Dance, Interactive Technology, and the Device Paradigm

Eric Mullis

Not unlike other art forms, dance has been significantly influenced by the development of digital technology over the last two decades.[1] The advent and widespread use of computers with increased processing speed, the development of programs—such as *Isadora* and *Bodycoder*—that were designed for use in dance performance, and the development of affordable and increasingly accurate sensory devices have allowed dancers and choreographers to creatively explore the intersection of the body and digital technology. The 1990s saw a proliferation of dance artists experimenting with and incorporating interactive digital technology into their work—artists such as Yacov Sharir, Ellen Bromberg, Suzan Kozel, Robert Wechsler, and Lisa Naugle, and companies such as Troika Ranch, Random Dance Company, Company in Space, Palindrome, and Chunky Move. These artists and companies have increasingly implemented the use of sensory devices such as microphones, motion tracking cameras, and wearable computers in order to give dancers the ability to manipulate and respond to projections, sounds, and lighting in real time.

Since such work is predicated on increasingly interactive systems, it raises questions about the relationship between the dancer's body and the technology with which it is kinetically intertwined. Dance theorists such as Johannes Birringer, Scott deLahunta, Lisa Naugle, and Susan Kozel consider how the implementation of interactive platforms affects the manner in which dancers and audience members perceive movement.[2] Dancers who perform through interactive platforms at times report becoming aware of the manner in which digital technology affects their performances, with some suggesting that the platform can be experienced as a partner that responds to and influences their movement as the performance unfolds.[3] This bidirectionality presents dancers and choreographers with novel avenues of creative expression and fosters consideration of the manner in which interactivity affects conceptions of dance.

More specifically, utilizing performance technologies allows dance to extend its reach, as interactive systems allow for the creation of fluid performance spaces that need not be constrained by the proscenium. Dancers who move within such spaces can be seen as active co-creators of the performance space, since the responsive relational architecture that they interact with produces environmental effects in real time. Creating interactive spaces entails technological mediation, since the dancer's movement is tracked, translated into digital information, processed in terms of various computer algorithms, and then rendered into scenic output. When fast and efficient interactivity is achieved, systematic technical mediation occurs, but it remains unperceived by the dancer and the audience

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member. This efficient mediation allows the dancer to experience bidirectionality and allows the audience member to view the dancer as causally intertwined with aspects of the performance environment.

In this essay, I consider bidirectionality and technological mediation through the lens of Albert Borgmann's philosophy of technology. Borgmann is an influential twentieth-century American philosopher of technology who draws on a range of European and American thinkers including Hannah Arendt, Jacques Ellul, Martin Heidegger, and Lewis Mumford. Like his predecessors, Borgmann's approach focuses on the manner in which technology has affected the human relation to the physical world.[4] Although he does not specifically discuss dance or performance, his notions of the "device paradigm" and the "focal thing" can be applied to the phenomena of bidirectionality and technological mediation in fruitful ways that encourage a consideration of the implications of interactive dance technology use. More specifically, it will become clear that an approach that draws on Borgmann's concepts calls into question those who advocate for "digital materiality" and/or who suggest that the line between the dancer's body and the digital platform with which it interacts is blurred during performance.[5]

Opening Up Interactive Technology

At the outset, I should say that a wide range of performance technologies demonstrate bidirectionality and a high degree of technological mediation, and could be considered in light of Borgmann's philosophy of technology, but I will focus on interactive technology in order to consider technological mediation and the notion of technologically enhanced corporeality. After discussing various forms of dance technology, in this section I will discuss Chunky Move's *Glow* (2006), a solo piece that features interactive imagery developed by software developer Frieder Weiss.

I take "interactive dance performance" to designate performances in which a dancer's movement, gesture, and action are read by sensory devices, translated into digital information, processed by a computer program, and rendered into output that shapes the performance environment in real time. A causal relationship between movement and environmental output is made possible by an interactive platform that functions as a continuous biofeedback system. As mentioned above, this process allows performers to experience bidirectionality, since they are aware of their ability to modify the environment and are aware that the interactive technology can affect their actions. Birringer (2004b, 96) points out that there are several forms of performance that draw on technological devices and networks to create responsive interaction, and it is worth taking a moment to discuss them in order to gain a clearer sense of the kind of performance on which this article will focus.

"Derived performances" are characterized by the use of technologies that allow for the capture and projection of specific movement phrases.[6] Merce Cunningham famously collaborated with The OpenEnded Group to produce *BIPED* (1999), a work that utilizes motion capture data derived from Cunningham's choreography to produce digitally animated dance forms that are projected onto a transparent scrim, behind which live dance is performed. *BIPED* is an instance of derived performance, since the technology presents viewers with scenic output that is derived from movement that was presented in the past. A sense of interactivity may arise when live dancers move with the projected images on stage, but this sense is ultimately illusory since the images cannot respond to the live dancer's movement in real time.

