

# 3

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## Movement's contagion: the kinesthetic impact of performance

This chapter pursues answers to a question, most urgently posed in relation to dance events, but equally central to all performance: what do you feel, physically, when you watch another body performing? How and why do you respond to the motions of another body? What do you sense? How does your physical experience of what you are seeing help you understand what you are watching? Focusing the inquiry with these questions, I seek to emphasize the sensations of our bones, muscles, ligaments, tendons, and joints. The sensory experience provided by these corporeal elements, often referred to as the kinesthetic sense, has been largely ignored in theories of performance, yet for those of us in dance studies, it remains a predominant aspect of aesthetic experience, one that must be interrogated as part of any inquiry into dance's significance.

In the 1930s the dance critic John Martin described movement's effect on viewers as contagious, a term that is defined as the rapid spread of influence or emotion from one body to another, but that also suggests pollution and disease. More recently, the neurophysiologist Vittorio Gallese has described the phenomenon of yawning when someone yawns, or laughing when they laugh, as contagious behavior.<sup>1</sup> What kind of interkinesthetic connectivity forms the basis for such claims? What hold does the kinesthetic have over subjectivity such that its influence would be described as contagious? In what follows I offer a brief and partial genealogy of the term kinesthesia, framed to historicize the claims to know or feel what another body is feeling. Juxtaposing neurophysiological investigations of the term and aestheticians' accounts of dance's impact, I hope to show how the influence that one body can exert over another, its propensity toward contagion, has changed radically over the past hundred years.

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### Kinesthesia as interiorization

The term kinesthesia, deriving from the Greek *kine* (movement) and *aesthe-sis* (sensation), is first implemented in physiological studies of the late nineteenth century to refer to the sense of the body's movement, yet the notion of internal bodily sensation was widely discussed in eighteenth-century philosophy and aesthetics. Often referred to as a kind of "sixth sense," this repertoire of sensations is isolated from the other senses by the Abbé de Condillac, who calls it the most fundamental feeling. In order to examine the act of perception, Condillac posits the existence of a statue whose senses are enlivened one at a time:

Our statue, deprived of smell, of hearing, of taste, of vision, and limited to the sense of touch, now exists through the feeling which she has of the parts of her body one upon the other – above all the movements of respiration: and this is the least degree of feeling to which one may reduce her. I call it fundamental feeling, because it is with this play of the machine that the life of the animal begins; she depends on it alone. . . . This feeling and her "I" are consequently the same thing in their origin.<sup>2</sup>

Utterly immobile, the statue nonetheless feels parts of her body touching other areas, and also the sensation of breathing. For Condillac, both the viscera and the muscles and joints contribute to this bodily sensing.

Slowly over the nineteenth century, however, the sixth sense begins to acquire increased precision. Investigating the skeletal musculature, Thomas Brown, as early as 1820, observes that "our muscular frame is not merely a part of the living machinery of motion, but is also truly an organ of sense."<sup>3</sup> In the 1820s and 1830s, Sir Charles Bell identifies "muscle sense" as responsible for three groups of sensations – pain and fatigue, weight and resistance, and movement and position – all of which result from sensations arising when a muscle contracts. The Pacinian corpuscles, muscle spindles, and Golgi tendon organs that all contribute to these sensations are identified in the 1840s, 1860s, and 1880s respectively.<sup>4</sup> In 1880 Henry Charlton Bastian is able to synthesize investigations of these specialized receptors with his own work on their connections to the cerebral cortex in order to assert definitively the sense of movement which he names kinesthesia.<sup>5</sup>

Thereafter, kinesthesia is replaced by a new term, proprioception, that focuses investigation of muscular sensation on its participation in the afferent-efferent arc. Named by C. S. Sherrington in 1906, proprioceptors are those sense organs that deliver internal or afferent sensations about the status of the muscle or joint to the spinal cord and brain where they connect to motor, or efferent, responses.<sup>6</sup> Functioning at an unconscious

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level, proprioceptors participate in spinal-level reflexes that primarily assist in maintaining posture and balance, and they also contribute to the learning and remembering of physical activities such as sports. Sherrington's pioneering studies of reflex actions and the role of proprioception in guiding and refining muscular action dominate the field for several decades.

