BODILY HEARING:

PHYSIOLOGICAL METAPHORS AND

MUSICAL UNDERSTANDING

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I want to borrow an opening gambit from Suzanne Cusick's "On a Lesbian Relationship with Music: A Serious Effort Not to Think Straight" (Cusick, 1994), both because it suits my topic well, but more importantly because her work has served to help me give voice to a central aspect of my own engagement with music, an aspect that had for many years simply gone without saying. In her paper, Cusick speaks of a couple of shocks of recognition (one actually of non-recognition) that cued her to her own omission of crucial aspects of her identity from her professional work. Her work in turn has served me several tonic jolts, one in particular that pertains to my subject.

I, too, wish to open with a couple of shocks of recognition, as well as not so much a shock as a chronic state of non-recognition that has plagued my attempts to share my musical experience. The first entails a brief annecdote. Some years ago I attended a concert at which my colleague, oboist Harry Sargous, played the premiere of a concerto written for him by a Detroit composer. During the piece, I found myself at one point in intense pain (not from the music per se, I should add), which abated when I found myself taking a deep, gasping breath. What had happened, I realized, was that I had quite unconsciously been breathing along with the soloist. Harry, however, had been using circular breathing

for a particular patch, and I had quite literally run out of breath. This moment was a physical embodiment of something that had been lurking at the edges of my musical consciousness, the fact that a significant part of my engagement with music, be it as listener or composer, had to do with a sense of how the music was made—that the sound of the music was an embodiment of that making, and that hearing that making in the sound had much to do with my understanding of music.

That point remained mute for some time, it striking me as a truism that needn't be mentioned. That it could, that it should, be both mentioned and explored, emerged in another shock of recognition, this occurring during Suzanne Cusick's more recent presentation, "Feminist Theory, Music Theory, and the Mind/Body Problem" (Cusick, 1994a). In working through issues related to questions of gender tied to the mind/body duality, she writes,

> Music, an art which self-evidently does not exist until bodies make it and/or receive it, is thought about as if it were a mind-mind game. Thus when we think analytically about music, what we ordinarily do is describe practices of the mind (the composer's choices) for the sake of informing the practices of other minds. . . . We end by ignoring the fact that these practices of the mind are nonpractices without the bodily practices they call for—about which it has become unthinkable to think.
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> . . . Metaphorically, we have denied the very thing that makes music music, the thing which gives it such enormous symbolic and sensual power (16).

Hearing this produced in me a sense of relief and release, a mental exhalation as it were balancing the actual intake of breath that first brought these issues to the forefront for me, and granting me an even greater surcease from pain. In Cusick's words, music for the performer is "something you do;" moreover,

> . . . the score is not the work to a performer; nor is the score-made-sound the work: the work includes the performer's mobilizing of previously studied skills so as to embody, to make real, to make sounding, a set of relationships that are only partly relationships among sounds (Cusick 1994a, 18).

She follows this with an example from one of Bach's chorale preludes, on "Aus tiefer Not," showing how Bach's setting places the organist first into and then out of a position of physical imbalance, correlated with that portion of the text that implores God to send the psalmist grace. Taking the work as "something you do" infuses this passage with meaning for the performer.

Cusick concentrates her attention to this kind of knowledge on the

performer, but I would like to extend this awareness of music as "something you do" to the experience of the composer and the listener as well. Writing a piece of music certainly entails the marshalling of sounds and relationships to be understood by the mind, but it can also be deeply engaged with the direction of human action, sometimes, as Cusick demonstrates with her example from Bach, in very subtle ways. How this impinges upon us as listeners, however, is what I shall begin to examine in the body of what follows. As for the chronic state of non-recognition I mentioned at the outset, that not surprisingly refers to my fondness for a body of music that is, by a great many people, considered purely cerebral, yet for me attains an enormous expressive power in large part through its implicit physicality. Part of my purpose here will be to suggest this.