In addition, "immersive performances" draw on technologies that allow one to participate in virtual reality environments. Stereoscopic goggles, datagloves, and body suits are donned to provide motion data that a computer uses to affect change in the immersant's virtual environment.[7] Diana Gromola, Yacov Sharir, and Morkos Novak collaborated to produce *Dancing with the*

Virtual Dervish (1994), which allows the immersant to travel through and explore a virtual representation of Gromola's internal anatomy.[8] When the piece is performed, a dancer stands on stage and navigates through the virtual landscape while the images that the dancer sees are projected on a forty-foot video screen. After the performance, audience members are encouraged to don the goggles and datagloves and to explore the virtual reality environment as well.

Bidirectionality does arise in immersive performances, since the performer actively navigates through and explores a responsive virtual landscape. The virtual landscape is akin to the physical environment that contextualizes everyday movement—an environment that both affords and closes off pathways of movement. However, the privacy of virtual reality comes to the fore, since the audience cannot directly perceive the private virtual environment that the performer is immersed in. Unlike the shared interactive spaces that will be described in a moment, immersive performances are characterized by an audience that views the performer's visual experience on screen and that cannot directly perceive what he is experiencing.

Last, "networked performances" entail using telecommunication technology to distribute aspects of a performance to remote locations.[9] The notion of telepresence is relevant here, that is, the ability to use cameras and microphones to transmit movement images (as well as sound and text) to locations where dancers and audiences can observe and respond to them. For example, Troika Ranch's *An Adjacent Exposure* (1991) utilizes composite-image video techniques to put two remotely located dancers in communication with one another. The dancers can respond to each other's movement, but it becomes clear that they cannot physically touch one another even though their images appear to intersect on screen.

It can be seen that distinguishing interactive dance performance from derived, immersive, or networked dance performances is a tenuous affair, since they all entail a degree of technological responsiveness and can ground experiences of bidirectionality in which the dancer controls and is affected by the relevant environmental output. Virtual reality environments and networked platforms respond to and influence the performer's experience in the same manner as do performances that unfold in a shared geographical space. However, the technologies utilized in the performances are distinct, and they differently affect perceptions of space. Networked performances rely on the Internet and/or communication technologies in order to connect geographically distinct performance spaces, while immersive performances rely on stereoscopic goggle and datagloves in order to create a private virtual performance space.

Interactive performance entails the use of sensory technologies to directly affect environmental changes in real-time and in a space that is shared by audience and performer. I focus on interactive performance because it draws bidirectionality and technological mediation into sharp relief for both the dancer and the audience member. The dancer experiences a technologically amplified articulation of movement and is affected by the environment that his or her movement creates, and, since the causal connection between movement and environmental output is instantaneous, the viewer can readily appreciate this interplay. The intertwining of the dancer's body, interactive platform, and environmental output creates a shared, innervated environment in which the interplay of the body and interactive technology comes to the fore.

Glow

Founded in 1995, Chunky Move is an Australian contemporary dance company that began to explore multimedia interactive performance technologies in 2005. *Glow* (2006) is a solo piece choreographed by Gideon Obarzanek that was developed in collaboration with EyeCon software developer Frieder Weiss. It is roughly thirty minutes in length, is danced alternately by Kristy Ayre and Sara Black, and features a haunting original score by Luke Smiles with additional music by Ben

Photo 1. Dance movement disrupts uniform bands of light. Photo by Rom Anthoni, dancer: Kristy Ayre.

Frost. The piece utilizes motion tracking cameras and a projector that are both oriented above the dancer. Obarzanek notes that difficulties associated with projecting images behind performers standing on a stage are avoided by projecting from above. Dancers are observed by audience members who are seated on all four sides of a ten by fifteen foot stage.[10] The imagery that is projected onto the dancer ranges from angular lines, grids, and geometric shapes to more organic forms including what appear to be inky clouds and swarming gnats.

