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## JOINT IMPROVISATION IN THE ARTS PRACTICES:

### ENTRAINMENT, ENGAGEMENT, AND EXPERT SKILL

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#### **INTRODUCTION**

To improvise together for the pure curiosity, joy, and beauty of it constitutes a central but often neglected ability of human beings. Integrating pragmatic, practical, and technical skills with conceptual understanding, improvisation is adaptive and collaborative (Sawyer 2004). It seems made to counter the challenges of living in a fleeting present, unconstrained by physical and historical boundaries, and very likely has deep evolutionary roots.

As part of a larger, joint project of providing an integral theoretical framework of improvisation, I will present an account of joint improvisation in the performative arts based in reviews of empirical research in the cognitive sciences, phenomenology, neuroscience, and philosophy, using examples from modern dance and jazz music. The account may be used for generating cross-disciplinary hypotheses about improvisation for investigation within a multitude of fields and is meant to encourage interdisciplinary work and collaboration between practitioners and academic researchers. The major goal is to elucidate the interaction dynamics that underlies joint improvisation by considering the variety of processes that support sensorimotor, experiential, emotional, meta-cognitive, and collaborative forms of interaction and lead to the coordination and synchronization of behavior (Brinck and Liljenfors 2013; Musa, Carré and Cornejo 2015; Richardson et al. 2015).

Improvisation is an intelligent cognitive skill associated with meta-awareness and open to monitoring and control that involves both automatized and flexible behavior and can occur without conscious awareness. Improvising in principle is independent of verbal language and

higher-order thought, but nevertheless profits from the presence of multiple converging processes. Causation is bi-directional and dynamic, or non-linear, and propagates along two interconnected axes: vertically, between simultaneous processes that differ in kind and complexity, and horizontally, between the successive parts or fragments of processes that unfold in real time.

In the present framework, that improvisation is cognitive means that it is embodied and embedded (see e.g. Barker 1968; Beer 2004 and 2014; Clark 1997; Haugeland 1998; Kirsh 1995; Varela, Thompson and Rosch 1991). Embodiment implies that cognition is functionally and constitutively dependent on implicit sensorimotor processes and bodily experiences. Embeddedness implies that cognition is socio-culturally situated in physical contexts populated by a manifold of material, conceptual, and narrative artefacts that essentially influence the ways in which cognition works and what it concerns. Accordingly, understanding persons as living and feeling human beings requires considering behavior in the context of concrete activities, “emerging from the manifold of self-organizing interactions between embodied brain and environment across multiple space-time scales” (Schmidt et al. 2014). Meaning-making is pragmatic and occurs between agents who are socially present to each other (Gill 2012). There is no strict distinction between individual and social cognition: Social interaction is fundamental to cognition.

## **WHAT IS JOINT IMPROVISATION?**

Looking into the concept of improvisation and what it means to practitioners allows for identifying the core properties of joint improvisation in the context of the arts practices. Identifying these properties is important from a methodological perspective because they constitute adequacy conditions for the theory of joint improvisation, i.e., any account that

aims for completeness will have to explain them. The idea is to have the core properties guide the present investigation in a certain direction.

To begin, everyday improvisation is ubiquitous. It occurs in many of the rituals of daily life including verbal conversation, and is set to maintain status quo and compensate for ambiguity or error. It is a device for repair rather than invention. For instance, cooking calls for improvisation when you realize you have forgotten to buy the main ingredient for tonight's dinner party and the guests are arriving. Often it involves automatized behavior patterns that are tied to a certain social and material context and are activated when the regular course of action is impeded (Pentland and Hærem 2015), e.g. when there is a traffic jam along the way you drive to work and you need to take another route.

