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Grounding Creativity in Music Perception? A Multidisciplinary Conceptual Analysis

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Abstract
To what extent can we understand and account for music perception as a creative process? In this paper we draw on recent work in music, creativity, and the cognitive humanities to suggest that the fundamentally creative aspect of music perception is not yet satisfactorily examined in existing research. We briefly review the state of scholarship into both creativity and music perception, and identify key points of convergence, which are prominent in work that investigates the mutuality of action and perception, and the exploratory bases of the latter, among others. Inspired by a growing number of contributions in 4E music cognition research, we argue that listening to music can involve mechanisms of active bodily engagement, along with the imaginative exploration of novel possibilities for thought and action. We put forward the view that this approach is important because of the way in which it can bring to the analytical centre stage a creative dimension that may not otherwise be apparent. The contribution of this paper involves this presentation of a multidisciplinary framework for the study of music perception, highlighting the integration of perception and action, and foregrounding this conception of creative cognition as a central aspect of music perception.

Keywords
Action-perception coupling, embodiment, music perception, musical creativity, musical experience

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Introduction

Human creativity is a complex phenomenon that shapes various aspects of art, science, and (mental) life. Creative thought and action are seen to drive progress and play an important role in, among others, academic research, business, education, and technology. Creativity is celebrated among athletes and artists and can be observed in everyday activities such as cooking or counterfactual thinking (see, e.g., Benedek et al., 2020; Boden, 1998; 2004; Byrne, 2005; Kaufman & Beghetto, 2009). As such, the term "creative" may be applied to people, processes, or outcomes (Burnard, 2012; Diedrich et al., 2015; Kozbelt et al., 2010), "whether it is an idea in someone's mind or an observable performance or artefact" (Paul & Kaufman, 2014, p. 6).

In relation to music, scholarship that theorizes creativity demands a particularly nuanced and deliberate approach. The idea of "musical creativity" in common use tends broadly and affirmatively to relate to the outcomes and benefits of musical activities, often focusing on the domains of composition and performance and their reception. While these are indeed important general areas of musical practice, there are other domains of musical thought and action that involve a myriad of cognitive and perceptual abilities. Accordingly, scholars are now offering accounts of musical creativity that develop more refined perspectives (see Schubert, 2021). Further, some writers suggest more focused conceptions of what

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musical creativity should involve, defining it more clearly against other factors. Notably, David Hargreaves (2012) has argued for context-specificity in the way that creativity is defined and examined, proposing that musical imagination is a better conceptual frame to indicate the generative source of whichever internal cognitive processes are implicated in both "musical perception and production, such that the concept of musical creativity is seen as much more restricted in scope" (p. 545). This solution drives towards a clear methodological distinction "between the internal mental processes and the behavioural manifestations of "creativity"; between these behavioural manifestations and the social–environmental influences involved; and between creative production and creative perception" (p. 546). While we agree with Hargreaves that music perception displays a profound link with creativity, and we fully recognize the utility of the analytical distinctions proposed here, we also advance the idea that the creative properties of music perception may be best understood in light of perceptual experience's tight coupling with bodily action (Novembre & Keller, 2014). In other words, we suggest that a way to explore the creative dynamics that often permeate musical perceptual activity involves examining the corporeal dimension inherent to human perception more closely. Not only can this offer significant insights into the constituent factors, and definition, of creative phenomena in general, but it can also illuminate the very nature of musical creativity in particular – as it plays out in perceptual contexts.

Among other things, such an idea is inspired by recent accounts in music scholarship and the cognitive humanities enlightened by the notion of *4E cognition* (Newen et al., 2018; Reybrouck, 2021; van der Schyff et al., 2022), as well as by the theoretical resources of so-called *embodied simulation* theory (Gallese, 2001, 2005, 2014). As we will see later in more detail, the former is a school of thought that sees mental life as a fundamentally embodied, embedded, extended, and enactive phenomenon. In a nutshell, advocates of this view conceive of human cognition as an active, dynamic, and adaptive process of organism-world interaction. Embodied simulation theory, as it will be also illustrated later, is an approach developed in the social cognitive neurosciences to capture how humans can understand what others are doing and feeling without recruiting complex mental states, relying instead on a prereflective mechanism that operates "before and below" conscious mental activity (Gallese, 2007). We argue that 4E cognition and simulation theory can offer important conceptual tools to our understanding of creativity in the context of human perception of music, inspiring in turn new ways of thinking about music perception in more creative terms.

In general, something can be conceived of as creative when it exhibits the two main properties of *novelty* and *appropriateness* (Runco & Jaeger, 2012). The former term refers to originality – a creative thought or product needs to go beyond the current state of the art in a given field. For example, a musical composition may feature harmonic progressions or expressive solutions that are unusual or surprising for a given genre. Yet, evidence for originality is not sufficient for or equivalent to creativity. Runco and Jaeger (2012) contend that any random process can, in principle, give rise to an outcome that is "merely original". To be distinguished as creative, a response must also be task-functional, valuable, or indeed "appropriate". As such, a creative item often needs to be operationalizable: it must be actualized in a specific setting and effective. In this view, a musical composition too complex for performance, or lacking coherence, tends not to be described as creative. Similarly, processes such as thinking or acting in a specific context can only be understood as creative when they are valuable and efficient in terms of the contributions they bring: an innovative offensive solution by a team or a player during a football match cannot simply work "in theory", it must be enacted in the concrete dynamics of the game in the hope of providing tangible benefits for the whole team, by exploiting specific goals. As such, the notion of creativity appears intrinsically bound to both individual creators and their surrounding space of action (see also Glăveanu, 2014; Hristovski et al., 2011; Kimmel et al., 2018; Malafouris, 2014; Orth et al., 2017; van der Schyff & Schiavio, 2022). Because of this, recent accounts of creativity (in music and beyond) do not tend to adhere to perspectives that may perpetuate myths related to the notion of the so-called "creative genius" – a creative individual who isolate themselves from society to achieve eminent outcomes relying on their innate talent (see Montuori & Purser, 1995).[1] Furthermore, although issues of reception (e.g., social evaluation of performances and musical artefacts) remain relevant to creativity studies (as suggested earlier) current research also examines the forms of adaptive behaviour that give rise to creative thought-in-action. In brief, creativity cannot be understood only in terms of outcomes (ideas, products, and so on) and their reception by a given audience, nor in terms of individual achievements. Instead, it relies on a *combination* of individual (i.e., bodily-based, imaginative) and environmental (i.e., social, physical) factors that involve both processes and products (see also van der Schyff et al., 2018).