The interest in skeletal musculature evidenced in the work of Bastian and then Sherrington parallels a new fascination with physical fitness that likewise focuses on the muscles. In a period of mass migration into urban centers, where daily living offers far fewer opportunities for physical exercise, exercise is seen as an effective way of building up nervous reserves. It both interrupts the depletion of those reserves brought on by laboring in the factory, with its highly repetitive phrases of motion that frequently interface with machinery, and at the same time it provides a respite from the nervous taxation of city life.<sup>7</sup> For many psychologists of the period, the whole body is seen as contributing to the energy needed to maintain mental and motor activity. They also see the cultivation of the body as a manly pursuit.<sup>8</sup>

As part of this growing interest in the musculature, Dudley Allen Sargent is awarded a professorship at Harvard to establish physical education in 1879.<sup>9</sup> There he elaborates an exercise regime that implements pulley-weight machines that can be adjusted to the strength of the individual and focused around the cultivation of specific muscle groups. By 1912, Sargent boasts that 270 colleges now offer programs in physical education; 300 city school systems around the United States require it; and 500 YMCA (Young Men's Christian Association) gymnasiums with 80,000 members provide versions of his machines.<sup>10</sup> Sargent's regimens, along with several other similar systems of exercise that work with dumbbells, balls, and ropes, help forge an entirely new experience of the body as a muscular entity. Its newly identified muscles, contributing vitally to the health and wellbeing of the person, must be developed and maintained through regular exercise devoted specifically to them.

This elasticity and tensility of the musculature in motion provides the medium of expression for the newly emerging modern dance; its chief apologist, the *New York Times* critic John Martin, draws heavily on assumptions about kinesthesia to formulate his theory of dance expression. Martin argues that the viewer, on witnessing the dancing body, is inspired to feel equivalent kinesthetic sensations. This process, which he called "inner mimicry," is grounded in a fundamental physical reactivity to all events: we pucker when we witness someone tasting a lemon, and when they yawn or cry we feel similar impulses.<sup>11</sup> Not only events but also objects elicit this kinesthetic responsiveness:

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Since we respond muscularly to the strains in architectural masses and the attitudes of rocks, it is plain to be seen that we will respond even more vigorously to the action of a body exactly like our own. We shall cease to be mere spectators and become participants in the movement that is presented to us, and though to all outward appearances we shall be sitting quietly in our chairs, we shall nevertheless be dancing synthetically with all our musculature. Naturally these motor responses are registered by our movement-sense receptors, and awaken appropriate emotional associations akin to those which have animated the dancer in the first place. It is the dancer's whole function to lead us into imitating his actions with our faculty for inner mimicry in order that we may experience his feelings.<sup>12</sup>

Viewers' bodies, even in their seated stillness, nonetheless feel what the dancing body is feeling – the tensions or expansiveness, the floating or driving momentums that compose the dancer's motion. Then, because such muscular sensations are inextricably linked to emotions, the viewer also feels the choreographer's desires and intentions.

Martin's argument is geared to rationalize the emergence of a new genre of concert dance, the modern dance, which deploys radically new presuppositions about movement and meaning. Rather than locate the dancer within a story, as in ballet, or as part of a spectacle, as burlesque had done, the modern dance utilizes dance movement itself as the vehicle for developing narrative. The body's special proximity to both emotional and unconscious realms of the psyche endows its movement with a special charge. When properly cultivated by the choreographer, dance movement can unite both dancer and viewer in the experience of fundamental human emotion:

The modern dancer, instead of employing the cumulative resources of academic tradition, cuts through directly to the source of all dancing. He utilizes the principle that every emotional state tends to express itself in movement, and that the movements thus created spontaneously, though they are not representational, reflect accurately in each case the character of the particular emotional state. Because of the inherent contagion of bodily movement, which makes the onlooker feel sympathetically in his own musculature the exertions he sees in somebody else's musculature, the dancer is able to convey through movement the most intangible emotional experience.<sup>13</sup>

Emotional states, described here in the language of disease as contagious, are transmitted through movement that has been devised spontaneously. The choreographer, tapping the emotional depths of his or her psyche, is moved by the force of the feelings found there. Even as re-presented on the concert stage, the resulting dance carries this primal force.