In the arts, improvisation is related to transformative power and expected to, if not revolutionize, at least alter the ways in which we make sense of ourselves, each other, and the world. In joint improvisation, the participants engage in multiple, multi-modal, reciprocal, and open-ended interactions in real time "without a script or designated leader" (Noy et al. 2011) and "without anticipated preparation" (Gueugnon et al. 2016). Contrary to other kinds of joint action, improvisation repudiates detailed plans and rarely has precise goals or a well-defined end-state. It aims for continuous development, novelty, and surprise, which necessitates massive background knowledge and takes effort and control.

Performers' testimonies provide important insights into the nature of improvisation. Thus Gustavsen (2010: 18f), researcher, pianist, and composer, reports that the task of jazz improvisation is to bring "fresh curiosity to the situation, while hanging on to familiarity and intimacy with the musical landscape", and declares that when improvisation is flowing, these oppositions are "constantly enriching each other in a dynamic movement". Santi and Illetirati (2010: 3) assert that improvisation lies in the paradox of repeating the past (technique) and

creating a present (spontaneity): “[W]e have to follow a model and then surpass this model; have to evoke past rules, while proposing new constraints”. They end on a conciliatory note, claiming that technique and spontaneity “far from being opposite poles, find within improvisation a place to reconcile” (ibid.), but side with Gustavsen (2010) in presenting a picture of improvisation as largely paradoxical. Other studies confirm the latter view. Several mention conflicts between individuality and tradition, innovation and routine (e.g. Bjoerkemo and Engelsrud 2011; Sawyer 2004). Bertinetto (2012: 132) holds that improvisation “lives in the tension between the routine and the new. It results from the clash between contrary elements: preparation and invention, planning and surprise, structure and process, legality and spontaneity”. Similarly, van der Schyff (2017) describes improvisation as a meeting place for opposing values.

Research in dance education and dance therapy draws attention to the personal significance of improvisation and the tension between individual freedom and companionship or group commitment. Dance teachers emphasize the joy of autonomy and freedom to explore (“you do not follow preconceived movements and are free to be guided by your intuitions”) (Biasutti 2013: 124). Certain express a normative stance in mentioning the pleasure of authenticity, truth, and surprise (“to feel you are on the right side and on the true side”) (ibid.). Therapists underline that departing from fixed rules creates insecurity and requires risk-taking and the courage to throw oneself into activity. Because participants place themselves in a vulnerable position, there must be mutual trust within the group, something that requires sensitive dialogue (Bjorkbaekmo and Engelsrud 2011). Building trust and fellowship is decisive for participating (Berk and Trieber 2009).

These observations raise precise questions about joint improvisation, e.g., How does the mutual trust emerge that balances risk-taking? How can improvisation transcend the tradition

and rules it presupposes? What kind of interaction can embrace the inherent tensions while also surpassing them? I submit that an explanation of improvisation in terms of three distinct but interrelated types of interaction permits answering these and other questions concerning the core properties, and present them one by one in the following sections.

## **ENTRAINMENT**

Entrainment is pervasive. Physical and biological systems on any level tend to respond to temporally structured events or rhythmic movements and coordinate with them. Interpersonal entrainment consists in mutually constraining, stabilizing behavior (Chartrand and Bargh 1999; Knoblich, Butterfill and Sebanz 2011; Schmidt and Richardson 2008). It occurs automatically, e.g., when people play music and dance together they visibly engage in shared rhythmic timing. Emergent behavior patterns organize the on-going interaction and increase predictability.

Because entrainment includes the matching of perception, emotion, attention, and action, agents who improvise together will come to share the action space. Importantly, the shared action space contains social affordances for action that are not available to individual agents (Sinaglia 2012). This makes entrainment a strong facilitator of joint action. The effect is increased by implicit information leakage between agents who share the action space via bodily motor intentions and emotions that signal what the agent will do next and induces implicit online adjustments of behavior for the benefit of the others (Becchio et al. 2010; Sartori et al. 2011).

I suggest that the behavior patterns that emerge via entrainment constitute a rudimentary form of (non-conceptual) common ground that enables temporarily sharing the vantage point on the world. This will enable agents to react to the same differences and detect similar possibilities

for action. In short, sharing the vantage point allows for participatory sense-making (de Jaegher and di Paolo 2007; de Jaegher and McGann 2014).

