* (2nd ed., Vol. 21, pp. 279). London: Macmillan.

London, J. (2004). *Hearing in Time: psychological aspects of musical meter*. New York: Oxford University Press.

Longuet-Higgins, H. C. (1978). The perception of music. *Interdisciplinary Science Review, 3*, 148-56.

Losely, G. S. (1978). Information Theory and Communication. In P. Colgan (Ed.), *Quantitative Ethology* (pp. 43-78). New York: John Wiley & Sons.

Luck, G. (2002). Conductors' Gestures: Perception of, and Synchronisation with, Visual Beats. In C. Stevens, D. Burnham, G. McPherson, E. Schubert & J. Renwick (Eds.), *Proceedings of the 7th International Conference on Music Perception and Cognition, Sydney, 2002.* (pp. 638). Adelaide: Causal Productions.

MacKay, D. M. (1972). Formal analysis of communicative process. In R. A. Hinde (Ed.), *Non-verbal Communication* (pp. 3-25). Cambridge: Cambridge University Press.

Malinowski, B. (1974). *Magic, science, and religion, and other essays*. London: Souvenir Press.

Malloch, S. (2002). Musicality: The art of human gesture. In C. Stevens, D. Burnham, G. McPherson, E. Schubert & J. Renwick (Eds.), *Proceedings of the 7th International Conference on Music Perception and Cognition, Sydney, 2002.* (pp. 143-6). Adelaide: Causal Productions.

Martin, P., & Bateson, P. (1993). *Measuring Behaviour: an introductory guide* (2nd ed.). Cambridge: Cambridge University Press.

Mason, G. J. (1991). Stereotypies: a critical review. *Animal Behaviour, 41*, 1015-37.

McClary, S., & Walser, R. (1994). Theorizing the Body in African-American Music. *Black Music Research Journal, 14*(1), 75-84.

McDermott, R. P., & Roth, D. (1978). The Social Organisation of Behaviour: Interactional Approaches. *Annual Review of Anthropology, 7*, 321-45.

McMullen, E., & Saffran, J. R. (2004). Music and Language: A Developmental Comparison. *Music Perception, 21*(3), 289-311.

McNeill, D. (1992). *Hand and Mind: What Gestures Reveal about Thought.* Chicago and London: University of Chicago press.

McNeill, D. (2000). *Language and Gesture.* Cambridge: Cambridge University Press.

McNeill, D., & Levy, E. T. (1993). Cohesion and Gesture. *Discourse Processes, 16*(93), 363-86.

Meltzoff, A. N. (2005). Imitation and Other Minds: The "Like Me" Hypothesis. In S. Hurley & N. Chater (Eds.), *Perspective on Imitation: From Neuroscience to Social Science* (Vol. 2, pp. 55-77). Cambridge, Mass: MIT Press.

Merleau-Ponty, M. (1964). *The Primacy of Perception* (W. Cobb, Trans.). Evanston, Illinois: Northwestern University Press.

Merriam, A. P. (1964). *The Anthropology of Music.* Illinois: Northwestern University Press.

Meyer, L. (1956). *Emotion and Meaning in Music*. London: University of Chicago Press.

Mitchell, R. W., & Gallaher, M. C. (2001). Embodying Music: Matching Music and Dance in Memory. *Music Perception, 19*(1), 65-85.

Mithen, S. (2005). *Singing Neanderthals: The Origins of Music, Language, Mind and Body*. London: Weidenfeld and Nicolson.

Monk, A. F., & Gale, C. (2002). A look is worth a thousand words: full gaze awareness in video-mediated conversation. *Discourse Processes, 33*(3), 257-78.

Monson, I. (1995). Responses to Keil, Prögler, Alén. *Ethnomusicology, 39*(1), 87-9.

Monson, I. (1996). *Saying Something: Jazz Improvisation and Interaction*. Chicago: University of Chicago Press.

Myers, H. (1992). Field Technology. In H. Myers (Ed.), *Ethnomusiocology: An Introduction* (Vol. 1, pp. 50-87). London and Houndmills, Basingstoke: Macmillan Press.

Nattiez, J.-J. (1990). *Music and Discourse: Towards a semiology of music* (C. Abbate, Trans.). Princeton: Princeton University Press.

Neuman, D. M. (1980). *The life of music in North India*. Chicago: University of Chicago Press.

Newell, A., Rosenbloom, P. S., & Laird, J. E. (1989). Symbolic Architectures for Cognition. In M. I. Posner (Ed.), *Foundations of Cognitive Science* (pp. 93-131). Cambridge, Mass: MIT Press.

