THE MUSICAL INSTRUMENT
AS A NATURAL EXTENSION OF THE MUSICIAN

Nijs, Luc, IPEM, Dpt. of Musicology, Ghent University (Belgium), *luc.nijs@ugent.be*
Lesaffre, Micheline, IPEM, Dpt. of Musicology, Ghent University (Belgium), *micheline.lesaffre@ugent.be*
Leman, Marc, IPEM, Dpt. of Musicology, Ghent University (Belgium), *marc.leman@ugent.be*

ABSTRACT

Background in Music Performance

The study of music performance is a fast evolving research area. The advent of new technologies and the view on the embodied nature of music cognition [1] have given a major impulse to new empirical studies on the involvement of the human body during music performance.
Although the body of literature on the performers instrumental and expressive gestures [2, 3] is growing, far less has been written on the musical instrument as an extension of the human body. The latter is considered to be the most natural mediator between subjective experience and physical reality. This extension can become natural, i.e. part of the body, as a result of several processes. Research is needed to address these processes and the way in which the musical instrument influences both the construction and communication of musical meaning.

Background in Philosophy

Analysis of the relationship between musician and musical instrument raises fundamental ontological and epistemological questions. To grasp the full meaning of this relationship, it should be examined from a broader philosophical perspective in which the interaction between musician and musical environment, the nature of human activity, the role of (self-) consciousness and the nature and quality of subjective experience are of central importance.
The philosophical background of the research presented in this paper consists of a combination of ecological philosophy [4], activity theory [5] and the philosophy of presence [6].

Aims

This paper aims at gaining a theoretical understanding of the relationship between musician and musical instrument. Thorough knowledge of the nature and value of this relationship will reveal basic components of the embodied interaction during music performance. We develop a conceptual framework that provides an interdisciplinary theoretical basis for future in-depth studies related to ongoing empirical research (e.g. the EmcoMetteca project at IPEM, Ghent University).

Main Contribution

The main contribution of this paper is a refinement of the concept of musical embodiment in two ways. First, concepts from ecological philosophy, activity theory and presence research are used to identify different components of the music performance situation (e.g. musician, instrument, score, audience, room…) and to clarify their mutual interaction. Second, the study of a non-verbal (social and technology related) communication domain as a concrete example of embodied interaction will contribute to the refinement of philosophical concepts (such as the second-person perspective in music performance, the instrument as mediator, the coupling of action and perception).
The starting point of the presented research is a finding that is shared and intuitively apprehended by many musicians, namely the experience that the musical instrument has become part of the body. We support to the viewpoint that this awareness is a necessary condition for a fine-grained expressive communication of musical meaning.
In this paper it is argued that a symbiosis between musician and musical instrument results from a growing integration of instrumental and interpretative movements into a coherent whole that is compatible with the body of the musician and with the movement repertoire of daily life. Such integration leads to the transparency of the musical instrument that just like "natural" body parts disappears from consciousness. The musical instrument has then become part of the body as stable background of every human experience and is no longer an obstacle to an embodied interaction with the music. It has become a natural extension of the musician, thus allowing a spontaneous corporeal articulation of the music.

Implications

A further elaborated theoretical framework for embodied music cognition will give empirical research a firm ontological and epistemological ground. This is linked up with modern philosophical approaches that go beyond the Cartesian dualism. Research into embodied music cognition is of particularly interesting for the development of interactive multimedia platforms, music education, applications in rehabilitation and numerousof applications within the cultural and creative sector (e.g. for music gaming).

1. INTRODUCTION

Music performance is recognized as one of the most complex human activities, pushing performers beyond the boundaries of their bodily and cognitive capacities. The study of this interesting human phenomenon is a fast evolving research area. The advent of new technologies and the understanding of the embodied nature of music cognition [1] have given a major impulse towards new empirical studies about the involvement of the human body during music performance. Although the body of literature on the performers instrumental and expressive gestures [e.g. 2, 3, 7] is growing, far less has been written on the musical instrument as an extension of the human body. Research is needed that reveals the underlying processes of the relationship between musician and musical instrument by investigating the way in which the musical instrument influences both the construction and communication of musical meaning.

