

# Ecologies of Practice in Musical Performance

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*Abstract: This article presents an ecological model of musical performance drawn from the field of Gibsonian Ecological Psychology and the techniques of Actor-Network Theory as explicated by Bruno Latour and others. Citing a wide body of empirical research, it is argued that musicians and their musical instruments exist in an ecological relationship at the level of embodied gesture. Furthermore, it is proposed that every act of musicking amounts to a construction of a network of actors that define an “Ecology of Practice,” a thick description more fully encompassing the complexities of musicking than traditional notions of performance practice.*

*Résumé : Cet article présente un modèle écologique de l'interprétation musicale inspiré du champ de la psychologie écologique gibsonienne et des techniques de la théorie de l'acteur-réseau telle que définie par Bruno Latour et d'autres. Sur la base d'un large corpus de recherche empirique, il avance que les musiciens et leurs instruments existent dans une relation écologique au niveau du geste incarné. En outre, il propose que chaque acte consistant à jouer de la musique corresponde à la construction d'un réseau d'acteurs qui définissent une « écologie de la pratique », description dense qui englobe plus pleinement les complexités du fait de jouer de la musique que les notions de pratiques performancielles.*

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“He sits on the bench, engages the pedals, and pulls out the stops, he sizes up the instrument with his body, he incorporates its directions and dimensions, and he settles into the organ as one settles into a house.”

Maurice Merleau-Ponty (2012 [1945]: 146)

Writing in 1945, Maurice Merleau-Ponty's description of the psychological state of an organist familiarizing himself with a new and unfamiliar organ is notable not only as part of a work whose objective in

breaking down the dualisms of subject and object, perception and cognition holds striking similarities to that of his American contemporary, psychologist James J. Gibson but also as an early foray into the study of the psychological complexities of musical perception and performance (Sanders 1993: 289). Merleau-Ponty describes the organist settling into an environment, a habitat, for whom the gestures of interaction are ingrained *gestalts*, wherein a “direct relationship” is established between the organist’s body and the organ (Merleau-Ponty 2012 [1945]: 147). The parallels with Gibson’s work are undeniable, a musical analogue to Gibson’s concept of “direct perception” by an organism of the affordances of an environment forged through cycles of perception and action (Gibson 2002 [1972]: 77). Following Merleau-Ponty’s early insight, engagement with “musicking”<sup>1</sup> as a Gibsonian ecological situation has recently begun to be explored more thoroughly, including the semiotic dimensions of ecological listening (Clarke 2005), the confluence of ecological listening and ecological psychology in the construction of the opposition of music and noise (Windsor 2016), and the constraints of musical instruments on the act of performance (Windsor and de Bezenac 2012).

The rich and complex act of musicking has been and continues to be examined from several perspectives: from the cultural factors shaping, and shaped by, the practice of performance, to the social dimensions of the musical situation; from the politics and economics of a cultural practice, to the empirical psychological or cognitive picture of the performer in action. Among these diverse approaches, performance is often, even if inadvertently, presented in a sort of Cartesian Dualism: the cultural and social dimensions of “performance practice” seem to be independent from the embodied cognition and action of the individual performer. For example, many culture-centred approaches offer a top-down perspective, evaluating a performance tradition as a whole. Such approaches may offer a picture of what an individual musical situation may have been like by contextualizing new primary source material within the context of stabilized social collectives. On the other hand, many cognition-centred approaches tend to offer a bottom-up perspective, gathering empirical evidence from individual musical acts to build a broad and predictive model of the human mind during performance, a model from which the social collective is more or less an emergent property. This is not to say that scholars have not sought to cross this divide. Indeed, practices in ethnomusicology and, more recently, performance studies<sup>2</sup> connect the social and cognitive in compelling ways, examples of which will be discussed below. As such, this paper does not seek to solve a specific problem or argue that a social-cognitive divide is prevalent across all areas of music studies. Rather, it attempts to present a new, more systematic, and comprehensive framework with which to connect the two.

The gulf that can sometimes be found between social and cognitive studies of musicking is analogous to what Philippe Descola calls the “anthropological dualism” of cultural vs. nature-centred approaches in his field (2013: 27). Social and cognitive approaches to performance studies may each be left alone, their respective epistemologies borne of conflicting ontologies — as Descola says about anthropology, “Each one ends up at a point from which the other believes to be departing” (54). However, one can reconcile these approaches by stepping back from this dualism to find new ways with which to allow these perspectives to inform and shape one another (54). This paper presents a Gibsonian ecological<sup>3</sup> model that draws upon empirical research and the techniques of actor-network theory as explicated by Bruno Latour. I present musical performance as a network of “actors” constructed ecologically by an individual through gesture. In this view, individuals construct and embody what I call “ecologies of practice.” Though this paper primarily takes the viewpoint of a performer in action, this theory is generalizable to any individual situated in the act of musicking, including performers, composers, listeners, or participants of all kinds and across all cultures.

## Performance as Ecology

Over the span of a quarter century, Gibson presented a new model of perception which rejected a linear computational and abstract symbol-processing model of the mind (Goldstein 1981: 191). Rather, Gibson postulated that organisms directly perceive what he calls the “affordances” for agency in their environment (Gibson 1979: 18). As mentioned above, Gibson’s perspective was symbiotic with Merleau-Ponty’s contemporaneous deconstruction of the dichotomies of subject and object, organism and environment, perception and action. From the moment of birth, an organism moves, reaches, and grasps. Every action precipitates new perceptual stimuli, which in turn shape decisions for future actions and construct the organism’s environment as an assemblage of affordances. That is, an organism’s environment, as defined from an ecological perspective, is a reality specific to the individual organism as perceived through the lens of affordances assembled from the individual’s unique experiences.