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Until the advent of recording and electronic transmission, virtually every musical sound one heard was the direct product of human action. Intensity, duration, attack, rhythmic placement, and so forth, were an immediate index of a player's skill, strength and dexterity, either directly embodied in the human voice, or mediated by the otherwise inert mechanism of an instrument. The interpersonal aspect of music making was highly charged with the physical—you were in the same room with the music makers, and the energy of the sound made was an immediate measure of the energy used by another human being to make that sound. There were exceptions, of course—the pipe organ being perhaps the most obvious—but the exceptions themselves acquired certain kinds of significance from their being exceptions.

The fact that most music has been made in this way invites us to consider music in light of the physiology of its making. In what follows I shall outline some of the ways physiology, the study of bodily function, inhabits how we talk and think about music, both directly and metaphorically. We shall examine what a physiological perspective might reveal about different types of musical spaces and instrumental arenas of action. I will illustrate with a couple of thought experiments, and I shall consider a couple of questions raised recently by philosopher Kendall Walton in light of this perspective. By reflecting on the fact that many listeners are or have been historically themselves makers of music, I shall posit the notion of *kinesthetic empathy* as a significant contributor to our musical understanding, and examine a couple of contemporary compositions from this point of view. I should note that my remarks shouldn't be taken as a critique either of electronic music or of recording and transmission; rather, I hope they invite a consideration of the perceptual and aesthetic differences among different kinds of music making.

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While most theoretical discourse tends to deal with music as sounds, those sounds are the result of human action, and therefore can be usefully construed in terms of those actions. Our response to music frequently entails such an understanding, if only at a subliminal level, and our language about music constantly reflects this. A physiological sensibility is particularly evident in the language that musicians use to communicate with each other in lessons, rehearsals, and in scores themselves. Words used to describe a variety of musical domains, including pitch, rhythm, tone quality and intensity, all invoke in various ways the bodily activities needed to effect their projection. Our sense as listeners of the resulting sounds can in turn be characterized in terms of our understanding of these physiological cues. Let us consider examples from a few domains.

We'll first look at intensity. While dynamic markings can be read as referring to the sound itself, *forte* and *piano* can also be understood as instructions regarding the strength with which a performer draws a sound from his or her voice or instrument. Similar understanding of articulation marks can be made: *staccato, legato, tenuto,* can speak to us as much about the way we address an instrument as about the sounds we should produce, while our language is rife with terms that, although sometimes used to describe sounds themselves, are overtly descriptive of how we play: *pizzicato, spiccato, martellato, gestopft* are only the tip of the iceberg. We as listeners can understand sound qualities in terms of the actions used to produce them, and dynamic level certainly reflects the amount of energy being expended to create a sound. But the situation is a little more complex: we are not simply responding to the strength of the signal as it reaches our ears. Dynamics are relative; the sound of offstage brass playing *forte* may be a fainter signal than that of an onstage flute playing with less physical intensity, yet we can understand the former as strong action heard at a distance, and the latter as gentler action closer to hand. A particularly good example of this can be heard during the finale of Mahler's Second Symphony, just before the entrance of the chorus.

Distance need not be our only criterion for distinguishing among different qualities of sounds with the same signal strength. We can readily understand a significant difference of effort inherent in a *pianissimo* high A as sung by a soprano, compared to the same note at the same dynamic level produced as a natural harmonic on the cello, by recognizing the differences of control and restraint needed to produce them. This issue applies readily to our understanding of familiar repertoire—any opera fan will immediately recognize what I'm talking about—but it can also serve to explain dynamic markings in certain contemporary music.[1] Milton Babbitt's use of dynamics frequently demands that we recognize similar contours of intensity projected by instruments of wildly divergent ab-

solute dynamic ranges. However, if we are attentive to the way a sound reveals a player's intensity of address to an instrument, then we can readily comprehend the equivalence of effort in otherwise disparate signals. We understand the music as played, as something done.