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Martin's theory relies on the increasingly individuated experience of the musculature and its particular properties of tensility, dynamism, and momentum. At the same time, he connects this musculature intimately with the unconscious depths of the psyche, assuming that the kind of impulse originating there is so rudimentary that it can never be articulated verbally. Establishing an organic opposition between movement and language, Martin argues that the peripatetic volatility of kinesthetic information as it journeys through the unconscious is what the dance so uniquely captures. The creative process of making a dance, an entirely individual rather than collective experience, does not socialize the unconscious so much as enrich the number of ways in which to witness what a human being is. Choreography, not unlike psychoanalysis, may shed light on the inner workings of the psyche, but the energy it taps within the human body undercuts civilizing mechanisms with its primal veracity about the human condition.

#### Kinesthesia as orientation

Although Martin's theory of meaning in dance depends on kinesthetic empathy, the term kinesthesia was rarely used, apart from an occasional dance class, for the first half of the twentieth century.<sup>14</sup> It came into new and more widespread use with the 1966 publication of James J. Gibson's influential study, *The Senses Considered as Perceptual Systems*. Following Sherrington, scientists working in psychology and perception studies upheld an absolute separation between perception and action. They agreed that afferent and efferent neural systems were entirely distinct and incommensurate: the afferent processed incoming stimuli and the efferent conveyed the command for bodily movements. As it had been for Condillac's statue, perception was investigated as the passive experience of receiving input from distinctive kinds of receptors, individually responsible for sight, hearing, taste, touch, and smell. Gibson, in contrast, argues that perception is the act of extracting information from the environment. A highly active project, perception requires participation from both afferent and efferent systems. In fact, any given act of perceiving depends on a complex sorting through of that which is invariant and that which is in flux. Gibson identifies proprioception as central to that process.

Kinesthetic information, identified now as a subset of proprioception, comes from muscle and joint receptors and also the vestibular organs of the inner ear. Gibson argues that these sense organs contribute a continuous sense of one's orientation with respect to gravity and one's motion through space as well as a generalized sense of bodily disposition – where one is

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tense or relaxed, expanded or compressed, even the precise angle of each joint. Gibson further proposes that any act of perception depends on the detection of the just-noticeable difference between sensory input and bodily disposition. The eyeball itself can tell us very little about the visual world around us, but the eyeball combined with the ocular musculature that surrounds it and the vestibular system that orients it with respect to gravity can give very precise information about our surroundings. Gibson identifies this integrative processing of external and internal stimuli as the perceptual system. He further argues that kinesthesia plays a central role in integrating all the senses.

Gibson's theory of perception is almost literally fleshed out in the dance practice known as contact improvisation that emerged just a few years after the publication of his book. Like contact improvisation, which asks participants to forge a moving point of contact between two bodies and to follow that contact wherever it leads, Gibson's theory proposes an ongoing duet between perceiver and surroundings in which both are equally active. The environment does not impinge upon a passive observer. Nor does the perceiver survey the environment, as Condillac's statue does, from a static and omniscient position. Instead, the perceiver negotiates the perpetual flux of surroundings by determining that which is constant and that which is changing. Gibson argues that vision is especially successful in determining these constancies, and as a result, we associate a sense of self with the head. I (my head) and my body (the rest of my body) exist as identifiably separate, partially because of vision's extreme precision in coordinating with locomotion to navigate the world, and partially because of our ability to see many other parts of our bodies. Recognizing this hierarchical arrangement of the senses, contact improvisation encourages participants to defuse the visual and to focus more intensively on their sense of touch. In so doing, a new experience of self is produced in which the "I" is contingent upon and a product of the ongoing contact between the two bodies.

As Cynthia Novack has observed, contact improvisation emerged during a period of prolific experimentation with altered states of consciousness, some drug-induced, that endeavor to probe the boundaries of perception and its effects on subjectivity.<sup>15</sup> Numerous forms of meditation, martial arts practices, and yoga, as well as social dancing, all conceptualize the body's movement as a potential conduit to new ways of perceiving and orienting oneself in the world. Rather than offer access to repressed or primal experience, as in Martin's theory, movement holds the promise of expanding consciousness. Like Gibson's understanding of the role that movement plays in extracting information from the environment, movement can be tapped to give insight into new dimensions of reality.