In considering an ecological model of performance analogous to Gibson’s ecological model of perception, consider the musical counterparts to the three pillars of Gibsonian Ecology: perception and action, perceptual learning, and adaptation. A performing musician can be said to enact cycles of perception and action much like an organism in its environment. The relationship between perception and action can be represented by a continuous feedback loop (Fig.

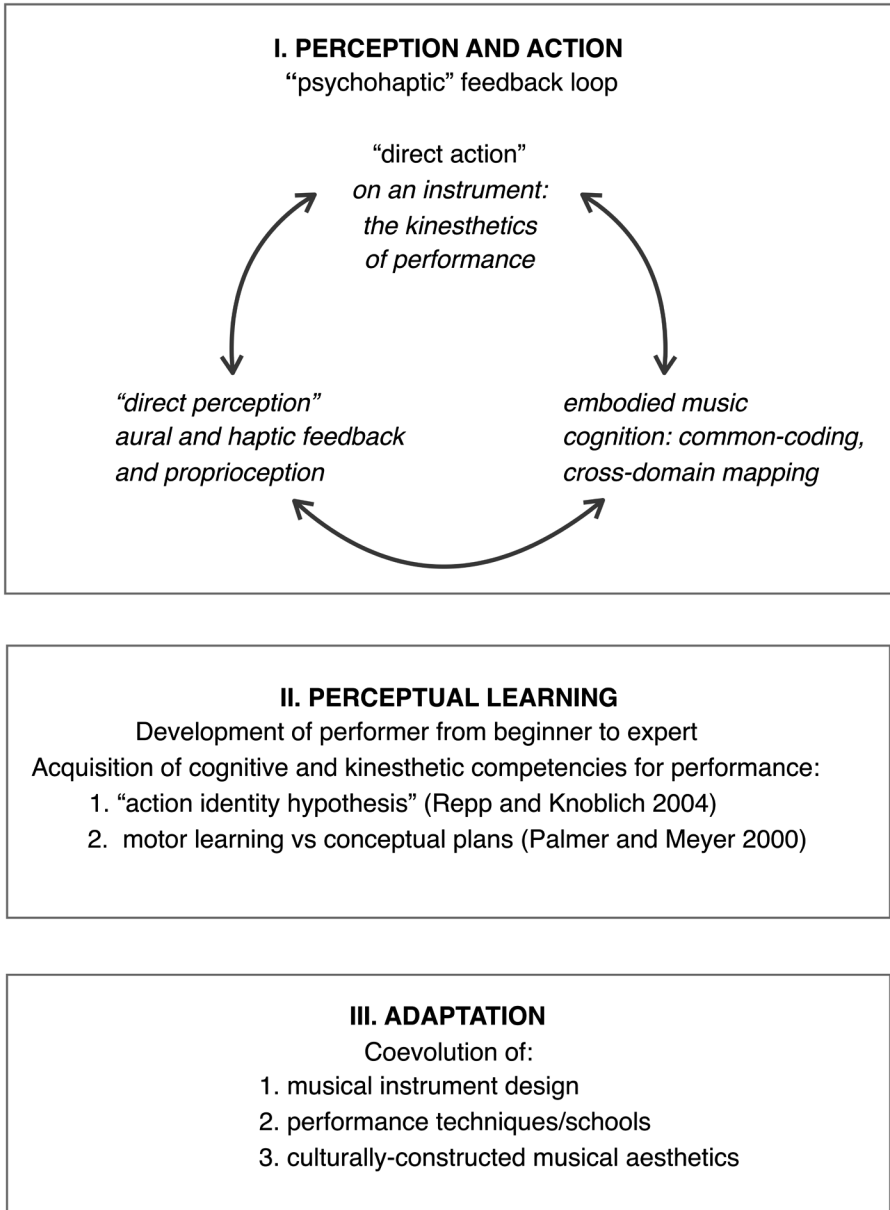


Fig 1. Perception and Action, Perceptual Learning, and Adaptation in a Gibsonian ecological model of musical performance.

1). Consider a performer playing a familiar piece of music. She sees the music on the page and immediately conjures up an aural sound concept, an “auditory image” (Highben, Zebulon, and Palmer 2004: 64). She knows what this passage sounds like, the result of an unmediated cognitive realization of the notes on the page, the accuracy of which is a function of musical skill and level of experience with the given piece. As she is seeing and “hearing” the music on the page, she musters up her carefully honed technique and operates the mechanics of the instrument using kinesthetic action to generate the desired sounds. As the music emerges from the instrument, it is immediately fed back into the performer aurally and haptically. This feedback influences both decisions relating to the past, “Is this the sound I intended to make?” and future, “How should I play the following passage given what I just heard?” or “Should I change what I had originally intended to do as a result?” This stage might simply be described as music cognition, the ecological dynamics of which will be thoroughly considered below. Despite the visual mapping in Fig. 1, this so-called “psychohaptic” feedback loop is not a linear process with stages moving in one direction or another. Rather, it is constantly moving in all directions at once at many conscious and unconscious levels.

The process of perceptual learning is evident in the development of the performer from beginner to expert. It is borne out through countless cycles of perception and action during practice, lessons, and formal performance. Returning to our hypothetical performer, from the first moment she picked up her instrument she has honed her abilities at kinesthetic action, sharpened her aural perception, and developed an increasingly sophisticated cognition of music. Through cycles of perception and action, perceptual learning achieves an increased “resonance” to the affordances of the instrument and music at hand; a symbiotic relationship develops between aural perception, kinesthetic action, and cognition. To quote Gibson, “the orienting of the organs of perception is governed by the brain so that the whole system of input and output resonates to the external information” (1966: 5).

