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Musical Creativity in Performance

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Abstract

Creativity studies have traditionally tended to focus on the evaluation of *products* generated by creative people, which are categorized in various ways according to their reception and impact on society. This orientation has been advanced in various ways by including factors such as process, personality, cultural pressures. While these approaches have produced many important insights, it may be argued that the types of creativity involved in music performance involve additional aspects. Musical performance necessarily entails developing forms of bodily skill that play out in real-time interactive contexts that involve other people, musical instruments and technologies, acoustic spaces, and various socio-cultural factors. Accordingly, some scholars have recently posited relational, environmentally distributed, and cooperative models that better capture the complex nature of musical creativity in action. In this chapter, we review some key approaches to creative cognition, with a special focus on understanding creativity as it unfolds in the real-time dynamics of musical performance. In doing so, we introduce a number of concepts associated with recent work in cognitive science that may help to capture the adaptive interplay of body and environment in the co-enactment of musical events.

Keywords

Musical creativity, musical performance, 4E cognition, skilled coping, bodily skills, socio-cultural

Introduction

The words ‘music’ and ‘creativity’ refer to a vast range of human thought, action, and experience. And the ways these two terms are understood vary culturally and historically (Lubart, 2010; Niu & Sternberg, 2006). What is considered creative today in Berlin or Tokyo would not necessarily have been recognized as such in the same areas a few hundred years ago. Likewise, the artifacts created by different cultures reflect various experiences and conceptions of self, society, and politics, as well as contrasting understandings of the uses and meaning of creativity—across cultures and time ‘creativity’ can entail different boundaries and assumptions. For example, in modern Western societies our concept of creativity has often been guided by what is sometimes referred to as the “myth of the lone creative genius” (see Montuori & Purser, 1995). This involves

the view that creativity—or at least the only kind of creativity worth recognizing—dwells in individuals who are ‘gifted’ (or immanently special in some way or another) and who produce creative products at a distance from the rest of the society. As the composer Aaron Copland (1952) writes in *Music and Imagination*:

It doesn’t matter how many times we tell the familiar story of Bach writing each week for the honest burghers of Leipzig, or Mozart’s relations with the courtly musical patrons of his day; audiences still prefer to think of the musical creator as a man closeted with his idea, unsullied by the rough and tumble of the world around him. (p. 47)

But this conception of creativity is a relatively recent development in Western culture. For the ancient Greeks, the types of performances and artifacts we refer to as ‘creative’ (music, sculpture, dance, storytelling) were thought to be driven by forces external to people who make and do them—this involved the influences of the Muses (the daughters of Zeus), or possession by some other god or a divine spirit. In the Middle Ages, art and music-making often reflected the will of the Christian God, and human creators were thus understood as touched or ‘gifted’ vehicles of divine inspiration. With the humanistic turn in the late Renaissance, this notion of giftedness turned inward so that by the nineteenth century it had become a special property of the artist himself, who was often conceived of as a heroic or god-like figure (see Dacey, 1999).

Creativity in traditional, modern, and post-modern contexts

Changing notions of creativity are intimately connected to shifting conceptions of the relationship between self and society. Pre-modern and non-Western forms of expression often involve iconographic artifacts and performance traditions that do not bear the image or name of the artists who realize them, but rather are intended to maintain the continuity of the broader culture they are associated with. Modern art and performance, by contrast, are often characterized by self-portraiture, ‘innovation’, and the association of a single name with a creative work (a composer, a film director, a choreographer, a painter, and so on).

With the advent of European exploration and colonization, differing cultural perspectives, traditional and ‘modern’ came into contact with each other. Consider, for example, the African and Oceanic art and music that was admired by European painters and composers in the late 19th and early 20th centuries. When Europeans encountered such artifacts and practices at events such as the *Paris Exposition Universelle* of 1889, they did so through the lens of a Western colonialist worldview. But the African masks and Javanese gamelan performances that so captivated creators like Picasso and Debussy are not themselves indicative of the bold forms of individual self-expression they inspired in these artists (Briggs, 1988). Rather, these expressions reflect the traditions and shared identities of the people who make and do them—they denote ‘transpersonal’ (Levi-Strauss, 1988) connections to place and people, and the images, sounds, stories, and

activities that bind a society together. This is not to say that art, music, and storytelling in traditional cultures exhibit no creativity. Even in contexts that are highly prescribed by traditional norms, the act of bringing forth an artifact or a performance will always involve making adaptations to contingencies—e.g., how master carvers or instrument makers adjust to the grain of wood or other materials they are using (Malafouris, 2013), or how a drummer and singer might adapt to, and influence, the movements of a dancer (and the audience) as they co-realize a traditional performance (Bokor, 2017). Traditional artists also make subtle but unique expressions and variations within age-old forms that reflect their own aesthetic contribution to the culture. However, this does require care as in some social groups too much innovation could result in exclusion (Gardner, 1988).

Today, the use of indigenous and traditional imagery, sound and music, dance, clothing, and storytelling in the creation of works and performances by artists who do not come from the cultures such materials are drawn from is subject to growing scrutiny—issues surrounding appropriation and colonialism loom large in the critical discourse. It is also recognized that modern Western culture itself exhibits forms of exclusion and marginalization with regard to creative practices and products that reflect experiences from outside the mainstream of society. These expressions involve approaches to technique, aesthetics, and performance that sometimes challenge established norms. Additionally, a range of gendered, cross-cultural, and critical perspectives, as well as new hybrid forms of production and performance, are intersecting and changing the cultural landscape around the world (e.g., Keenan, 2015). Developments in global communication, travel, digital technology, and cross-cultural awareness have also led to major shifts in how we plan and realize creative projects. In line with this, postmodern conceptions of self-hood have decentered the presumptions of creative autonomy and originality that characterized modern and romantic thinking—creative agents no longer assumed to stand apart from the world; they are now complicated in a shifting ecology of signs, tropes, and critical discourses that must be continually negotiated (Kearny, 1988). Accordingly, conceptions of ‘skill’, the meaning and value of ‘virtuosity’, and the relationship between composer/creator and performer have also been problematized and transformed (Cook, 1999, 2013; Leech-Wilkinson, 2018). Many artists develop their own techniques and methods, which influence, and are influenced by, the creative process; and, as such, many instances of creativity can be seen as ‘performative’ since they are highly dependent on a range of communicative actions between cooperating agents and the society they are situated within.

In brief, it is now understood that creativity often plays out in explicitly collaborative ways, involving various levels of negotiation, adaptation, and interactivity between creative agents who come from different backgrounds and who use various tools and approaches to realize their projects (Glăveanu, 2014; Sawyer, 2012). Interestingly, this recent recognition of the situated, socially interactive, and collaborative aspects of creativity can shed light on areas of human

thought and action that have traditionally been under researched, including the kinds of shared and in-the-moment creative activity associated with musical performance.

Key Perspectives

With the above concerns in mind, we now turn to consider some key perspectives on creativity. As we go, we move from more traditional frameworks that examine the products and processes associated with individual agents, to more recent models that explore creativity as an adaptive multi-agent phenomenon. Here, we place a special focus on current work in embodied cognitive science and ecological dynamics as these perspectives provide theoretical and analytical tools that can help us to better understand the complexities of musical creativity as it unfolds in action. What follows, then, is not intended as a comprehensive overview of musical creativity. Rather, the chapter aims to offer possibilities for thinking about creativity in musical performance that may be useful to performers who work across a range of musical styles and genres.

Creative products

In musical contexts, researchers often examine creativity in terms of the different qualities exhibited by a musical composition, a performed interpretation, or an improvisation. This process usually involves a report of listener responses (such as surprise), and/or an evaluation of balances between novelty and functionality offered by a panel of experts (see e.g., Baer & McKool 2009; Sloboda, 1983). As Sloboda (1985) notes, much of this research has tended to place a strong emphasis on how these elements contribute to the final products of such activities. This focus on the outcome of the performative process aligns with trends in creativity studies more generally that categorize the products (ideas, knowledge, procedures, artefacts, or other items) produced by individuals in terms of their utility, novelty, and perhaps most centrally, their reception by society. For example, a prominent approach explores creative outputs in terms of categories such as ‘big-C’ (major domain changing outputs), ‘pro-c’ (professional-level outputs), little-c (everyday problem solving), and mini-c (the new abilities and understandings that stem from learning processes) (see Lubart, 2010; Runco, 2014). Other approaches make distinctions between the outputs of *adaptors* and *innovators* (Kirton, 2005). The former involves the novel use, combination, and improvements of existing ideas and methods, while the latter concerns the creation of more revolutionary products that significantly alter a given domain.