From this perspective, music offers a fascinating test case for research into creativity (see, e.g., Burnard, 2012; Nagy, 2017). Examples of musical creativity research are abundant, including the study of how musicians from different cultures become creative (Hill, 2018); the analysis of the cognitive processes involved in particularly creative musical performances (Bishop, 2018) or compositions (Collins, 2005; Schiavio et al., 2020); the evaluation of creative musical outcomes in learning settings (Kokotsaki & Newton, 2015; Randles & Webster, 2013); and the investigation of situations such as musical improvisation, where creative products and processes are necessarily co-determined and constantly co-evolving (Sawyer, 2006; Wilson & MacDonald, 2015). The richness and impact of this growing, multidisciplinary literature suggests that better understanding of creative cognition is vital for gaining a deeper comprehension of musical activity, and perhaps artistic practice more generally. While much research aims to capture the complexity of creative behaviour in musical contexts such as performance, learning, or composing, less attention has yet been devoted to investigating the possible link between creativity and music perception (although see Hargreaves et al., 2005, 2012).

In this paper, we aim to address this gap and explore the connection between perceptual and creative factors in musical experience. To do so, we offer a preliminary conceptual analysis based on the framework of 4E cognitive science, and on multiple resources from existing scholarship in creative and music cognition. We suggest that such a liaison can show how music perception, traditionally conceived of as a more "passive" phenomenon when compared to areas such as performance and composition, can be instead seen as inherently active, exploratory, and ultimately *creative*. Building on a range of contributions pointing to a similar direction from multiple perspectives (e.g., Baroni, 2006, 2009; Hargreaves et al., 2005, 2012; Kratus, 2017), we provide a unique synthesis of such a scholarship, and argue that perceiving music involves bodily-based and creative elements that shape how we engage with the musical material contextually. As such, our analysis might pave the way for future empirical and theoretical work interested in exploring the interplay between creativity, perception, and action more broadly. A richer understanding of the entanglement of creativity and perception should be of major importance for numerous fields of enquiry interested in how we actively make sense of the environment we inhabit, in how we communicate meaningfully with others, and in how we adapt to ecological contingencies with various degrees of complexity. That said, we find this analysis particularly interesting in the musical domain, where perceptual, emotional, intersubjective, artistic, and creative processes are important driving factors in establishing, transforming, and maintaining such agent-world relationships (e.g., Borgo, 2005; Loaiza, 2016; Moran, 2014; Reybrouck, 2021; Reybrouck et al., 2020; Schiavio et al., 2017; Small, 1999).

This paper is organized as follows: we begin with a critical assessment of existing scholarship in music perception and creativity research, observing that a unitary approach is not yet developed which fully links such domains to 4E-inspired accounts of cognition. We then suggest that our understanding of music perception can be improved when exploring its complementary embodied and creative components, and we highlight the explanatory power of the move through different examples. In conclusion, we compare our approach to recent contributions in the field, and lay out an experimental possibility for future research.

Situating Music Perception

Human perception of musical sound is a multifaceted phenomenon that implicates different layers of cognitive activity (see Koelsch, 2011). As a research topic, music perception is conceptualized through programmes that span various academic fields of enquiry and their concomitant ontologies and practices. This array bridges sciences and the humanities, including experimental, behavioural, and social psychology – as well as musicology, ethnomusicology, philosophy, and literary criticism, for example. These various viewpoints naturally broach the topic of music perception in different ways. Commonly agreed parameters of investigation include psychoacoustic constructs with clearly associated material indicators, such as pitch, duration, timbre, and loudness. A substantial body of musical perception literature has also become established during the past two decades, which addresses the dimension of bodily motion and the associated multimodal parameters that support both production and perception of the expressive shaping of sound (see, e.g., Timmers et al., 2021). It is arguably still the case, however, that those dimensions which have a long-standing existence in common-use forms of musical literacy and visualization – pitch, duration, timbre, loudness – remain the most readily conceived and examined in relation to developmental, social, and genetic constraints (Deutsch, 2007; McDermott & Oxenham, 2008). The perception of sound as music thus presents a context in which to understand human perception itself, showcasing the imaginative collision of cultural and subjective factors (e.g., emotional experience, meaning) against those considerations associated with measurable properties (e.g., basic attributes of sound). As such, musical perception should offer a valuable laboratory for the investigation of more general cognitive processes and their experiential, behavioural, neural, and, as we shall see, creative bases. It is appropriate, then, that contemporary music perception scholarship includes a growing corpus of experience-focused music listening work (see Greasley & Lamont, 2011; Hargreaves & North, 1999; Herbert, 2011).