The last pillar of Gibsonian Ecology, adaptation, can be traced through the evolution of musical instrument design, schools of performance techniques and pedagogy, and shifting cultural musical aesthetics in the time and place of the performer. How these factors evolve and interact of course encompasses whole fields of study. However, the fact of their interaction, and the specific ways in which they shape perception, action, and perceptual learning is central to the thesis of this paper and will be elaborated upon below.

Gibson’s theories garnered skepticism early on regarding their epistemological veracity. However, as theoretical and neurological cognitive science has advanced over the past quarter century, Gibsonian ecological

psychology has been found to be remarkably symbiotic with empirical research. On the other hand, regardless of whether Gibson's model of perception is physiologically supported, it has been argued that Gibsonian ecology can serve as a powerful tool for discourse on metaphysics and epistemology (Sanders 1993: 293). One can thus argue for an ecological model of music performance on its own merits as a means to untangle the intersecting and often conflicting ontologies of music discourse.

Empirical support for Gibsonian ecology can be found in the back-propagating, connectionist model of the brain and its applications in machine learning software. This model is remarkably isomorphic with the Gibsonian idea of "direct perception" and the process of perceptual learning through feedback cycles of perception and action. Other evidence for the empirical veracity of Gibsonian ecology can be found in common coding theory in cognitive neuroscience, a model that is also highly sympathetic to Gibson's and Merleau-Ponty's approaches. Furthermore, current theories of a mind centred on embodied cognition are consistent with Gibson's principle of direct perception.

In the connectionist model of the brain, the process of back-propagation accounts for learning in both perception and action through the construction of neural networks stabilized through repeated reinforcement (Churchland 1995). First introduced by Werbos (1975) in the period between two important works by Gibson (2002 [1972] and 1977), the back-propagation model offers a physiological grounding for Gibson's theories of direct perception and perceptual learning, eschewing intermediary representations in the cognitive process. More recently, this model has been applied toward so-called "deep learning" as a means for software to network connections within data sets through recursive refinement, compelling novel solutions from such connections without intermediary logics (LeCun, Bengio, and Hinton 2015).

Turning to common coding theory, numerous studies support Gibson's model of perceptual learning formed through cycles of perception and action and the ecological model of performance presented here. Common coding postulates that action perception, action imagery, and kinesthetic action share a common cognitive domain (van der Wel, Sebanz, and Knoblich 2012: 102). Studies supporting this hypothesis show, for example, that observers are better able to predict the outcome of kinesthetic action when observing their own past actions vs. those of others (Knoblich and Flach 2001: 471), or when observing actions in which they have considerable first-hand expertise vs. those where experience is primarily observational (Aglioti et al. 2008). One brain study showed that dancers exhibited similar brain activation when observing dance patterns for which they had trained physically or visually, but different activation when observing patterns for which they had not trained

at all and thus had no prior gestural perceptual learning (Cross et al. 2009). Additionally, the discovery of so-called “mirror neurons” has offered a possible physiological explanation for these results. Such neurons fire during both action and perception, suggesting that the common coding of perception and action may be hardwired in the brain. However, the specific theoretical implications of mirror neurons, and indeed their existence in humans, remains hotly debated (Kilner and Lemon 2013).

Connecting common coding to the music field, Bruno Repp and Günther Knoblich postulate an “action-identity hypothesis” linking auditory perception and kinesthetic action. They present a study in which pianists were able to recognize their own performances months later and could identify recordings altered to leave only nuance in timing (Repp and Knoblich 2004: 607). In a later study, Repp and Knoblich show that higher levels of performance expertise can shape pitch perception accuracy, both positively and negatively, depending on the mapping of perception with the action of procedural memory (Repp and Knoblich 2007: 7). In sum, empirical evidence seems to support Gibson’s model based on perceptual learning through cycles of perception and action.

Other similarities to Gibson’s theories can be found in embodied cognitive theories of mind. Conceptual metaphor theory, as developed by Mark Turner, George Lakoff, and Mark Johnson, among others, argues that much of human communication and signification is constructed through mappings of concepts across domains. The foundations of such mappings trace back to our embodied experience of the world, structured through pre-conceptual image schemas. The concept of image schemas is roughly analogous to Gibson’s catalog of so-called “invariants” in the environment that govern new mappings in direct perception. As humans encounter new signifiers, they are interpreted through similarities in the underlying image schemas, much as an organism identifies invariants in stimuli during novel perceptual situations to construct a meaningful environment. Applications of conceptual metaphor theory to music can be found most notably in the work of Lawrence Zbikowski. Utilizing the principles of cross-domain mapping, Zbikowski demonstrates how we construct, through established signifiers, new musical hermeneutics grounded in the invariants of abstract, generic conceptual space (Zbikowski 2005). Music theorist Steve Larson identifies three metaphorical forces central to the syntax and semantics of common Western music: magnetism, gravity, and inertia (Larson 1997-98). Each provides a tool for mapping musical sound to kinesthetic experience, providing an embodied cognitive foundation for a large part of the musical hermeneutic process. Additionally, scholars in evolutionary psychology postulate that music itself may have evolved not for mating, but specifically as a means for embodied cross-domain mapping,

increasing the human mind's capacity for abstract thought and paving the way for the development of language (Cross 2005: 37).