Related issues arise more globally when we consider the different senses of musical intensity produced by various sizes of ensembles. If one compares a performance of Schoenberg's *Verklärte Nacht* in the original version for six solo strings with one using his later string orchestra arrangement, one cannot help but notice that the versions are qualitatively different due to the nature of the different forces. The chamber version has (at least for me) far greater intensity, as the instrumental parts body forth the individuality of each instrumentalist. Because there are far fewer people involved in the chamber version, each player's contribution must be much more vivid. On the other hand, the string orchestra version evinces a sense of power, due to the sheer number of players on a part. Individual contributions seem less intense, but the sum total of their involvement creates a sense of greater force and mass.[2] Once again, I believe, it is the listener's sense of what is entailed in producing the sounds that is a major contributing factor in making this distinction.

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Obviously, similar considerations can be addressed to issues of rhythm, and it is certainly not hard to see how so much of our sense of rhythm stems from our different ways of moving to music, whether marching, dancing or doing repetitive work.[3] Our terminology certainly reflects this: one need only consider the range of familiar tempo markings that reflect speeds and qualities of locomotion. I suspect that further aspects of rhythm also derive from our physical motion, however. We are extremely sensitive to the differences between even and odd groups of pulses, whether they be at the level of the beat, its subdivision, or numbers of bars in a phrase. It strikes me as not unreasonable to reflect that our sensitivity to this difference is at least in part derived from our sense of the difference between those cyclic actions that involve reciprocal motion, such walking, and those that do not.

Many theorists have noted the experiential difference between rhythmic patterns over different timespans, a difference that must be accounted for when we attempt to make theories that employ hierarchical levels of rhythm from the smallest to the largest span.[4] One can demonstrate this fairly easily, as follows. Start by tapping a steady pulse at a comfortable tempo (I find 60 beats a minute a good place to start). Halve the tempo, then halve it again, and then again. As you continue this way, at a certain point you will find that you can no longer keep track of the timespans accurately except by maintaining a subdivision pulse in your

mind and keeping count. Return to the original tempo, and now double it, again and then again. As you continue this way, you will find that at a certain point you will no longer be able to tap the pulse with a single finger, but must create it by a reciprocal motion between two fingers. Continuing in this direction will eventually lead to a rate that is perceived as pitch, not rhythm. The operation we have used to change the pulse-rate has always been the same, either halving or doubling. It is our physiological limitations that define the narrow band of rates that allow us to hear these beats as a steady stream of pulses.

While some have adduced our different qualitative understandings of rhythms in different timespans to different modes of memory,[5] I would like to suggest that our differing notions of the measure, the beat, and the subdivision of the beat may be all correlated to different interpretive framings of the oscillatory rates of major muscle groups. Taking the beat as determined by one half of an oscillatory cycle of a major muscle group, we can see how this divider helps us distinguish the quality of a subdivision of such an action from the action itself, or from batched iterations of that action, despite the fact that all of these levels might project proportionally equivalent pulse patterns. Meter, of course, falls right out of this, batching as it does complete oscillations, sets of oscillations, or in the case of triple meters, iterations of nonreciprocal cyclic motions. The range of different durations that an oscillatory cycle might fill is limited at both the short and the long end by our physical selves, and corresponds nicely to the range of tempi that beats have tended to take. This coordinates as well with our awareness that absolute pulse rates can be radically reinterpreted metrically, for certain ranges behaving as either instances of subdivisions or as actual beats. It is a downright physical pleasure to experience an abrupt change of metrical interpretation; a moment I have always found enormously satisfying in this way occurs at the return of the Theme during the fugue of Benjamin Britten's *Purcell Variations*. What makes this spot particularly heart-wrenching is the fact that it is not a simple halving of the tempo, but a change with a ratio of 2/3 that relates the tempo of the fugue to that of the Theme.