Yet, the very notion of *music perception* is frequently bound up with "WEIRD"[2] (Henrich et al., 2010) assumptions about what, materially, such perception refers to. Within Anglophone and European music perception research, the longest standing, so-called common-sense view assumes that most individuals in a population are not themselves *performers*, whose musical engagement is therefore passive – in the sense that their activities appear largely to be based on listening to the recorded sound of a minority of expert performers. This dominant conception of musical engagement is one that has been shaped in the crucible of globalizing and systematizing music education and industry practices, associated with technologies of recorded sound; it refers to preconceptions of musical listening that might be more fully understood in relation to normative, aspirational ideals of informed and appreciative listening practices. Over 15 years ago, Eric Clarke (2005) described how music-listeners' submission "to the discipline of the musical structure has become the norm of both musical academia and … (in milder form, perhaps) the concert hall" (p. 135); since then, Nicholas Cook (2013) has fully expounded the problematic but pervasive elision between "the music" and "the score", which percolates from academic, to mainstream educational, to public discourse and imagination about the defining parameters of musical listening experience. Thus, even while this particular conception of listening is evidently contra to overtly active and interactive popular music genres common to the same cultural communities as music perception researchers themselves inhabit, a unimodal, audition-only notion of musical listening parameters remains normative, and represents the practices that many researchers see around them. While this ideology and its problematic construction of objective, directed listening has been revealed in musicological and scientific scholarship, the conceptualization of music listening as a simplistic perceptual activity is often the most practicable for experimental design: in crude terms, the object of analysis (material trace of recorded sound) stays put, the parameters of sound may be manipulated, and the individual subject's response can be measured.

Yet, as we can see, this view carries fundamentally problematic assumptions about the value and purpose of musical engagement which, arguably, do not belong in scientific programmes of experimental perceptual research. The presumed interaction of an educated, non-performing audience with a theoretically and structurally coherent autonomous artwork rather obscures what else is known about music listening and perception. This is that – even at the most passive extreme of abstracted, intellectualized listening process – music perception remains a pragmatic and socially driven contextual experience: an active process of meaning-making, in which listeners bring forth their musical, cultural, and social identity (Clarke, 2005; Hargreaves et al., 2012; Kozak, 2019; Moran, 2017; Schiavio & van der Schyff, 2016). To do so, listeners must also engage with covert and overt forms of bodily activity (see, e.g., Brown & Martinez, 2007; Cross, 2010; Gordon et al., 2018). By example, consider how perceiving the same song at home or during a concert may give rise to different experiences, re-shaping our musical engagement through the presence of other individuals, through our contextually meaningful bodily movements, and so on. Regarding such a notion of listening as active construction, Hargreaves and colleagues quote the American composer Aaron Copland: "It is the freely imaginative mind that is at the core of all vital music-making and listening" (Hargreaves et al., 2012, p. 160). It seems that whatever we consider to be a "baseline" perception of musical sounds, additional cognitive processes of meaning-making and bodily engagement are implicated.

In the terms of creativity defined here in the current paper, this explorative-perceptual activity might be understood as creative when it brings forth an innovative and valued outcome. For instance, when it produces a novel emotional experience, such an activity might make us enjoy the song we are listening to even more by disclosing unexpected layers of significance. Different perceptual contexts and localized, subjective aspects of audition may reveal different rhythmic, harmonic, and timbral relationships; sonic aspects previously at the fore of our attention may recede, and vice versa. Consider how immediate, active engagement with the resonant sound of a low drum normally in the background of an ensemble might evoke imaginative episodes in the moment and in recollection over time – episodes that are intimately linked to the emotional and bodily experience of making sense of the musical-sonic environment as it unfolds (including perceived or imagined movements of the performers). These episodes might involve the imaginative development of new sonic and rhythmic relationships, and this could inspire new expressive movements, or dance forms; or it could motivate new compositions or improvisations that utilize the new sonic relationships initiated by the experience of the drum in context, and so forth. Importantly, here imagination is not abstracted from context and action – rather these factors develop dynamically and continuously over various timescales, being highly dependent on the motor experience of the listener. Indeed, an expert drummer might be able to give rise to, explore, and navigate a broader horizon of possibilities of musical actions when compared to a novice.[3]

To illustrate things with a further example, a particularly moving keyboard passage from a rock ballad might shift our listening focus from the lyrical content to its underlying harmonic structure, giving rise to *novel* layers of significance that drive and shape our perceptual experience in a contextually *valuable* manner (e.g., allowing us to disclose new meanings and opportunities for musical and social engagement). Again, we note that an experienced listener (e.g., a rock keyboardist) might be facilitated in engaging with such an attentional drift. Having first-hand experience in piano and keyboard playing, indeed, might give rise here to a richer musical experience – one in which motor-related components inherent to the sound (i.e., the set of action necessary to perform the perceived moving passage) are automatically recruited and unconsciously re-enacted (see Cox, 2016). This bodily experience, we suggest, can provide further creative scaffolding when it offers a ground from which exploratory forms of perception can take place and flourish. While these exploratory forms of perception, such as the attentional drifts described here, might seem to be a somewhat "inefficient" form of musical engagement (as if they would take the listener away from an "actual", focused musical experience), there is an important sense by which they should also be regarded as creative(ly motivated), as they display both novelty and value. In what follows, we link these preliminary insights to work in music cognition and psychology that explores the intimate connection between perceptual activity and action through the lenses of embodied cognition and simulation.