## Gesture in the Ecology of Performance

It may be all well and good to claim that one can map the act of musical performance onto a Gibsonian ecological model, but how *exactly* do these pieces connect? How does embodied music cognition founded on conceptual metaphor connect with aural perception, and how exactly are they both shaped by and shaping the kinesthetic act of performance? Furthermore, precisely how do pedagogical schools, culturally-defined performance practices, and musical instrument design influence all three parts of the perception and action psychohaptic feedback loop? In other words, where does the “rubber meet the road”? I argue that the element uniting all these diverse processes is gesture. I refer to gesture in a literal sense — as kinesthetic action, i.e., patterns of tension and release in the human musculature system — but also in the metaphorical sense, defined generically by Robert Hatten as an indivisible “energetic shaping through time” (2004: 287).

In practice, it can be difficult to pin down exactly where a gesture begins and ends in both physical and metaphorical domains. Hatten's general definition of gesture provides a cogent basis from which to reason about gesture's role in all domains of perception, action, and cognition. Most of the studies cited above can be seen as pertaining to gesture. For instance, effects of common coding theory are primarily observed in a gestural context, illustrating physiological and behavioural connections between the “energetic shaping through time” of action perception, action imagery, and kinesthetic action. Embodied metaphor theory and Larson's musical forces offer the means by which gesture is mapped from the physical to the aural and up the semiotic ladder.

Empirical support for the primacy of gesture in action, perception, and perceptual learning in music is vast. In examining spontaneous hand gestures, Rolf Godøy provides insight into what he calls “motormimetic cognition”: the idea that motor imagery and perceived or imagined musical sound run in parallel (2009: 205). Godøy argues that hand gestures have a “privileged role in motormimetic cognition of musical sound,” in that they “trace the *geometry* (i.e. elements such as pitch contour, pitch spread, rhythmic patterns, textures, timbral features), as well as convey sensations of *effort* of musical sound” (205; emphasis in original). Following the latter point, Jan Schacher and Angela Stoecklin demonstrate that inertia, rather than absolute spatial position, is the central carrier of emotion in dance gestures (2011). Additionally, Marc Leman



and Luiz Naveda examine the ways in which musical cues embody dance gestures (2010).

There is also a body of research connecting physical gesture with musical expression. Sofia Dahl and Anders Friberg studied how subjects rate the emotional intentions of performers based on full and partial views of their performances. Specific gestural geometries from one performer to the next differed greatly, being unique to the physicality of their instruments, but invariants in the physical gestures of each were perceived as associated with sadness, happiness, and anger (Dahl and Friberg 2007). Bruno Repp sought to define the constraints of expressive timing in a study that asked listeners to rate the expressive timing of one specific gesture in Robert Schumann's "Träumerei." The most experienced listeners rated parabolic temporal shapes the highest (Repp 1992). This suggests certain optimal energetic shapings through time within specific cultural musical practices.

Evidence suggests that there is a very deep connection between the gestures of performance and the perception of musical meaning. I have demonstrated how in organ performance specific Baroque fingering patterns and figures generate unexpected variations in note lengths, and hence construct idiomatic musical gestures (Harlow 2013). Similarly, Joel Speerstra argues, with regards to Baroque keyboard figures and clavichord technique, that for a meaningful understanding of baroque keyboard aesthetics one cannot separate the rhetorical figure from the subtleties (the energetic shaping through time) of the physical gesture at the keyboard, and one cannot separate the physical gesture at the keyboard from the resulting musical rhetoric (2004). Music teachers regularly utilize the cross-domain fluidity of gesture. They exert a great deal of energy coaxing students to execute a musical passage with precisely the right kinesthetic action (i.e. physical gesture) toward specific musical ends. Pedagogues often unconsciously utilize arm gestures, body gestures, and vocal gestures to influence the kinesthetic actions of the pupil at the instrument.

It follows that musical gesture and kinesthetic gesture are not only the fundamental gestalts underlying the cognition of most musical meaning and the performance of musical expression, but are also in fact one and the same from an ecological perspective. In connecting gesture from the domain of physical action on an instrument to its role in music cognition, I reject Jonathan De Souza's delineation, following the work of David McNeill, between the gestures of musical interpretation (such as spontaneous hand gestures and swaying of the body) and those used to operate a musical instrument (De Souza 2017: 2). In an ecological model of performance, gesture is gesture.

The central role of gesture, both physical and metaphorical, in musical performance is clear. Listeners perceive musical meaning directly at the level of

embodied gesture, performers define their own “action identities” at the level of physical gesture, and perception and execution of gesture occupy the same cognitive domains through common coding. Consequently, performers and their instruments can be said to exist in an ecological relationship exactly at the level of embodied gesture. Performers exhibit direct perception of musical meaning at the level of gesture, but at the same time play their instruments at the level of physical gesture through what one might call “direct action,” the common coding mirror to Gibson’s direct perception. The idea of direct action is akin to Merleau-Ponty’s description of the organist settling into the habitat of the instrument, wherein meticulous, conscious control of every minute action gives way to gestalt, well-practiced gestures which “discover emotional sources, and ... create an expressive space” (Merleau-Ponty 2012 [1945]: 147). De Souza examines how Martin Heidegger’s concept of *zuhanden* predates Merleau-Ponty’s account and appears to anticipate an ecological view of music performance. According to Heidegger, an object “withdraws” from one’s awareness and becomes *zuhanden* following significant experience with its manipulation — a process akin to perceptual learning (De Souza 2017: 20). What Heidegger misses in the *zuhanden* process is a cohesive exploration of the agency of cultural norms, and of an individual’s history of perception and action. While the cultural dimensions of this process are taken up by Merleau-Ponty, he neglects to explain the construction of the gestalts of object manipulation.