Newtson, D. (1994). The perception and coupling of behaviour waves. In R. R. Vallacher & A. Nowak (Eds.), *Dynamical Systems in Social Psychology* (pp. 139-67). San Diego: Academic Press.

Newtson, D., Enquist, G., & Bois, J. (1977). The objective basis of behaviour units. *Journal of Personality and Social Psychology, 35*, 847-62.

Newtson, D., Hairfield, J., Bloomingdale, J., & Cutino, S. (1987). The structure of action and interaction. *Social Cognition, 5*, 191-237.

Oatley, K., & Johnson-Laird, P. N. (1998). The Communicative Theory of Emotion. In J. M. Jenkins, K. Oatley & N. L. Stein (Eds.), *Human Emotions: A reader* (pp. 84-97). Oxford: Blackwell.

Owings, D. H., & Morton, E. S. (1998). *Animal Vocal Communication: a new approach*. Cambridge: Cambridge University Press.

Pike, K. L. (1967). *Language in Relation to a Unified Theory of the Structure of Human Behavior*. The Hague: Mouton.

Pinker, S. (1994). *The Language Instinct: how the mind creates language*. New York: William Morrow and Company.

Pöppel, E. (1978). Time perception. In R. Held, H. W. Leibowitz & H. L. Teuber (Eds.), *Handbook of Sensory Physiology* (Vol. VIII, pp. 713-29). Heidelberg: Springer-Verl.

Pöppel, E. (1989). The measurement of time and the cerebral clock: a new theory. *Leonardo, 22*(1), 83-9.

Pöppel, E., & Wittmann, M. (1999). Time in the mind. In *MIT Encyclopedia of the Cognitive Sciences*. Cambridge, Mass.: MIT Press.

Qureshi, R. B. (1986). *Sufi Music of India and Pakistan: Sound, context and Meaning in Qawwali*. Cambridge: Cambridge University Press.

Qureshi, R. B. (1987). Musical Sound and Contextual Input: A Performance Model for Musical Analysis. *Ethnomusicology, 31*(1), 56-86.

Qureshi, R. B. (1994). Exploring Time Cross-Culturally: Ideology and Performance of Time in the Sufi Qawwali. *The Journal of Musicology, XII*(4), pp.491-528.

Reddy, V., Hay, D., Murray, L., & Trevarthen, C. (1997). Communication in Infancy: Mutual Regulation of Affect and Attention. In G. Bremner, A. Slater & G. Butterworth (Eds.), *Infant Development : Recent Advances*. Hove, East Sussex: Psychology Press.

Repp, B. H. (2006). Rate Limits of Sensorimotor Synchronization. *Advances in Cognitive Psychology, 2*(2-3), 163-81.

Reybrouck, M. (2005). Body, mind and music: musical semantics between experiential cognition and cognitive economy. *Transcultural Music Review, 9.*

Rice, T. (1994). *May It Fill Your Soul: Experiencing Bulgarian Music*. Chicago: University of Chicago Press.

Richardson, D. C., & Dale, R. (2005). Looking to Understand: The Coupling Between Speakers' and Listeners' Eye Movements and Its Relationship to Discourse Comprehension. *Cognitive Science, 29*, 1045-60.

Richardson, D. C., Dale, R., & Kirkham, N. Z. (in press). The art of conversation is coordination: common ground and the coupling of eye movements during dialogue. *Psychological Science*.

Richardson, M. J., Marsh, K. L., & Schmidt, R. C. (2005). Effects of Visual and Verbal Interaction on Unintentional Interpersonal Coordination. *Journal of Experimental Psychology - Human Perception and Performance, 31*(1), 62-79.

Rimé, B., & Schiatura, L. (1991). Gesture and Speech. In R. S. Feldman & B. Rimé (Eds.), *Fundamentals of nonverbal behavior* (pp. 239-81). New York: Cambridge University Press.

Ristau, C. A. (1991). Cognitive Ethology: an overview. In C. A. Ristau (Ed.), *Cognitive ethology: the minds of other animals. Essays in honor of Donald Griffin* (pp. 291-313). New Jersey: Lawrence Erlbaum Associates.

Rogoff, B. (1990). *Apprenticeship in Thinking: cognitive development in social context*. New York: Oxford University Press.

Rohrer, T. (2006). Embodiment and Experientialism. In D. Geeraerts & H. Cuyckens (Eds.), *The Handbook of Cognitive Linguistics*. Oxford: Oxford University Press.

Rosch, E. H. (1973). Natural categories. *Cognitive Psychology, 4*, 328 - 50.

Sacks, H., & Schegloff, E. (2002). Home position. *Gesture*(2), 133-46.