This product-based perspective can be applied to the outputs of musical performers. For instance, Jimi Hendrix not only redefined the possibilities of the guitar in the context of rock music, but also played a huge role in transforming what performance entailed in that domain. Hendrix’s work might be said to exhibit big-C characteristics and are certainly innovative and transformational—in contrast, perhaps, to the many skilled (pro-c) guitarists who might effectively combine some of the concepts and techniques introduced by Hendrix in their own playing. The Canadian pianist,

Glenn Gould (1932-1982), provides another noteworthy example. Consider the following passage (Henahan, 1982) that appeared in the New York Times shortly after Gould died:

My first encounter with Gould was in the late 1950's at a recital whose opening half included selections from the harpsichord literature—Byrd and Gibbons, probably. The playing was clean and lucid but awfully fussy and affected. At intermission, some pianists were shrugging their shoulders and asking one another what was so wonderful about this Glenn Gould. But then came half a program of Bach, and it was Bach of an exalted quality, an unbroken flow of contrapuntal sound in which details of articulation were not only etched sharply but were used intelligently and sensitively to give shape and meaning to phrases. No one could doubt it then: Gould was a Bach pianist in a class by himself. (p 23).

Gould's performances across the repertoire remain highly regarded among listeners, critics, and scholars. However, it is his interpretations of Bach that made him an international celebrity—and most famously his first recording of Bach's Goldberg Variations (1955). The sales of this recording were extraordinary for a classical music album (Bazzana, 2003). This popularity was due in large part to Gould's innovative technique and vision for the music. He integrated bold new approaches to tempo, phrasing, counterpoint, and dynamics that redefined the performance possibilities of Bach's keyboard repertoire. Notably, Gould also used the recording studio as a creative tool to finely tune his rendering of a given piece and thereby produce a final product that closely matched his aesthetic vision.

Given the reception of Gould's contribution in this area of keyboard performance, one could distinguish him as an *innovator*, place him in the big-C category in this domain of keyboard performance, and so on. But while the qualities and reception of Gould's performances have been described by different authors, the majority of writings on Gould do not provide detailed discussions of the processual aspects involved in his playing style and its evolution. Despite some reports on his personal eccentricities, little has been written on why he opted for certain artistic choices in his performances. Like Hendrix, the creative outcomes Gould produced were guided by a range of factors including forms of exploration, combination, risk-taking, and experimentation while practicing at the instrument. This is to say that although descriptions of the qualities of his artifacts and performances are important aspects to consider, they tell us little about the actual experience of creativity, how it develops and unfolds, and how it can be nurtured or enhanced. Likewise, while the focus on the categorization of creative products and their reception has much to offer—especially for studying and comparing the output of historical figures—this kind of analysis provides only a limited view of what creativity entails.

Creative processes

To address such issues, other approaches to creativity have focused more on the *processes* involved. This orientation characterized post-World War II research in creativity, which was

initially concerned with understanding the kinds of cognitive abilities and personalities required of pilots and spies if they were to be effective in highly adverse and unpredictable conditions (see Guilford, 1967). This approach soon developed into a broader research program dedicated to understanding the factors involved in understanding and nurturing the forms of thought that would contribute to scientific, social, and cultural innovation (see Sawyer, 2012). This work revealed that to achieve high-level creative outputs agents require the capacity (and freedom) to develop multiple possibilities for solving a given problem. These processes are often referred to as ‘divergent’ and ‘convergent’ thinking, which describe how various options and solutions are identified and then combined in ways that function effectively in a specific situation. These forms of thought have since been examined across a range of other contexts (Runco, 2014) resulting in a number of empirically testable hypotheses associated with our ability to “change existing thinking patterns, break with the present, and build something new” (Dietrich & Kanso, 2010, p. 822).

In line with this, other thinkers have explored the combinatorial aspects of creativity and problem solving, examining how seemingly disconnected ideas, concepts, techniques, and ‘frames of mind’ are integrated (Koestler, 1964). Here it is important to note the pioneering work of Wallas (1926), who proposed an influential framework for examining creativity in terms of conscious (explicit) and subconscious (intuitive) processes. These processes involve stages of (a) *preparation*, or the acquisition of knowledge; (b) *incubation*, the subconscious restructuring of knowledge; (c) *illumination*, the flash of insight; and (d) *verification*, the evaluation and application of the new idea. Wallas’ approach inspired a number of more complex perspectives that describe forms of creative problem solving in terms of how stages of knowledge generation and exploration influence each other and how this leads to the production of creative outcomes (Finke, Ward, & Smith, 1992; Helie & Sun, 2010). Put very simply, these processes involve the creation of mental structures that are combined and recombined in novel ways at various levels of processing.

Process-based approaches shift the focus from the product to the creative agent. They may therefore be better suited to examining how musical artists go about creating novel performances. Thinking of Wallas’ model, for example, one might examine how performers engage in forms of technical and conceptual knowledge acquisition (*preparation*) by practicing at the instrument, by exploring new possibilities and combinations, and by learning about existing performance models and traditions. One could then explore how such knowledge is structured and restructured at various levels of thought. For musical performers, such forms of *incubation* may occur over a range of timescales and across various contexts, including periods when they are engaged in activities away from the instrument. These processes may result in *illuminations*, where new technical, perceptual, and conceptual relationships are revealed, and/or where solutions to aesthetic problems are discovered. Such new understandings and possibilities are then subject to *verification*—they are applied and evaluated in terms of their feasibility and functionality in practice. As we mentioned above, more recent models suggest that these ‘stages’ do not need to be understood as unfolding as a linear construct. Rather they influence each other in various ways.

For example, a performer's illumination might involve the need to revisit an aspect of their technical ability before the new ability can be effectively applied in performance. Or it might involve the refinement of a novel technique. We can imagine this in the case of Hendrix, for example, as he developed and refined his remarkable use of amplifier feedback; or, how Gould may have engaged in such processes, for instance, when he used the recording studio to evaluate and perfect his recorded performances.

It should also be noted that in all of these cases, creative products and processes are shaped by the unique histories of specific people who think and act in specific environments. The innovations of Hendrix and Gould were guided by their personality traits and the cultural milieu they were situated within—indeed, the latter plays a central role in whether an outcome can be recognized as creative at all. Someone not familiar with the styles of baroque piano performance might not fully recognize the weight of Gould's contribution. Likewise, Hendrix's innovations might not be appreciated by listeners who have little experience and understanding of rock and blues performance. In other words, products are deemed creative (or not) by communities of practitioners and consumers—how they are received and categorized (e.g., big-C, little-c, and so on) involves a process of “sociocultural validation” (Cropley, 2011). These aspects have been recognized by researchers who, in addition to products and processes, highlight two other ‘P’s’. One of these involves ‘person’, which studies the various personal factors that underpin creative outputs. The other is referred to as ‘press’, which examines how the external ‘pressures’ of the cultural context impact the creative person and shape the products they produce (Rhodes, 1961).

Creativity in Action

Thus far we have seen that understanding creativity in musical performance requires more than the descriptive analysis of products and their reception by society. We can also consider the developmental history and personal traits of the creative agent, the cultural context, and how these influence and the kinds of processes in which they engage. Admittedly, it can be difficult to tease out how such factors actually played out in the lives of many historical performers. We are dependent on the accounts left to us by historians and musicologists, and therefore we are often left to speculate on such details. Nevertheless, models that integrate product, process, people, and press can help to frame studies of living artists and offer useful frameworks for performers to reflect upon their own creative processes. This said, these models may still provide only a partial story of what creativity entails when they place a focus on individual creators and sometimes ignore the socially interactive (interpersonal, collaborative) and material environmental factors involved (Sawyer, 1998). With this last concern in mind, we now turn to consider another context for creativity: the dynamics of performance as it unfolds in action.