## Ecologies of Practice

Having demonstrated the essential and central role of gesture in the ecology of music performance, let us revise the diagram of this model to illustrate where gesture fits into perception and action, perceptual learning, and adaptation (Fig. 2). In the psychohaptic feedback loop of perception and action, the performer engages the affordances of the instrument through direct action at the level of physical gesture. That is, she does not simply “play the right notes at the right time” as Bach is said to have quipped,<sup>4</sup> since there are often too many notes and nuances going by too rapidly to consciously control every one in a linear computational manner (Wolff, Mendel, and David 1998: 412). Rather, a performer, through practice and years of guided pedagogy, engages groups of notes shaped through complex physical gestures that correspond to the desired musical gestures. During this act of performance, the intended and perceived musical gestures continually mediate the direct action of physical gesture, and vice versa, through aural perception, haptic feedback, and proprioception. The performer is able to directly execute the instrument’s affordances for musical

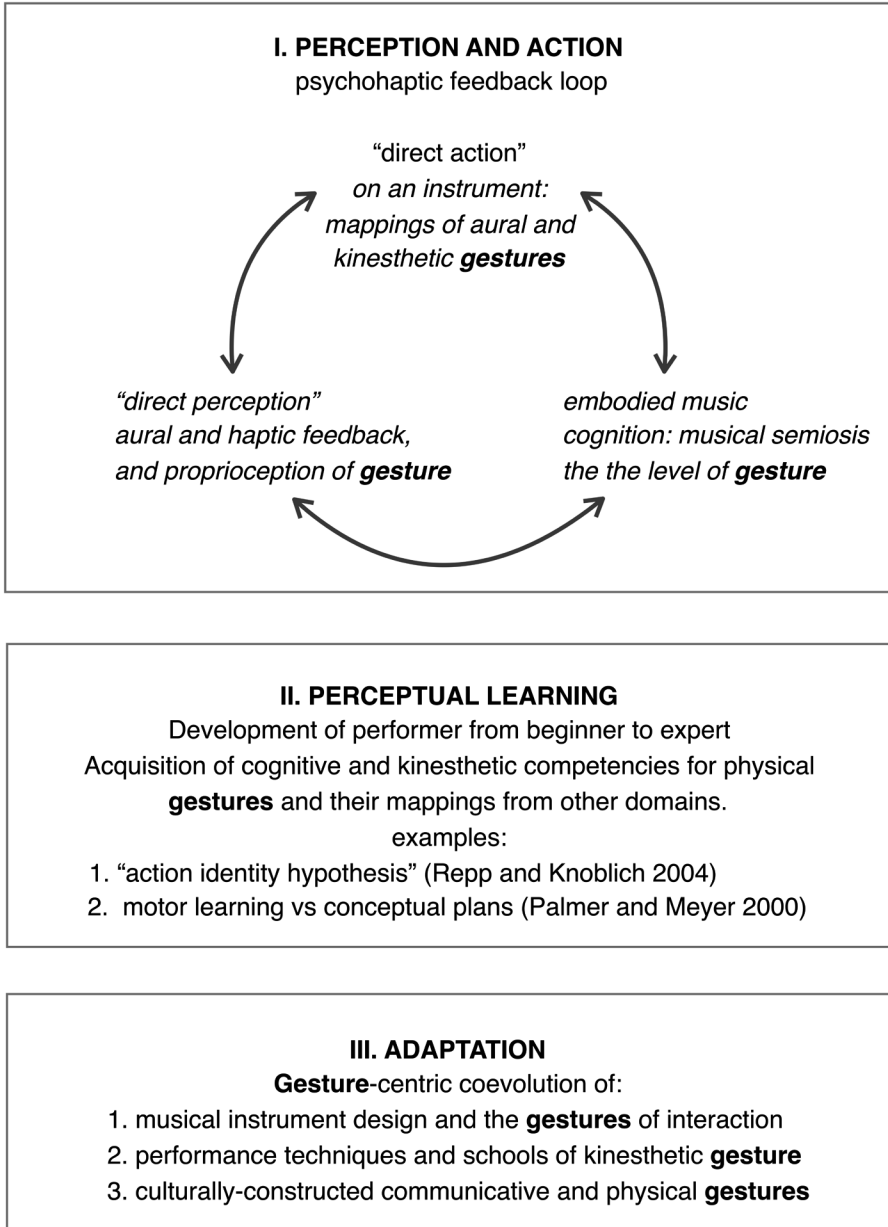


Fig 2. The role of gesture in a Gibsonian ecological model of musical performance.

gesture through countless cycles of perceptual learning, developing cognitive and kinesthetic gestural competencies along the way from beginner to expert. The principles of perceptual learning grounded in musical and physical gesture are illustrated in Repp and Knoblich's action identity hypothesis, as well as in Palmer and Meyer's research suggesting that the physical gestures and schemas of instrumental performance become more abstract as expertise increases (Palmer and Meyer 2000).

While the psychohaptic feedback loop of performance and the process of perceptual learning are locked in a reciprocal relationship, this dynamic is set up, or assembled, through what Gibson calls adaptation. The ecology of the performer and instrument is a symbiotic relationship forged through evolution, much as the ecology of an organism in its environment. The coevolution of the ecology of the performer and instrument relies on many factors, including the evolution of musical instrument design, performance techniques, pedagogical schools, and cultural musical aesthetics.