The dancer executes intricate, low-level movements that remain bound to the floor; this maximizes surfaces of the body that are oriented toward the overhead camera and projector. The choreography is generally characterized by angular percussive movement that is contrasted with belabored undulations and weighted sequential movements initiated from the spine. The choreography also

Photo 2. Rays of light stream from the dancer's huddled form. Photo by Artur Radeki, dancer: Kristy Ayre.
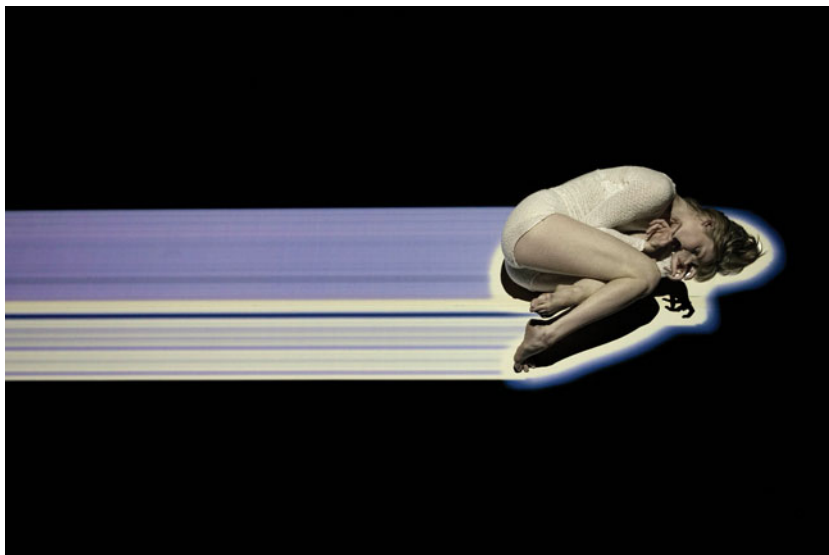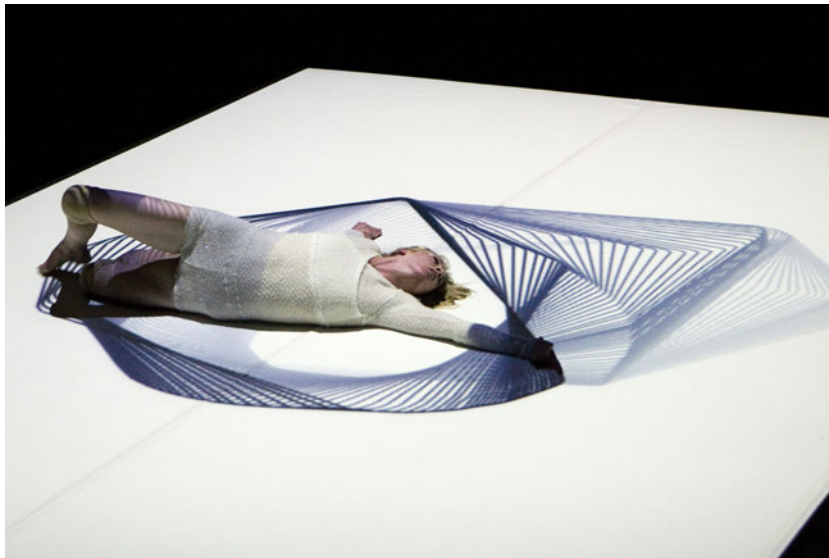
Photo 3. Drawing fluid geometric shapes. Photo by Artur Radeki, dancer: Kristy Ayre.

includes a rich array of disjointed and isolated gestures that originate distally and are often used to set up explosive actions that throw the body into new space. Together, these factors give the viewer a sense that the movement is imposed on the dancer. It appears fitful, bound, awkward, and uncomfortable to perform, and gives the viewer a sense that a struggle is unfolding.

As the piece develops, the dancer's interaction with the images varies. At times, she appears to play with the technology as she draws dark shifting shapes with her hands, arms, legs, and feet. She creates and manipulates fluid geometric enclosures as she waves her arms, rolls, and tumbles in a manner that expresses carefree pleasure. At one point, she appears to create a dark snow-angel on the stark white stage floor. At other times, her interaction with the imagery is less carefree and expresses a darker and perhaps a more conflicted relationship with the technology. There are several sequences in which the only source of light takes the form of thin bands that appear to repeatedly scan her body. There are also moments in which a pulsating aura of light illuminates and appears to shock her, causing her body to writhe and contort. Further, she intermittently emits guttural choking sounds as these shocks flash on the stage.

Weiss's programming is highly responsive to the dancer's movement and presents a rich palette of dynamic, contrasting colors. At the outset of the piece, the viewer is immediately aware that the digital platform and the scenic platform are seamlessly intertwined, as the dancer's huddled body is scanned. At the same time, bidirectionality becomes clear, as the dancer responds to pulsating electric bursts and then shifts to a more active role in which she extends her sphere of intentionality by playfully controlling the images.[11]

A-Contextual Devices and Contextualized Bodies

The viewer of *Glow* is struck by the degree of interactivity that Weiss's platform achieves. The digital images efficiently and accurately respond to the dancer's movements and more generally articulate the dancer's kinetic space. And since the technological platform is concealed, the viewer witnesses only the fusion of movement and digital imagery. The viewer is aware that sophisticated technologies are being used to create rich aesthetic effects; however, it is manifestly unclear how those effects are being achieved. Albert Borgmann considers the manner in which modern technological

devices—such as those used by Weiss—conceal the means that allow them to manifest the desired ends. At this point, I would like to turn to Albert Borgmann's philosophy of technology; specifically, I would like to focus on the two concepts that are central to Borgmann's approach—the "device paradigm" and the "focal thing." These concepts will set up my argument concerning the "digital materiality" emphasized by some advocates of interactive digital performance.