Obviously, entrainment is a *sine qua non* for joint improvisation as for many other forms of joint action. However, exactly because it is pervasive it does not reveal what is typical for or specific to improvisation in the arts practices. We should look for an answer to this among forms of interaction that essentially incorporate conscious awareness.

## **EMOTIONAL ENGAGEMENT**

Emotional engagement is consciously aware, yet pre-reflective. It provides the resources for developing second-person relations (Reddy 2008) in which the other agent is recognized as a fellow-being, somebody whose experiences are radically different from one's own yet seem strangely familiar (Halpern 2003; Zahavi 2008). Bodily interaction is physically manifest to agents who are engaging with each other, and during engagement intersubjectivity can be directly perceived as an intimate relation between self and other.

People who engage emotionally with each other may experience bodily coordination as a sensation of resonating with the other. Having this sensation will make the sharing of a vantage point on the world mutually manifest to the agents (Brinck, Reddy and Zahavi 2017). Furthermore, episodes of joint attention while dancing or playing music permit acknowledging others' felt experiences by mutual attention, as in having eye contact or holding hands (Brinck 2008). Thus acting together creates a *we*-space where people have access to highly social affordances for action that presuppose intersubjectivity and reciprocity (Brinck, Reddy and Zahavi 2017).

Emotional engagement involves the co-regulation of action and emotion and supports intentional participatory sense-making (de Jaegher and di Paolo 2007). Making meaning



together emerge from jointly detecting a difference that makes a difference (Bateson 1975), and then acting on it as a plural subject. Regulators of the interaction that emerges during emotional engagement include eye gaze, facial and bodily expression of emotion, movement, motion, breathing, vocalization, and gesture (Biasutti et al. 2016; Glowinski et al. 2013; Volpe et al. 2016).

As the interaction proceeds, emotional bonding and synchronization will increase, and the agents eventually develop shared values, caring, and concern for each other and the space they inhabit (Hodges and Barron 1992). Engagement supports strong forms of collaboration during which participants have recurring (never constant) experiences of being in the zone together, as measured by increased cardiovascular activity and correlation of heart rates and subjective self-reports of enjoyment (Noy et al. 2011). I claim that feelings of togetherness make regular commitment obsolete (Brinck 2014) and provide a robust motivation for individual risk-taking. Consequently, the emergence of emotional engagement explains in fact what encourages performers to take risks, and how mutual trust arises within improvisation.

Because emotional engagement much like entrainment reinforces agreement, conformity, and convergence, it is doubtful that it can explain, say, the feeling of tension that improvisation invokes in performer and audience or the transformative power of improvisation. Divergence is essential for complexity, for progress and change (Hodges 2014). Moreover, values such as truthfulness and authenticity that allegedly belong to the core of improvisation in the performative arts sooner motivate doubt and continued interrogation than conformity (Hodges et al. 2014). Acting to satisfy truthfulness places truth and authenticity at center-stage while degrading conformity and renouncing group commitment for its own sake. Conflict and argument may in the end be more productive for improvisation than convergence, as long as entrainment provides a rudimentary common ground that brings the agents together on a basic

level of interaction.

## **MINDFUL COLLABORATION**

Improvisation implies novelty -- a difference that is exogenous or extrinsic to the system. I suggest that the transitions that characterize improvisation occur by radical qualitative change among the conditions that shape the organization of the interaction, and furthermore, that performers intentionally produce such change by identifying and manipulating control parameters, i.e., variables that act as constraints on the collective behavior and move the agents together, and can lead to new attractor states (cf. Miura et al. 2015). When phase transitions are nonlinear, small changes in a part of the system can have profound effects on it. To explain the transformative power of joint improvisation, we need to determine what skills are required to recognize control parameters and how practitioners may acquire them, and moreover identify the interaction dynamics through which these skills emerge. The performers' own observations about learning during music and dance rehearsal are instructive in this regard.