Perception, Action, and the 4E Perspective

Music scholarship inspired by enactivism, embodied cognition, and ecological psychology (e.g., Clarke, 2005; De Souza, 2017; Godøy, 2003; Iyer, 2002; Leman, 2007; Reybrouck, 2005; van der Schyff et al., 2022) has offered fresh conceptual tools to study musical activity and its variety of manifestations from a perspective that highlights the crucial role of action and bodily experience in perception (Leman & Maes, 2014; Maes, 2016; Maes et al., 2014a, 2014b; Overy & Molnar-Szakacs, 2009). This approach places considerable emphasis on the meanings emerging from the multiple types of interaction unfolding between agents and their musical environments, ideas which have begun to be explored elsewhere; for example, in the work of Moran (2014) and Krueger (2013). These ideas in themselves help to bridge musicological discussions of artwork and aesthetics, alongside developmental issues around the role of motivations, impulses, spontaneity, and the creative drive which appears to inform our musicking and our being-in-the-world since early infancy (Delafield-Butt & Trevarthen, 2015; Trevarthen et al., 2011, 2014).

One of the central tenets of these approaches to music perception can be summarized as *music perception is rooted in action* – a broad statement that has been scrutinized theoretically (e.g., Cox, 2016; Reybrouck, 2006a) and empirically (e.g., Bangert & Altenmüller, 2003; D'Ausilio, 2007; Maes et al., 2014a). Echoing classic insights of motor theory of speech perception (see, e.g., Liberman et al., 1967), and drawing on work in neuroscience, including the discovery of a human mirror mechanism (Rizzolatti & Sinigaglia, 2008; Rizzolatti & Fogassi, 2014), this claim can be conceptualized through appeal to what is now known as "Embodied Simulation Theory" (Gallese, 2001; 2005; see also Gallese & Lakoff, 2005). Very generally speaking, its main idea is that we can use our cognitive resources to *simulate* internally the (psychological motives of) actions and emotions of other people (see also Gallese, 2009, 2014, 2017).

From this view, goal-directed sensory stimuli – for example, the sight of a person preparing to shoot a ball into a basket, or the audition of a familiar musical scale on the violin – give rise, in competent perceivers, to an automatic activation of the same motor program necessary to perform them. Such a mechanism of simulation may thus endow the agent with the ability to engage with a specific auditory signal (e.g., to anticipate, predict, respond to it), as long as the percept is familiar enough to be simulated motorically. This means that simulation works well only if the perceiver has the motor knowledge required to perform the perceived action – for example, competence to shoot the ball, or play the violin. So, while an expert instrumentalist perceiving a well-known musical phrase is often able to map the sensory input into congruent motor actions with her own cognitive system "as if" she were playing it herself, a musician with less expertise, or someone untrained on the same instrument, would only be able to do so in part. In this view, the mechanism should variably give rise to different (some may argue, weaker) perceptual experiences (see D'Ausilio, 2009; Maes et al., 2014b; Novembre & Keller, 2014).[4] Lahav and colleagues (2007), to offer another well-known example, primed participants without prior dedicated musical training to play a simple piece of music by ear, and then studied their brain activity while they were listening to it. Audition of the familiar stimulus after practice gave rise to higher activations of brain regions associated with simulation mechanisms in the frontoparietal motor-related network when compared with the perception of the same notes in different order (less activation), or with the perception of a musical passage that is equally familiar, but which involves an unknown motor sequence (no activation).

The relevance of such findings seems clear in such examples of live music perception. Broader applications – also beyond specifically musical scenarios and including remote or online interactions and group activity – have received substantial attention in philosophy, psychology, and neuroscience, generating multidisciplinary debates (Gallagher, 2017; Gallese & Sinigaglia, 2011; Grafton, 2009). In all, this strongly suggests that music perception and experience are at least partly dependent on our music-motor expertise. Embodied simulation, as stated, permits a non-conscious recall of the motor knowledge that is recruited to perform those actions that we perceive in/as musical engagement. It can be conceived of, then, as a mechanism serving functions such as prediction and preparation for new musical actions. In line with such ideas, cognitive scientist Barsalou (2009) describes simulation as a "computational mechanism in the brain that supports a broad spectrum of processes from perception to social cognition". From a musical perspective, Patel and Iversen's (2014) Action Simulation for Auditory Prediction (ASAP) posits that our perception of the musical beat involves action simulation serving auditory prediction, and that it rests upon a dynamical interaction of auditory and motor-planning regions in the brain. This combination is proposed to guide agents to optimize their best fit with the shifting dynamics of their surrounding environment. This mechanism of embodied simulation, then, provides opportunity for individuals to engage in novel musical activities and to generate new behavioural, emotional, and social responses to it (see Cox, 2016; Schiavio et al., 2015).

This account of perception as deeply rooted in bodily activity can help us bring closer together two categories that may often appear detached from one another: that of "perception" and that of "understanding". Where an act of perception is at least partly determined by the motor knowledge stemming from the living system's coupling with the world (i.e., its personal repertoire of action), then perceiving might arguably be conceived of as a basic form of understanding – one that is predicated through the various modes of musical engagement one can come up with in such contexts. In our view, this is what makes music perception itself an active, exploratory, and ultimately *creative* phenomenon. This idea builds on well-known work by O'Regan and Noë (2001), which examines cognition through the lens of sensorimotor enactivism – a view which maintains that sensorimotor skills constitute our perceptual activity in great part, through an active engagement and exploration with the world we inhabit. Because such sensorimotor skills develop from a situated coupling between organisms and environment, this process implies a fundamental lack of "indifference" (Colombetti, 2014). Varela and co-workers (1991) and Thompson (2007) argue that such interactions are what give rise to an "identity" or "point of view". Philosopher Mark Johnson (2015) examines the implications of such processes of situated, embodied understanding:

> This grounding in organism/environment interactions means that … we must not base our account of understanding on any abstractions from experience, such as "sensations," "concepts," "propositions," or "knowledge judgments."

