

Entrainment and joint action in music performance

Martin Clayton, Durham University @ CMPCP, 17th July 2014



Outline

- ▶ Introduce 'Joint action'
- ▶ Introduce one aspect of joint action – Entrainment – and its application to music performance
- ▶ Show how ethnographic enquiry complements this approach
- ▶ Examples are taken from our work in India and Brazil



Joint action

- ▶ Joint action is a current research topic in cognitive sciences
- ▶ It concerns the shared and socially-situated nature of thinking
- ▶ “joint action can be regarded as any form of social interaction whereby two or more individuals coordinate their actions in space and time to bring about a change in the environment”
(Sebanz, Bekkering and Knoblich 2006: 70)



Joint action



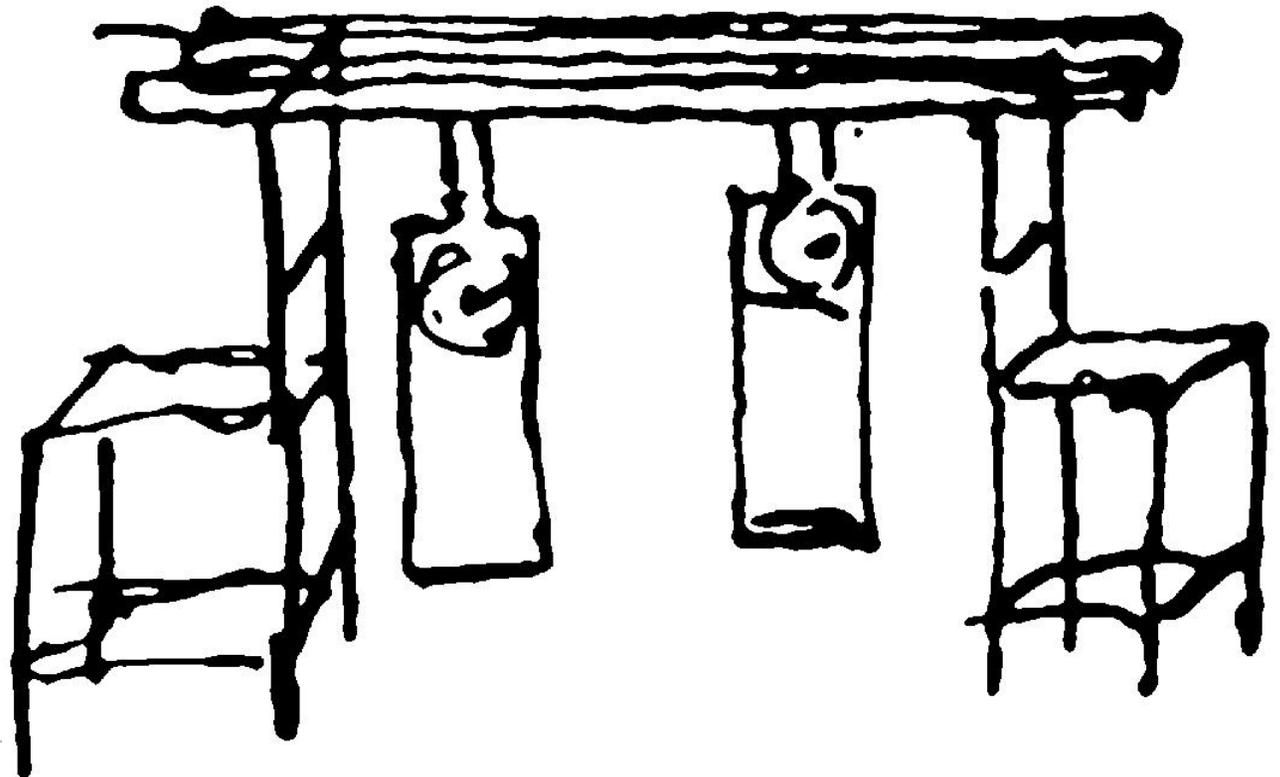
Joint action in music

- ▶ Music performance is an ideal laboratory for studies of joint action
 - ▶ In Keller's (2008) application of joint action theory to music performance, three cognitive processes are involved:
 - ▶ **Auditory imagery** (imagining one's own and others' upcoming sounds)
 - ▶ **Dividing attention** between one's own and others' performance, while monitoring overall ensemble sound ('prioritized integrative attention')
 - ▶ **Adaptive timing** (adjusting timing to maintain synchrony with others)
- Entrainment
-