Gustavsen (2010) reports that in jamming together, jazz musicians aim to get a firmer grip of the practical ways to simultaneously unite with the music and confront it by exploiting intervals, harmonic contents, registral direction, different voicings, etc., and exploit processes of association, repetition, variation, etc. He argues that the way a sound works and acquires meaning in different musical and motor relations belongs to the improviser's internalized, embodied knowledge, which is fundamental to anticipate potential sound events and interpret past events during performance.

In a study of the rehearsal of Forsythe's ballet *Duo*, Waterhouse et al. (2014) describe how the two dancers jointly attend to the choreography and each other's bodies while performing.

Knowledge of movement concerns cues of bodily sensation: modulations of tension, skin intensity, joint torsions, muscle contraction, balance, and much more. Feedback from one's own body is continuous via proprioception, interoception, kinesthesia, and to some extent vision. Players and dancers attend to their own sensations in the first person and to those of each other in the second person while exchanging experiences in a movement-based dialog (Legrand and Ravn 2009). Learning a choreography involves analyzing one's bodily conditions for movement relative to the movements of the other dancers. Instructed to focus on the inter-dependence between breathing and movement, perception and action, etc., the two dancers attend to the sensations that they are having while performing the same movements and they can observe in each other.

Joint improvisation comprises experimenting while feeling you are on the right or true side (Biasutti 2013), by working out and re-shaping pre-existing forms and shaped materials in new or different ways and contexts (Bertinetto 2012). It depends on expert skills about movement and sound that involve skillful attending to what a given action feels or sounds like and what it looks like in relations to others' actions. Repeated training during rehearsal of variations in attending -- of how, what, and when -- is essential to develop abilities for monitoring on-going interaction and evaluate its reliability, precision, and authenticity (cf. Brinck and Liljenfors 2013), and constitutes the basis for rich anticipatory imagery.

The above observations suggest that how musicians and dancers variably choose to engage time and space is more important than coordination and synchronization. Joint improvisation is explorative and involves active learning and analysis by en-acting one's own and others' attention, emotion, perception, and action. Phenomenology plays a crucial role in the monitoring and control of performance, which is embodied and intersubjective via meta-attention, meta-memory, and anticipatory meta-imagery (viz., meta-cognition without

hierarchical or higher-order representation) (Brinck 1999; Brinck and Liljenfors 2013). The progress of the interaction is evaluated by its moment-moment quality, effort and ease, organization, variation, and deviation, relative to the agents individually as well as together, as *we*. The development of bodily movement and action in interaction is continuous in response to the other performers and emergent, transitory spatial and temporal constraints. Because the progress of the interaction is unpredictable, monitoring and control in real time is necessary for sensitivity and calibration, in brief, for quality performance (Montero 2010, 2011; Nyberg 2016; Toner and Moran 2014; Toner, Montero and Moran 2015). This prevents strategic planning of execution as well as automatized execution of individual and serial/complex movements.

Escaping pre-existing biological, physical, historical, and internal or structural constraints on interaction requires what Ryle (1949) calls expertise, or intelligent practice, including critical skills that ensure reliability. Ryle depicts expertise as a mindful activity that entails effort, attention, and control. Mountaineering, free-skiing, and skating/skate-boarding (Nyberg 2016; Tholander & Johansson 2013) are paradigmatic examples of intelligent practices that demand thinking-in-doing because the conditions for these activities never repeat. Critical skills enable evaluation and assessment of a task environment in constant change and lead to authenticity and quality. Similarly to improvisation in the arts, the latter practices they aim at continuous improvement and refinement.

