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Introduction to the special issue on *Dance and Cognitive Science*

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In recent years significant advances have been made in our understanding of the neural concomitants of many mental processes. These findings also hold the promise of offering novel insights into the aesthetics and practice of dance and choreography. Various researchers have sought to apply findings from experimental psychology and cognitive neuroscience to dance. More recently some cognitive neuroscientists have discovered dance as a means to study different aspects of the central nervous system. Some dancers and choreographers have also taken an interest in cognitive science and have collaborated with cognitive scientists and psychologists in order to explore joint avenues of cooperation.

Of course one may ask whether there is any point in such a rapprochement between dance and cognitive neuroscience. Does it matter in any way what happens where in the brain when one watches dance or learns a dance phrase? How does this knowledge enhance our understanding of dance and choreography? Who cares whether it is the insula rather than the amygdala that is activated in a particular task? This might be of interest to neuroscientists, neurologists and neurosurgeons, but why should artists and audiences care about these findings? And, as Currie (2003: 718) asks with respect to neuroaesthetics in general, "is [this research] intended merely to discover the underpinnings of responses we can describe and evaluate in the familiar language of criticism and connoisseurship? Or is the aim to interpolate unfamiliar concepts into the domain of aesthetics itself leading perhaps to a revised understanding of aesthetic values?"

I am the first to admit that there is little to be learned from neuroimaging studies which proclaim to study the neural basis of judging whether something is beautiful by having a dozen or so people watch some reproductions of paintings while inside a brain scanner other than that something happens inside the brain (e.g. Vartanian and Goel 2004; Kawabata and Zeki 2004). There is nothing new or exciting about the observation that the brain is active when one engages in a mental task. It would be

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truly revolutionary if it would turn out that nothing happens! Looking at a painting and watching a movie engages multiple mental capacities, and if the threshold is set low enough, the entire brain will show increased activity. Recording the brain activity of someone watching a video recording of a dance performance or a short dance phrase inside a brain scanner will therefore tell us little, if anything at all. It might tell us something about the brain, but it won't offer any insight into dance and choreography. Sure enough the cerebral blood flow in different parts of the brain will change; there may even be patterns across different individuals, but then, so what? We might also observe that people's heart rate goes up when they are excited, but what does that tell us about the structure of the objects and events that are a cause for excitement?

As Bennett and Hacker (2003) argue, it is the person who interprets, understands, judges and gets excited, not the body, the brain or some part of the brain. Humans cannot be ontologically reduced to their nervous system. One does not like chocolate because of some neurons firing in the posterior ventral pallidum. One likes it because it has a particular balance of sweetness and bitterness. One does not enjoy a comedy because of increased activity in some part of the brain, but because it is funny. The observation that the orbitofrontal cortex gets activated when one eats chocolate or appreciates something as funny does not add any relevant information in this respect.

However, to cite one of the three main lines of defence that I myself like to put forth against this kind of criticism, when you listen to music you don't just hear a stream of sound, you hear musical structures: you hear rhythm, themes, motives, phrases and refrains. Of course, the reason that you hear structures and patterns when you listen to music is that the sounds have been composed by a musician or composer. But a composer can only compose music because he or she is capable of hearing and imagining musical structures. We may thus ask which mental capacities are engaged when people listen to music that make it possible to hear musical structures (Jackendoff and Lerdahl 2006). We may ask how these capacities are acquired and whether they rely on a more general capacity, for instance the capacity for language. These questions are the province of psychology and cognitive science.

We may also ask which neural conditions make our mental capacities possible. This question is the province of cognitive neuroscience (Bennett and Hacker 2003: 1 and 114). We may ask whether those conditions constrain and bias our mental capacities in systematic ways. For instance, there is a limit to the number of objects that one can simultaneously attend to, and when one's attention is consumed by a demanding task one may fail to notice otherwise attention grabbing events. As I have argued, the fact that dance is unlikely to elicit disgust may also have its roots in the brain (Hagendoorn 2007). Directors and choreographers systematically manipulate the audience's attention and emotion, and so understanding the neural mechanisms of attention and emotion may also further our understanding of cinema, theatre and choreography. Experimental psychologists have documented a steadily growing list of cognitive biases, which affect both how we perceive the world and act in the world. Since art is part of the world we inhabit, the same cognitive biases also affect how we perceive, interpret and judge works of art.

A neuroimaging study is unlikely to reveal the structure of a fugue or the difference between a Beethoven string quartet and a Mahler symphony or a Bach

fugue and a Shostakovich fugue for that matter. The most that it will bring to light are the neural correlates of music perception. But using the tools of cognitive science, we may learn more about the capacity for music and the metrical structure, the pitch structure and the grouping organization of music. The same tools may also tell us more about the nature and perception of dance and choreography.

The authors in this special issue address the issues that I have just sketched in five articles that vary both in scope and approach. Cross and Ticini provide a concise overview of recent papers in cognitive neuroscience that reference dance. Jola, Ehrenberg and Reynolds discuss how first-person accounts of watching a dance performance might be related to their neurophysiological correlates. Starting from a phenomenological analysis of movement, rooted in Husserl's original phenomenological methodology and setting forth the qualitative structure of movement, Sheets-Johnstone shows that present-day cognitive science is unable to provide insights into dance because it ignores the actual experience of movement, which is to say, it ignores kinesthesia, the neuromuscular sensory modality common to all humans, and thus the proper point of departure for investigations into pan-cultural universals underlying the art of dance. Drawing on research into the link between action control and action perception, Montero argues that dance training makes one a better observer of certain aesthetic qualities of dance. Hagendoorn briefly reviews the literature on spatial cognition and speculates that watching dance, or at least some choreographies, can give us access to a unique experience of space. Additionally, he argues that the concepts used by cognitive neuroscientists to frame their findings can be applied in a choreographic context.

It is my hope that the papers included in this special issue give rise to much debate and many further questions and research at the intersection of dance and cognitive science.

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