This last segment of the Gibsonian trivium, adaptation, has far reaching consequences in the context of the ecology of performance. Factors, or "actors," in this category construct the process of perceptual learning and the perception/action feedback loops of each performer. It is here where the social meets the psychological, where forces outside the performer's control shape his or her individual development, abilities, and musical traits. And again, it is gesture that connects these forces with the ecology of the performer in situ. Gestures in the form of kinesthetic action and response shape the evolution and design of musical instruments themselves. Patterns of gesture and metaphor define and shape the evolution of instrumental technique and schools of pedagogy and performance. Gestures from other social domains shape the physical embodiment of the individual, from socially constructed communicative gestures, posture, and walking gaits, to embodiments of gesture in dance, and the vocal cadences of language. There is a growing body of research studying the broader role of gesture in the construction of social dynamics, and the very foundations of human cognition. Michael Corballis (2003) offers a provocative exegesis on the gestural origins of human language itself, while Jessica Phillips-Silver, C. Athena Aktipis, and Gregory Bryant (2010) offer an evolutionary account for what appears to be our hardwired propensity for conveying meaning through embodied physical and metaphorical gesture.

The gestures that form the foundation of perception and action cycles and the process of perceptual learning in the individual are themselves mappings of the gestural discourse of adaptation. Exactly *how* gestures in other social and developmental domains map onto the domains active in performance is a question which is only beginning to be addressed. Naveda and Leman have

developed sophisticated analytical means with which to measure and analyze spontaneous physical gestures in response to music using the mathematics of topology (2010). Guerino Mazzola has applied analyses of the geometry of gesture to the study of collaborative improvisation (2009), while Friberg has built complex computer models to generate simulations and reconstructions of the expressive gestural nuances of performance (2006). Additionally, I have argued that the dynamic “inertial discourse” of gesture, rather than topology, forms the invariants which compel mappings across domains (Harlow 2016).

Regardless of exactly how gestures beget gestures across domains, the simultaneous social and psychological gestural construction of perception and action and perceptual learning in an individual compels approaches in music studies that eschew both a top-down analysis of the performer as arising from the social, and a bottom-up picture of the performer as psychologically determined. Such approaches would side-step Descola’s “anthropological dualism.” As such, I contend that every act of musical performance is a construction of what I call an “ecology of practice.” To gain a thick description of any given performance situation, or to generalize about a genre of performance synchronically or diachronically, one must “follow the actors,” to quote Bruno Latour, that brought the performer’s ecology of practice into being. It is not enough to simply posit casualty between a cultural or social dynamic and the act of performance, nor is it enough to gather empirical data on the act of performance without considering the social fabric. As Latour and other scholars of actor-network theory (ANT) posit, one must trace the mediators networking these actors and agents.<sup>5</sup> In the case of music, we must trace them to the point where the social meets the physical. That point, I contend, is at the level of musical and physical gesture in the context of a performer’s ecological situation of performance, or ecology of practice. While each performance situation represents a unique ecology of practice, some can be said to be variations of another, or tokens of a type, if the actors are stabilized, as in a defined performance genre or “performance practice.”

When examining a performer’s ecology of practice, one must trace how mediators shape the gestures underlying the perception and action feedback loop of the performer in action, culminating in the ecology of practice at hand. Such mediators, actors, and agents may include all the physical, psychological, pedagogical, aesthetic, and social — both human and non-human — factors underlying adaptation. In tracing and normalizing the diverse actors that are constructed through direct action by a performer, we effectively give equal weight to the two poles of nature and culture as described by Descola. We eschew anthropological dualism by tracing the construction of the ecology of practice — that is, by operating a “kind of triage,” to quote Descola’s evocative summary

of ANT methodology (Descola 2013: 69). In his analysis of microtiming in African-American music, Vijay Iyer utilizes both embodied and situated cognition, tracing the actors shaping the practices under discussion through each framework (2002). However, in an ecologically grounded ANT analysis of musicking — that is, the tracing of a particular ecology of practice — embodied and situated cognition form two sides of the same coin. Consequently, the concept of ecologies of practice grounded at the level of gesture unites the actors and mediators constructing a musical practice in a more universal and inclusive manner, flattening the ontologies of the social and physical — a multiplicity in the manner of the rhizome of Deleuze and Guattari (1987).

Other scholars have employed the techniques of ANT for musicological discourse. Notably, Benjamin Piekut examines American experimental music by tracing the actors networking to construct diverse practices, arguing that experimentalism is best understood not as a movement but rather as the result of convergent aesthetic, political, and physical forces (2011). Piekut discusses Charlotte Moorman's performance of John Cage's *26'1.1499*, of which the composer was highly critical. Rather than fail within Cage's experimental aesthetic, a view which would necessarily posit a definition of Cagean experimentalism antithetical to the assemblage of experimentalism in practice, Piekut argues that Moorman uses the work to "reapproach her corporeal relationship" with the cello (2011: 149). In doing so, she redefines her subjectivity of self in a Foucaultian sense of experimentalism. In the language of the framework proposed in this paper, Cage's work becomes a disruptive agent within Moorman's ecological relationship with her instrument. The act of grappling with the work forms an essential part of the cultural and physical construction of Moorman's ecology of practice. Moving beyond music, Carrie Noland offers a theoretical account of the role of gesture as a means for individual agency in constructing the cultural collective (2009). This process is analogous to Piekut's example of the construction of Moorman's gestures, mediated by Cage's score, as part of the networking of experimental music practices.