Let's begin by imagining a drummer in a modern jazz ensemble named Kim. Kim is an accomplished musician. She has been playing with her band for two years and they are beginning

to make an impact on the local scene. The band performs a mix of original material and arrangements of standards—they are concerned to give the music they play a unique sound, while staying true to certain stylistic models associated with the jazz tradition. Much of their music is up-tempo and high-energy, with many dynamic and rhythmic shifts between sections. These arrangements have formed overtime, mostly through the cooperative dynamics of the group as they rehearse and perform—they develop what works, and revise or discard what does not. Kim plays an important part in this process and her role in performance is challenging as it requires her to maintain the right mix of novelty and stability, of the new and the familiar. Indeed, being a modern jazz drummer is no easy task—it demands precision, technical proficiency, energy, restraint, and coordination. One has to push the music while also supporting it, create grooves that are solid, but not static, and orchestrate dynamics and timbres for the various sections of the arrangements. Kim has to understand, and be able to utilize, combine, and adapt, the various styles that mix together in contemporary jazz performance (e.g., hard bop, free, Afro-Cuban, and so on). She also has to find ways of supporting the evolution of the music by introducing new rhythms and sounds that help to create new moods for each soloist. On a personal level, Kim doesn't want to sound exactly like all other drummers of the jazz scene; she wants to show that she has her own style and identity. However, she also needs to work within and around the recognized constraints of the genre in collaboration with her bandmates, otherwise the elements that characterize this kind of music performance will not emerge, resulting in an unconvincing performance. For Kim, this means finding the right balances of freedom and constraint to offer a performance that is coherent and exciting.

Importantly, engaging with freedom and constraint does not need to be seen as an 'either/or' dichotomy. While playing, Kim can explore the space of action that stands between adherence to well-known musical norms and novel possibilities; boundaries can be explored and pushed. For example, as a trumpet solo begins Kim decides to shift from the common 'four-four' swing time she was playing with the saxophone solo. She moves to a more 'broken-time' feel employing a mix of dotted quarter and syncopated rhythms to give a more 'floating' character to the music (a common creative tactic in modern jazz drumming). However, while these rhythms are more irregular than those of the previous feel, and may imply various polyrhythms from bar to bar, they nevertheless remain connected to the original pulse and to the four-four meter the group is working within. To reinforce this connection, Kim quietly maintains the two and four pulse on hi-hat from the previous pattern. As Kim makes this shift, she notes the sonic, emotional, and physical responses of her bandmates. Most of the band members appear to enjoy the change, as indicated by their smiles and head nods—they adapt musically to the shift introduced by Kim without difficulty. However, while looking at and listening to the piano player, Kim realizes that this change in feel may have come across as too sudden as it appears to have thrown him off slightly. The rest of the band also begins to sense this dynamic and a moment of discomfort and uncertainty starts to spread through the ensemble. Kim decides to return to the original swing pattern for the

rest of the piece. Later on, the band discusses what happened in performance and they practice transitioning into new feels, which also inspires new additions to the arrangement of the piece.

These kinds of experiences should be familiar to anyone who has worked in a cooperative musical setting where communication and collaboration are functioning well. Notably, while the product (the quality of the musical performance) and its reception (the reaction of the audience) are important driving factors here, it is the processual aspects that come to the foreground. Once again, the aspects of the four-part model could be used to analyze this situation in terms of *preparation* (Kim needs to develop the skills and understandings involved in playing with the ensemble), *incubation* (she combines her knowledge in various ways), *illuminations* of new possibilities (e.g., new rhythmic patterns that push the music in new directions), and *verification* (how new ideas are implemented, evaluated, revised, and redeveloped). Additionally, this kind of situation could be explored in terms of the ‘divergent’ and ‘convergent’ thinking processes mentioned above. As Kim generated the idea of changing the feel of the music, she diverged from the present state of things to add something new to the performance. These forms of thinking were then taken up by the group as they collaboratively developed a new arrangement of the piece.

Here it is also worth noting the range of phenomena associated with decision making and thinking in this context. At certain points in musical performance, decision making entails intentional cognitive process that imply conscious deliberation. In other cases, the shifts initiated by performers involve more immediately impulsive and adaptive actions. Importantly, the balances of these forms of thought-in-action are constantly in play within the flow of the music—they evolve within the webs of mutual dependence that characterize a social musical system. This means that in performance contexts ‘thinking’ and ‘deciding’ are dynamic processes that span a variety of experiences and timescales. These observations also suggest that musical creativity in performance cannot simply be reduced to the thoughts and actions of individual agents.

Creativity as socially distributed

While the account discussed above begins with a focus on Kim, the story quickly evolves to include the social context in which the music happens. Kim’s drumming experience changes after an exchange of glances with the piano player, which impacts the unfolding dynamics of the piece being performed; discussion and collaborative experimentation and practice lead to new possibilities, and so on. Again, the creative processes involved here occur over multiple timescales and entail various interactive dynamics that are situated within a social and material environment. These involve bi-directional, or back-and-forth interactions between performers and instruments; between various stages of development (e.g., as performers discuss and enact possibilities given their abilities, understandings, and what they have experienced); and between various modalities of perception (bodily movement and feeling, emotion and empathy, abstract thinking, imagination, counterfactuals, and so on). Accordingly, the idea of a creative ‘product’ or an ‘outcome’ can be reconceived of here as an emergent property of dynamic, interpersonal processes that play out

within a socio-cultural context (e.g., jazz performance). The context provides certain constraints (style, sounds, phrasing, and so on) on the development of the musical system and sets the stage for various goals to arise—e.g., maintaining an enjoyable groove, making the appropriate musical shifts to keep the music exciting, and, more generally, creating a show that will be well-received by the audience. Indeed, the audience plays an important part both in how musicians plan their performances and how their creativity develops in the moment. In some genres the real-time audience responses and feedback are crucial for guiding musical choices and the overall feeling of the event as it unfolds (see Geeves et al., 2016). Just how this plays out will differ from performance to performance as ensemble and audience adapt to each other, and collectively create new shared musical experiences.

The example of Kim and her band reveals an aspect of creativity that has gone relatively under researched (see Glăveanu, 2014), but that is nevertheless central to participatory activities like music performance. Above, we considered the influence of the Western romantic assumption that creativity involves a detached autonomous individual who, in extending their cognitive reach, produces products that impact society to various degrees. More recent product- and process-based approaches have adopted much more nuanced views of creativity, but sometimes still display traces of older assumptions when they limit creativity to the personal domain of individual agents. As we have seen, however, understanding musical creativity in performance requires an interpersonal perspective. Keith Sawyer (2007) makes similar observations with regard to the situated and emergent nature of creativity in the context of jazz improvisation:

Try to imagine a separate drummer, bassist, pianist, and saxophone player, each playing the same song but in separate rooms and unable to hear each other [...]. Imagine then using a recording studio to overlay their four performances to create a single recording; it would sound horrible [...]. The real jazz group would win, hands down. (p. 68)

Sawyer therefore posits that “the creativity in improvised innovation isn’t additive; it’s exponential” (ibid). By this he means to capture the emergent, evolving, and socially distributed nature of creativity in contexts where “no performer is capable of playing every phrase or rhythm” and how therefore “jazz musicians can play the same song hundreds of times over the course of their career, and each time they play something new” (ibid).

These insights highlight the kinds of feedback and feedforward loops that characterize creativity in intersubjective contexts, where co-actors stimulate each other in a dance of invitations and challenges, support and surprises, which give rise to outcomes that are not entirely predictable (Sawyer, 2007). While these kinds of dynamics have been documented mostly in jazz and improvised music contexts (Monson, 1996; Borgo, 2005), they play out in all kinds of musical performance. The members of a string quartet, for instance, rely on and make adaptations to each other, solve musical problems on the fly, and push and pull the music in various and sometimes

unexpected ways to keep the musical environment exciting and ‘alive’ (see Seddon & Biasutti, 2009). In doing so, they must also maintain certain balances and constraints to ensure that the performance does not fall apart. No two performances of a composed work will be same, each entails its own challenges and discoveries. Similarly, the members of a Ghanaian drumming ensemble perform within the constraints of the tradition. But within those constraints, they play with different rhythmic combinations, tempi, and other musical factors (and interact with dancers), and the ways they do this varies from ensemble to ensemble, and from performance to performance. Importantly, considering the socially distributed aspects of musical activity decenters the focus on individual agents and the works they produce, and highlights the collaborative, situated, and performative nature of creativity as it plays out in lived experience (Linson & Clarke, 2018). Musical creativity, by this light, is best understood as a relational process, a ‘social fact’ (Frith, 2012).

These insights advance the concerns discussed at the outset where we touched upon the various ways creativity plays out across a range of collaborative and cooperative contexts (Montuori & Purser, 1995). Accordingly, this perspective can also cast new light on the work of historical musical creators, who, as Copeland points out (above), are always situated within a social environment. The lives and music of Hendrix and John Coltrane, for example, were enmeshed with the culture of the United States in the 1960’s (civil-rights, anti-war, black spirituality), but their groundbreaking explorations of the guitar and saxophone, respectively, were also supported and fueled by their interactions with long-time bandmates. Their performances pushed against constraints across personal, instrumental, musical, social, and cultural domains. The ‘outcomes’ of this then feed back into the culture to redefine the possibilities of performance in their respective domains.