This paper aims to contribute to the theoretical understanding of the relationship between musician and musical instrument. Analysis of this relationship raises fundamental ontological and epistemological questions. To grasp its full meaning, it should be considered from a broader philosophical perspective in which the interaction between musician and musical environment, the nature of human activity, and the quality of subjective experience are addressed.

The structure of this paper is as follows: in the next section (2) we first outline our approach. The three following sections consider the pillars of the framework. First we elaborate the role of the relationship between musician and musical instrument for the musician's interaction with the musical environment (section 3). Then we consider the influence of this relationship on the actions of the musician (section 4). In the next section (5) we look into the subjective experience of the musician and how it relates to the musician-instrument relationship. Finally (section 6) a conclusion is formulated regarding the proposed framework, followed by some remarks on the need for further research (section 7).

2. APPROACH

In this theoretical study, we focus on expert music performance in the tradition of Western classical music. We start from a performance situation in which a professional musician performs a composition from notation. Futhermore we consider only instrumental music in order not to complicate things unnecessarily by the presence of language and content in vocal music. We stress the "performing" element, being distinguished by its occasional and ritual character from mere "playing" [8].

The starting point of the presented research is a finding that is intuitively apprehended by many musicians, namely the experience that the musical instrument has become part of the body. We support the opinion that this awareness is the result of an embodied experience that is rooted in an optimal relationship between musician and musical instrument. Moreover we consider it to be a necessary condition for a flexible and spontaneous expression of artistic ideas [1].

In our framework the relationship between musician and musical instrument is approached from three different but strongly related viewpoints: the musician-instrument connection

1. determines the interaction process between the musician and the musical environment that is created throughout performance.
2. regulates the goal-directed activity structure of music performance.
3. is closely related to the musician's subjective experience during performance. Both elements influence each other and optimalize through an iterative process.

These viewpoints are elaborated within the framework of the embodied music cognition research [1], based on three philosophical frameworks:

1. Ecological Philosophy: the study of relationships between subject and environment
2. Activity Theory: a conceptual framework based on six principles (i.e. merging of activity and consciousness, goal-directedness, hierarchic activity structure, mediation, internalization and externalization, continuous development)
3. Flow and Presence Research: the psychology of optimal experience.

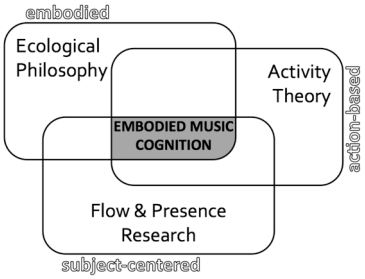

Figure 1. Structure of the theoretical background

3. THE MERGING OF MUSICIAN AND MUSICAL INSTRUMENT

The merging of musician and musical instrument implies that the musician no longer experiences a boundary between himself and the instrument. The instrument is felt from within and has become like an organic component of the body [9, 10]. This means that the musical instrument is integrated in the bodily coordination system. Technical-instrumental movements become constituents of the dynamic structure of the body (*body schema*) and thereby part of the somatic know-how of the musician [11, 12]. As a result material, functional and formal features of the musical instrument no longer require to be explicitly represented and the musical instrument becomes relationally and functionally transparent in use [13]. The relational transparency implies that the musical instrument does not interfere with the direct perception of the musical environment. The functional transparency makes the musician feel that he is responding directly to the musical environment that is without cognitive reflection and solely relying on acquired skills.

Direct perception (clear feedback) and skill-based playing (clear goals) are intrinsically linked to each other and based on a balance between the skills of the musician and the challenges he finds in the musical environment. Thereby all the necessary conditions are fulfilled for the musician to have an optimal subjective experience or so called flow experience while performing.

In the next sections direct perception, skill-based playing and flow experience are elaborated upon with regard to the relationship between musician and musical instrument.

4. DIRECT PERCEPTION OF THE MUSICAL ENVIRONMENT

Music performance entails a series of perceptually guided actions that are embedded in a whole of specific physical and cultural elements such as cultural and musical traditions, the specific configuration of the performance situation and personal characteristics of the musician [14, 15]. These elements give rise to the constraints and possibilities of the musical environment that is created during the performance. Because of the specific timeframe of music performance, it is impossible to take every action or its result into account as if it was a perceptually distinct unit. Therefore the musician must be able to pick up information without the need for cognitive processes (*direct perception*) and act directly in attunement with the environment (*body schematic acting*).