A suggestive thought experiment that might help shed some light on this way of thinking about rhythm is to imagine what 'slow' or 'fast' music might be under different fields of gravity. Obviously, our accustomed muscular motions are determined by earth's gravity; one need only think of films of people walking on the moon to see that. Imagine, then, what music conceived of under such circumstances might be like. It is no surprise that Stanley Kubrick opted for Strauss's *Blue Danube Waltz* to underscore several sequences of spaceflight in *2001: A Space Odyssey*. While the rhythmic organization at hypermetrical levels is duple, the triple meter invites us to feel each bar as the iteration of a circular motion, lifting us from the earthbound striding or plodding of a rec-

iprocal oscillatory duple motion.[6] It should also be no surprise that so much New Age "space" music minimizes pulse at all, or enormously elongates the span between each ictus, as part of what seems to be an intention to suggest weightlessness.

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Ways we familiarly talk about pitch, too, are to various degrees conditioned by our physiological sense of how they are produced, as well as the physiology of our perception. What I want to examine for a minute here is our habit of scaling pitch from low to high. First it is worth taking a moment to think a little bit about why we even range pitch on a linear scale. The fact that our linear scale of pitch correlates with wavelength certainly is a contributing factor, but a counterexample points to the significance of the actual physiological mechanism of our perception of pitch. Color is also correlated with wavelength, but while we can certainly be aware of the linear arrangement that induces the correlation—see any rainbow—nevertheless, I would warrant that the linear scaling of hue is not the most vivid expression of our day-to-day experience of colors. Further, although I expect some, even many people, may have developed such an ability, I suspect that intervallic equivalency in a scale of color, although easily defined, is probably not the most immediate experience of color we tend to have. I confess it is not mine. I don't see red to yellow as the equivalent of orange to green, for instance, as I do hear C up to F as equivalent to E up to A. The reason for this can be attributed to the way we perceive colors—an interesting topic but beyond our purview.[7] All of this is by way of alerting us to the fact that even our simple assumption of linear scaling of pitch needs to account for the physiology of hearing: that we recognize octave equivalency with ease further invites us to treat our way of thinking of a linear pitch scale with care.

Given that we can and do scale pitch in a linear way, why characterize it as low to high? Everyday language frequently describes the extremes of the same linearity in terms of size: a bass drum, even struck softly, might easily get called a 'big' sound, while mice are often said to utter a 'tiny' squeak. It is certainly no news that our conventional terms of low and high are culturally conditioned. In Java and Bali pitch is ranged from large to small, and ancient Greek theory uses terms of heaviness and sharpness.[8] Certainly our notation reinforces the metaphor of low and high by translating it into the visual domain, but I believe there is a physiological reason that we cling to this metaphor. Our most immediate experience of pitch comes from our voice, and pitch control derives from muscle contraction and relaxation. The shorter the vocal chords, the higher the pitch—reproducing the same physical sensation of muscular contraction experienced when lifting our arms, objects, or ourselves.

Taking the physical experience of singing as a locus for our thinking about pitch can give us a provisional sense of why we seem comfortable describing the pitch scale in terms of low and high, but we must remember that even those terms can be physiologically contextualized. We thrill to a tenor's high A, but the same frequency sung by a soprano creates a very different sense of 'highness.' David Butler cites a particularly good demonstration of this phenomenon: try humming your highest note, then whistling your lowest (Butler 1992). Your sense of their relative height derived from how they feel in terms of muscle contraction can reverse their actual relationship in terms of absolute frequency.[9]

Both our perception of pitch and our production of pitch allow us to scale pitch linearly, but these two factors contribute differently to our thinking about pitch relations. First, let us consider some familiar terms about scales that invoke notions of physical behavior. While talk of scale steps and skips might be thought of as a visual metaphor, they match nicely the different types of efforts needed to sing such intervals. Scale steps represent the least effort of change; they are in that sense the 'nearest' notes. However, our mechanisms of pitch perception allow us rather easily to privilege notes related by octave; in fact, to relate pitch classes to a point of reference in terms of the overtone system. From this point of view, 'nearest' or most closely related note would not be the scale step.