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Gibson's theory of perception likewise aligns with a general shift in conceptions of dance meaning that occur in the 1960s and 1970s in response to choreographic initiatives of the same period. Rather than impressing itself upon viewers, the dance now presents itself to viewers, asking them to extract from the dance whatever meaning they find. As the composer John Cage observes, in outlining his collaboration with the choreographer Merce Cunningham:

We are not, in these dances and music, saying something. We are simpleminded enough to think that if we were saying something we would use words. We are rather doing something. The meaning of what we do is determined by each one who sees and hears it . . . I may add there are no stories and no psychological problems. There is simply an activity of movement, sound and light.<sup>16</sup>

Unlike Martin, who assumes that dance is intrinsically connected to the emotions, making its meaning felt by staging a progression of feelings, Cage asserts the primacy of physical activity as distinct from any other psychological experience. What a dance offers its viewers is the opportunity to perceive bodies in motion. As part of that process, viewers can focus on whatever parts or aspects of the dance they find interesting, and as a consequence, they will each experience the dance differently. Nonetheless, their experience of the dance will be grounded in the physical factuality of the body's articulations.

Similarly, Gibson's vocabulary for discussing the phenomenon of perception focuses on the "real" experience of sensing the world around us. Rather than immobilize the subject in order to study an isolated reflex, he devises experiments that simulate the ways we actually perceive as part of moving through our surroundings. Like Cunningham's ideal viewers, he envisions his subjects as active and willful perceivers. At the same time, he identifies the features of our surroundings using a neutral terminology – stimulation, ambient array, external invariants – that rebuffs any cultural or historical specificities.

Thus both conceptualizations of kinesthesia – as the muscular connection to our deepest feelings, and as the orientor of our senses and sense of identity – are rationalized by distinctive universalist worldviews. Kinesthesia as entwined with the emotions presumes that all humans share this same connection and that they are all equally moved by the same depictions of human predicament or struggle. Kinesthesia as baseline for evaluating the senses presumes that all humans have equal access to the same conditions for sensing the world. Although physical impairment can cause a person to perceive the world differently, social difference does not. Both

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conceptions of the kinesthetic cast dance as a unique medium of communication; it functions either to awaken and enliven feelings or to assert the vitality of physicality as separate from the emotions. In the first case, the dancer's body becomes a vessel for the dance's message and the viewer receives that message by being moved by it. In the second, the dancer's body emits actions to a viewing body that actively seeks out their message.

### Kinesthesia as simulation

The definition of kinesthesia transforms once again in the 1990s with work done by Alain Berthoz, among others, on the brain's sense of movement and with the discovery of a new class of brain cells, called "mirror neurons." Building on Gibson's theory of perception as an active engagement with the world, Berthoz approaches the external senses as systems rather than channels and as interrelated rather than mutually exclusive.<sup>17</sup> And like him, he sees kinesthesia as playing a central role in orienting and organizing all the senses. He departs from Gibson, however, in two crucial ways: firstly, he argues that perception is a simulation of action; and secondly, he does not assume that observers share a common environment, instead holding that each individual may perceive the world quite differently, based on the kinds of cultural and gendered differences from which the *habitus* is formed.

Synthesizing a large number of experiments on perception and cognition, Berthoz emphasizes the anticipatory quality of attention. As one is looking at the armchair, one is already simulating the motions associated with seating oneself in it. As one sees the brake lights on the car ahead, one is already coordinating exactly when and how strongly to apply the brakes. Increasingly, neuroscientists are establishing that perception and action are embedded in each other, arguing that

cortico-ponto-cerebello-thalamo-cortical loops exist, within which internal simulation of movement can occur completely independent of its actual execution. These loops contain . . . here I do well to hesitate, like Faust. "Representations" is too vague; "models" is modern but probably vague as well; "images" is too visual; "schema" is the term perhaps most common in the literature; "kinesthetic series" would make Husserl happy.<sup>18</sup>

Through these "kinesthetic series" the brain simulates various movement options in order to choose the best strategy. Thus the cat can catch a mouse, anticipating its future position, because "its neurons are sensitive to the velocity of movement: they do not calculate a velocity."<sup>19</sup> Rather, the cat

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has evolved this capacity as part of its adaptation to and survival in its environment.