As Johnson goes on to explain, such a view seems to call out as fallacy the idea that we should try to account for perceptual understanding without regard for the way that "experience includes both the structure and activity of the organism as well as the structure of the environment". According to Johnson, it is only by keeping this in mind that:

> we will appreciate how bodily processes are absolutely crucial for the possibility of any form of cognition, feeling, or action, and we will not abstract away from the body and its environments. Otherwise, we end up selecting some part or phase of an experience and then mistakenly assuming that what we have selected out (a sensation, quality, concept, image, judgment) defines the whole of that experience, in all its depth and richness.

These insights may be developed further through the lenses of the 4E approach mentioned earlier – where again cognition is understood to be fundamentally embodied, embedded, extended, and enactive (see Newen et al., 2018). Put simply, this framework sees mental life as guided by the developmental history of the situated, living body (Thompson, 2007). From a 4E perspective, cognition is itself a creative or enacted process (see Schiavio & Benedek, 2020; van der Schyff, 2019). Possibilities for thought and action emerge and stabilize through adaptive interactions with the social and material environment in which agents are embedded. Such interactions are "extended" in the sense that meaning-making involves the use of technologies (musical instruments, recording devices) and socio-cultural engagements that allow agents to think and act in ways that go beyond the capacities afforded by their bodies alone – to "offload" and "take on" various cognitive tasks, and to thereby develop novel networks of adaptive behaviour. This permits forms of joint action and perception and the *enactment* of complex creative environments (e.g., a musical ensemble, studio collaboration), and the new worlds of meaning they produce.

Given that core aspects of musical creativity arise from the (sensorimotor) capacities of situated embodied agents as they actively engage with social and material environments, we suggest that the conceptual tools of both embodied simulation theory and 4E cognitive science can be advantageously taken together to offer the richest perspective on musical perception and creativity. Where the former sees internal (neural) simulations as the foundation for social understanding, the latter highlights the environmentally distributed nature of cognition, decentring the role of simulation for mental life. While this theoretical dissonance is not unproblematic, we argue that both approaches remain compatible: as long as simulation is seen as a mechanism through which experience may emerge in relation to the motor expertise of a subject, and not identified with experience itself.

The Missing Link between Music Perception and Creativity

In the previous section, building on previous research and theory, we set out some concerns regarding the way in which cognition as well as (music-)perceptual experience may normally be approached as passive phenomena. We have also considered in what ways the ideas of perception-action coupling and 4E cognition contribute to a change in such assumptions. We now leave aside these discussions and move on to examine in more detail the key role that we see for creativity within situated processes of music perception, setting the stage for more specific observations that could help in such an analysis and pave the way to future applied research. In doing so, we attempt to weave together insights from embodied simulation theory and 4E cognition to offer some provisional thoughts on how both approaches might enhance our view of musical perception.

A Matter of Organism-World Coupling

In all its various situations and manifestations, music perception – as we have seen – should rarely be described as a passive phenomenon (see also Reybrouck, 2021). As expressed through extant literature highlighting its sensorimotor foundations, music perception is tightly coupled to action. Simulation-like mechanisms may often shape how we resonate with the musical material, activating action-programmes that partly drive our musical understanding. This may in turn stimulate novel and valuable ways to engage with music through an active exploration of different modes of listening and acting. We can thus understand perception as inherently *active* and *creative* when it involves exploration, motor resonance, and the enactment of bodily movement (Chemero, 2009; Kozak, 2019). This view resonates with the radical organism-world mutuality at the heart of 4E approaches to cognition when it emphasizes meaning-making and active experience as central components of mental life. Motor, emotional, and creative factors can therefore be seen to contribute to the realization of one's perceptual activity, ensuring the continuity between internal (e.g., neural) and external (e.g., social) dimensions.

At the outset, we considered some examples of how music perception may involve exploratory activities that display intrinsically creative properties, being at the same time innovative and task-appropriate for the perceptual task and its meaningful experience. We now focus on the interplay of creative cognition and action. The following discussion seeks to develop and explain such a link, from action to music perception and its creative components. By addressing this connection, we would hope to move closer to existing research avenues interested in the interplay of action and perception (e.g., those inspired by simulation theory), and contributions that either associate perception with creativity from a psychological perspective (i.e., without explicitly referring to an action component) or that explore the connection between action and creative cognition from a more general viewpoint (i.e., without explicitly referring to perceptual processes).

A domain in which the connection between creative cognition, action, and perception has already been examined – albeit not often explicitly considered from a musical perspective as we do it here – is that of *ecological dynamics* (see, e.g., Araújo et al., 2006, 2009; Davids et al., 2012). An important insight developed by scholars working in such a multidisciplinary field holds that creativity need not be understood as an individual's mental property developed in isolation; instead, it is better understood as a phenomenon that flourishes as we engage with, and actively perceive, the world we inhabit (see also Kimmel et al., 2018). This view, it is argued, may help explain how novel and functional (i.e., creative) motor actions may be developed with little or no pre-planning in various performative contexts, ranging from improvisational dancing practices to team sports, where actors may need to give rise to meaningful set of behaviours in order to address specific contextual needs (see Gesbert et al., 2022; Hristovski et al., 2012; Seifert et al., 2017). In a recent book chapter, Schiavio and Kimmel (2021) adopted the theoretical tools of ecological dynamics to examine musical creativity, with a focus on motor productivity in expert jazz performers as well as young infants. Here, great focus is placed on the notions of perceptual attunement and adaptation, through which creative action is seen to nourish and develop via patterns of organism–world interaction. By this view, action-perception laws might be seen to constitute "a flexibility-warranting generative system in which softly assembled structures allow to respond to real time constraints, and which frequently incorporate external dynamics into 'live' synergies" (p. 124). A similar focus on the moment-to-moment negotiation between organism and world within a musical context focused on creativity is at the heart of a chapter by Mark Reybrouck (2006b). Reybrouck's account closely connects action, perception, and creativity by examining how music perceivers may be seen to develop a context-sensitive control, which allows them to modify their cross-modal entanglement with the world through listening. Such transformative capacities, in other words, can offer the listener new opportunities to meaningfully adapt to the (sonic) world, generating novel actions and thoughts in the process. In what follows, we expand on such insights to focus more directly on how creative action and bodily experience take on a predominant role on one's perceptual experience.

