

Grounding the Analysis of Cognitive Processes in Music Performance: Distributed Cognition in Musical Activity

by Linda T. Kaastra

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The opening of *Grounding the Analysis of Cognitive Processes in Music* by Linda T. Kaastra poses a question that implies an ambitious agenda: what is music? As the title of the book suggests, Kaastra addresses this question by locating her work firmly in a performance-centered ontology: music as action rather than object. Not so much “what is music?”, then, but rather “where”, “how”, or even “when is music?”. In this way, the main concern of the book—the location of (musical) knowledge, and, therefore, (musical) meaning—is fundamentally interdisciplinary in its intersection of musicology and cognitive science. Kaastra advocates for attending to the “activities” of western art music, whereby music is understood through performing, composing, improvising, and rehearsing.¹ As Kaastra describes, since the 1990s, musicology has increasingly moved away from a structuralist, work-centered approach, and towards an understanding of music as a social, cultural, and embodied practice (e.g., most recently, Clarke & Doffman, 2017; Cook, 2018). And, within the broad field of cognitive science, there is now a large body of work on music cognition that has similarly challenged representational, or “head-bound”, models of processing as part of a paradigm shift towards an ecological model that understands knowledge as a multi-modal phenomenon that emerges through the dynamic interactions between organisms and their environment (Lesaffre et al., 2017; Schiavio & Benedek, 2020; van der Schyff et al., 2018). This book, then, is a timely attempt to present a rich interdisciplinary model for exploring the embodied and distributed dimensions of western musical performance, from the micro level and, in some cases, overlooked interactions between a musician and their instrument, to the macro level in exploring the interactions across a performing ensemble.

Alongside Herbert Clark’s (1996) theory of language use as joint activity and Roy d’Andrade’s (1995) integrated ontology of mind, Kaastra’s theoretical framework is

influenced by Hutchins’s (1995) framework of distributed cognition, which studies the propagation and transformation of processes across social groups, to illustrate the active way in which material culture participates in human activity. Hutchins’s now classic account of the navigation of a US Navy vessel demonstrates the way in which the crew of the ship operate as a distributed system, with each agent contributing to the shared cognition that is required to operate the vessel. Here, tools are understood as a set of “representational media” that are manifestations of “repositories of knowledge [...] constructed in durable media so that a single artifact might come to represent more than any individual could know” (Hutchins, 1995, p. 96). While Jonathan de Souza (2017) has engaged with Hutchins’s work to investigate the relationship between performer and instrument from a music-theoretical perspective, Kaastra is the first to apply Hutchins’s model of distributed cognition to analyze the processes of solo and ensemble performance. What this means for her discussion is that musical actions are not reliant on inner mental states, but rather emerge through the interactions with various information resources in the environment, both human and non-human. The Gibson (1986) notion of affordance is logically and convincingly deployed in Kaastra’s detailed qualitative analysis of case studies of instrumental techniques and rehearsal practices, enabling her to draw out insights on the inextricable link between the musical, psychological, and sociocultural. Her framework underlines the dynamic and mutual dependency between performer and environment, which is essential to rethink the creative processes of music-making. A simple example of this is that an instrument’s possibilities for action are likely to differ considerably depending on whether it is played by a novice or highly skilled musician. Equally, cultural and environmental factors are vitally important in shaping a musician’s interactions with their instrument: a jazz musician performing on a double bass in a trio in a busy club is likely to interact with their instrument in quite a different way to a classical double bassist playing alone in a practice room. In this way, Kaastra’s approach is distinct from work on embodied music cognition that retains an emphasis on



internal representation as the basis for cognitive processes (e.g., among many others, Leman, 2007; MacRitchie et al., 2017), and sits more comfortably with more radical approaches that understand cognition as an integration between the mind and the environment (Loaiza, 2021; van der Schyff et al., 2018; Witek, 2019). Kaastra stops short of ascribing the instrument its own agency in the creative process, rather, musical instruments are one of the cognitive artefacts (alongside other media such as technologies, scores, and even annotations) that play a role in cognitive processing.

Kaastra's framework of distributed cognition in music-making is first explored at the micro level, through a detailed analysis of instructional videos by professional bassoonists. The case studies demonstrate particularly vividly the everyday and taken-for-granted techniques of practice that constitute the craft of performance. The processes of breaking down passages of music into chunks, or applying different rhythms to a particular phrase to embed the player's embodied knowledge of it, are likely to be familiar to most musicians, but Kaastra's meticulous analysis illustrates the inextricable relationship between technique and meaning: once embedded in a player's knowledge, fingerings can be deployed in a particular way to convey a particular musical idea. Kaastra reframes these episodes in terms of the awarenesses of performance technique in order to shed light on the "layering of focal targets" (p. 43) which can shift in and out of a player's attention in the moment of performance. Importantly, as she underlines, these sorts of details—the sense of shape of the lips or tongue, the feel of the tone holes or keys beneath the fingers, the sense of breath and the reed's response to it—are not merely technical, but have consequences for musical meaning, whether in subtle or quite radically different ways. This integration of technique and interpretation has consequences for the ways in which musical expression is defined and analyzed, and is important for developing empirical research on the topic (Davidson, 2014).