For Borgmann, "devices" are technological instruments that function in a particular manner that distinguishes them from earlier forms of technological instruments. Early technological hardware was generally large and bulky, to the extent that one could readily see how internal mechanisms functioned. For example, one can see how a phonograph functions, as cranking the handle sets the table in motion and placing the needle in the grooves of a record produces sounds that one can hear through the cone. This is distinct from modern technological devices that produce music—such as MP3 players—as such devices are increasingly so compact that their inner workings are not visible to the naked eye. Generally speaking, technological devices have become increasingly small, fast, and efficient to the extent that the manner in which they realize their ends is unclear to the majority of those who consume them. Speaking of the television, Borgmann notes that "the sets became relatively smaller and less conspicuous in their machinery. And this development continues and has its limit in match-box-sized sets which provide large and most finely grained moving and colored pictures" (1984, 43).

This leads Borgmann to conclude that modern technological devices are characterized by a particular relationship between means and ends in that they present a unique relationship between machinery and function. He notes that, "In the case of the technological device . . . the machinery can be changed radically without threat to the identity and familiarity of the function of the device" (1984, 44). One MP3 player is internally indistinguishable from the next as long as the machinery provides the desired end or function—playing music. Modern life is characterized by the "device paradigm" in which the means and ends of production appear to be separate from one another. Borgmann says, "In a device, the relatedness of the world is replaced by machinery, but the machinery is concealed, and the commodities, which are made available by the device, are enjoyed without encumbrance of or engagement with a context" (1984, 47). Writing on Borgmann's position, Pieter Tijmes observes that, "Modern technology is all about product, while the device itself withdraws. The consumer knows nothing of the science of sound recording and production, nor of the distribution system that brought the CD from Japan (or wherever) into the home" (2001, 13).

This is a positive thing, in that present-day technological devices do not require the space and materials that were required by early machine hardware, but Borgmann adds that the separation of means and ends fostered by modern devices is problematic in that it detaches the consumer from the processes that are necessary to bring about desired ends. If I want fresh water, I simply press a button or turn a knob and am likely unaware of the system of devices that is necessary to bring the water to my glass, and, perhaps more importantly, I am unaware of the natural source from which the water is drawn. The device paradigm fosters a robust consumer society, since one can effortlessly consume without being aware of the work required for one's consumption.

Weiss's interactive platform is a system of devices that readily produces a desired end, namely, perceptually rich interactive digital imagery. It is also clear that the platform conceals the manner in which it produces that end. Indeed, the process of gathering and translating visual data into a digital format, applying algorithms to that data, and rendering the data into perceivable images is likely a mystery for most of those who encounter the piece. As with other devices, a sense of wonder can arise when one enjoys a product that is effortlessly produced by a device, and I would suggest that *Glow*'s captivating power hinges, in part, on this sense of wonder. Writing for *The New York Times*, Jennifer Dunning notes that Weiss's visuals are a marvel that create "an eerie though frequently handsome world" (2008), and Judith Mackrell of *The Guardian* writes that Weiss's visuals are

"aggressively invasive of the dancers' space yet richly beautiful in texture, these effects create layers of virtual choreography and drama" (2008).[12]

A concealed interactive platform and a high degree of technological responsiveness focus attention on the intersection of dance movement and light. Wonder can arise while viewing many forms of theatrical spectacle, but, if Borgmann is correct, the significance of interactive performance that relies on a digital platform hinges on a broader social paradigm that characterizes much of everyday life. Weiss's platform presents a dramatic and perceptually rich end without presenting the means that are necessary to bring it about, and this is in keeping with society's broader consumption of the products provided by increasingly complex and efficient devices. Borgmann's notion of the device paradigm consequently allows us to analyze the sense of wonder that arises when observing interactive imagery and pushes us to consider how such technology use is connected with a broader technological culture.

Further, since technological devices conceal the material realities that are necessary for the production of the ends that they procure, they are entities without a context. Borgmann notes that mass produced wine is severed from its context, or, speaking more precisely, the world that is opened up in wine as a thing is closed off when it becomes machinery and commodity. Technological wine no longer bespeaks the particular weather of the year in which it grew, since technology is at pains to provide assured, i.e., uniform, quality. It no longer speaks of a particular place, since it is a blend of raw materials from different places (Borgmann 1984, 49).