Other examples of ANT can be found across ethnomusicology, including Harris Berger's ethnography of heavy metal, rock, and jazz in Cleveland (1999). Relying on extensive interviews with practicing musicians, Berger offers a phenomenological perspective of practice. Matthew Rahaim traces nuances of Indian vocal practice through the pedagogical lineage of performative hand gestures, connecting the kinesthetics of performance with the construction of cultural practices (2012). Connecting the cultural and kinesthetic in the opposite direction, Deborah Wong traces the cultural agencies constructing bodily practice in Asian-American musicians (2004). Such approaches eschew

the Cartesian dualism discussed earlier, though they do not offer the same degree of ontological flattening as the ecologically-mediated model of ecologies of practice, a model that provides a framework with which to potentially trace the construction of practice from the level of the neuron through the cultural and political.

From a philosophical standpoint, my concept of ecologies of practice has kinship with Isabelle Stengers' term "ecology of practices." Stengers' concept concerns the ontology of patterns of thought; in her sense, an ecology of practice is a "tool for thinking" (2005: 185). It refers to the networking of actors that construct human epistemologies, politics, and ethics.<sup>6</sup> Similarly, my concept of ecologies of practice concerns the construction of individuals' states of being, but in the domain of kinesthetic action (or the cognitive mapping thereof, in the case of composers and listeners). In this respect, my concept also holds similarities to David Kirsh's concept of "enactive landscapes," illustrating how the design of tools and the affordances they present compel specific modes of usage and shapes the development of new practices of kinesthetic action (Kirsh 2013). However, Kirsh does not offer an explanation for exactly how tools compel modes of usage, or, as in the case of Heidegger's *zuhanden*, how the cultural dimension fits into the construction of such modes. The concept of ecologies of practice and the ecological model of performance presented here account for the reciprocal ways in which individuals manipulate objects (musical instruments) and how the design of these objects and the mediators of culture shape their usage, namely at the level of gesture. Rather than an inactive landscape, an ecology of practice in my sense can be thought of as an "enactive gesturescape." Alternatively, whereas Stengers' ecology of practices may be said to be an enactive landscape of the ethical/political and of the construction of value, my concept of an ecology of practice can be said to be an enactive landscape of gesture in the construction of a musical hermeneutic.

An ecology of practice is not a defined, stable entity, nor is it a field for agency. Rather, it is process; it is a means of coming into being. It is an act of musicking. As opposed to a musical performance, which is an event in time and space, an ecology of practice is a fragile, temporal "thing" in Latour's sense (2004: 233). It is forever being assembled and can only be examined as long as the mediators can continue to be traced. Two performers might play the same piece of music in two entirely different ways, constructing two very different ecologies of practice. The fundamental gestural identities of these two ecologies may be the result of differences in the materials and designs of their instruments, or the metaphors and schemas of the pedagogical schools in which they were trained, or their respective cultural traditions of dance and social kinesthetic action, or all these and more, at the same time.

I will conclude by briefly exploring two examples of musical performance to further illustrate how ecologies of practice are constructed, and how this concept can help illuminate crucial mediators connecting the social and physical which might otherwise be overlooked, connections which may lead to unexpected new insights. From the time of Heinrich Scheidemann in the early 17th century through Johann Sebastian Bach, the improvised organ chorale fantasy remained an essential and pinnacle skill for keyboard players and composers in central and northern Germany (Belotti 1995). Consisting of the contrapuntal and highly varied elaboration of each line of a hymn melody, a masterful chorale fantasy would offer a hermeneutic exposition of the sacred text through the practice of musical rhetoric (Dirksen 1999). Furthermore, the chorale fantasy compelled the organist, more than in any other genre, to utilize to the widest expressive capacity the vast tonal, textural, and haptic affordances unique to the particular organ at hand. The combined affordances of the specific organ's physical action, corpus of finger-scaled musical rhetorical figures, and culturally-bound application of these figures for hermeneutic expression — all examples of affordances co-evolved through adaptation and made available through perceptual learning for direct action by the performer — define the organ chorale fantasy's "ecology of practice" in an individual. It is an ecology within which the improvising performer, through the reciprocity of perception and action and perceptual learning assembled by adaptation, is equipped to direct consciousness through the creative act. In other words, when the organist sits at the organ console, he or she is immersed in an ecological situation, as in Merleau-Ponty's example, that can only be mediated through direct perception and action, not through a linear computational/analytical model of mind and performance.

Through years of perceptual learning — including haptic/embodied experience on a variety of individual organs, a pedagogy of embodied metaphor and contrapuntal practice shaping the use of musical *figuren*, and knowledge of the Lutheran Catechism and chorale texts — the organist is able to improvise with musical gestures, select deliberate and symbolic stop combinations, and shape sound through architectural space across the numerous keyboards and pedal boards through direct action, saving the conscious level of attention for shaping the larger rhetorical and music structure. The ecological situation of the chorale fantasy links together the cultural and physical actors which shape the genre. At the same time, by examining adaptation in the ecology of practice, further questions arise as to how these actors and agents are themselves formed and mediated. For example, what does the shape of musical figures owe to the design and weight of the organ action in North Germany — that is, the mechanical connections between the keys and pipe valves? And what



does the tradition of action construction among the organ building guilds in that time and place owe to the economic and raw material realities of the day? Furthermore, how does the mean-tone temperament of the organ shape the contrapuntal sequences and “patterns of invention” of these musical figures (Dreyfus 2004), and how do these tonally constrained contrapuntal affordances shape the larger structures and rhetorical-theological discourse of the chorale text?