The complex entanglements between musicians and their instruments interaction have been a long-standing concern of ethnomusicology (Baily, 1985; Blacking, 1977; Clayton & Leante, 2013; Dawe, 2012). From a musicological perspective, recent research has reconsidered instruments as materializations of knowledge and cognition (de Souza, 2017; Rehding, 2016), and scholarship situated in the "new organology" demonstrates renewed interest in the instrument's role in the construction and transmission of (musical) knowledge, culture, and creativity (Bates, 2012; Dolan, 2012; Moseley, 2016). Yet, as Kaastra observes, empirical work within the field of performance studies has tended to be limited to the piano (Clarke, 2004). There are some exceptions to this that have examined the role of instrumentality in creative work, such as the clarinet (McLaughlin, 2022), guitar (Clarke et al., 2017), and oboe (Hooper, 2013; Redgate, 2007); however, these studies are less explicitly concerned with

cognition. Kaastra, then, is unique in her focus on the bassoon, arguably one of the most intriguing and cognitively rich of the orchestral instruments, and I found this section of the book particularly fascinating. Sound activation on the bassoon involves a complex interaction between embouchure, breath configuration, and finger technique, aside from any ancillary actions deployed in the moment of performance. For example, as Kaastra points out, the depression of keys is not simply related to achieving a specific pitch, but can be used to facilitate articulation and sound activation; the bassoon is a unique wind instrument in this respect. Realizing a sound therefore necessitates a complex configuration of cognitive resources, even before the situational aspects of the musical activity are considered. Operationalizing these resources in the moment of performance can be direct targets of awareness, but as Kaastra argues compellingly, many of these dimensions are tacit: breathing becomes not just a technique for sound activation, but has its own aesthetic meaning. Drawing on Michael Polanyi's (1966) dimensions of tacit knowledge, she shows how playing, or as she puts it rather more evocatively, "coaxing" (p. 27) out a note on the bassoon requires the employment of "proximal" and "distal" forms of tacit knowledge—proximal being the physiological processes mentioned above that might be unspecifiable in the moment but which coordinate to create the sound; distal being the target of focal awareness, that is, the note itself. As Kaastra puts it: "When I play an A to tune at the beginning of a rehearsal, I attend focally to the A, not the particulars of producing the A. But the aspects of subsidiary awareness, the manipulanda, are engaged in the production of the tone" (p. 32). While not explicitly engaging with the ideomotor aspects of instruments, her discussion here is suggestive of the ways in which action and sound appear to be experienced and planned by performers as monadic rather than as separable (Pfordresher, 2019; Wollman et al., 2014).

In addition to the bassoon serving as a particularly intriguing example of the tacit coupling of sound and action in performance, I would argue too, that it has a particularly rich history, with various schools of performance that have developed particular technical approaches to elements such as phrasing and timbre: it is therefore perhaps the least "standardized" of orchestral instruments. In his treatise on bassoon technique, Pascal Gallois (2009) goes as far as stating that "it is possible to recognize a bassoonist's specific school and even sometimes her/his country by simply listening to the sonority, volume and phrasing" (p. 8). In this way, the bassoon demonstrates particularly acutely the reality that instruments are more than just functional tools; they are sensory, aesthetic objects (de Souza, 2017), possessed with cultural baggage which shapes performers' relationships to them—established pedagogies, practices, and bodily relationships, associations with players and performance contexts. Kaastra's focus on the bassoon therefore makes both a novel and fruitful contribution to the fields of cognitive science and performance studies.

Widening the focus beyond body-instrument interaction to include the role of notation, the second case study examines Kaastra's own experiences of learning the guitar. Here she engages with a range of guitar notations (including western notation, TAB, and less formal sketches by practitioners), arguing for moving beyond thinking about notation as a fixed and abstract representation of musical knowledge, but a cognitive artifact that maps out and invites different kinds of actions. Visual representations of musical action can prioritize musical knowledge in different ways. The function of the notation is dependent on, in Kaastra's words, its "basis for participation" (p. 63). This means that it could be designed to shape different kinds of instrumental interaction, such as facilitating improvisation around particular chords, developing skills such as achieving a smooth transition between fingers, or helping to guide harmonic understanding. Notation can therefore animate different features of musical events, and shape musical meaning accordingly. The ecological framework reveals the layer of cognitive labor that that might otherwise be lost in an approach underpinned by a structuralist ontology; Kaastra calls this a "representational blind spot" (p. 18). Moreover, while notation has frequently been associated with disembodiment, the case study ascribes a positive function to notation within the bodily processes of music-making, which might otherwise be overlooked in performance-orientated musical scholarship. The study of notation can therefore complement the study of music as an embodied and interactive practice (Schuiling, 2019; Schuiling & Payne, 2022).