Sapir, E. (1977). *Edward Sapir monograph series in language, culture, and cognition* (Vol. Supplement). Lake Bluff, Illinois: Jupiter Press.

Scheflen, A. E. (1963). Communication and regulation in psychotherapy. *Psychiatry, 26*(2), 126-36.

Scheflen, A. E. (1964). The significance of posture in communication systems. *Psychiatry*(27), 316-21.

Scherer, K. R. (1985). Emotions can be Rational. *Social Science Information, 24*, 331-5.

Schleidt, M. (1988). A universal time constant operating in human short-term behaviour repetitions. *Ethology, 77*, 67-75.

Schleidt, M., Pöppel, E., & Eibl-Eibesfeldt, I. (1987). A universal constant in temporal segmentation of human short-term behaviour. *Naturwissenschaften, 74*, 289-90.

Schober, M. F., & Brennan, S. (2003). Processes of interactive spoken discourse: the role of the partner. In A. C. Graesser, M. A. Gernsbacher & S. Goldman (Eds.), *Handbook of Discourse Processes* (pp. 123-64). New Jersey: Lawrence Erlbaum Associates.

Seashore, C. E. (1967 (1938)). *The Psychology of Music*: Dover Publications.

Seeger, C. (1958). Prescriptive and Descriptive Music-Writing. *The Musical Quarterly, 44*(2), 184-95.

Shepherd, J. (1995). Responses to Keil, Prögler, Alén. *Ethnomusicology, 39*(1), 89-90.

Slater, P. J. B. (1983). The Study of Communication. In T. R. Halliday & P. J. B. Slater (Eds.), *Animal Behaviour: Communication* (Vol. 2, pp. 9-42). Oxford: Blackwell.

Sloboda, J. (1988). *Generative Processes in Music: The Psychology of Performance, Improvisation and Cognition.* New York: Oxford University Press.

Small, C. (1998). *Musicking: the meanings of performing and listening*: Wesleyan University Press.

Smith, L. B. (2006). Movement Matters: the contributions of Esther Thelen. *Biological Theory, 1*(1), 87-9.

Snarrenberg, R. (2001). Article on Heinrich Schenker. In S. Sadie & J. Tyrrell (Eds.), *The New Grove Dictionary of Music and Musicians* (Vol. 22, pp. 479). London: Macmillan.

Soanes, C., & Stevenson, A. (2004). *The Concise Oxford English Dictionary*. Retrieved 26 October, 2006, from Open University, HTTP://WWW.OXFORDREFERENCE.COM/VIEWS/ENTRY.HTML?SUBVIEW=MAIN&ENTRY=T23.E11301

Soltis, J. (2004). The signal functions of early infant crying. *Behavioural and Brain Sciences, 27*(4), 443-90.

Sommer, R., & Sommer, B. (2002). *A Practical Guide to Behavioural Research: tools and techniques* (5th ed.). Oxford: Oxford University Press.

Soussignan, R., & Koch, P. (1985). Rhythmical stereotypies (leg-swinging) associated with reductions in heart rate in normal school children. *Biological Psychology, 21*, 161.

Stern, D. N. (1993). *The interpersonal world of the infant: A view from psycholanalysis and developmental psychology*. New York: Basic Books.

Stevens, C., Malloch, S., McKechnie, S., & Steven, N. (2003). Choreographic cognition: the time-course and phenomenology of creating a dance. *Pragmatics & Cognition, 11*(2), 197-326.

Stobart, H., & Cross, I. (2000). The Andean Anacrusis? rhythmic structure and perception in Easter songs of Northern Potosí, Bolivia. *British Journal of Ethnmusicology, 9*(2), 63-94.

Stone, R. (1982). *Let the inside be sweet: The interpretation of music event among the Kpelle of Liberia*. Indiana: Indiana University Press.

Strauss, A. L., & Corbin, J. (1997). *Grounded Theory in Practice*. Thousand Oaks, CA: Sage.

Strauss, A. L., & Corbin, J. M. (1990). *Basics of qualitative research: Techniques and procedures for developing grounded theory* (1st ed.).

Sturman, J. (1997). Movement analysis as a tool for understanding identity: Retentions, borrowings, and transformations in Native American waila (With schematic definitions of "waila" and Mexican American "norteño" music). *World of Music, 39*(3), 51-69.

Subotnik, R. R. (1987). On Grounding Chopin. In R. Leppert & S. McClary (Eds.), *Music and Society*.

Thelen, E. (1979). Rhythmical stereotypies in normal human infants. *Animal Behaviour, 27*, 699-715.