Although most cats are similarly talented at catching mice, humans, Berthoz argues, undergo a far more complex perceptual process. They do not necessarily perceive all events in the same way. Where Gibson assumes that all individuals can stand in the same place at different times and be afforded an equal opportunity to explore it,<sup>20</sup> Berthoz emphasizes research that shows that “the oculomotor path followed to explore a face is completely different depending on what the observer is thinking: whether she thinks that the individual is rich, sad, or well-coifed, that his ears are protruding, and so on.”<sup>21</sup> Pleasure or fear or interest all influence the tiny motions of the eye, known as saccades, through which visual perception occurs.<sup>22</sup> One’s history of engagement with the environment profoundly affects how one sees, and consequently what one sees.<sup>23</sup> Berthoz references Pierre Bourdieu’s notion of the *habitus* as a way to theorize these perceptual inclinations.<sup>24</sup> The long-standing features of our cultural as well as physical environment inform the way we perceive the world.

Strong evidence in support of Berthoz’s argument that perception simulates action has been provided with the discovery of mirror neurons, located in several areas of the cortex. These neurons fire when the subject performs an action, and they also fire when the subject sees the action being performed. Thus as we watch someone moving, motor circuits in the brain are activated that do not necessarily result in visible movement but nonetheless rehearse that movement. Although the physiological mechanisms underlying this response are not entirely understood, many scientists describe the mutuality of observing and acting as a kind of resonance. As Vittorio Gallese, among others, puts it:

A metaphor that describes well this correspondence between observed and executed biological motions is that of a physical “resonance.” It is as if neurons in these motor areas start to “resonate” as soon as the appropriate visual input is presented. This “resonance” does not necessarily produce a movement or an action. It is an internal motor representation of the observed event which, subsequently, may be used for different functions, among which is imitation.<sup>25</sup>

This resonance is responsible for our ability to predict others’ actions, and to know what will result if we move in a certain way. It also accounts for “‘contagious behavior’ commonly experienced in our daily life, in which the observation of particular actions displayed by others leads to our repetition of them . . . including such actions as yawning and laughter.”<sup>26</sup>

So there seems to be strong neurophysiological support for Martin’s theory of why a dance moves us. The viewer, watching a dance, is literally

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dancing along. Yet Martin's conceptualization of inner mimicry attaches the physical feelings of the musculature to universally felt emotions, whereas the resonance hypothesis focuses simply on behavior. Although the acts of perceiving and moving may be infused with emotion, what the mirror neurons indicate is the mutuality of sensing and physical action. Whether or not we feel afraid as we watch someone walk along the edge of a precipice, we may well move our arms and legs so as to displace our body's weight to the side of safety.<sup>27</sup> Whether or not we are hoping for victory, we twist and incline as if to exert a magic force over the bowling ball as it rolls toward the pins. And as many scientists have determined, "the resonance phenomenon [is] present not only during the observation of goal-oriented movements, but also during the observation of meaningless art movements."<sup>28</sup>

In keeping with Berthoz's hypothesis that the perception of these "meaningless movements" could be culturally specific, scientists have found that viewers trained in a specific form of dance will "dance" along more intensively with that form than with a form they do not know. Studying the mirror-neuron responses of ballet and capoeira practitioners, chosen especially because the two forms manifest well-established yet distinctive vocabularies, they note that those trained in the form they are watching have a significantly greater neural activity.<sup>29</sup> Furthermore, their study shows that what the observers see is not muscle activation, but rather cultivated action. Many of the movements in both forms, such as jumping and turning, for example, involve the use of the same muscles, yet what viewers respond to is the organized interplay of these muscles as it constructs a specific vocabulary of movements.