The third case study moves to the macro level by expanding the creative ecosystem to include co-performers, through the analysis of rehearsal strategies of a flute duo. The focus here is on collaborative work in pre-performance activities such as rehearsal, rather than group dynamics in the immediate moment of performance (see, e.g., Høffding, 2019; McCaleb, 2014; Sawyer, 2014; Sawyer & DeZutter, 2009). Understanding the ways in which performers coordinate their musical actions remains an important theoretical and empirical challenge, and Kaastra is rigorous in the level of detail in her analysis. The case study demonstrates that rather than presenting an achievement of each player obeying an external abstract structure provided by the score, temporal unison is co-created in performance: musicians *make*, rather than adhere to, time (Schuiling, 2021). To achieve this, Kaastra argues, musicians attune to one another by cultivating and negotiating common ground for participation, achieved by co-creating shared sets of experiences and "mutually salient coordination devices" (p. 121). These devices are both musical and non-musical, and can occur both before (e.g., through preparation activities such as conversations, repetition, counting strategies, engagement with the score, annotation) and during performance (e.g., through bodily movement and breath cues). The discussion shows how ensemble music-making is contingent on a careful balancing act of attentional resources, and emerges through the highly

refined but spontaneous coupling of action and perception. There is a slight risk of getting lost in the analytical detail in this case study, but Kaastra is admirably unapologetic about this. As she contends, musical performance is a multifaceted and highly complex activity; this complexity inevitably increases as the creative ecosystem grows in size from a soloist working with an instrument to a large ensemble (p. 147). The book concludes by suggesting ways in which the framework can be scaled up or down, and in particular, how it might be deployed to analyze the dynamics and mechanisms of an orchestra. Her approach here is valuable in challenging previous models of distributed creativity in orchestral performance which have ascribed creative leadership to the conductor (Sawyer & DeZutter, 2009); as she argues, orchestral musicians are not "'given everything' by a conductor. They are not simply following along, lifting and pressing fingers at the right time" (p. 154). In this way, the book pursues a similar line of inquiry to other recent scholarship that challenges romantic ideals of creative authority and authorship in orchestral performance (Cottrell, 2017; Ponchione-Bailey, 2016, 2018) and has the potential to examine the endlessly variable individual and collective experiences and actions of orchestral musicians in meaningful ways.²

To return to the fundamental question of the book highlighted at the start of this review, Kaastra firmly asserts that the framework is not intended to be a catch-all "theory of everything". Indeed, as she contends, "It is not possible to study everything at once" (p. 148), and the framework is very clear in delineating its parameters and limits. I would agree that the value of the framework lies in its methodological depth, rather than its breadth. The discussion of bassoon performance practice makes a particularly novel and valuable contribution, and is a resource to which I am sure I will return in future. Furthermore, the level of systematic detail set out in the framework allows for the formulation of new hypotheses that will pave the way for further ecologically valid empirical investigations. One particularly fruitful contribution is its focus on musicians' interactions with notation, which has wide-ranging potential applications for pedagogical research. To suggest just a few potential research questions: what insights might a distributed model of cognition offer to the empirical study of sight-reading? How might the model contribute to the analysis and understanding of the experiences of dyslexic musicians? What role does an understanding of notation as a cognitive artifact play in musicians' memorization strategies?

In sum, *Grounding the Analysis of Cognitive Processes in Music* provides a carefully developed theoretical starting point for empirical investigations of the perceptual connections that are grounded in the embodied nature of musical action and experience. Given that, as Kaastra acknowledges, this book is an extension of her PhD work begun in 2008, the claim (drawing on Cross, 2012) that "most scientific work in music cognition assumes a materials ontology and takes a structural approach" (p. 4) carries

somewhat less weight today, with ecological approaches to perception and musical meaning beginning to be fairly standard views in the field. Nevertheless, while the book's overarching argument may not appear entirely novel, there is considerable value in its drawing together of key literature in music and cognitive science to study performance, and it is likely to complement approaches of other recently-published or forthcoming work on creative cognition that are grounded in (inter-)active bodily approaches to performance (Timmers, 2022; van der Schyff et al., 2022) and related domains such as music listening (Kozak, 2020; Reybrouck, 2021), education (van der Schyff et al., 2016), and composition (Schiavio et al., 2022). Indeed, the fact that this book coincides with several other similar publications demonstrates that the field has reached an exciting stage, opening up a number of future avenues for empirical enquiry into the creative processes of musicking in the broadest sense.

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Notes

1. To which I would add listening (Reybrouck, 2021) and imagining (Hargreaves et al., 2012).
2. For some recent innovative digital methods used to analyze orchestral performance, see Ponchione-Bailey and Clarke (2021, 2022).

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