Action Is Integral to Perceptual Experience and Is Central to Creativity

O'Regan and Noë (2001) define "sensorimotor contingencies" as the law-like relationships between action and associated sensory information, whose regularities describe meaningful changes occurring at both behavioural and perceptual level (Clark, 2006, p. 2). Perceptual experience may be thus regarded as a "temporally extended process of exploration of the environment on the part of an embodied animal" (Noë, 2000, p. 128). From a more general perspective, the crucial role of action for cognition has been increasingly recognized by research with a specific focus on creativity (see Bashwiner & Bacon, 2019). Glăveanu and colleagues (2013), among others, have offered a preliminary framework on creative cognition that brings together psychological and behavioural sides, in an attempt to place crucial emphasis on the material, concrete, and contextual dimension of creation. In a similar vein, neuroimaging work to date has sought to explore correlations between brain regions associated with sensorimotor and creative functions. For instance, Kenett and colleagues (2018) adopted a computational approach to explore how neural dynamics involved in creative cognition are partly driven by different brain areas, finding a correlation between the functional organization of specific sensorimotor regions and divergent thinking (the ability to generate novel creative ideas by exploring different solutions). This suggests that various processes of mental manipulation involved in such a conceptual, explorative activity may be grounded in sensorimotor experience (see also Barsalou, 2008). In specifically musical situations, one recent neuroscientific study by Anic and co-workers (2018) used Transcranial direct current stimulation (tDCS) to demonstrate a connection between the primary motor cortex and explicitly creative musical activities involving the production of improvised musical phrases. In this study, a panel of expert musicians judged as more creative (but not more technically fluent) those musical patterns improvised by participants who received excitatory tDCS.

Because motor activity may be a crucial component of creative experience, we should now address the role that simulation theory may play for creative thought and action. Prima facie, it may seem almost paradoxical that simulation may be involved in creativity. Embodied simulation involves the re-deployment of existing patterns of action, which may be hardly considered as innovative and functional. However, we suggest that the optimal recruitment of specific sets of actions at the heart of simulation-like mechanisms can be associated with creativity. In particular, we advance the idea that the stronger the simulation process, the more creative outcomes can be generated in perception. This positive correlation could be explained in terms of organism–world complementarity: because perception involves a meaningful, active entanglement of subject and environment, the more bodily resources take part in the process, the more possibilities for such an interaction to develop may flourish.[5] Accordingly, motor involvement in perceptual experience provides the bases upon which one can achieve greater creative outcomes when compared with forms of perception where this motor component is less present. Compare the following situations where an expert guitarist and a non-musician listen to a guitar rendition of *Invierno Porteño* by Astor Piazzolla. In both cases, listening can be conceived of as a meaningful activity where creative outcomes may be brought forth into the daylight of experience. However, as we have suggested, the stronger motor component at the core of the former's listening experience, the more creative outcomes can be generated; the understanding of a surprising fingering solution by the performer in a certain passage might inspire the listener to explore novel performative options, to imagine a new range of dynamical possibilities, or to think about rhythmical nuances that can be highlighted by such fingering. Conversely, the creative aspects involved in the novice's listening experience may not include such music-related motor schemata, which can only be redeployed by the expert musician – familiar with the piece being perceived.

By this view, while perceptual experience can be generally understood as a meaningful exploratory activity, its creative properties may be fully realized when it contributes (i.e., via simulation) to shaping the online assemblage and constitution of novel movements, motor sequences, and modes of engagement with the world. As such, re-enacting relevant patterns of action can disclose *novel* horizons of meaning that are *appropriate* for certain situations, opening up possibilities for further interactions with the sonic environment. This involves negotiating meanings, exchanging information, interacting with others, and developing artistic identities in *novel* and *valuable* ways (see also Sheets-Johnstone, 2009; van der Schyff et al., 2018).

This perspective aligns well with existing research that sees embodied simulation as a "scaffold for creativity" (Leschziner & Brett, 2019, p. 346), and – as mentioned earlier – resonates with the increasing number of contributions interested in exploring the ecological dynamics governing creative cognition in various performative domains (see, e.g., Hristovski et al., 2011, 2012; Kimmel, 2017, 2019) and how mental imagery impacts on our ability to simulate possible future actions (LeBoutillier & Marks, 2003). In addition, in more general terms, as Glăveanu (2018) puts it, minds might be best understood as "creative actions … [that] open up, exploit, and expand the possible for both self and others" (2018, p. 12, quoted in Loughlin, 2020). As such, future investigations into the ways that different exploratory and action-based categories are experienced within music perception situations should inspire richer understanding of the underlying creative features that such an activity entails.

Imagination and Creative Thinking

This complementary but distinct research direction might be generally seen to explore the cognitive capacities needed to construct one's personal perceptual experience in a creative way. This approach is best captured and defined by Hargreaves and colleagues (2012):

> Listening to music is an active, creative process which exists at different levels of engagement: people display characteristically different listening styles, and they consciously use music in different situations in order to produce different psychological states in themselves. (Hargreaves et al., 2012)

This statement constitutes one of ten propositions the authors advance with regard to the centrality of music listening for music psychology and to the possibilities it holds for further empirical and theoretical investigations. As anticipated, we find this perspective particularly useful to gain relevant knowledge of the several situations in which we can purposively orient our music listening to achieve a perceptual goal that is at once innovative and contextually valuable. In studying this matter from a purely psychological perspective, however, the role of action and bodily experience might remain downplayed.