The direct perception of the musician can be defined as a bias to perceive the music performance situation in terms of affordances [1]. These are elements of the musical environment that capture the musician's attention by standing out as figure to background. As the expression of action-perception couplings they invite the musician to act according to the coupling between motor trajectories and sensory information.

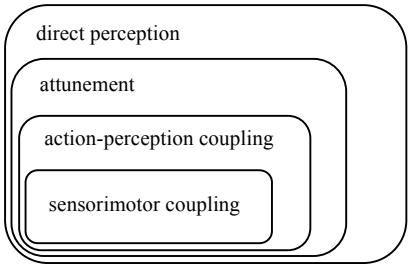

Figure 2. Roots of direct perception

In music performance the affordances are first of all the performance cues. These are orientation points that trigger executive, interpretative or expressive actions as stored in memory during rehearsal [16]. Although performance cues are the result of a carefully prepared action plan, they are neither absolute determinants of the performance nor the constituents of obligatory performance logarithm. As a result of the interaction during performance new elements come to the foreground and create new affordances to which the musician can respond. On the one hand, these new affordances arise due to changes in the constituents of the musical performance situation. Inspired by for example the atmosphere in the concert hall or the interaction with the public, new interpretative elements can come up and invite the musician to realize them. On the other hand they can be the result of sudden insights that pop up during performance.

Affordances have their counterpart in the *effectivities* of the musician [4]. Whether the affordances are perceived, selected and processed in order to guide or even change the way of performing depends on the embodiment of knowledge, skills and experience. When these are incorporated in the body schema, the musician can engage in an embodied interaction with the music and act body schematically, that is automatically select and generate the appropriate responses to the (new) elements that capture attention [17, 18].

It is important that the musical instrument does not restrain a direct engagement with the music. Only then the musician can freely resonate with the music and respond continuously in a body schematic way to the inspiration of the moment or the constraints that arise from the complex interaction within the music performance situation. Therefore the musical instrument must be incorporated in the body schema. This is possible because the physical body and the body schema do not necessarily coincide [19-22].

5. MUSIC PERFORMANCE AS SKILL-BASED ACTIVITY

Mastering the musical instrument implies its incorporation in the musician's body so he can be focused on the musical goal rather then on the technicalities of playing the instrument [1]. The high-level skills of the musician allow a fine-grained control over the music performance and prevent the musical instrument from standing in between what the musician wants and what he gets. This means that the goal-directedness of music performance, the way the musician's actions are structured and the mediated character of the musical performance are intrinsically related. To analyze the goal-directedness, the structure and the mediated character of music performance we rely on Activity Theory.

Although Activity Theory has been used by many researchers, the field of music research seems not to be familiar with it. Except for a few exceptions [23-25] we found no literature using Activity Theory to investigate music performance. Yet there are some essential parallels between Activity Theory and the embodied music cognition framework such as the action orientedness, the importance of the subjective experience and mediation. Therefore a combination of both frameworks can contribute to their further refinement.

Rather then being a theory Activity Theory is a set of principles that provide a conceptual framework to approach the interaction between subject and environment [26, 27]. These principles are (1) the unity of consciousness and activity, (2) object-orientedness, (3) hierarchical structure of an activity, (4) internalization and externalization, (5) mediation and (6) continuous development [26, 28]. It is beyond the scope of this article to elaborate on all these principles with regard to music performance. Therefore we will focus on the most relevant principles: object-orientedness, hierarchic structure and mediation.

5.1. The object-orientedness of music performance

According to Activity Theory every human action is directed towards an *Object*. This is the imagined result of a future activity [29]. An activity consists of the transformation of its *Object* in an actual outcome. The motivation to act comes from the coupling of the object to a certain need [27]. This coupling regulates the dynamics of perceptual and cognitive processes and their interaction during performance by determining the musician's perceptive selection, attention and memory retrieval [30].

With regard to music performance we consider this *Object* to be the inner model of the music that the musician has constructed on the basis of deliberate practice and former experiences. This model gives rise to a set of executive and interpretative/expressive goals that find their expression in the basic, interpretative, structural and expressive performance cues [31]. According to the focus of the musician his predefined goals are structured into a hierarchy of conscious *goals* and an unconscious *orienting basis*. The conscious goals are concrete anticipations of future results of the actions during performance, the orienting basis is a set of expectations established through experience [32].