Creativity as technologically distributed

The example of Hendrix brings to light yet another important aspect of the environments in which performers work. This, as we mentioned above, includes technologies like musical instruments, recording devices, and other media (television, film, radio, and so on) and the possibilities and constraints they impose on creative processes. Indeed, to listeners equipped with the expectations imposed by previous models of rock guitar playing, Hendrix’s bold use of amplifier feedback, distortion, and other novel ways of interacting with the technology may have seemed like incoherent noise. However, a closer inspection reveals that he developed a highly refined set of techniques for producing the sounds he did. This is especially apparent in his famous performance of the Star-Spangled Banner at Woodstock, which displays a remarkable soundscape that clearly evokes the sounds of war in juxtaposition with the Anthem (see Clarke, 2005b; Maurice & Wadleigh, 1970). The use of technology plays out in a different way with Gould in his use of the recording studio to refine his recorded performances. In both cases, however, the creative processes and outcomes cannot be separated from the technological devices that afforded their creation. Therefore, in addition to being socially distributed, musical creativity in performance is

often materially and technologically distributed—where the technology plays a central role in defining the constraints and possibilities of the creative act (Borgo 2016).

An Ecological Perspective

Taking the socially and materially distributed nature of creativity into account can help us develop a richer perspective on what musical performance entails (see Clarke & Doffman, 2018). However, this perspective also introduces a rather daunting level of complexity. As we have seen, musical creativity in performance may be understood as an emergent property that arises from interactions that span personal (corporeal-emotional-neural), social, cultural, and technological domains and how these play out over developmental, historical, and in-the-moment time scales (Johnson-Laird, 1988; Pressing, 1987). Additionally, the nature of these interactions is ‘synergistic’, meaning that each component of the extended network involved in the act of musical performance influences, and is influenced by, every other component of the system. This synergistic aspect also highlights the fact that when such interactions are functioning well the system can exhibit certain emergent features that cannot be reduced to the sum of its parts. In line with Sawyer’s insights from above, this means that the properties of a musical performance cannot be fully grasped in terms of an additive or ‘linear’ causal framework. Rather, they emerge from the circular, recursive, or non-linear interactions between a range of components within a complex, evolving, musical ecology (Abraham et al., 2012; Borgo, 2005; Fabian, 2017).

Fortunately, there exist a number of interrelated perspectives associated with current trends in cognitive science that can aid in understanding such phenomena. These perspectives are referred to as ‘embodied cognitive science’, ‘enactivism’, ‘ecological dynamics’, and ‘ecological psychology’ (Hristovski et al., 2011; Kimmel et al., 2018; Kello & Van Orden, 2009; Chemero, 2009). While these approaches support and diverge from each other in various ways, they all examine cognition with an emphasis on the active environmentally situated body. As such, they draw on a number of shared principles and insights that are useful for thinking about musical performance.

Affordances

One of these principles involves the idea of ‘affordances’ (Gibson, 1966; Chemero, 2009). This term describes the possibilities for action an organism discovers through its history of interactions within a given environment. Similar ecological features can offer different affordances to agents exhibiting various physiologies and developmental backgrounds—the manifold ways the affordances of things and situations ‘show up’ and become significant for agents depends on their history of activity within an environment. A chair, for example, implies a different set of affordances for an infant (essentially none), a toddler (as an area of support as they learn to walk), an adult (offers the invitation to sit, or to stand upon for elevation), or for someone skilled in Chinese acrobatics (sitting, stacking, climbing, throwing and so on). Similarly, for beginning

musical performers the affordances offered by an instrument are limited, whereas an expert instrumentalist will be able to discern a much wider and more refined set of possibilities. An advanced trumpet player, for example, will be able to shade the timbre and tuning of sounds the instrument is capable of producing using subtle shifts in embouchure in combination with fine movements of the valves. This trumpeter could also influence the actions of others by communicating shifts in tempo and dynamics. Likewise, the wider range of affordances available to experts means that they can also adjust their playing to meet the needs and invitations of the other members of the ensemble, the acoustics of the performance space, or the specific character of the audience.

In line with this, affordances can also be co-enacted by multiple agents as they develop together in a musical environment. Indeed, the ability to realize and exploit shared affordances is foundational for creativity in performance. Again, such forms of cooperative action and perception do not simply involve responses to environmental causes. They are active, adaptive, or ‘creative’ processes that are guided by the possibilities and constraints inherent to both animal (physiology, growth, learning, perceptual capacities) and the shared socio-material environment (stable features, evolving features). This is to say that, the (social) enactment of affordances is guided by processes that play out over various developmental and in- the-moment timescales, and across corporeal and environmental domains. These processes are shaped by the activity of the agents as they develop in interaction with their environment.

Self-organization

This leads to another key principle referred to as ‘self-organization’. Self-organizing systems can be observed across a range of biological and non-biological contexts, from the way wall-mounted pendulums tend to synchronize over time, to the shifting patterns of behavior exhibited by insect swarming, bird flocking, and schooling fish; from the transforming macro-level structures found in weather patterns, to the micro-level behaviors of heated molecules (Haken, 1977; Strogatz, 1994). In each case, the patterns of behavior that characterize these examples are not simply reducible to the sum of components involved. Rather, it is through the ongoing interactivity of these components that these so-called ‘emergent properties’ arise (Capra, 1996; Schuldberg, 1999). The fields of mathematics referred to as ‘complexity theory’ and ‘dynamical systems theory’ offer useful tools that help to model and describe such phenomena. Here, researchers use non-linear differential equations to examine how the mutually influencing trajectories of a system unfold over time. Most centrally this involves mapping the network in terms of relative instantiations of stability and entropy. This mapping is often represented as a topography: periods where trajectories that tend to converge are shown as basins. These so-called ‘attractor basins’ represent stability and can be discerned across a range of contexts.

In brief, this perspective has helped to illuminate how living systems enact new patterns for action through adaptive goal-directed behavior (Kello & Van Orden, 2009). It has also shown how, in

realizing these new patterns, agents also often gain more flexibility within a given domain—how they are able to work, think, or move in new and more adaptive ways within a given set of constraints (Amazeen et al., 1996; Dixon et al., 2010). An important aspect that characterizes biological systems is that, in order to survive, they need to engage in forms of behavior that exhibit varying degrees of stability and instability. Indeed, if an animal is to create a niche that remains functional under a range of conditions, then the forms of action and perception it develops must be both patterned and flexible, recurrent and adaptable. This involves striking balances between constraint and freedom: too much constraint and the living system cannot evolve or adapt its repertoire of behavior in relation to perturbations that threaten its well-being; too much freedom and the system risks falling into incoherence. This connects with the dynamical systems idea of a ‘strange’ or ‘chaotic’ attractor (Schulberg, 1999), which describes aspects of a system that are stable, but that nevertheless exhibit degrees of freedom within such stability. Moreover, in certain cases these strange attractors can bifurcate, leading to the development of new attractors and attractor layouts across neural, bodily, and environmental trajectories (Abraham et al., 2012).

As children learn to walk, for example, they trade one set of attractors for another (Thelen & Smith, 1994). In doing so, each child traverses a period of instability from which new body-environment relationships and possibilities for actions and understanding emerge (new attractor layouts). Likewise, as infants make their first connections with the social environment, the communicative (and often music-like) patterns of movement and sound they co-realize with caregivers are not determined only by genetic programming, but rather unfold collaboratively as of repertoires of recurrent yet adaptable behavior emerge between them (see Fantasia et al. 2014; Reddy, 2008). Importantly, these developmental processes can involve challenging periods where the trajectories between neural, emotional, muscular, and environmental (material, social) factors exhibit a high degree of instability, resulting in moments of physical, emotional, and social discomfort (falling, chaotic crying, frustration, and so on). Once new patterns of behavior are stabilized, however, a range of new affordances arise.