Speculating on the evolutionary implications of mirror-neuron activity, Gallese argues that the ability to sense the physical actions of those around us forms the basis on which socialization and the experience of the social takes place. Although none of this neuromuscular activity registers in consciousness, according to Gallese, it does not exist in opposition to language and culture. Rather, the kinesthetic simulation of others' actions establishes an empathetic connection among all humans who recognize in those actions an equivalent intention and goal. Action thus becomes the "*a priori*" principle that enables social bonding.<sup>30</sup>

Gallese cites both phenomenology and American pragmatist branches of philosophy as having anticipated early in the twentieth century this shared consciousness.<sup>31</sup> However, the architecture of the brain's sense of movement established through the discovery of mirror neurons seems more to approximate the networked and hyperlinked world that has emerged with the advent of new digital technologies.<sup>32</sup> It likewise summons up the theories of performativity, such as those proposed by Judith Butler in her

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application of speech act theory in the 1990s.<sup>33</sup> The perceiver no longer performs a contact improvisation with the environment, but instead rehearses and simulates multiple roles, through one's own actions as well as those of others. In the process of rehearsing these roles, individuals formulate a self, not as an entity that will then perform an action, but rather as performance itself.

What implications does this theorization of individual and social bodies hold for the experience of watching a dance? Extrapolating from the anticipatory function of mirror neurons, the dancer and dance scholar Ivar Hagendoorn proposes that dance's intrinsic appeal lies in its ability to excite viewers' interest in movement's trajectory.<sup>34</sup> Many laboratory studies show that when a person executes a simple task, such as grabbing a cup, the brain of the observer creates movement arcs that it sees itself or others fulfilling. But what if the goal of the movement arc is not obvious? What if the form of movement is exploratory rather than goal-oriented?: "meaningless" as one study terms it, rather than functional? Hagendoorn argues that the viewer completes the movement in advance and then sees the guess confirmed or refuted, leading to added engagement with the movement and increased efforts to predict the next arc correctly.

Where Martin presumes that kinesthetic engagement leads to emotional attachment, and Cage hopes that movement can be enjoyed simply for its physical factuality, Hagendoorn envisions watching a dance as a continual conjecturing of possible arcs and flows. The viewer, like the choreographer, thinks up the movement and decides how and where to move next. He or she does not simply decide where or what to watch, but instead creates versions of the dance. The process of comparing possible dances with the dance being seen can provoke many feelings and sensations in the viewer, which, according to Hagendoorn, have likely been experienced by the choreographer in the process of making the dance. In this way the choreographer's intention is communicated to the audience.

Rather than flesh out a narrative, or convey a deep psychic impulse, dance movement in Hagendoorn's conception emphasizes its physical unpredictability. Like the choreographers he discusses – William Forsythe, George Balanchine, and Cunningham, his idea of dance, based on the body's articulateness, envisions dance as opening up the viewer to new moves that one can make. Rather than a body that is beefed up and fortified through muscular exertions, or a body that serves as channel for various perceptual states, Hagendoorn focuses on the body as malleable indicator of multiple scenarios. Like the bodies in the twenty-first-century gyms that sculpt the musculature to approximate (simulate) whatever social identity the user

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desires, the bodies on stage revel in the many directions their moves could take.

What do we feel, kinesthetically, when we watch a performance? This chapter's trajectory suggests that our experience is contingent, in part, on the conception of the body that pervades our historical moment. The dancing body's "contagion" can impel our bodies as outward manifestations of an interiorized psyche, to mimic its movement, and, as a result, feel its feelings. Or it can prompt an active engagement with physicality, enlivening our perception of our own bodies' articulateness. Or it can beckon us to try out/on various scenarios for moving. However it moves us, it does affect our bodies, and this need not be construed as an act of contamination to which we succumb, but instead, as Gallese suggests, as the basis for creating our social existence. Perhaps with an awareness of this crucial interaction between performer and viewer we can cultivate a more conscious registering of the kinesthetic impact that movement exercises. Perhaps such an awareness, enhanced by a few dance classes, can enable us more purposefully to feel how bodies move as they do and why.