Entrainment

- ▶ Entrainment (synchronisation) theory describes how rhythmical systems interact
- ▶ Entrainment requires at least 2 independent rhythmic systems connected by a coupling force
- ▶ The classic example:
Huygens' clocks



Entrainment

- ▶ Other (biological) examples:
 - ▶ Synchronised fireflies;
 - ▶ Night/day \leftrightarrow sleep/wake cycles;
 - ▶ Musicians playing in time together
- ▶ Are the dynamics of a group of musicians synchronising the same as those of clocks or fireflies?



Video example 1: Veena Sahasrabuddhe

Shree Rag



Recorded Mumbai, 9th April 2003



Tanpuras: a performer's view

Plucking should be such as not to produce pronounced attack. The complete cycle takes 2 to 2½ seconds. An even volume is heard all through the cycle when the tanpura is plucked well. Beginners often unconsciously adjust the plucking rate to tempi of singing — they have to be told to break the connection. Tanpura should be plucked at an even rate not connected with singing

Veena Sahasrabuddhe, pers. comm., 12 Sept 2004



Unintended entrainment

- ▶ This study demonstrated the occurrence of *unintended* entrainment between players of the tanpura
- ▶ Entrainment between tanpura players depends on visual attention and on periods close to an integer ratio
- ▶ This entrainment included synchronisation in a 2:3 ratio (periods of 2 secs and 3 secs)
- ▶ A study of the hand/finger-tapping movements quantified the degree of synchrony (mean vector length $r = 0.67$)
 - ▶ Clayton, M. 'Observing entrainment in music performance: video-based observational analysis of Indian musicians' tanpura playing and beat marking'. *Musicae Scientiae* 11/1 (2007), pp.27-60.



Inter-group entrainment: Congado



Collaboration with Glaura Lucas and Laura Leante

- ▶ This study examined unintended entrainment between groups taking part in the Congado ritual in Minas Gerais, Brazil
- ▶ Groups representing different communities gathered to celebrate the anniversary of the abolition of slavery

Inter-group entrainment

- ▶ Depending on the context, groups either (a) entrain in-phase, (b) entrain out-of-phase, or (c) don't entrain
- ▶ The determining factors: (a) visual attention and (b) similarity of starting tempo (the closer the tempi, the more likely they are to entrain)
- ▶ Entrainment and its avoidance are directly linked to the meaning of the ritual
 - ▶ Lucas, G., M. Clayton and L. Leante, 2011. 'Inter-group entrainment in Afro-Brazilian Congado ritual' *Empirical Musicology Review*, 6(2): 75-102



A performer's perspective...