Expert musicians and dancers can switch coordination and synchronization patterns according to their intention or feeling. Switching may demand practice and planning ahead, e.g., if the switch requires learning a novel movement or behavior. Among the control parameters that directly determine the motor actions in improvisation and that skillful performers have the power to influence at will, we find direction, force, relative size, speed, and latitude of

movement, shape and velocity of motion, and timing. It is noteworthy that practice of a part of a movement can alter the self-organizing tendency within the whole system by causing increased or new muscle control, control of tempo change of body movement, limb movement reversal, increased limb or muscle resilience, increased speed of motion, and much more. Miura et al. (2015) noticed that skilled street dancers exhibited a reduced tendency to unintentional entrainment as opposed to novice dancers, and draw attention to motor learning of rhythmic performance as a process of acquiring freedom from intrinsic constraints. They suggest that identifying the control parameters that determine unintentional entrainment and manipulating them will make it possible to intentionally settle into patterns that do not emerge implicitly.

Sometimes radical transitions occur naturally without premeditation, as when the boxer after a prolonged period of training learns to automatically fine-tune the gradual turning of her hand while extending her arm, moving the hand from its resting position close to the chin towards the target. As a side-effect, learning to do so enables quicker, more explosive extension of the arm in an accelerating movement that significantly increases the force of the blow as it hits the target and leads to a comprehensive change in the way the boxer fights.

In sum, changing the control parameters will demand, on the one hand, developing sensorimotor skills for playing music or dancing, and on the other, exploiting general phenomenological and intersubjective skills of two kinds: regulatory and meta-cognitive. The latter skills are powerful means for managing interaction and elaborate it in new directions in response to contextual and task affordances. Expert performers negotiate the progress of improvisation in a dialogue that equally calls for inter-listening (Lipari 2014) as for questions and answers, nonverbal while performing and verbal before and after performance. Joint improvisation has affinities with negotiation because it advances by concessions and bids.

Reciprocal negotiation presupposes mutual respect and appreciation among the participants and motivate them to anticipate and scaffold each other's actions while these still are taking form, letting mutual other-regarding concerns guide the interaction. I submit that the notion of mindful collaboration captures the gist of the intricate interaction dynamics that characterizes joint improvisation.

## REFERENCES

Barker R (1968) *Ecological psychology: concepts and methods for studying the environment of human behavior*. Stanford University Press, Stanford CA

Becchio C, Bertone C, Castiello U (2008) How the gaze of others influences object processing. *Trends in Cognitive Science*, 12: 254-258

Becchio C, Sartori L, Castiello U (2010) Toward you: the social side of actions. *Current Directions in Psychological Science*, 19 (3):183–188

Becchio C, Sartori L, Bulgheroni M, Castiello U (2008) Both your intention and mine are reflected in the kinematics of my reach-to-grasp movement. *Cognition*, 106: 894–912

Beer R (2000) Dynamical approaches to cognitive science. *Trends in Cognitive Sciences* 4 (3):91-98

Beer R (2014) Dynamical systems and embedded cognition. In: Frankish K, Ramsey WM (eds) *The Cambridge handbook of artificial intelligence*, Cambridge University Press, Cambridge, pp 128-150

Berk RA, Trieber RH (2009) Whose classroom is it, anyway? Improvisation as a teaching tool. *Journal on Excellence in College Teaching*, 20 (3): 29-60

Bertinetto A (2012) *Performing the unexpected. Improvisation and Artistic Creativity*.

Daimon. Revista Internacional de Filosofía, 57: 117-135

Biasutti M (2013) Improvisation in dance education: teacher views, *Research in Dance Education*, 14 (2): 120-140

Biasutti M, Concina E, Wasley D, Williamon A (2016) Music Regulators in Two String Quartets: A Comparison of Communicative Behaviors between Low- and High-Stress Performance Conditions. *Front Psychol.*, 7:1229.