Creative Performers in Practice

Let’s now turn to consider how the ideas and insights discussed above can help to illuminate aspects of musical performance. The first thing we might note is that musical actions and environments involve self-organizing dynamics that are similar to the developmental contexts just mentioned (Borgo, 2005; Sudnow, 2001). Indeed, human musical performers are living systems and, accordingly, synergetic processes—and the push and pull of constraint and freedom, of stability and instability—are a central feature of the musical environments they participate in and actively shape. For example, learning a new multi-limb pattern on a drum kit requires enacting new ways of engaging bodily with an instrument, and can result in physically uncomfortable and frustrating periods indicative of unstable and dissociated relationships within the body and between the body and the instrument (van der Schyff, 2016). However, this process is necessary

to create new relationships between corporeal, neural, and environmental trajectories—new patterns of action that permit a performer to develop a wider range of musical possibilities, to be more flexible and adaptive (new attractor layouts), and to perceive new affordances in the musical instruments one is using. Similarly, musical ensembles need to co-realize the patterns of interactivity that will allow them to work together effectively (Høffding & Satne, 2019; Salice et al., 2017). This involves being able to keep the dynamics of their performance within certain ranges and developing the ability to understand the communicative gestures they make to each other through sound, bodily movement and gestures, facial emotional expression, and so on. And here too, sometimes a group must experience moments of instability, frustration, and discomfort where these balances break down. These situations need to be understood and solutions must be negotiated. In doing so, the ensemble may develop more flexibility and be able to push the boundaries of their performances in new and sometimes unexpected ways.

These dynamics have begun to be examined empirically. For example, Walton and colleagues (2015) used the mathematical tools of dynamical systems theory to analyze how changes in the structure of a musical environment impacts the experience of creativity for pairs of interacting keyboard improvisers, and how this is reflected in their bodily movements and the ways they adapt to the sonic environment they co-create. Here, musicians performed improvised duets along with different backing tracks while their head, left arm, and right arm movements were recorded, as was the music they made. Variations in the musicians' movements were found that correlated with periods of stability and instability in the audio documents, as well as with the musicians' reports that they felt most creative in environments that afforded a balance of freedom and constraint, where varying degrees of instability could be introduced and resolved cooperatively.

Skilled coping, flow, and risk

Crucially, performing musicians need to develop, both individually and collectively, repertoires of action and perception that can be pushed and pulled in various directions across modalities, that are adaptive, and that can be combined in different ways. Moreover, these dynamics need to be able to play out in the moment, and therefore depend deeply on the knowledge possessed by the body (Gallagher, 2005; Sutton et al., 2011). This idea of 'bodily knowledge' is useful as it provides a richer conception of what knowing and understanding entails—one that looks beyond knowledge as a collection of facts, or knowing *this* or *that*, to include the kinds of practical *know-how* that allows us to move, act, and participate effectively within the social and material environments we inhabit.

As experienced basketball players move down the court, they do not need to focus on all of the movements they produce. Nor do they need to objectively account for all the properties of their environment—doing so would impede their performance. Likewise, a performing musician needs to be able to enact the appropriate bodily (e.g., embouchure, fingering, grip) and social (e.g., tuning, rhythmic coordination) configurations without stopping to deliberate on such factors. Such

forms of contextual know-how are sometimes referred to as ‘skilled coping’ (Dreyfus, 2013; Høffding, 2014) and are shaped through various developmental processes (exploration, adaptation, learning, experimentation, practice and training, and so on). It is also important to note that recognizing the centrality of the situated body for skilled coping does not necessarily mean that there is no thinking or reflecting involved (Høffding, 2018; Montero, 2016; Sutton et al., 2011). However, as we touched on above, performance contexts require a more dynamic and embodied conception of thought-in-action, where more deliberative decision making and problem-solving processes are enmeshed synergistically with movement, context, and feeling. The experience of seamless integration of bodily knowledge and thought-in-action is referred to as ‘flow’ (Csikszentmihalyi, 1996). Flow is related to skilled coping and affordance as it describes an agent’s ability to be engaged in contextually situated activities where the actions and equipment involved become transparent with regard to the moment-to-moment goals and contingencies of the event—whereby agents initiate and engage with the invitations and challenges that arise in the course of performance in a fluid way. It is the capacity to enact and maintain this flow, this deep embodied connection with the environment (being ‘in the zone’), that affords creative action in musical performance.

Affordance, skilled coping, and flow highlight a continuity between cognition, creativity in action, and the objects and tools we use. For example, Merleau-Ponty (2002) discusses how when a blind person uses a cane to navigate an environment, the cane becomes an extension of their perceptual apparatus. That is, how their perception now extends beyond the person’s hand to the tip of the cane (see also Malafouris, 2013). Similarly, an expert cellist will feel an important focal point of contact with the instrument where the bow hair engages with the strings—and they will be able to perceive the variations in texture, tension, friction, and so on that are required to express themselves and engage with the music environment through that material extension of their bodily consciousness. This can be seen with the mastery of a musical instrument more generally, where the instrument is no longer experienced simply as an object—rather, it gains a certain transparency as there is a sense in which the (musical) world is enacted and experienced through it. The saxophonist free-improviser, Evan Parker, discusses this in terms of a ‘bio-feedback’ between himself and the instrument (see Borgo, 2005). He explains that the “instrument teaches you as much you tell it what to do” (Borgo, 2014, p. 95) resulting in a hybrid system where it sometimes becomes difficult to discern who is playing whom. As we began to consider above, developing this deep connection between body and instrument involves synergetic self-organizing processes that play out over periods of practice, exploration, reflection, and performance.

We can also consider how these environmentally extended aspects of perception and action play out in social contexts. Here we can think again of an interacting musical ensemble, where the musicians involved develop shared repertoires of action and perception that allow them to enact rhythmic structures, timing, phrasing, intonation and dynamics, as well as the various forms of emotional and corporeal coordination required to sustain the music they co-create (Keller, 2001).

In doing so, they participate in and shape an extended musical environment by taking on and offloading various tasks to and from each other (e.g., entraining with a beat provided by a drummer; by adapting to each other's phrasing; by leading or following harmonic and dynamic shifts, and so on). In other words, performing musicians enact affordances for each other, resulting in an interpersonal flow and a certain social transparency where strict distinctions between self and other recede into the background (Krueger, 2019). To be clear, this does not mean that the individual is necessarily effaced in such contexts; that the musicians become the same person, or that they have identical experiences. Rather, these situations highlight how individual embodied minds support, challenge, and “extend into” each other as they engage in the realization of a shared musical world. In connection with this, Høffding (2018) has examined the experiences involved in collective music making through a series of interviews with the Danish String Quartet. Notably, this research develops a richer understanding of what ‘musical absorption’ involves—one that ranges from something close to a total immersion in the shared activity, to “frustrated playing” (associated with overcoming obstacles and challenges), to more reflective experiences while performing. Such insights are helping to revise conceptions of what flow and skilled coping entail to include the forms deliberate thought-in-action mentioned above.

Importantly, developing high levels of adaptive skilled coping and flow allows musical performers to trust each other and to take risks by introducing new elements into the system (as with Kim, our drummer). Indeed, risk taking can entail the deliberate initiation of moments of instability as a prompt for creative action—i.e., to keep the music evolving, adaptive, and ‘alive’. Such actions can involve the intentional introduction of subtle shifts in phrasing and dynamics, or the use of novel ornamentation (e.g., in the performance of Baroque music). In other contexts, more radical shifts might take place that involve new ways of interacting with instruments and co-performers that break from traditional models of technique, virtuosity, and even what ‘music’ involves. Examples of these kinds of performance can be found in such fields as ‘new music’, ‘experimental music’, and ‘free improvisation’, where musicians become highly adept at pushing the balances of freedom and constraint, stability and instability, to extremes (Borgo, 2005; Clarke, 2005a).

All of this implies that, to be creative in performance, musicians need to develop skills that go beyond the reproduction of style or the musical notes on the page of a composition. They need to understand how the patterns of action and perception they engage in are developed and gain the flexibility to explore how these patterns might evolve. This means that musicians need to take risks, experiment, and be willing to endure uncomfortable periods of instability and negotiation in order to enact new affordances for thought and (inter)action. It seems likely, therefore, that performers who are unwilling to engage in these kinds of processes will not experience, or exhibit, a high degree of creativity, regardless of the musical genre in which they work. It is important to clarify here that “going beyond reproduction” does not mean abandoning the constraints of culture and the community of practice one is situated within. To creatively contribute to, advance, or challenge a form of musical activity, performers need to have a deep grasp of their culture and

community, and how their work draws on, informs, and transforms that social environment. Otherwise, the products they create risk being irrelevant and possibly incoherent.