The hierarchical structure of goals and orienting basis is dynamic. Because of the situated nature of music performance, new constraints and affordances can always arise. As a result it is possible that predefined goals need to be adapted or even transformed [33].

5.2. Music performance as a hierarchically structured activity

The hierarchy of goals and orientations gives rise to a hierarchical structure of conscious and unconscious actions. Activity Theory makes a distinction between *actions* and *operations*. Actions are conscious goal-directed processes that are planned and performed with conscious thought and attempt to fulfil the objective of the activity [34, 35]. Operations are actions that became routinized and unconscious through practice [34-36]. They are always related to the object and goals of the activity and therefore controlled by the conditions in which the goal is presented [34]. The hierarchic structure is not static. Depending on the goals that are consciously pursued, operations can become actions and vice versa.

When considering music performance, operations are of particular interest. Music performance consists to a large degree of a stable basis that results from deliberate practice. The musician constructs the necessary motor trajectories to be able to play the music. Expert musician's can rely on a large repertoire of automatized subroutines (e.g. chords, scales, articulations) but some passages have to be practiced extensively. Both subroutines and well-practiced passages lead to motor trajectories that can be triggered during performance by the performance cues without the need for conscious reflection. Planning the performance influences the teleological structure of the activity through the hierarchical ordering of the performance cues in accordance with the generic structure of the music [31]. Actions that are linked to the basic, interpretative, structural and expressive performance cues become operations by deliberately practicing the

executive strategy, i.e. establishing the internal model of the music on the basis of the action reaction cycle (play-listen-judge-change) as put forward by Leman [1]. Through the direct perception of these cues the necessary operations are triggered.

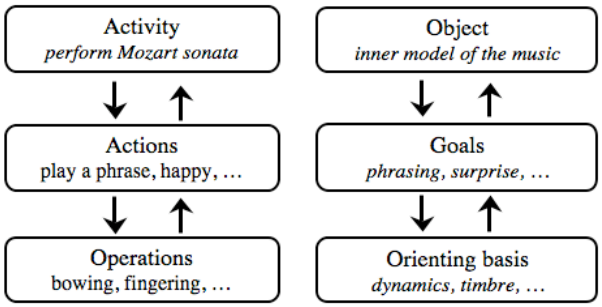

Figure 3. The dynamic hierarchical structure of music performance

5.3. Music performance as mediated activity

To communicate his artistic ideas the musician relies upon his instrument. The flexible and spontaneous expression of these ideas depends on the direct perception of the musical environment (section 4) and a skill-based coping with the challenging conditions that arise from the complex interaction during performance.

The mediating position of the musical instrument is grounded in its relation to the activity. According to Activity Theory the mechanism that underlies the mediation is the formation of a functional organ [26]. This entails the establishment of an intimate relationship between musician and instrument during which both are no longer separated but become a whole in which the sum is more then the parts [37]. In the next two paragraphs we first consider the mental level of the musician-instrument connection and second the physical coupling.

5.3.1. Instrumental genesis: the musical instrument as functional organ

The dialectic process that leads to the intimate relationship between musician and instrument is called "instrumental genesis" [38]. It involves the transformation of the musical instrument as a mere material artefact into an "instrument" that is a "functionally integrated, goal-oriented configuration of internal [musician] and external [musical artifact] resources" [26].

Instrumental genesis is a twofold process in which the reciprocal influence of musician and musical instrument is reflected. On the one hand the musician influences the musical instrument (*instrumentalization*). According to his needs he will attribute specific functions to the instrument. Moreover a musician always seeks to perfect his instrument by making material adaptations (e.g. by choosing strings, reeds, ligatures). On the other hand the musical instrument has an impact on the musician (*instrumentation*) through the cognitive structuring of the his involvement during performance [39]. The necessary skills to play the instrument are developed by establishing new or adapting existing mental schemes. These are specialized subsystems that realize a tight action-perception coupling [40].