Notes

1. Vittorio Gallese, "The Shared Manifold Hypothesis," *Journal of Consciousness Studies* 8 (2001), 38–9.
2. E. B. Abbé de Condillac, *Treatise on the Sensations* (1754), trans. G. Carr (London: Favil Press, 1930), 75.
3. Quoted in E. G. Edwards, "The Development of the 'Muscular Sense' Concept during the Nineteenth Century and the work of H. Charlton Bastian," *Journal of the History of Medicine and Allied Sciences* 27 (July 1972), 299.
4. See E. G. Boring, *Sensation and Perception in the History of Experimental Psychology* (New York: D. Appleton-Century, 1942), 523–35.
5. See Edwards, "The Development of the 'Muscular Sense' Concept," for an excellent overview of Bastian's work.
6. Proprioception is the term introduced by C. S. Sherrington in his 1906 publication *The Integrative Action of the Nervous System* (New York: Scribner, 1906).
7. See J. C. Whorton, *Crusaders for Fitness: The History of American Health Reformers* (Princeton: Princeton University Press, 1982), 287.
8. Not only did they see physical education as manly, but many also found a religious dimension in daily exercise. Described as "muscular Christianity," the impetus to develop the physique is rationalized by the educator G. Stanley Hall in these terms: "We are soldiers of Christ, strengthening our muscles not against a foreign foe, but against sin within and without us." Quoted in *ibid.*, 289–90.
9. *Ibid.*, 283.

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10. J. Ross, *Moving Lessons: Margaret D’Houbler and the Beginning of Dance in American Education* (Madison: University of Wisconsin Press, 2000), 58.
11. J. Martin, *Introduction to the Dance* (New York: W. W. Norton, 1939), 47.
12. *Ibid.*, 53.
13. J. Martin, *The Dance* (New York: Tudor Publishing Company, 1946), 105.
14. The dance educator Margaret H’Doubler, who founded the first dance program in the United States at the University of Wisconsin, did invoke the term frequently. See, for example, M. H’Doubler, *The Dance* (New York: Harcourt, Brace and Company, 1925), 60. For information on H’Doubler, see Ross, *Moving Lessons*.
15. See C. Novack, *Sharing the Dance: Contact Improvisation and American Culture* (Madison: University of Wisconsin Press, 1990).
16. J. Cage, “In This Day,” *Dance Observer* (January 1957), 10.
17. A. Berthoz, *The Brain’s Sense of Movement*, trans. G. Weiss (Cambridge, MA: Harvard University Press, 2000), 58.
18. *Ibid.*, 164.
19. *Ibid.*, 22–3.
20. See J. J. Gibson, *The Ecological Approach to Visual Perception* (Boston: Houghton Mifflin, 1979), 43.
21. Berthoz, *The Brain’s Sense of Movement*, 196.
22. *Ibid.*, 201.
23. *Ibid.*, 221.
24. *Ibid.*, 187–8.
25. See G. Rizzolatti, L. Fadiga, L. Fogassi, and V. Gallese, “From Mirror Neurons to Imitation: Facts and Speculations,” in A. N. Meltzoff and W. Prinz, eds., *The Imitative Mind* (Cambridge: Cambridge University Press, 2002), 253.
26. Gallese, “The Shared Manifold Hypothesis,” 39.
27. W. Prinz, “Experimental Approaches to Imitation,” in Meltzoff and Prinz, eds., *The Imitative Mind*, 155–7.
28. Rizzolatti *et al.*, “From Mirror Neurons to Imitation,” 256.
29. B. Calvo-Merino, D. E. Glaser, J. Grèzes, R. E. Passingham, and P. Haggard, “Action Observation and Acquired Motor Skills: An fMRI Study with Expert Dancers,” *Cerebral Cortex* 15 (August 2005), 1243–9.
30. Gallese, “The Shared Manifold Hypothesis,” 41–2. Gallese is not alone in speculating along these lines about human development and the foundation of social and individual identities. See also A. N. Meltzoff, “Elements of a Development Theory of Imitation,” in Meltzoff and Prinz, eds., *The Imitative Mind*, 19–42.
31. Gallese cites Herbert Mead, who at the beginning of the twentieth century argued that the individual determines the boundaries of self through the use of gesture. Similarly, he looks to the work of the phenomenologists Edith Stein, Edmund Husserl, and Maurice Merleau-Ponty. See Gallese, “The Shared Manifold Hypothesis,” 43–4.
32. I am indebted to Harmony Bench for her research on mirror neurons, her comments on this essay, and her insight that the metaphor of the “network,” so pervasive in contemporary culture, likewise pervades neuroscientists’ theorization of mirror neurons.

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33. See Judith Butler, *Gender Trouble: Feminism and the Subversion of Identity* (New York: Routledge, 1990).
34. See Ivar Hagendoorn, "Some Speculative Hypothesis about the Nature and Perception of Dance and Choreography," *Journal of Consciousness Studies* 11 (2004), 79-110.