Borgmann suggests that devices are noncontextual entities since they do not speak of their places of origin, and because devices are primarily functional entities, they are readily interchangeable with one another. Since any instance of a particular device will realize the desired end, and since the means that are necessary for the production of the ends are concealed, devices appear to be universal and free from the specificities of history and place. Borgmann's example of mass-produced wine nicely illustrates this point, since mass-produced wine is not indicative of the land that the grape vines grew in, the weather and nutrition that fostered the growth of the grapes, and so on. Likewise, computers, MP3 players, tablets, and other devices are not indicative of a particular place of origin since they are primarily functional entities. Borgmann questions the device paradigm by drawing attention issues concerning the a-contextuality of devices and the manner in which they separate means and ends; however, he considers the benefits of the device paradigm by considering how it positively affects labor, leisure, health, and so on.[13] This leads him to suggest that the device paradigm be tempered with the pursuit of contextualized "focal things" that embody the unity of means and ends that devices obscure. Drawing on Heidegger's reflections on rustic objects used in traditionally pastoral settings, Borgmann draws attention to a simple jug, an earthen vessel that "teaches us to pour and to give. In its clay, it gathers for us the earth as it does in containing the wine. It refreshes and animates us in our mortality. And in the libation it acknowledges and calls on the divinities" (1984, 198). Hence, in these ways the focal thing "gathers and discloses what Heidegger calls the fourfold, the interplay of the crucial dimensions of earth and sky, mortals and divinities" (1984, 198).[14]

With this said, Borgmann acknowledges that Heidegger's examples of focal things are drawn from a rustic, rural setting and he goes on to consider the focal things that can be found and appreciated in contemporary settings.[15] Although he does not discuss dance, he does spend a good deal of time discussing running and the manner in which the runner's body is a focal thing that presents a union of means and ends. In running, and I believe in many somatic practices, we find the unity of achievement and enjoyment, of competence and consummation. Borgmann writes, "This unity of ends and means, of mind and body and of body and world is one and the same. It makes itself felt in the vividness with which the runner experiences reality" (1984, 203). The runner finds that the technique developed through repetitious practice allows for the appreciation of movement and the achievement of specific goals (e.g., running a certain distance in a certain

amount of time). The means that are necessary for the achievement of those ends are present in each step. Further, Borgmann suggests that running heightens the runner's sense of the landscape that he or she runs through. His or her technique is developed and expressed in the physical environment—breathing brings attention to the air, steps bring attention to the terrain, and stride brings attention to space. In this manner, running presents the fusion of means and ends in activity and fosters a robust and unmediated sense of the body's relationship to its environment.

To return to *Glow*, we find an interesting interplay of an a-contextual platform with a focal thing—the dancer's body. Weiss's interactive platform is a-contextual in that the images that it produces appear to be disconnected from the artist-technician who developed the relevant program and technological infrastructure. The imagery is the product of a platform that gathers visual information, translates that information into digital data, processes that data through algorithms, and renders interactive scenic output. The observer knows that someone created the platform, but specific details about the author are difficult to grasp since the scenic output is mediated by an array of technologies and computer processing. This is contrasted by the presence of a live dancer on stage who presents her body to the interactive platform and to the audience. In this way, an interesting tension develops in which the two ontologically distinct creative forces contribute to the work. The audience is presented with a noncorporeal concealed digital actor and a unique embodied performer.

More specifically, the images produced by Weiss's interactive platform are a-contextual in that they have no clear relationship to the historical particularities of the entities that they interact with. The platform will produce stunning visuals on *any* object that moves in its visual field. One could move any object on the stage, and the platform would accurately track and respond to the object's location and trajectory. However, the dancer's body is a focal thing in that it presents a particular somatic biography or history of training in the present moment.[16] As discussed above, focal things are entities that present the fusion of means and ends. In this case, Ayre presents the audience with a body that can accurately execute choreography and can performatively express the tense relationship that exists between the projected images and the body. As the piece unfolds, the audience gains a sense of the training that has been done to develop an aesthetically expressive body and, indeed, that training is manifested as Ayre moves on stage. In this way, Ayre's performance presents a fusion of means and ends, as the somatic habits and performative skills that have been developed over time allow Ayre to execute movement. On another night, when Sara Black dances the piece, the images will accurately respond to her movement, but they will not register personal differences between the two dancers. They will both be read as a source of kinetic data with relevant differences between the two dancers only being registered in terms of location and movement trajectory. The particularities of their somatic biographies and their personal reactions to the piece on any given night are irrelevant for the platform.[17]