While the ear acts as a feedback system to singing, the sheer muscular change for an octave is not privileged over those for, say, a seventh or a ninth, leading to different patterns of nearness for production versus perception. Obviously, the two are highly intertwined—we hear what we sing—but the difference is suggestive with regard to musical syntax: *the most closely related notes are not those that are easiest to get to.* We are fortunate for this difference. Indeed, one might argue that tonality depends on this difference, that Schenker's "Chord of Nature" is very much of *our* nature, our physiology, and that the simplest motions away from it (voices moving by step) reflect what is physically the easiest thing for voices to do. It is interesting to imagine what music might be like if things were different: if our pitch perception were not modular, for instance, or if our vocal production were not continuous in pitch.[10]

I have been addressing almost exclusively very basic relations between our physical selves and our musical understanding, but it is easy to see how the connection can be extended metaphorically into larger issues of syntax and form.[11] As an obvious example, the term 'phrase' is often defined in terms of our physiological limitations—a phrase is frequently considered what could be sung in a single breath, even when it is part of a keyboard work. It may be a cliche to point it out, but the basic method for teaching tonal harmonic understanding is through voice leading. And while this concept becomes abstract in a vast variety of musical contexts, its derivation, and the derivation of a huge amount of tonal behavior,

stems from vocal practice: voice leading is a study of what voices, *our* voices, *do* in certain musical contexts, and though it is a truism to point it out, nevertheless it often gets lost in the shuffle. Why a dissonance resolves down by step in the same voice it occurs in, why such a move is related to tension and release, can be traced very easily to the physical experience of singing.[12]

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So far I have used the voice to consider how our physical experience affects how we think about pitch, but it is interesting to see how our engagement with different instruments can also affect it. Various instruments can create for their players different sorts of physically imagined musical spaces. For me, playing the organ has made bass lines inextricably associated with motions of the feet. On the other hand, a theorist who is also a harpist reports that for her, foot motions are associated with accidentals; when she shifts to keyboards, she must make a conscious adjustment. For some instruments, registral changes create radical changes of effort. High notes on brass instruments have acquired all sorts of special significance, due to the extra "oomph" and nerve required to bring them off. On some string instruments, both the physical contraction of the spaces the fingers must move and the extra strength needed to to connect with the fingerboard give the upper register qualities not found lower down. Change of register on other instruments, however, is sometimes much more just a change of position. The keys of a piano are all the same two sizes, no matter where they are on the keyboard, and while the weight of the action varies, it actually gets slightly lighter and easier to play the higher one goes.[13]

Such differences are most apparent to players, but instruments, by the way sounds are produced on them, and the sorts of motions needed to move from one sound to another, create different arenas of musical action that can definitely inform our hearing. Each instrument in effect produces a different sense of what work might entail, and these senses become an essential part of musical experience, for the listener as well as the player. While musicians work for ease through all registers and intervals on an instrument, nevertheless the qualitative difference between, for example, a two-octave leap downward on a horn and the same interval played on the two outer strings of a guitar will be considerable, because of the radically different difficulties of the two acts: the latter is trivial, a flutter of the hand, while the former can seem as daring as jumping off a cliff. Think, if you can bring yourself to do so, of the famous horn passage from *Til Eulenspiegel* played on the piano, or even worse, on the guitar!

Think also what might happen if a given arena for action were radically changed: musical meaning could change radically as well. That

such can and has happened is brought to our ears dramatically when we hear, for example, works written for the natural horn actually played on a natural horn. Mozart's Horn Concertos, or Schubert's *Auf dem Strom*, not to mention Brahms's Horn Trio, are strikingly different works (and to me much more thrilling) when heard on the natural horn.[14]

Listeners cannot help but be made aware of these issues from a sensitivity to the qualities of the sounds produced. Sound qualities are not neutral: the sounds of the flute and of the oboe, for example, carry with them the implications of the airflow differences between the two instruments, and thus to hear each of those instruments traversing the same musical line invites the listener to construe that line in significantly different ways. Composers are constantly taking advantage of this. Elgar in the finale of his Second Symphony runs a virtuosic lick through a series of instruments, climaxing in the horns. The sense of electricity in the passage is not so much a result of the change of timbre, but a result of our amazement both that he would be so daring as to bet the horns they could do it, and that they could succeed.