A complex activity as musical performance implies many different schemes that are coupled with the hierarchic structure of music performance. Their degree of activation depends on the specific configuration of the structure. The instrumental actions of the musician are performed on the basis of utilization schemes that contain the predefined structure of consecutive *operations*, the representation of the *object* (inner model of the music) and the music performance situation [41]. They are easily triggered and thereby contribute to the skill-based playing. As such they are an important part of the musician's *orienting basis*. Utilization schemes can be subdivided in *usage schemes* and *instrument mediated action schemes*. The former are determined by the possibilities and constraints of the musical instrument [38] and are related to the *instrumental signals*, i.e. the feedback given by the instrument. These schemes are responsible for the integration of the instrument related movements in the coordination system of the musician's body and the resulting geometrical match between musician and instrument (see section 3). Instrument mediated action schemes focus on the transformation of the *Object* and related to the *non-instrumental signals*, i.e. signals. They allow the musician to generate automatic responses to elements within the musical environment.

Instrumental genesis is the process that leads to the expertise of the musician by establishing a relationship of reciprocal affordances. The artefact enables utilization schemes, the schemes enable the artefact to become functionally integrated in the activity [42]. Through the combination of instrumentation and instrumentalization the match between the musician's skills and the possibilities the instrument offers becomes consolidated. Throughout years of extensive training [43] an expert musician has developed a toolbox of utilization schemes from which he can select the necessary actions to creatively cope with the musical environment he creates during his performance. What he wants is what he gets. The musical instrument has become a functional organ or in other words: a natural extension of the musician [38].

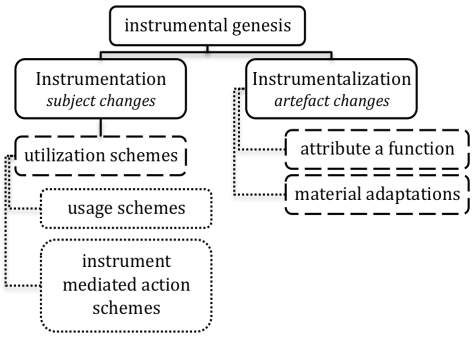

Figure 4. Instrumental genesis

5.3.2. The physical coupling between musician and instrument

Starting from an embodied framework means acknowledging that the body is the primary and the most natural mediator between the musician's subjective experience and the musical environment [1]. What the musician perceives is mirrored in his action-oriented ontology. The information stream that is picked up is disambiguated into an ontology of action relevant cues. This action-oriented bias is reflected in the corporeal articulations of the musician that are translated with the instrument into the sounding music.

When a musician plays an instrument it becomes attached to the body and this has a major influence on the mediating role of the body. The instruments *modalities of existence* (material characteristics), *finalization constraints* (functional aspects) and *action pre-structuring constraints* require a specific posture and movements that limit the musician's freedom to move [41]. Posture and technical movement are not always in line with the movements the music suggests. Therefore the musical instrument can block the process of corporeal articulation by restraining the body's motility. In this way the musical instrument can interfere with the body's natural mediating role. Therefore it is important that the instrument is incorporated in the body as the stable background of the musician's experience.

6. THE MUSICIAN IN A FLOW STATE

The musician's intuitive understanding of being fused with his musical instrument is grounded in a specific subjective experience often referred to as flow experience. This is an optimal experience that can be defined "*a holistic sensation that people feel when they act with total involvement*" [44]. When a musician experiences flow he is completely and from moment to moment involved in his playing, functioning at the highest capacity [45]. The occurrence of flow depends on the presence of certain conditions (antecedents). These are (1) a balance between the skills of the musician and the challenges posed by the performance, (2) clear goals every step of the way and (3) immediate and unambiguous feedback [46]. Once these conditions are fulfilled and the musician does actually experiences flow, his subjective experience is characterized by (1) the merging of activity and awareness (2) complete concentration on the task at hand, (3) a sense of potential control, (4) a loss of self-consciousness and (5) an altered sense of time [44, 46, 47]. Flow experience has a deep impact on the musician. First, it stimulates enjoyment and thereby contributes to a feeling of personal engagement with the activity. It contributes to an intrinsic motivation and to the personal and artistic development of the musician. Second, flow stimulates an implicit learning process. A deeper assimilation of the experience into the embodied background knowledge is established [17, 48]. This has major implications for the relationship between musician and musical instrument. Every time a musician experiences flow, the musical instrument becomes transparent and temporally a natural extension of the body. In the beginning such an optimal experience will only have a short-term effect on the relationship between musician and musical instrument. But the repeated experience will render the mental schemes that accompany the feeling of having merged with the musical instrument permanent. This results in a long-term intuition, even when the instrument is not at hand.