The Baroque organ chorale fantasy provides a very rarefied and clear view of a solo performer in action, constructing a mediated network of actors and agents through an ecology of practice. But what of collaborative performance? Consider a string quartet, jazz combo, or free-improvisation ensemble. Each performer occupies his or her own ecology of practice with his or her own instrument. These practices, similar to those of the Baroque organist, have been shaped through Gibsonian perceptual learning by the embodied metaphors of schools of pedagogy, musical aesthetics, and the haptic properties and affordances of the instrument. But how are these individual ecologies of practice shaped by and further shaping the ensemble dynamic and aesthetic identity? Again, it is because of perceptual learning through cycles of perception and action — cycles which take place aurally and verbally during rehearsal, individual practice, email, and even casual social interaction. Over time, the members resonate in an ecological manner of direct action and perception, shaped by the invariant underlying image schemas and embodied metaphors structuring the gestures of these interactions. The subtle nuances in timing, the synchronous aesthetic shifts and real-time decisions, the ineffable qualities of the ensemble, are all the result of resonating and ever-shifting ecologies of practice among the individual performers as assembled through the mediators of gesture. We must follow the actors and trace the mediators shaping the ecologies of practice of the performers — that is, shaping direct action in the physical gestures of each performer.

A particularly instructive example of the convergence of the cultural and cognitive in the construction of a performance practice can be found in Iyer’s analysis of rhythmic fluctuation in jazz and popular music (2002). Taking as a starting point Samuel Floyd’s 1995 study of the ring shout ritual among the African diaspora as the foundation for much of the stylistic practices of African-American art forms, Iyer traces physiological connections between the stomp and clap gestures of the ring shout and the subtle shaping of backbeat pulse and swing (Iyer 2002: 406-411). In connecting the tendency in African-American musical practices to play behind the beat with gestural practices found across the African diaspora (a common hermeneutic of such practices, and universal, human physiology constraints), Iyer is following the actors constructing these

diverse ecologies of practice. The resolution of the picture resulting from such an ANT approach is proportional to the number of actors and mediators being traced. Questions remain: how and where did individual performers absorb such practices? How do the physical affordances of the instruments at hand shape the temporal dimension of such gestures? What inertial dynamics are common between the associated gestures of the ring shout, African-American musical gestures, and the physical gestures of performance? Piekut (2011) and De Souza (2017) address the former two questions within their respective inquiries, while I address the latter in my inertial theory of gesture (Harlow 2016).

Furthermore, Iyer states that he offers examples from African-American musical practices because they particularly value “deliberately asynchronous unisons, subtle separation of rapid consecutive notes, asymmetrical subdivision of a pulse, and microscopic delays,” elements he claims are distinct from those commonly studied in the practices of Western classical art music (Iyer 2002: 411). However, all these elements can be found in the Western classical tradition. To name but one example, the practice of *notes inégales* in the French classical tradition offers a rough analogue to Iyer’s examples of swing in jazz, albeit the specific realization and actors behind the construction of each are entirely different. ANT approaches to the study of notes inégales include the comparison of prose found within treatises (Douglas 1995) and the irregular pinning of mechanical organs from the period (Moelants 2011: 449). Of course, Iyer does not deny that these elements can be found elsewhere and claims that such techniques “are found to varying degrees in *all* world music” (Iyer 2002: 411; emphasis in original). Similarly, the crux of this paper is the claim, illustrated in the diverse examples above, that physical and cultural actors and mediators converge at the level of gesture to ecologically construct the act of musicking among individuals across *all* cultures.

One key issue that remains to be addressed is the role of consciousness in the construction and realization of ecologies of practice. This is of course a complex topic that intersects many fields of inquiry, and as such is beyond the scope of this paper. However, I suggest that Iyer offers a key insight in this regard. On the topic of conscious choices presented to an improvising musician, he proposes that such conscious action decisions “may be understood partially as a dialectic between formal/symbolic and situational/embodied constraints” (Iyer 2002: 409). Not only does this apply to all types of performance, improvisational or otherwise, but I also propose that Iyer’s idea of a dialectic suggests that the consciousness of performance is not an agent or mediator in and of itself but is rather an emergent property of the interaction of cultural and physical agencies. For a phenomenological account of such of dialectic, see Sudnow (1978).

In summary, the act of musical performance is an inherently ecological situation. Performers engage with their instruments and music through cycles of perception and action, shaping and shaped by perceptual learning. This process is assembled through the mediators and actors of adaptation and is coordinated at the level of embodied gesture. In this manner, every act of performance amounts to the construction of an ecology of practice. Considering the act of musicking as an ecological situation is not only empirically demonstrable, but the concept of ecologies of practice also unites musical performance ontologies across disciplines and cultures, from historical- and ethnomusicology to cognitive- and neuropsychology, operating as a triage between the poles of *music musicking* and *music musicked*, to borrow from Spinoza, compelling us to reconsider the construction of every act of musicking. 🌱

## Notes

1. Throughout this paper, I will borrow Small's term, "musicking," in reference to music as process and as action — as something which is performed, composed, or perceived, rather than an object which *is* (Small 1998).
2. The term "performance studies" throughout this paper refers to the Anglo-European field that emerged from the confluence of empirical musicology, structural theory, and psychology, rather than the North American field of the same name that emerged from theatre, dance, sociology, and anthropology.
3. My use of the terms "ecology" and "ecological" are distinct from their general use in the field of ecomusicology (Allen and Dawe 2016) and in the scientific discipline of ecology. My work is an extension of ecological psychology, focusing on the influences shaping the specific actions of a situated individual.
4. From a quote anecdotally attributed to Bach, dating later than 1776 by Johann Friedrich Köhler (Wolff, Mendel, and David 1998: 412).
5. For a thorough overview of the techniques, origins, and epistemology of actor-network theory, see Latour (2005).
6. For a thorough presentation of Stengers' concept of "Ecology of Practices" see Stengers (2010).

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