Another way to highlight the tension that exists between an a-contextual device and a contextualized dancer is to stress differences—qua people—that Ayre and Black will bring to the performance. The previous point focuses on their training, which, in performance, presents a fusion of means and ends. At the same time, Ayre and Black are distinct individuals with personal biographies who may experience the technological interaction differently. Performative conventions aside, the dancer is a unique person who presents the audience with a situated mode of embodiment that is brought into relation with a performative technology, which cannot take into account contextual factors such as personhood, gender, race, or ethnicity.[18]

The interactive nature of the technology magnifies the tension between contextual focal things and a-contextual entities, since the dancer appears to manipulate and be manipulated by the images to the extent that a kinetic dialogue appears to develop between the two performers. In this way, they appear to both equally contribute to the conversation; however, the dialogue is always strained since the interactive platform can only acknowledge one aspect of the being with which it interacts.

Rethinking Bidirectionality

The previous points lead me to consider how the interactivity is perceived by the dancer. Thus far, I have been considering *Glow* from the perspective of the audience. However, my last point considering the nature of the kinetic dialogue presented by the piece raises the issue of bidirectionality, since it considers the nature of the beings that interact in the piece and the manner in which those factors shape the nature of the dialogue.

Birringer, Kozel, and Wilson-Bokowiec have drawn on experience with creating and performing work that utilizes interactive technologies, and they suggest that dancers can phenomenologically experience their bodies intertwining with the relevant scenic output. Birringer discusses the manner in which dancers can shift their attention away from their internal body awareness to the environment conceived and experienced, not as a "given space but rather [as] a shifting relational architecture that influences her and that she shapes or that in turn shapes her" (2004b, 91). This reorientation, in turn, fosters experiences of a "resonating environment" in which the line between technology and movement is blurred. Kozel draws on Merleau-Ponty's later work, and similarly advocates for a sense of reversibility that blurs the line between subject and object. With regard to her experiments with motion capture technologies, she writes:

> These were intercorporeal exchanges across beings of differing materiality. Any hierarchy between human and nonhuman was porous and plastic; I emerged from the studio with new ideas regarding my own body, the materiality of digital data, and a shifted ontology by which I mean a shifted sense of what constitutes a being. (Kozel 2007, 230–231)

More recently, Wilson-Bokowiec discusses her work with the *BodyCoder* system and suggests that such work allows for the experience of the body as extended into the digital realm, which in turn pushes us to reconsider our notion of the physical. She writes:

> If we consider *response* as a primary form of physicality, then we can begin to formulate a way of thinking about, and working with, technology that transcends established product orientations, that traverses "means-to-an-end" functionality and allows us to begin to conceive the digital as an innately physical medium. (Wilson-Bokowiec 2010, 65)

Hence, these authors are similar in that they advocate that traditional notions concerning dance performance, the body, technology, and interactivity need to be re-examined to the extent that the possibility of intertwining the dancing body and technology is realized and sufficiently explored. They are also similar in that they emphasize the first-hand phenomenological experience of the dancer when discussing the issue. Drawing on Borgmann's philosophy of technology, I would like to make two interrelated points about this phenomenological approach to interactive dance technology.

The first concerns the issue of mediation. Birringer, Kozel, and Wilson-Bokowiec all suggest that the mediation enacted by interactive technologies is positive in that it extends the dancer's sphere of intentionality and blurs the line between body and technology. The technology acts as a medium of expression that fosters a unique relationship between dancer and scenic environment. Further, Kozel and Wilson-Bokowiec suggest that the medium should not be understood as brute technology, but should instead be viewed as an extension of flesh or as physical in nature.

This approach can be seen as expressing a phenomenological stance on the use of devices that can be explained in terms of the device paradigm. As discussed previously, devices function as pure ends that conceal the means that are necessary to bring about those ends. With regard to *Glow*, the

imagery appears to efficiently and accurately interact with the dancer, but the manner in which it does so is unclear. The dancer may interact with the images to the extent that it feels as if the images are something of a dance partner that responds to and affects her movement. Phenomenologically speaking, there is an intertwining of scenic output and movement, but it is ultimately contingent upon the device qua device. Unencumbered by bulky and obtrusive technological hardware and efficiently producing the desired end, the device disappears leaving nothing but pure scenic output to interact with. The dancer's movement is mediated by an interactive platform, but this mediation is not phenomenologically apparent to the dancer and the audience, and consequently the distinction between body and technology appears to blur.