Musical Creativity in 4 dimensions

We have begun to consider how creativity in musical performance may be explored in a holistic context that involves the dynamic interaction of a range of factors distributed across personal and environmental domains (bodily, social, material, technological). Such interactions form a self-organizing network of feedback and feedforward loops that stabilize and evolve over various time scales—from in the moment impulses and adaptations, to how creativity unfolds over rehearsals, negotiations, and multiple performances. Generally speaking, we can also say that creativity in musical performance involves playing with and within constraints (Johnson-Laird, 1988). These constraints are defined by the physiological possibilities of performers' bodies in interaction with their instruments; the understandings performers can access (both individually and collectively) through experience; the types of meaningful social interactions available; as well as the norms that prescribe communication and meaning at socio-cultural levels. As we have also discussed, constraints can evolve over time through growth, learning, and exploration, leading to new musical affordances. This can entail discovering new ways to move within a recognized musical domain, as Gould did in his performances of Bach. It can also involve developing a new set of constraints in which one performs and creates, new ways of moving and interacting with instruments and technology, as Hendrix did with his innovative use of feedback. New affordances emerge as a musical performer adapts to new environmental factors. And these factors can involve the introduction of new technologies and the new modes of interaction they enable; and/or engagements with performers from different cultural backgrounds, resulting in the emergence of new, hybrid forms of expression. Once again, these experiences can involve periods of instability as agents enact cognitive structures that afford new social, emotional, bodily configurations at the intersection of self, technology, and culture.

Researchers associated with embodied and ecological trends in cognitive science have recently proposed a '4E' model (Newel et al., 2018) that may be useful for thinking about the intersecting corporeal and environmental aspects of musical creativity (Glăveanu, 2014; Torrance & Schumann, 2018; Wheeler, 2018). By this light, cognition is seen as fundamentally *embodied* (since it is based in the ability to move, sense, and feel), environmentally *embedded* (since it always occurs within a contingent socio-material ecology), and *extended* (since it includes factors that go beyond the brains and bodies of individual agents, like tools, musical instruments, and other people). In being embodied, embedded, and extended, cognition is also *enactive* (since it involves the active bringing-forth of a world of meaningful relationships between agent and environment).

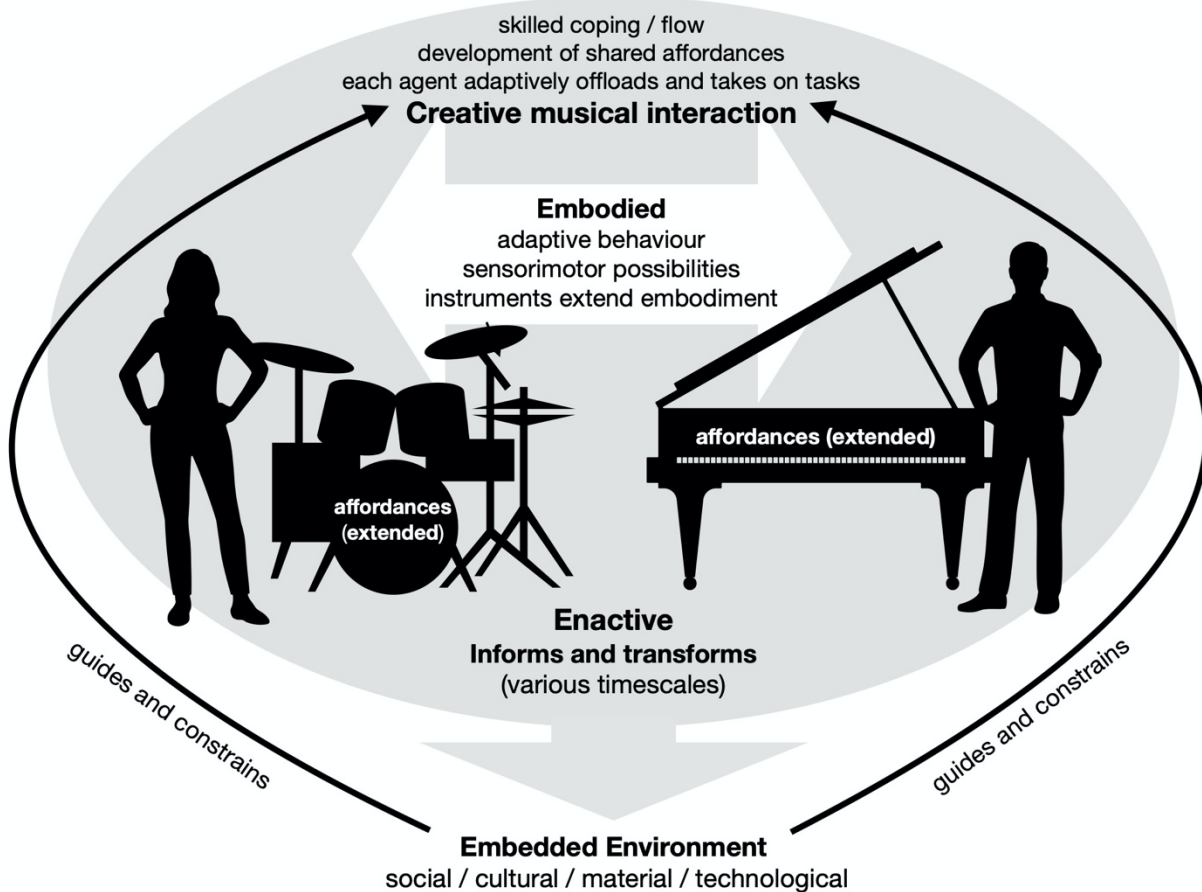


Figure 1: This image sketches the extended cognitive ecology of two interacting musicians (a drummer and a piano player). They bring-forth a musical world by co-enacting patterns of self-organizing behavior that are guided by, and that in turn inform and transform, environmental constraints. The process of musical creativity in performance involves interactions that span neural, corporeal, and environmental domains—a dynamic-synergistic process that plays out over various timescales (in-the-moment, developmental, historical). Adapted from van der Schyff et al., forthcoming.

This model provides a general four-dimensional framework (see van der Schyff et al., 2018, p. 10) for thinking about musical creativity in terms of:

1. The *embodied* dynamics of creative musical action: the motor and affective aspects associated with how musicians simultaneously produce and experience musical sound.
2. The *embedded* dynamics of the shared creative niche: how musicians adaptively situate themselves in relation to the physical, social, and cultural environments they inhabit and actively shape.
3. The *extended* dynamics of the musical event: how musicians use instruments and other technologies as parts of their cognitive domain; and how they adaptively offload and take

on various social tasks related to maintaining and manipulating the balance between stability and entropy within an ensemble.

4. The *enactive* dynamics of the performers' relational development: how unique musical identities and environments emerge through the self-organizing activity of musical agents, and how these processes shape relational and creative constraints in an ongoing way.

A 4E approach can help guide researchers in constructing participant questionnaires, or frame behavioral studies (e.g., see Schiavio et al., 2020). This orientation could also be useful in the context of reflective, first-person analysis of skill development. It is especially well-suited to explore creativity in the contexts of practice-led research and research-led practice (see Smith & Dean, 2009) where it might help performer-researchers gain new phenomenological insights into the experience of creativity in performance. Additionally, a 4E perspective may also be useful for examining and comparing the contributions of historical figures. As we touched on above, performers like Hendrix and Coltrane were *embedded* within the socio-cultural milieu of the mid-20th-century United States. Both artists developed unique approaches to performing that expressed that environment, drawing on, and radically transforming, existing musical conventions. In the process, they and their bandmates *enacted* new sets of relationships and meanings for ensemble and instrumental practice. This revealed new *extended* musician-instrument-ensemble affordances that, in turn, contributed to the evolution of the broader culture.

Conclusion

Approaching musical performance from a synergistic/4E orientation opens exciting possibilities for thought and research. As we have seen, this perspective recasts creative the idea of creative products, processes, people, and press in a more dynamical light—one that seems well positioned to offer new insights into the range of embodied practices and shared experiences associated with musical creativity in performance as it evolves through social, cultural, and technological worlds. Some researcher/performers have begun to use dynamical systems concepts of attractors, entropy, constraint, and self-organization alongside flow, affordance, and skilled coping to examine their creative process from a first-person perspective. Notably, Phil Slater (2020) develops these ideas to offer a rich ecological, embodied, and “constraints-led” account of his practice as an improvising trumpet player. An embodied-ecological approach can also help to address some of the concerns outlined at the start of this chapter. For example, thinking of creativity as an emergent property of multiple interacting agents—and the transformations and adaptation that occur over time in such contexts—could shed light on how creativity unfolds in cross-cultural and cross-disciplinary performance situations. As with the developmental contexts discussed above, it could also help us anticipate and better understand the periods of instability involved as new shared affordances and understandings stabilize and hybrid communities and forms of expression emerge. A 4E model could frame these kinds of processes by highlighting different aspects of the evolving system. Additionally, readers may also be interested to know that historical accounts of musical creativity

inspired by 4E thinking have emerged in recent years, such as Le Guin's *Boccherini's Body: an essay in carnal musicology* (2006), and the treatment of music and song in Tribble and Keene's *Cognitive Ecologies and the History of Remembering* (2011). There is, of course, much more to say about the possibilities of this orientation. And as more research and theory emerges—and as new techniques for analysis and modelling are developed—we can look forward to richer accounts of musical creativity across a range of contexts. For now, we hope that the ideas and insights introduced in this chapter have provided some compelling options for thought that will be useful to musicians of all styles and genres as they engage in their practice as creative performers.