Although activities in which a flow experience occurs are most of the time mediated by a material artefact (e.g. computer, musical instrument), the vast literature on flow experience shows a considerable lack of attention to the role of these artefacts [49]. The focus is mainly on the flow experience itself (most of the time in the context of education) and researchers assume a priori a balance between skills and challenges since this is a necessary condition of the flow experience. But this balance depends mainly on the relationship between musician and musical instrument and therefore the mediated character of musical performance should be taken into careful consideration.

Another element that has not received much attention in flow research is the role of the body. Music performance and in particular playing a musical instrument are to a large extent a corporeal activity. Although some authors mention a difference in the quality of movements during a flow experience, both the degree to which bodily involvement contributes to the flow experience and the way flow experience is reflected (and therefore measurable) in body posture and movements has not been thoroughly investigated [47, 50].

Our theoretical framework deals with these shortcomings (less attention to mediation and the body) by linking the concept of "presence" and "social presence" to the concept of flow experience. Riva et al. [51] define flow as a combination of the highest level of presence (*presence-as-feeling*) and a positive emotional state. Presence is defined as *the feeling of being and acting in a world outside us* [52]. Social Presence is the capacity to recognize another subject as intentional [53].

Introducing the concept of social presence contributes significantly to an elaboration of the second person perspective within the embodied music cognition paradigm [1]. Within this paradigm the possibility to attribute a second person status to music is considered to be an important way to understand music through the process of corporeal articulation of the moving sonic forms (*corporeal intentionality*).

Although the concept of flow is quite well-known in the field of music[1], the concepts of presence and social-presence have – to our knowledge – never before been elaborated upon thoroughly within the field of music performance research.

6.1. Flow, presence and engagement

The relationship between musician and musical instrument is a determining factor in the degree to which the musician's interaction with the musical environment is embodied. For this relationship to be optimal it must allow a direct and engaged interaction with the musical environment [54]. The directness of the interaction depends on direct perception (see section 4) and skill-based playing (see section 5). Engagement is related to the immersion of the musician in the activity of performing. According to Custodero [47] musical engagement is initiated & maintained through skilled awareness of and responsiveness to opportunities for increased complexity implicit in the musical material. Skilled awareness reflects the complementary relation between the musician's *effectivities* (skills) and the *affordances* and *constraints* of the musical environment (awareness). The responsiveness depends on the musician's skills. Expertise implies an optimal responsiveness. The expert musician has built up an extensive toolbox [18] of utilization schemes from which he can unconsciously select and execute the appropriate responses to the challenges provided by the musical environment. Finally the increased complexity of the musical material has to do with the ambiguous character of the music and with the situated nature of music performance. Both lead to an interpretative margin that, as an open space of possibilities, invites the musician to push performance to the limits of his abilities.

According to Brown and Cairns [55] there are three levels of immersion as a degree of engagement. The first level is the mere engagement based on the accessibility (in accordance with personal preferences) and its challenging nature. When the musician directs attention, time and effort the engagement might be complemented with an emotional involvement. This leads to the second level of immersion, engrossment. Now the emotions are affected and the musician is increasingly cut off from the world outside the activity. The final stage is complete immersion. All that matters is performing. The musician feels the atmosphere of the performance and is empathically involved with the music [56].

Brown and Cairns [55] acknowledge the similarities between the experiences of complete immersion and flow experience. But although they acknowledge that complete immersion is possibly accompanied by enjoyment, they consider it to be the same as presence. Presence however is a feeling that can be experienced without enjoyment. In line with Takatalo et al [57] and Riva et al [51], we consider flow to be the combination of presence and a positive emotional state. Flow cannot be experienced without presence but presence can be experienced without flow. The positive emotional state is related to playfulness, creativity and the potential to be creative [58].

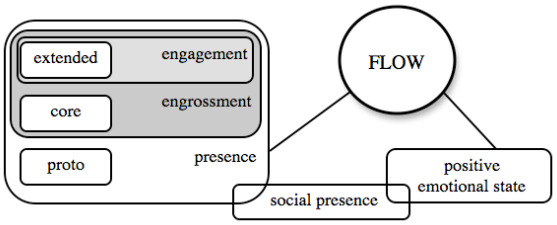

Figure 5. Flow, presence, and engagement

6.2. Presence and the relationship between musician and musical instrument

If flow cannot be experienced without a sense of presence, then it can only occur when the relationship between musician and musical instrument is characterized by the transparency of the medium. The disappearance of the musical instrument from consciousness enables the musician to be immersed in performing the music. Both transparency and immersion are expressed in the concept of presence when it is interpreted as (1) the feeling of being there, which is intrinsically coupled to (2) the perceptual illusion of non-mediation.