Tickle-Degnen, L., & Rosenthal, R. (1990). The Nature of Rapport and Its Nonverbal Correlates. *Psychological Inquiry, 1*(4), 285-93.

Tolbert, E. (2003). Theorizing the Musically Abject. In C. Washburne & M. Derno (Eds.), *Bad Music*: Routledge.

Tomasello, M., Carpenter, M., Cal, J., Behne, T., & Moll, H. (2005). Understanding and sharing intentions: the origins of cultural cognition. *Behavioural and Brain Sciences, 28*(5), 675-91.

Tomasello, M., Kruger, A., & Ratner, H. (1993). Cultural learning. *Behavioral and Brain Sciences, 16*, 495-552.

Tomkins, S. S. (1980). Affect as Amplifications: Some Modifications in Theory. In R. Plutchik & H. Kellerman (Eds.), *Emotion: theory, research and experience* (pp. 141-64). New York and London: Academic Press.

Trevarthen, C. (1979). Communication and Co-operation in Early Infancy: a description of primary intersubjectivity. In M. Bullowa (Ed.), *Before Speech: the beginning of interpersonal communication*. Cambridge: Cambridge University Press.

Trevarthen, C. (1982). The primary motives for co-operative understanding. In G. Butterworth & P. Light (Eds.), *Social Cognition: Studies of the Development of Understanding* (pp. 77-109). Brighton: Harvester Press.

Trevarthen, C. (1986). Development of intersubjective motor control in infants. In M. G. Wade & H. t. A. Whiting (Eds.), *Motor development in children: Aspects of coordination and control* (pp. 209-61). Dordrecht: Martinus Nijhof.

Trevarthen, C., & Aitken, K. J. (2001). Infant Intersubjectivity: Research, Theory, and Clinical Applications. *Journal of Child Psychology and Psychiatry, 42*(1), 3-48.

Tronick, E. Z., Als, H., Adamson, L., Wise, S., & Brazelton, T. B. (1978). The infant's response to entrapment between contradictory messages in face-to-face interaction. *Journal of the American Academy of Child Psychiatry, 17*, 1-13.

Tuite, K. (1993). The production of gesture. *Semiotica, 93*(1;2), 83-105.

Turner, V. (1969). *The Ritual Process: Structure and Anti-Structure*. London: Routledge and Kegan Paul.

van Gennep, A. (1909 (1961)). *Les rites de passage (The Rites of Passage)* (M. B. Vizedon & G. L. Caffee, Trans.). Chicago: University Of Chicago Press.

Wallin, N. L. (1991a). *Biomusicology: Neurophysiological, Neuropsychoogical and Evolutionary Perspectives on the Origins and Purposes of Music*. Stuyvesant, NY: Pendragon Press.

Wallin, N. L. (1991b). The Epistemological Impact of Musical Notation. In *Biomusicology: Neurophysiological, Neuropsychological and Evolutionary Perspectives on the Origins of Music*. Stuyvesant, NY: Pendragon Press.

Wanderley, M. M. (1999). Non-obvious performer gestures in instrumental music. In *Gesture-Based Communication in Human-Computer Interaction* (Vol. 1739, pp. 37-48).

Wang, T. S., Shum, H. Y., Xu, Y. Q., & Zheng, N. N. (2001). Unsupervised analysis of human gestures. In *Advances in Mutlimedia Information Processing - Pcm 2001, Proceedings* (Vol. 2195, pp. 174-81).

Waterman, C. A. (1990). *Juju: a social history and ethnography of an African popular music*. Chicago: University of Chicago Press.

Watzlawick, P., Bavelas, J. B., & Jackson, D. D. (1967). *Pragmatics of Human Communication: A Study of Interactional Patterns, Pathologies, and Paradoxes*. New York: Norton.

Weiner, N. (1965 (1948)). *Cybernetics: Or Control and Communication in the Animal and the Machine* (2nd ed.). Cambridge, Mass: MIT Press.

Wetherell, M., Taylor, S., & Yates, S. J. (Eds.). (2001). *Discourse Theory and Practice: a reader*. London: Sage.

Wierzbicka, A. (1999). *Emotions across languages and cultures: diversity and universals*. Cambridge, UK: Cambridge University Press.

Williamon, A., & Davidson, J. W. (2002). Exploring co-performer communication. *Musicae Scientiae, 6*(1), 53-72.

Wylie, L. (1985). Language Learning and Communication. *The French Review, 58*(6), 777-85.

Zbikowski, L. M. (2004). Modelling the Groove: Conceptual Structure and Popular Music. *Journal of the Royal Musical Association, 129*(2), 272-97.