The shift from phenomenology to ontology can be called into question. Again, Kozel and Wilson-Bokowiec suggest that interactivity grounds an ontology that is characterized by a novel understanding of materiality. The phenomenological experience of interactivity grounds the belief that the dancer's body and the technology with which it moves are fused into an organic material whole. The difficulty here is that this approach must somehow take the digital and align it with flesh; in doing so it must account for the manner in which two characteristically different entities or "materials" can be synthesized into one interactive system. As discussed a moment ago, a performance of *Glow* is characterized by the interaction of a contextual body and an a-contextual interactive platform, and the tense relationship between the two entities creates an aesthetically significant effect. Qua device, the interactive platform and the images that it produces cannot take the history and uniqueness of the dancing body fully into account, since the device can only process kinetic data.

Viewing the relationship from the other direction brings me to my second point: One begins to consider how the contextualized dancer can react to the device. It is clear that he or she can react to the visual images and can let the images affect his or her movement, but to do so is to respond to the device's product. It is difficult to see how he or she could interact with the device itself, given that the means that it uses to produce the images are grounded in processing digital information in terms of algorithms and binary code. Interestingly, Birringer and Wilson-Bokowiec suggest that this is possible. Wilson-Bokowiec writes, "Although we talk about technology as a 'medium,' the rawness of its zeros and ones is seldom exposed. However, the language of digital technology is visible if we strip away the product packaging, it is revealed in *response behaviors* formed in the *either/or* of processing code, it its zeros and ones" (2010, 65). And Birringer suggests that a way to performatively respond to the invisibility of computation and computer code is to utilize "real-time magnetic and optical capturing systems that wire the hardware/software to video projectors, which display the data processing and mapping *immediately* to the performers and to audiences" (2004b, 104).

I am puzzled by both of these suggestions. With regard to the former, it is clear that a performer can interact with digital imagery, but it is unclear how the language of computer code can be conceived of in a way that can truly render it amenable to interaction. The language used in computer processing is a rarified language that is utilized to process information about the world that has been translated and simplified to zeros and ones, and it is difficult to see how a performer can interact with such information. Wilson-Bokowiec suggests that zeros and ones can be conceived of as being physical in nature and that the technological medium can be touched: "Crucially, the mapping of the complexities and idiosyncrasies of human movement and technology and digital content allows for *empathy* with the digital medium: to literally *touch* its potential and physical commonality, through the mutual sensing of each in the action of the other" (2010, 73). This leads her to the conclusion that the physical is "the dynamic edge where the physicality of theatre meets the physicality of zeros and ones, not in theory, but in practice" (2010, 74). It seems that the notion of "the physical" is being equivocated to the extent that purely digital information processed within a device can be touched by a performer. Again, this seems to ignore that the two kinds of entities under consideration are significantly different.

Birringer's suggestion is intriguing but runs into similar difficulties. Projecting visualizations of the relevant computer code in real time addresses the concealment of the device and brings attention to the invisible and rarified processes that unfold within it. If projected on stage, the code becomes relevant scenic output, and this leads one to consider how the dancer can meaningfully interact with it, given that it is a sequence of numbers and algorithms. One can see how the digital imagery of *Glow* fosters a sense of bidirectionality since the dancer can experience the imagery as affecting her movement, intention, and sense of space; however, one wonders whether a dancer can experience computer code in the same manner. The projected code responds to scenic input by processing visual information that has been translated into digital form, but the dancer would need to interpret the code and try to explicitly connect changes in the code with changes in her movement. I believe that this would hinder the experience of bidirectionality. The effort required to interpret computer computation would interfere with a phenomenological sense of intertwining, since the dancer would be engaged in a demanding cognitive process. Further, one can imagine a scenario in which a performer "interacts" with a pre-recorded video of code projected on stage. It seems to me that this is not a viable possibility, given the fact that the dancer would be in engaged in an open-ended act of translation and interpretation in the sense that the source that is being translated and interpreted is ambiguous. This possibility points to both the practical difficulties of reading code and of the tendency of the human mind to causally link two ambiguously related phenomena.

Consequently, I do not believe that these two approaches to first-hand experience with devices sufficiently acknowledge the nature of the devices that make interactivity possible. I should say that I do not discount the experience of the dancers who have first-hand experiences of interactivity, since, all things being equal, one cannot discount the veracity of another's phenomenological experience. I believe that such experiences are possible and frequently occur, because interactive platforms such as Weiss's are devices in the manner that Borgmann describes.[19] They allow for experiences of bidirectionality, since they are purely functional and are not encumbered by their means. At the same time, I believe that the move from phenomenology to ontology is questionable, since it ignores differences between the body as a focal thing and the device as commodity producer. If Borgmann is correct, then the relations of means and ends presented by the two entities are quite distinct.