Bjorbaekmo W, Engelsrud G (2011) “My Own Way Of Moving” - Movement Improvisation In Children's Rehabilitation. *Phenomenology and Practice* 5 (1):27-47

Brinck I (1999) Non-conceptual content and the distinction between implicit and explicit knowledge, *Behavioral and Brain Sciences* 22 (5):760-761

Brinck I (2007) Situated cognition, dynamic systems and art. *JanusHead* 9 (2):407-431

Brinck I (2014) Developing an understanding of social norms and games: Emotional engagement, nonverbal agreement, and conversation. *Theory and Psychology*, 24 (6): 737-754

Brinck I, Liljenfors R (2013) The developmental origin of metacognition. *Infant and Child Development* 22:85-101

Brinck I, Reddy V, Zahavi D (2017) The primacy of the We? In: Durt C, Fuchs T, Tewes C (eds) *Embodiment, enaction and culture. Investigating the constitution of the shared world.* MIT Press, Cambridge Mass, pp. 131-147.

Chartrand TL, Bargh JA (1999) The chameleon effect: the perception–behavior link and social interaction. *Journal of Personality and Social Psychology*, 76 (6):893-910

Clark A (1997) *Being there: putting mind, body, and world together again.* MIT Press, Cambridge, MA

- De Jaegher H, Di Paolo EA (2007) Participatory sense-making: an enactive approach to social cognition. *Phenomenology and the Cognitive Sciences* 6 (4):485–507
- De Jaegher, H (2009) Social understanding through direct perception? Yes, by interacting. *Consciousness and Cognition*, 18 (2): 535-42.
- Gill S (2012) Rhythmic synchrony and mediated interaction: towards a framework of rhythm in embodied interaction. *AI & Society*, 27 (1):111–127
- Glowinski D, Mancini M, Cowie R, Camurri A, Chiorri C, Doherty C (2013) The movements made by performers in a skilled quartet: a distinctive pattern, and the function that it serves. *Front Psychol.* 13 (4):841.
- Gueugnon M, Salesse RN, Coste A, Zhao Z, Bardy BG, Marin L (2016) The acquisition of socio-motor improvisation in the mirror game. *Hum Mov Sci.* 46:117-28.
- Gustavsen T (2010) The dialectical eroticism of improvisation. In: Santi M (ed) *Improvisation between technique and spontaneity*, Cambridge Scholars, Newcastle upon Tyne, pp.7-51.
- Halpern J (2003) What is clinical empathy? *J Gen Intern Med.* 18(8): 670–674
- Hart Y, Noy L, Feniger-Schaal R, Mayo AE, Alon U (2014) Individuality and togetherness in joint improvised motion. *PLoS One*, 9 (2):e87213
- Haugeland J (1998) Mind embodied and embedded. In: Haugeland J (ed) *Having thought: essays in the metaphysics of mind*, Harvard University Press, Cambridge MA, pp 207–237
- Heft H (2007) The social constitution of perceiver-environment reciprocity. *Ecological Psychology* 19 (2):85-105
- Hodges BH, Baron, RM (1992) Values as constraints on affordances: Perceiving and acting properly. *Journal for the Theory of Social Behaviour*, 22, 263–294.



Hodges BH (2014) Rethinking conformity and imitation: divergence, convergence, and social understanding. *Front. Psychol.* 5:726.

Hodges BH, Meagher BR, Norton DJ, McBain R, Sroubek A (2014) Speaking from ignorance: not agreeing with others we believe are correct. *J. Pers. Soc. Psychol.* 106: 218–234.

Kelso JAS (1995) *Dynamic patterns: The self-organization of brain and behavior*. Cambridge, Mass.: The MIT Press

Kirsh D (1995) The intelligent use of space. *Artificial Intelligence*, 73 (1-2): 31-68.

Knoblich G, Butterfill S, Sebanz N (2011) Psychological research on joint action: theory and data. In: Ross B (ed) *The psychology of learning and motivation* 54, Academic Press, Burlington MA, pp 59-101

McGann M, De Jaegher H (2009) Self–other contingencies: Enacting social perception. *Phenom Cogn Sci* 8:417–437.