Recent research by Kratus (2017), who explores a similar topic in the context of music education, might offer a complementary view given the practical context in which it is operationalized. The central tenet of this work is that, from an educational standpoint, music listening can be understood as a skill. As a skill, it can be nurtured and improved systematically. A way to do so, it is suggested, consists of "regarding listening as a creative endeavour, one in which the listener's creativity shapes the meaning and value of the experience" (Kratus, 2017). By assessing such a proposal in light of previous literature, the author reviews a number of contributions, including that by Dunn (1997), summarized in the following quote:

> Creative listening: (1) is an active process that involves unique, individual cognitive and affective responses to music, (2) allows individuals … to become co-creators of the musical experience, (3) involves both objective and subjective, including imaginative, response, (4) can involve extra-musical references …, (5) is directly affected by individual feelings …, (6) enables us to create holistic, inner perceptual structures of the music, the creative product …, (7) involves "thinking in sound," (8) involves reflection-in-action …, (9) is an authentic natural process, and (10) can be influenced by education. (Dunn, 1997, pp. 42–45, quoted in Kratus, 2017).

The list is fascinating, and deals with many categories covered in the present contribution. Of particular importance for us is item 8, which addresses the notion of action explicitly. Action, however, assumes here a different connotation from that presented in our analysis, as its use in association with "reflection" is meant to indicate the activity of "selecting what will be attended and at what level; perceiving what is occurring; reflecting on what has happened; creating expectations of what might follow; examining what actually occurred in light of those expectations; and affectively responding to the musical experience as a whole, mediated in part by past experience" (Dunn, 1997, p. 43). Whilst referring to action, this view does not actually imply movement (simulation) or any sort of behaviour: what can be understood as novel and valuable here is arguably the product that results from the (conscious) mental act of listening and exploring the sonic material, the description of which is offered in purely psychological terms (see also Reimer, 1989, 1992). As discussed earlier, such an understanding of music perception (and perception in general) as a sort of pictorial, mental representation that results from the information processing of external stimuli and its conscious outcome has been challenged by many scholars inspired by embodied, ecological, and enactive approaches (see Clarke, 2005; van der Schyff & Schiavio, 2017). As Peterson (2006) put it:

> During music listening, the listener constructs mental objects that not only correspond to auditory events presented by a performance, but also legitimately differ from the mental representations of other listeners. In accordance with the skills, background knowledge, attitudes, and goals of the listener, and through a process that can involve creative musical decisions on the part of the listener, these aural mental objects are selected, categorized, organized, related to other memory objects, transformed in various ways in combination with those memory objects, and incorporated into a mental model that becomes the listener's unique perception of that musical work. (p. 18)

The abundance of current approaches to 4E music cognition promises a great deal for music perception research, including extant work (1) in contributions focusing on how perceptual activity may help us discover novel layers of significance that can recursively influence how we move and what we perceive (see, e.g., Hogg, 2011; Peñalba, 2011), and (2), in research concerning the association of creative thinking and perception (see, e.g., Bamberger, 1991; Baroni, 2006). While research exploring the dynamical interplay of action and perception might benefit from a stronger conceptual focus on the creative properties inherent to perceptual activity and its exploratory bases, we argue that an important step in this narrative is to make a more direct link which can explain and express the *creativity* inherent in music-perceptual processes. We argue that this should include more detailed analyses of how action participates in perception, placing more analytical emphasis on the ways in which sensorimotor experience contributes to the imaginative construction and transformation of music listening activities. Similarly, existing research investigating the relationship between action and creativity in various (non-music related) domains of experience often neglect the area of perception. We recognize a need for new, interdisciplinary, and integrative approaches to bring these three categories (action, perception, and creativity) closer for mutual illumination.

The theoretical tools of 4E cognition, as examined for example in the recent music-focused contributions by Pohjannoro (2022), Reybrouck (2021), van der Schyff and colleagues (2022) among others, can help offer a way forward in these regards. Indeed, such an approach places major emphasis on action when it recognizes the fundamentally *embodied* character of our being-in-the-world; when it emphasizes the active roles that *embedded and extended* forms of agent–world interaction play in meaning-making and experience; and when it sees life and mind as a uniquely continuous phenomenon whereby organisms *enact* their concerned perspective as they flourish and actively explore their environment in ways that are novel and appropriate (Thompson, 2007; Varela et al., 1991). Because of this, exploring perceptual activity through the 4E lens, might disclose novel opportunities to fully appreciate the roles of action and creativity for mind and life, revealing at the same time novel aspects of musical experience and that may have been under addressed in previous research and theory.

Conclusion

Examined lately in a range of contexts, from business innovation to the arts, creativity has drawn the attention of psychologists, linguists, health scientists, psychotherapists, sociologists, neuroscientists, and musicologists (see, e.g., Carson & Becker, 2004; Cook, 2018; Dietrich, 2004; Green et al., 2016; Odena, 2018). Current research in the field of creativity studies has made important advancements for our understanding of creative thought (see, e.g., Abraham, 2018; Forgeard & Kaufman, 2016). Yet – compared to those contributions that examine both categories separately – the connection between structural accounts of creative thinking and the expression of such presumed structures as perceptual experience remains somewhat under-addressed.