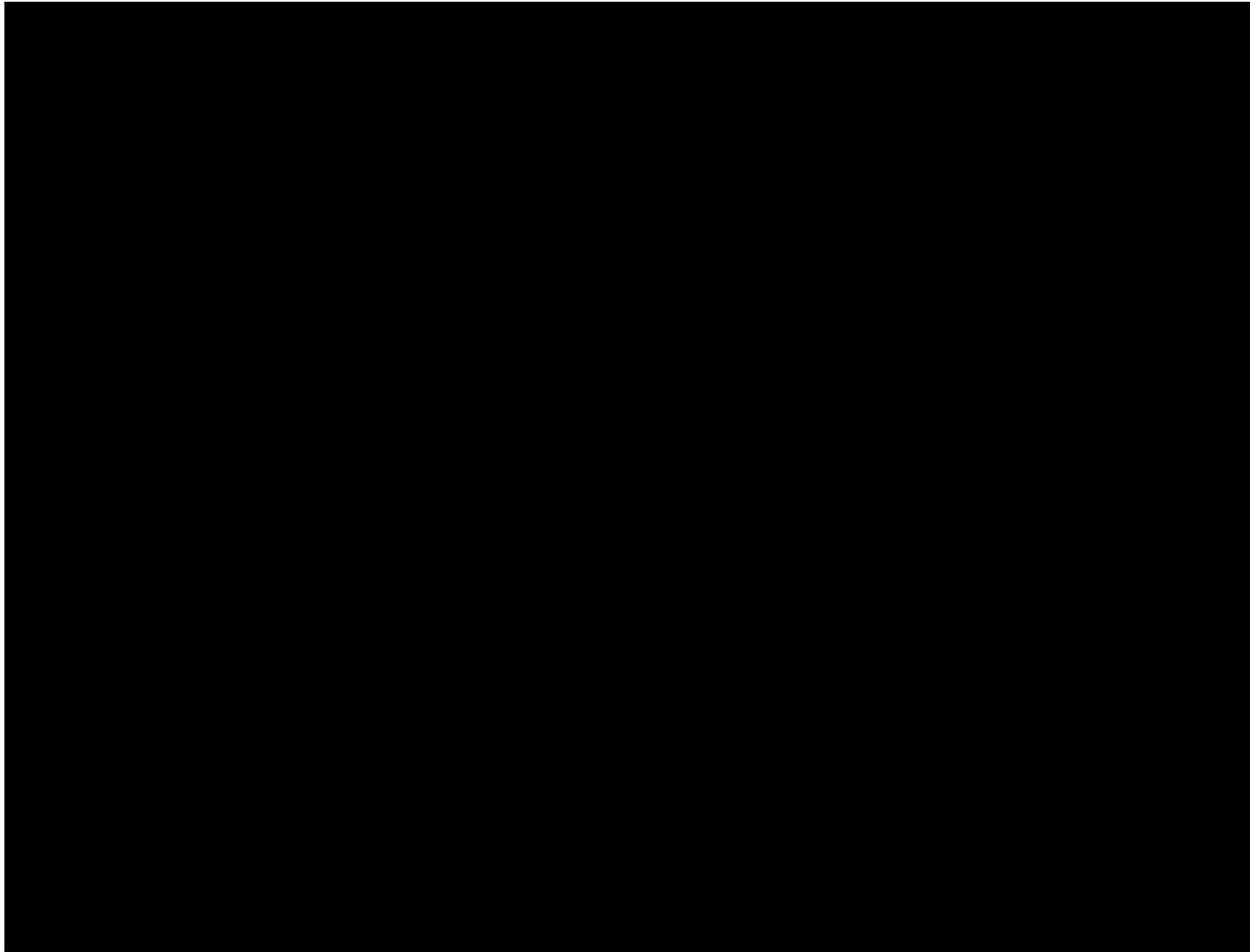
... what I perceive is the need to keep apart. And if the people who are playing, the drummers, are not paying much attention, each one with its own rhythm, then they might come together. But, as I said, each group needs to preserve what belongs to them, and this is what makes it beautiful...

Quim, Arturos captain (interview with Glaura Lucas 20 Oct 2007)



Video example 2: Two groups meet

Arturos Congo (pink) with Jardim Industrial Congo (blue)



Entrainment in this encounter

- ▶ In this instance, the groups entrain 223° out of phase
- ▶ The two groups are highly synchronised, with drum strokes other than the main downbeat aligning (2nd stroke of one group with 3rd stroke of the other group)
- ▶ The groups experienced this as *not* playing in time with each other



Summary: Entrainment

- ▶ Entrainment is ubiquitous in musical performance
- ▶ Entrainment occurs spontaneously and unintentionally
- ▶ Performers often intend to entrain *in particular ways*
- ▶ ...and the way they entrain can be described in terms of (i) strength of coupling and (ii) relative phase
- ▶ They can also intend *not to entrain*



Summary: Entrainment, joint action, ethnography

- ▶ Entrainment theory helps us to understand interpersonal coordination and joint action
- ▶ People's *intentions* can affect the dynamics of coordination
- ▶ Ethnography is essential to understand what those intentions are
- ▶ Coordination in musical joint action can only be fully understood through a combination of ethnography and empirical analysis





thanks to:

**Laure Leante, Simone Tarsitani, Nikki Moran, Tarun Kumar Nayak,
Manjiri Asanare Kelkar, Sanjay Mukherjee, Shankar Ghosh,
Ranjani Ramachandran, Surashree Ulhas Joshi, Vishwanath Shirodkar,
Seema Shirodkar, Ram Deshpande, and Veena Sahasrabuddhe**

martin.clayton@durham.ac.uk