Conclusion

I have discussed *Glow* and Albert Borgmann's philosophy of technology in order to raise two points. The first concerns the tension that arises during performances that are characterized by the intersection of the focal dancing body and an a-contextual interactive platform. An aesthetically rich effect is created when a contextual body is intertwined with scenic output produced by an a-contextual device. But, the second point concerns the manner in which dancers perceive their interactions with interactive platforms. A robust sense of bidirectional interactivity can arise, but that sense is contingent on the platform's device nature, and experiences of interactivity should be tempered with the understanding of the essential differences that characterize the dancers and platform.

Dance artists and theorists who experiment with interactive technologies often stress that their work encourages viewers to consider the relationship between technology and human beings. Interactive dance performance presents an intertwining of human corporeality and technological device that the audience member will relate to, since he or she likely interacts with responsive technologies on a day-to-day basis. I believe that this essay demonstrates that much of the work done on this topic emphasizes the dancer's phenomenological experience of interactivity but does not sufficiently consider the nature of the devices and platforms that make such experiences possible. Albert Borgmann's philosophy of technology focuses on the experience and consumption of technological products, and then goes on to consider the nature of the devices that ground such experiences. I believe that such an approach is essential when considering the implications of the

human–technology relationship, whether it is performed by a dancer onstage or experienced in day-to-day life.

Notes

1. For a thorough discussion of the use of interactive technology in dance, see Dixon (2007).

2. For more on interactive technologies, see Birringer (2004a, 2004b, 2008), Kozel (2007), deLahunta (2002), and Naugle (1998).

3. See Kozel (2007, 85–135).

4. Borgmann outlines his philosophy in Borgmann (1984), Borgmann (1992), and Borgmann (2000). For Heidegger on technology, see Heidegger (1982). For an excellent introduction to the development of the philosophy of technology in Europe and America, see Scharff and Dusek (2003).

5. See Kozel (2007) and Julie Wilson-Bokowiec (2010). Also see Munster (2006).

6. Birringer describes these as "motion capture-based reanimations of bodily movement" (2004b, 96).

7. Birringer describes these kinds of interactions as integrating "the body with stereoscopic devices in front of the eyes, into a polysensual illusion of moving through space" (2004b, 96).

8. For more on immersive performances, see deLahunta (2002).

9. For more on distributed performance, see Birringer (2004a, 2010) and Naugle (1998).

10. An interview with Obarzanek on *Glow* and other works by Chunky Move can be found online (Obarzanek, 2008).

11. Chunky Move developed the technology and themes that characterize *Glow* with *Mortal Engine* (2008). *Mortal Engine* includes a full ensemble and an interactive platform developed by Weiss. Other works that utilize interactive platforms include Troika Ranch's *16 [R]evolutions* (2006) and Palindrome's *Flower . Wine . Moon . Me* (2010).

12. Mackrell's (2008) comment pertains to *Mortal Engine* (2008), which utilizes the interactive platform that is used in *Glow*.

13. For more on this, see Borgmann (1984, 114–143).

14. For Heidegger's account of the "four-fold," see Heidegger (1971).

15. For more on focal things and practices (music performance, the culture of the table, and communal celebrations), see Borgmann (1992, 116–147).

16. Of course, there are exceptions to the rule. Choreographers and dancers may emphasize social or personal fragmentation by separating the means and ends of movement. Still, the possibility remains that individuals can fuse means and ends within the body, thereby rendering it a focal thing.

17. One may suggest that the dancer is something of a "technological device" who strives to conceal rigorous training and to efficiently express technique in a manner that appears to be effortless. To fully address this, one would need to consider different genres of dance as well as particular works that fall within those genres. This task cannot be taken up here, but I believe that a distinction can be drawn between devices—as Borgmann defines them—and the human body. This can be done if one considers that, for the audience, the dancer's mode of embodiment is perceived as ontologically distinct from a technological platform in that the audience member is an embodied being who will likely be able to identify with and appreciate the work and training that another embodied being can undergo and perform in public. It is difficult to see how the audience member could appreciate the visual effects generated by an interactive digital platform in this manner, since there is no shared embodiment present.

18. One may suggest that the body of the dancer is "mediated" as well, in the sense that cultural values make it impossible to directly perceive the dancing body. This may be the case, but it still remains that the audience is presented with two kinds of mediation when the dancer interacts with the technology. As will be discussed in a moment, the mediation enacted by the technology is ontologically distinct from mediation based on cultural values, in that the former entails the use of computer processing and language while the latter is an affair of values.

19. Kozel discusses the anthropomorphism that may come into play when dancers perceive the technologies that they interact with and advocates for an animism that remains sensitive to the uniqueness of the technologies. I would suggest that such animism is contingent upon the device qua device and should be tempered with an understanding of the device paradigm. See Kozel (2007, 220–225).

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