Presence is often defined as the feeling of being present in a world outside us ("there") [52]. This feeling is rooted in a transparent mechanism, denoted as *presence-as-process* [51], that allows controlling behavior on the basis of an unconscious differentiation between the inner and outer world. In music performance the inner world is constituted by the space of motor trajectories, internal thought processes related to the self, and feelings [1, 59]. The outer world is the space of sensory trajectories that arise from the interaction with the music [1]. On the basis of this differentiation the musician can monitor whether the result of his actions match his expectations on the basis of predefined and ad hoc adapted goals.

Presence-as-process is situated at different levels, each of which is linked to a level of consciousness [60]. It relies

[1] Mainly in the field of music education.

on a coherent collaboration of bodily sensations, perception and cognition to keep attention focused on the activity. The first level, *extended presence*, is cognitive and occurs when the content of consciousness is experienced as meaningful on the basis of intentions, beliefs and personal preferences. The second level, *core presence*, is perceptual. It entails selective attention and is intrinsically coupled to the core affects [61]. These are the core of emotions and moods and influence perception, cognition and behavior. The third and most profound level is proto presence. Here the sensorimotor coupling of action and perception coupling plays a defining role. It is about the bodily being in the world. The musician anticipates body schematically and evaluates the action perception coupling. A positive match between efferent (inner world) and afferent (outer world) leads to proto presence. That way presence-as-process unconsciously monitors action and is responsible for the sense of control that is characteristic for flow experience.

A maximal sense of presence, denoted as *presence-as-feeling*, is the feeling of being "there". Such an experience occurs when the content of every level of consciousness is the same (*focus*) [62]. Depending on whether all levels of presence are focused on the inner or outer world (*locus*), the attention shifts to the self or the non-self [59]. Depending on the degree of arousal (*sensus*) attention becomes more focused on a limited set of stimuli [59]. This implies that presence-as-feeling will always be accompanied by the *perceptual illusion of non-mediation.* When all levels of the musician's consciousness are being occupied with the sensory trajectories (feedback on the result of playing the instrument, non-instrumental signals, outer world) the motor trajectories (feedback on the technical handling of the musical instrument, instrumental signal, inner world) will not enter consciousness. Accordingly the musical instrument is unconsciously considered as an aspect of the self and this results in the intuitive apprehension of the fusion between musician and musical instrument.

An important aspect of the layered nature of presence is the fact that maximal presence involves the orientedness of the body on the external world. Presence can occur without proto presence but this will not lead to a flow experience, for which maximal presence (presence on the proprioceptive, perceptual and cognitive level) is required. Based on the differentiation between the levels of presence, it can be argued that extended presence is similar to mere engagement, the combination of extended and core presence to engrossment and maximal presence with complete immersion. According to Brown and Cairns [55] empathy is one of the barriers for presence.

6.3. Social Presence: empathy with the music

Empathy is based on an understanding and identification but is also characterized by detachment in order to differentiate one's own (self) and the other's (non-self) intentions [63]. The detached position is based on presence as the mechanism to differentiate self and non-self. The understanding and identification is based on social presence that is defined by Biocca & Nowak [64] as "*the feeling that one has some level of access or insight into the other's intentional, cognitive, or affective states.*"

Social presence makes the musician conceive of the music as an intentional being or as the mediated embodiment of a person that is virtually present [65]. This is possible because of *naked intentionality*, the innate capacity to recognize intentions without immediately realizing whose intentions they are and what their content is [53, 66]. The behavior of the music as virtual person is suggested by the moving sonic forms (patterns in the sound energy). These are directly perceived in terms of the musician's action oriented ontology. Structural and semantic aspects of the music are translated into the affective, expressive and emotional world of experience of the musician based on the associations with his own movement repertoire [1].