In this paper, we have offered a novel conceptual analysis of the current state of research, which has drawn on diverse areas and frameworks (mainly 4E cognition and embodied simulation theory) to articulate empirical and theoretical considerations with regard to the intimate connection between perceptual experience, action, and creative cognition in the particular domain of musical experience. We have examined from different angles how listening to music often involves mechanisms of embodied simulation, imagination, and the meaningful exploration of novel conceptual and bodily possibilities for thought and action. This liaison can bring forth important meanings and experiences, particularly when its outcomes (e.g., emotional states, verbal descriptions, movements) motivate the emergence of new forms of musical engagement and behaviours as well as the development of novel organism–world interactions that listeners can cultivate further. This provides an apt counterpoint to normative conceptions of music perception which are implicitly oriented to examining the mental structures through which particular dimensions of musical experience should emerge. The holistic, embodied stance defended in this paper asks us to reconsider whether there is more room yet to manoeuvre away from the presumed separation between action and perception which is methodologically necessary for much traditional scholarship. The links between perception and action, and between creativity and action we have described so far, suggest that a discussion on the creative bases of music perception should include a focus on its action-based components too: thought, perception, action, and creative cognition may be seen to form a uniquely organized coalition of interacting factors. A key role here, as we saw, is played by novelty and appropriateness – understood as fundamental aspects of musical perceptual experience. Not only can creative thoughts orientate our perception towards possibly unknown territories, including shaping concrete possibilities for action (e.g., during a concert, moving towards the soloist to better hear the effect of a particular performance technique you just noticed them using), they can also be transformed and re-organized on the basis of what actions are deployed (e.g., by tapping along to a well-known piece, you may notice a new metrical feature that could reshape your previous interpretation).

Just as making music is creative in its own right, our approach suggests that perceiving music is equally creative, relying on a continuous assembly of bodily grounded and exploratory processes devoted to instantiating an (often novel and appropriate) active engagement with our physical, social, and cultural environment. In such cases, we can imagine that abstract concepts (e.g., the knowledge that a piece of music is a rebellious rock song calling for revolution) and sensorimotor experience (e.g., our emotional and bodily responses to the actions "felt" behind the auditory stimulus) would reciprocally influence one another, generating feedback loops that spur creative perceptual experiences of various degrees of complexity mainly depending on the (musical/motor) expertise of the subject. While this might be partially understood in terms of embodied simulations of musical actions, such simulations can only become meaningful in light of our history of interactivity with the environment (including extended social and material interactions).

An interesting experimental possibility that stems from our proposal involves exploring whether listening experience shapes creative cognition in more general terms. If music perception can be understood, at least in part, as a creative activity, then we may expect that expert music listeners would score higher than non-experts in creative tests such as the alternative use test (AUT) (Guilford, 1967). The latter was designed to measure how well participants could think of as many uses as possible for an everyday object such as a wallet, a pen, or a book. Because of this, it measures one's divergent thinking ability, that is, the capacity to generate many novel ideas that are task efficient. A pen, for example, cannot be used to protect yourself from the rain, though, under certain conditions, it can be used to perform an emergency tracheotomy, or to play a rhythmical pattern on a table. By measuring fluency (the number of alternative uses), originality (the uniqueness of the answers), flexibility (the range of domains covered) and elaboration (the detail provided in the answers), the test covers both quantity and quality. Supposing that expert music-listeners have developed ways to maintain their perceptual experience valuable by generating novel exploratory modes of listening, as well as an ability to map, among the other things, musical and non-musical categories cross-modally, then a comparison between expert listeners and non-listeners in the AUT may reveal that the former group would score higher in flexibility than the other.

Future research could also build on the conceptual resources offered here to examine more deeply the interplay of verbal and non-verbal factors involved in perception, exploring both separately and jointly how action and creativity shape the constellations of habits, thoughts, and behaviours, that music perception seems to entail. In conclusion, our preliminary conceptual analysis highlights both the deep continuity of action, creativity, and music perception and also some features of the existing research terrain which shape our exploration of these phenomena. While more empirical and theoretical research is needed, a more holistic, embodied, and enactive understanding of the musical mind continues to be theorized and developed.

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Notes

1. Here we can draw a parallel between the study of creativity and that of musical talent and skill development: as Lamont (2011) reminds us, research no longer supports the view of musical talent as genetically instantiated predictors of musical ability. In contrast to such a perspective, many scholars now maintain that basically all children "should … have the capacity to be musical" (ibid.). Elliott and Silverman (2015) make a similar point when they argue that "[t] hrough the progressive development of musical understanding with musical and educative teachers and facilitators, all students can achieve human flourishing, communal well-being, an empathetic sense of self-and-other, as well as a sense of meaningfulness, enjoyment, and a creative way of life" (p. 280, quoted in Silverman, 2020).
2. WEIRD stands for Western, Educated, Industrialized, Rich, and Democratic societies. Henrich and colleagues (2010) have argued that "researchers – often implicitly – assume that either there is little variation across human populations, or that these 'standard subjects' are as representative of the species as any other population" (p. 61).
3. As it will be clearer later, this richer range of experience can be seen to emerge from the mechanism of embodied simulation (Gallese, 2001, 2005).
4. Notably, those without musical performance or instrumental training may still resonate with other motor aspects of the same musical sound since they can use existing repertoires of familiar actions to engage with more basic motor components of the stimulus. For example, dedicated performance instruction is not required for individuals to synchronize their movements to regular beats, although individuals with dedicated training tend to perform with more precision (see Chen et al., 2008).
5. A similar perspective, aimed at examining how motor constraints allow the emergence of creative behaviour, has been recently put forward by Torrents and colleagues (2021). Their contribution, however, is mainly concerned with behaviour, and does not cover perceptual forms of creativity.

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