Composing, then, is not only about sound but also about action, and notation can reflect this. Consider the opening of Beethoven's *Hammerklavier* Sonata. The opening gesture takes on its particular qualities in a number of ways, one certainly being the fact that the chord on the down beat fleshes out the second, third and fourth partials of the up-beat's low B♭, but another being that both up beat and down beat are played with the same hand. Thus, the chord of the down beat is not merely 'these notes following the preceding note at such and such a time interval,' but all that plus 'all these notes played as part of a single gesture,' a single chord grabbed, as it were, by a giant hand. Now, performers get away with a certain amount of 'cheating,' and to good end, but I feel it is a disservice to the piece if, when breaking the gesture between two hands, the performer ignores the musical results implicit in the specified physical action. There are times when the musical import of a piece or passage derives from its pushing the limits of physical feasibility, and this can and should be understood by performers and listeners alike. Once again, I ask you to imagine, say, the Ravel or Prokofiev Concertos for Piano, Left Hand, and Orchestra, played with both hands.

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As the foregoing examples might suggest, I believe that a definite component of what we do as listeners involves our recognition of the doing in Cusick's 'something you do' that is the making of music. I think of it as a form of kinesthetic empathy, an identification with the embodiment of a sound. Clearly, one of the visceral thrills of hearing a singer

comes from the intimate knowledge of making sounds with our voices that we share as human beings. We are transported in part by what it must be like to make such a sound. Nor need such physical recognition be quite so immediate. As so many examples attest, we are constantly translating one sort of musical experience into some new arena, and these translations can result in empathies with physical engagements that are layers deep. I can imagine, for example, that listening to a Chopin Nocturne would engage our kinesthetic response to the player's touch and dexterity, while further engaging our response to the *bel canto* vocal style that the work emulates, while at still another level, our appreciation of its underlying abstract voice-leading would connect with our physical sense of how voices in part-writing behave. None of this is meant to supplant our mind's role in listening to music; I simply want to acknowledge and bring consciously into participation one of the ways we bring music to ourselves, and ourselves to music.

Kendall Walton has recently brought up a couple of intriguing musical issues that mesh with what I have been discussing.[15] For one, he has observed that of all the temporal arts, music is the only one that readily induces physical movements: a silent film with regularly pulsing shapes, for example, does not produce the sort of foot-tapping that a piece of music with the same rhythm would. For the other, he has observed that for the vast majority of the time, crescendi are interpreted not as sounds of fixed amplitude growing closer, but of sounds in a fixed location changing in intensity. While I don't think that the approach I am using here offers complete explanations, I think it allows us to take a step towards understanding these phenomena. If we know sound (as, for the most part, we don't know shape) as a translation of our own bodily efforts, then it is not hard for us to understand a rhythm in terms of the effort it took to make it.[16] We speak, sometimes cavalierly, about 'musical gesture,' but we should never forget that there is some reality to the notion that much music is indeed produced through physical gesture. It doesn't seem unreasonable that we might index those physical gestures through the music they produce, and then imitate them.[17] We want to feel in part what it feels like to make those sounds. As for the second point, at least two things come into play. One is our sheer ability to recognize the change of a sound's proximity based on ambience; the other has to do with our recognition of dynamics not so much as strength of signal but as index of effort. Thus, it takes additional musical cues to make us understand a crescendo as representing a change of location. Concerning this last point, it is interesting to note that in electronic music the sense of sound location and the change thereof becomes a compositional dimension.