Key Sources

Glăveanu, V. P. (2014). *Distributed creativity: Thinking outside the box of the creative individual*. New York, NY: Springer.

Runco, M. (2014). *Creativity: Theories and themes: Research, development, and practice*, 2nd edition. Amsterdam: Academic Press.

Sawyer, R. K. (2012). *Explaining creativity: The science of human innovation*. 2nd Edition. New York: Oxford University Press.

Reflective Questions

1. How might your experience as a performer be explained in terms of a 4E framework? How do these dimensions interact in your development and practice as a performer? In what ways do you act as part of the embedded and extended world of other creative people?
2. How would you describe the relationship between the absorbed states of consciousness associated with 'flow' and 'skilled coping' with more detached or analytical forms of thinking as you engage in musical performance?
3. What musical activities might be introduced into individual and ensemble practice that could help develop musical affordances, increase flexibility, and stimulate creativity?
4. How have you experienced 'instability' in the musical environments you participate in? In what ways can it foster or impede creativity? How do the ensembles you perform with negotiate novelty, freedom, constraint, and risk taking? How can you make yourself aware of the existing conventions, constraints, and expectations against which your creativity will be measured by others?
5. How might the concepts self-organization and synergy be used as heuristics for thinking about creative development? How might this apply in bodily, social, pedagogical, and cross-cultural contexts? What about interactions with technology?

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References

- Abraham, F. D., Krippner, S. & Richards, R. (2012). Dynamical concepts used in creativity and chaos. *NeuroQuantology*, 10(2), 177-182.
- Amazeen, E. L., Sternad, D., & Turvey, M. T. (1996). Predicting the nonlinear shift of stable equilibria in interlimb rhythmic coordination. *Human Movement Science*, 15, 521-542.
- Baer, J. & McKool, S. (2009). Assessing creativity using the consensual assessment technique. In C. Schreiner (Ed.), *Handbook of Research on Assessment Technologies, Methods, and Applications in Higher Education*. Hershey, PA: IGI Global.
- Bazzana, K. (2003). *Wondrous strange: The life and art of Glenn Gould*. New York: Oxford University Press.
- Bokor, M. (2017). When the drum speaks: The rhetoric of motion, emotion, and action in African societies. *Rhetorica*, 32(2), 165–194.
- Borgo, D. (2005). *Sync or swarm: Improvising music in a complex age*. New York, NY: Continuum.
- Borgo, D. (2014). Ghost in the music, or the perspective of an improvising ant. In G. E. Lewis & B. Piekut (Eds.), *The Oxford Handbook of Critical Improvisation Studies*. Oxford handbooks online DOI:10.1093/oxfordhb/9780195370935.013.005
- Borgo, D. (2016). Openness from closure: The puzzle of interagency in improvised music and a meocybernetic solution. In E. Waterman & G. Siddall (Eds.), *Negotiated Moments: Improvisation Sound and Subjectivity* (pp. 113-130). Durham and London: Duke University Press.
- Briggs, J. (1988). *Fire in the crucible: The alchemy of creative genius*. New York: St. Martin's.
- Capra, F. (1996). *The web of life: A new scientific understanding of living systems*. New York: Anchor Books.
- Chemero, A. (2009). *Radical embodied cognitive science*. Cambridge, MA: The MIT Press.
- Csikszentmihalyi, M. (1996). *Creativity: Flow and the psychology of discovery and invention*. New York, NY: Harper/Collins.

- Clarke, E. F. (2005). Creativity in performance. *Musicae Scientiae*, 9(1), 157–182.
- Clarke, E.F. (2005b). *Ways of listening: An ecological approach to the perception of musical meaning*. New York: Oxford University Press.
- Clarke, E. F., & Doffman, M. (2017). *Distributed creativity: Collaboration and improvisation in contemporary music*. New York: Oxford University Press.
- Cook, N. (1999). Analyzing performance and performing analysis. In N. Cook & M. Everist, (Eds.), *Rethinking music* (pp. 239-261). New York: Oxford University Press.
- Cook, N. (2013). *Beyond the score: Music as Performance*. New York: Oxford University Press.
- Copland, A. (1952). *Music and imagination*. Cambridge, MA: Harvard University Press.
- Cropley, A. (2011). Definitions of Creativity. In M. A. Runco & S. R. Pritzker (Eds.), *Encyclopedia of Creativity* (2nd ed, pp. 358–68). Elsevier.
- Dacey, J. (1999). Concepts of creativity: A history. In M. A. Runco & S. R. Pritzer (Eds.), *Encyclopedia of creativity, Vol. 1 A–H*. San Diego, CA: Academic Press.
- De Jaegher, H., & Di Paolo, E. A. (2007). Participatory sense-making: An enactive approach to social cognition. *Phenomenology and the Cognitive Sciences*, 6(4), 485–507.
- Dietrich, A. & Kanso, R. (2010). A review of EEG, ERP and neuroimaging studies of creativity and insight. *Psychological Bulletin*, 136(5), 822–848. DOI: 10.1037/a0019749
- Di Paolo, E., Buhrmann, T., & Barandiaran, X. (2017). *Sensorimotor life: An enactive proposal*. New York: Oxford University Press.
- Dixon, J. A., Stephen, D. G., Boncoddio, R. A., & Anastas, J. (2010). The self-organization of cognitive structure. In B. Ross (Ed.), *The psychology of learning & motivation*, vol. 52, (pp. 343-384). San Diego, CA: Elsevier.
- Dreyfus, H.L. (2013). The myth of the pervasiveness of the mental. In in J.K. Schear (Ed.), *Mind, Reason, and Being-in-the-World*. Oxford: Routledge.
- Fabian, D. (2017). Analyzing Difference in Recordings of Bach’s Violin Solos with a Lead from Gilles Deleuze. *Music Theory Online* 23, 1 - 23,
- Fantasia, V., De Jaegher, H., & Fasulo, A. (2014). We can work it out: An enactive look at cooperation. *Frontiers in Psychology*, 5, doi: 10.3389/fpsyg.2014.00874.
- Finke, R. A., Ward, T. B., & Smith, S. M. (1992). *Creative cognition*. Cambridge, MA: MIT Press.

- Frith, S. (2012). Creativity as a social fact. In Hargreaves, D. J., Miell, D. E., MacDonald, R. A. R. (Eds.), *Musical imaginations* (pp. 62–72). Oxford, UK: Oxford University Press.
- Gallagher, S. (2005). *How the body shapes the mind*. New York: Oxford University Press
- Gardner, H. (1988). Creativity: An interdisciplinary perspective. *Creativity Research Journal*, *1*, 8–26.
- Geeves, A. M., McIlwain, D. J., & Sutton, J. (2016). Seeing yellow: ‘Connection’ and routine in professional musicians’ experience of music performance. *Psychology of Music*, *44*(2), 183–201.
- Gibson, J. J. (1966). *The senses considered as perceptual systems*. Boston, MA: Houghton-Mifflin.
- Glăveanu, V. P. (2014). *Distributed creativity: Thinking outside the box of the creative individual*. New York, NY: Springer.
- Gould, G. (1955). *Bach: The Goldberg Variations* [Vinyl LP]. CBS Records.
- Guilford, J. P. (1967). *The nature of human intelligence*. New York, NY: McGraw-Hill.
- Haken, H. (1977). *Synergetics: An introduction*. Berlin: Springer.
- Helie, S., & Sun, R. (2010). Incubation, insight, and creative problem solving: A unified theory and a connectionist model. *Psychological Review*, *117*(3), 994–1024.
- Henahan, D. (1982, October 17th). What has Glenn Gould left us? *New York Times*, Section 2, pp. 23.
- Høffding, S. (2014). What is skilled coping? Experts on expertise. *Journal of Consciousness Studies*, *21*(9–10), 49–73.
- Høffding, S. & Satne, G. (2019). Interactive expertise in solo and joint musical performance. *Synthese*, 1-19.
- Høffding, S. (2018). *A Phenomenology of Musical Absorption*. New York: Palgrave Macmillan.
- Hristovski, R., Davids, K., Araújo, D., & Passos P. (2011). Constraints-induced emergence of functional novelty in complex neurobiological systems: A basis for creativity in sport. *Nonlinear Dynamics Psychology and the Life Sciences*, *15*(2), 175–206
- Johnson-Laird, P. N. (1988). Freedom and constraint in creativity. In R. J. Sternberg (Ed.), *The Nature of Creativity* (pp. 202-219). Cambridge: Cambridge University Press.