Legrand D, Ravn S (2009) Perceiving subjectivity in bodily movement: The case of dancers. *Phenomenology and the Cognitive Sciences*, 8 (3): 389-408

Lipari L (2014) On interlistening and the idea of dialogue, *Theory & Psychology*, 24 (4):504–523

Miura A, Fujii S, Yamamoto Y, Kudo K (2015) Motor control of rhythmic dance from a dynamical systems perspective: a review. *Journal of Dance Medicine & Science*, 19(1): 11-21

Montero BG (2010) Does bodily awareness interfere with highly skilled movement? *Inquiry* 53 (2):105-122

Montero, BG (2011) Effortless bodily movement, *Philosophical Topics* 39 (1):67-79.

Musa R, Carré D, Cornejo C (2015) Bodily synchronization and ecological validity: a relevant concern for nonlinear dynamical systems theory. *Front Hum Neurosci*. 2015 Feb 13;9:64.

Noy (2011) The mirror game as a paradigm for studying the dynamics of two people improvising motion together, *Proceedings of the National Academy of Sciences of the United States of America*; 108(52)

Noy L, Levit-Binun N, Golland Y (2015) Being in the zone: physiological markers of togetherness in joint improvisation. *Front Hum Neurosci*. 5 (9):187

Nyberg G (2015) *Qualitative Research in Sport, Exercise and Health* 7 (4): 488-503

Pentland BT, Hærem T (2015) Organizational routines as patterns of action: implications for organizational behavior, *Annual Review of Organizational Psychology and Organizational Behavior*, 2: 465-487

Reddy V (2008) *How Infants Know Minds*. Harvard: Harvard University Press.

Richardson MJ, Kallen RW (2015) Symmetry-breaking and the contextual emergence of human multiagent coordination and social activity, *World Scientific Review*, 229-286

Ryle, G (1949) *The concept of mind*

Santi M, Illitterati L (2010) Introduction: Improvisation between performance art and lifeworld, In: Santi M (ed) *Improvisation between technique and spontaneity*, Cambridge Scholars, Newcastle upon Tyne, pp. 1-6.

Sartori L, Becchio C, Castiello U (2011). Cues to intentions: the role of movement information. *Cognition*, 119, 242–252

Sawyer RK (2004) *Creating teaching: collaborative discussion as disciplined improvisation*.

Educational Researcher, 33(2)

Schmidt RC, Richardson MJ (2008) Dynamics of interpersonal coordination. In: Fuchs A, Jirsa V (eds) Coordination: neural, behavioral and social dynamics. Springer-Verlag, Heidelberg Germany, pp 281-308

Schmidt RC, Nie L, Franco A, Richardson MJ (2014) Bodily synchronization underlying joke telling Front Hum Neurosci.8: 633.

Tholander J, Johansson C (201) Design qualities for whole body interaction: learning from golf, skateboarding and BodyBugging. NordiCHI '10 Proceedings of the 6th Nordic Conference on Human-Computer Interaction: Extending Boundaries, 493-502

Toner J, Moran A (2014) In praise of conscious awareness: a new framework for the investigation of “continuous improvement” in expert athletes. Front. Psychol. 5:769.

Toner J, Montero BG, Moran A (2015) Considering the role of cognitive control in expert performance, Phenom Cogn Sci 14 (4):1127-1144

van der Schyff D (2017 Improvisation, Enaction & Self-Assessment. The Oxford Handbook of Philosophical and Qualitative Perspectives on Assessment in Music Education edited by David J. Elliott, Marissa Silverman, and Gary McPherson.

Varela F, Thompson E, Rosch E (1991) The embodied mind. Cambridge, MA: MIT Press.

Volpe G, D'Ausilio A, Badino L, Camurri A, Fadiga L (2016) Measuring social interaction in music ensembles. Philos Trans R Soc Lond B Biol Sci. 5;371(1693)

Waterhouse E, Watts R, Bläsing B (2014) Doing Duo - a case study of entrainment in William Forsythe's choreography “Duo.” Front. Hum. Neurosci. 8:812.

Zahavi D (2008) Simulation, projection and empathy. Consciousness and Cognition

17:514-522.