Social presence can be divided into *social presence-as-process* and *social presence-as-feeling*. The latter is a result of the former and entails the direct perception of the intentions. Social presence-as-process is a layered process that varies from the mere awareness of another's presence (*co-presence*) to a more intense feeling of insight in another's intentions. It enables the musician to recognize the music's D-, P- & M-Intentions as proposed by the dynamic theory of intentions [67, 68]. D-intentions are the result of a practical reasoning process about goals, means and executive strategies and can easily be linked to the interplay of rational and intuitive analysis that leads to the construction of the inner model of the music. P-intentions guide ongoing actions. While D-intentions concern the goal-motive coupling, P-intentions anchor the musician's actions in the actual performance situation. These intentions constitute the goals that are necessary to achieve the object as overall goal (what?). The M-intentions are responsible for the unconscious directing and monitoring of the activity (how?). These intentions find their expression in the orienting basis. D-, P- and M-Intentions are inextricably and causally coupled to each other in an *intentional cascade*. But not all activities require the conscious presence of the three levels of intentions. Well-prepared or practiced activities like musical performance do not always require online monitoring by he P-intentions. In the case of music performance the P-intentions (*goals*) are integrated in the inner model of the music and thereby unconsciously steer the M-intentions. Accordingly, music performance relies on proto social presence-as-feeling, which is an automatic response to something that moves, namely the music [65]. This means that the musician can play intuitively or as commonly expressed: "from the gut".

The automatic empathic response is based on the process of corporeal imitation [1]. Perceived movements in the music (*moving sonic forms*) are, via the body, turned into action-oriented percepts that are associated with expression. Music performance then is about the expression or articulation of the perceived intentions. This entails the enaction of the recognized intentions. The transformation of perceived intentions into a sonic result is monitored by presence, the latter being conceived of as the non mediated prereflexive perception of the successful transformation of an intention in action within an external world [52]. Presence thus makes social presence possible. Therefore we can conclude that an empathic relationship with the music and its expression on the basis of corporeal engagement is only possible when the performance is characterized by the perceptual illusion of non-mediation.

7. CONCLUSION

In this paper we have approached the relationship between musician and musical instrument from a broad philosophical perspective. By using concepts from ecological philosophy, activity theory and flow/presence research, we have elaborated upon a core idea of the embodied music cognition framework, namely that a fine-grained expressive communication of musical meaning results from an embodied interaction with the music.

In music performance the embodied interaction with the music implies the corporeal attunement of the musician to the sonic event that results from the performance. The embodied experience of participating in the musical environment in a direct and engaged way is based on the direct perception of the musical environment and on a *skill-based* coping with the challenges (*affordances* and *constraints*) that arise from the complex interaction within this musical environment. It becomes an optimal embodied experience (*flow*) when the musician is completely immersed in the created musical reality (*presence*) and enjoys himself through the playfulness of the performance. Therefore direct perception of the musical environment, skill-based playing and flow experience can be conceived of as the basic components of embodied interaction and communication pattern.

From the theoretical elaboration of the relationship between musician and musical instrument we learn that these three components are only possible when the musical instrument disappears from consciousness while performing. The resulting transparency of the musical instrument leads to a short-term intuitive apprehension of being one with the musical instrument. The repeated embodied experience of being merged with the musical instrument leads to the musician's long-term intuitive apprehension that it has become a natural extension. The naturalness of the extension follows from the incorporation of the musical instrument into the body schema. The resulting attuning of the extended body to the musical environment enables the musician to freely and expressively communicate his artistic intentions on the basis of the corporeal articulation of the moving sonic forms. Paraphrasing Yeats[1], we can say that musician and music have become one …

8. FUTURE WORK

An important aspect of the embodied music cognition research paradigm is the combination of objective and subjective measurement methods. The theoretical elaboration in this paper provides a conceptual framework that will contribute to the further development of these methods. For example the concepts can be used to guide the construction of questionnaires that probe flow and presence. This asks for a further elaboration of the relation between flow and presence. The elaboration of the three basic components of an embodied interaction with the music can also contribute to the design of new interactive multimedia platforms technologies. Furthermore insights in the process through which the relationship between musician and musical instrument is established, provide a top down strategy for the implementation of an embodied approach to music in instrumental music teaching.

Next to the top down strategies based on the above conceptual framework, an experimental framework needs to be elaborated on the basis of which the conceptual model can be further refined and validated.

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