- Kearny, R. (1988). *The wake of imagination: Toward a postmodern culture*. London: Routledge.
- Keenan, E. K. (2015). *Intersectionality in third-wave popular music*. Oxford Handbooks Online. Doi: 10.1093/oxfordhb/9780199935321.013.36
- Tribble, E. & Keene, N. (2011). *Cognitive ecologies and the history of remembering*. New York: Palgrave.
- Keller, P. E. (2001). Attentional Resource Allocation in Musical Ensemble Performance. *Psychology of Music*, 29(1), 20–38.
- Kello, C.T. & Van Orden, G.C. (2009). Soft-assembly of sensorimotor function. *Nonlinear Dynamics Psychology and Life Sciences* 13(1), 57-78
- Kelso, J. A. S. (1995). *Dynamic patterns*. Cambridge, MA: MIT Press.
- Kimmel, M., Hristova, D., & Kussmaul, K. (2018). Sources of embodied creativity: interactivity and ideation in contact improvisation. *Behavioral Sciences*, 8:52. doi: 10.3390/bs8060052.
- Kirton, M. J. (2003). *Adaption-innovation: In the context of diversity and change*. New York, NY: Routledge.
- Koestler, A. (1964). *The act of creation*. London, UK: Pan Books
- Krueger, J. (2019). Music as affective scaffolding. In D. Clarke, R. Herbert, & E. F. Clarke (Eds.), *Music and Consciousness II* (48-63). New York: Oxford University Press.
- Leech-Wilkinson, D. (2018). The danger of virtuosity. *Musicae Scientiae*, 22(4), 558–561.
- Le Guin, E. (2006). *Boccherini's body: An essay in carnal musicology*. University of California Press.
- Levi-Strauss, C. (1988). *The way of the masks*. Seattle, WA: University of Washington Press.
- Linson, A. & Clarke, E. F. (2017). Distributed cognition, ecological theory, and group improvisation. In E.F. Clarke & M. Doffman (Eds.). *Distributed Creativity: Collaboration and Improvisation in Contemporary Music*. New York: Oxford University Press.
- Lubart, T. (2010). Cross-cultural perspectives on creativity. In J. C. Kaufman & R. J. Sternberg (Eds.), *The Cambridge handbook of creativity* (p. 265–278). Cambridge, UK: Cambridge University Press.
- Malafouris, L. (2013). *How things shape the mind: A theory of material engagement*. Cambridge, MA: MIT Press

- Maurice, B. (Producer) & Wadleigh, M. (Director) (1970). *Woodstock* [Motion picture]. United States of America: Warner Brothers.
- Merleau-Ponty, M. (2002). *Phenomenology of perception*. London: Routledge.
- Monson, I. T. (1996). *Saying something: Jazz improvisation and interaction*. Chicago: University of Chicago Press.
- Montero, B. (2016). *Thought in action. Expertise and the conscious mind*. Oxford: Oxford University Press.
- Montuori, A. & Purser, R. (1995). Deconstructing the lone genius myth: Toward a contextual view of creativity. *Journal of Humanistic Psychology* 35(3), 69-112.
- Newen, A., De Bruin, L., & Gallagher, S. (2018). *The Oxford handbook of 4E cognition*. New York: Oxford University Press.
- Niu, W. & Sternberg, R. J. (2006). The philosophical roots of Western and Eastern conceptions of creativity. *Journal of Theoretical and Philosophical Psychology*, 26, 18–38.
- Pressing, J. (1988). Improvisation: methods and models. In J. A. Sloboda (Ed.), *Generative Processes in Music* (pp. 129-178). Oxford: Clarendon Press
- Reddy, V. (2008). *How infants know minds*. Cambridge, MA.: Harvard University Press.
- Rhodes, M. (1961). An Analysis of Creativity. *The Phi Delta Kappan*, 42(7), 305–310.
- Runco, M. (2014). *Creativity: Theories and themes: Research, development, and practice*, 2nd edition. Amsterdam: Academic Press.
- Sawyer, R.K. (1998). The interdisciplinary study of creativity in performance. *Creativity Research Journal* 11(1), 11-19.
- Sawyer, R.K. (2007). *Group Genius. The creative power of collaboration*. New York: Basic Books.
- Sawyer, R. K. (2012). *Explaining creativity: The science of human innovation. 2nd Edition*. New York: Oxford University Press.
- Salice, A., Høffding, S., & Gallagher, S. (2017). Putting plural self-awareness into practice: The phenomenology of expert musicianship. *Topoi*, 2017, 1–13.
- Schiavio, A., Stupacher, J., Parncutt, R., & Timmers, R. (2020). Learning music from each other. Synchronization, turn-taking, or imitation? *Music Perception*, 37(5), 403-422.

- Schuldberg, D. (1999). Chaos theory and creativity. In M. Runco & S. Pritzker (Eds.), *The encyclopedia of creativity, volume 1* (pp. 259–272). London, UK: Academic Press.
- Seddon, F.A. & Biasutti, M. (2009). A comparison of modes of communication between members of a string quartet and a Jazz sextet. *Psychology of Music* 37(4), 395-415.
- Slater, P. (2020). *The Dark Pattern: Towards a constraints-led approach to jazz trumpet* (Doctor of Philosophy Dissertation), University of Sydney, Sydney.
- Sloboda, J. A. (1983). The communication of musical metre in piano performance. *The Quarterly Journal of Experimental Psychology Section A*, 35(2), 377–396.
- Sloboda, J. (1985). *The musical mind: The cognitive psychology of music*. Oxford: Clarendon Press.
- Smith, H., & Dean, R. T. (2009). *Practice-led research, research-led practice in the creative arts*. U.K: Edinburgh University Press.
- Stephen, D. G., Dixon, J.A., & Isenhower, R.W. (2009). Dynamics of representational change: Entropy, action, and cognition. *Journal of Experimental Psychology: Human Perception and Performance*, 35(6), 1811–32.
- Strogatz, S. (1994). *Nonlinear dynamics and chaos: with applications to physics, biology, chemistry, and engineering*. Reading, MA: Perseus Books.
- Sudnow, D. (2001). *Ways of the hand: A rewritten account*. Cambridge, MA: MIT Press.
- Sutton, J., McIlwain, D., Chrisensen, W., & Geeves, A. (2011) Applying intelligence to the reflexes: Embodied skills and habits between Dreyfus and Descartes. *Journal of the British Society for Phenomenology*, 42(1), 78–103.
- Thelen, E., & Smith, L. B. (1994). *A dynamic systems approach to the development of cognition and action*. Cambridge, MA: The MIT Press.
- Thompson, E. (2007). *Mind in life: Biology, phenomenology, and the sciences of mind*. Cambridge, MA and London, UK: Harvard University Press.
- Torrance, S., & Schumann, F. (2018). The spur of the moment: What jazz improvisation tells cognitive science. *AI & Society*. <https://doi.org/10.1007/s00146-018-0838-4>
- van der Schyff, D. (2016). From Necker cubes to polyrhythms: Fostering a phenomenological attitude in music education. *Phenomenology and Practice*, 10, 4–24.

- van der Schyff, D., Schiavio, A., Walton, A., Velardo, V., & Chemero, A. (2018). Musical creativity and the embodied mind: Exploring the possibilities of 4E cognition and dynamical systems theory. *Music & Science, 1*. <https://doi.org/10.1177/2059204318792319>.
- van der Schyff, D., Schiavio, A., & Elliott, D. (forthcoming). *Musical bodies, musical minds: Enactive cognitive science and the meaning of human musicality*. Cambridge, MA: MIT Press.
- Varela, F., Thompson, E., & Rosch, E. (1991). *The embodied mind: Cognitive science and human experience*. Cambridge, MA: MIT Press.
- Wallas, G. (1926). *Art of thought*. New York, NY: Harcourt- Brace.
- Walton, A., Richardson, M. J., Langland-Hassan, P., & Chemero, A. (2015). Improvisation and the self-organization of multiple musical bodies. *Frontiers in Psychology, 1*. doi:10.3389/fpsyg.2015.00313
- Wheeler, M. (2018). *Talking about more than heads: The embodied, embedded and extended creative mind*. *Creativity and Philosophy*. London: Routledge.