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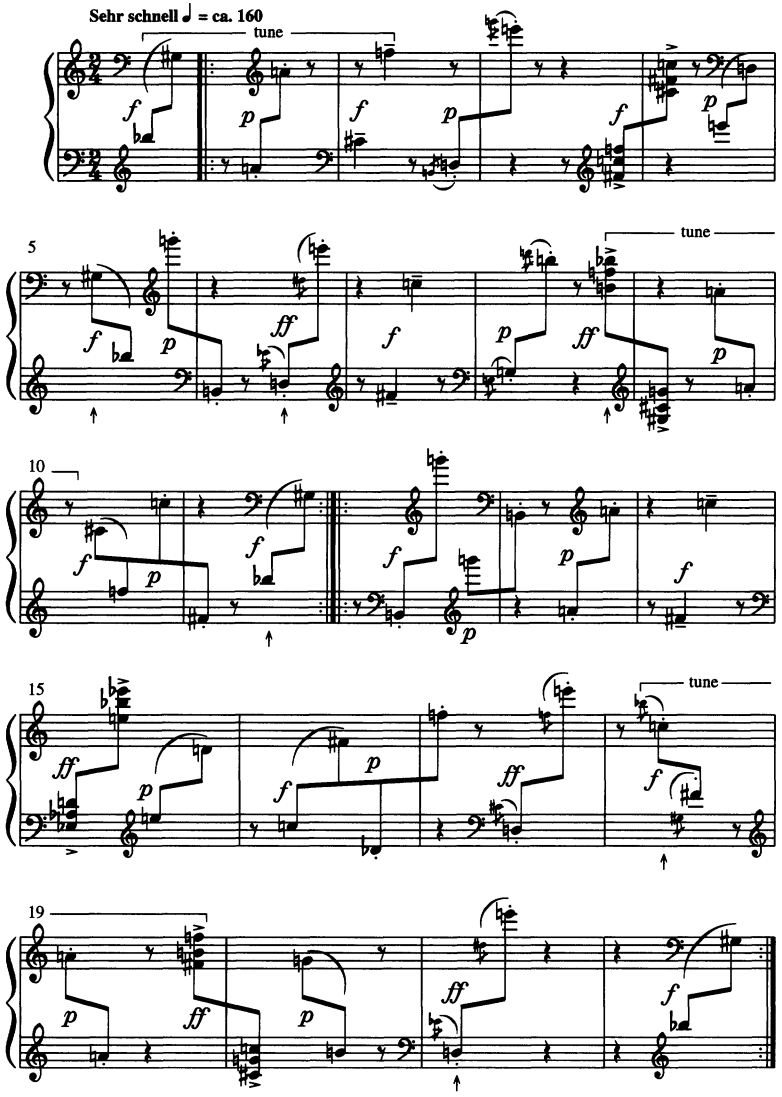
I want to close by suggesting how a physiological viewpoint can inform our thinking about larger issues of musical syntax and structure. I want to use a couple of examples that are drawn from music dear to my heart, a body of music usually regarded as particularly cerebral. I mentioned at the outset a chronic state of non-recognition, by which I mean the gulf I feel between my experience of twelve-tone and other nontonal music, and what I've tended to run into as popular descriptions of it. Despite a general tendency to dismiss this music as intellectual patterning, it has been the intense emotional directness of this music that has drawn me to it and kept me enthralled, and my experience has only been heightened and broadened by the time I have spent studying it. Perhaps by emphasizing the physical side of playing music by Webern and Babbitt—or Schoenberg and Carter, for that matter—I can enlarge an appreciation of this music as human action.

Milton Babbitt's *My Ends Are My Beginnings* is a big work for solo clarinetist. While the score, like all of Babbitt's music, is bereft of any of the traditional descriptive expressive markings, it is composed in such a way that, like Suzanne Cusick's Bach example, it carries a clear message to the player of how to understand it. In the course of its three sections, the piece unfolds three versions of a four-part all-partition array based on two sets of combinatorial row-pairs.[18] Babbitt, a clarinetist himself, has placed the two strata of combinatorial row-pairs above and below the instrument's registral break. As a result, the player is guided to an understanding of the underlying structures of the piece through the different kinds of effort entailed in articulating intervals within a register, or across the registral break. While these intervals are frequently of the same size, it is the physical difference in playing that helps mark their differing significance. Similarly, in the rhythmic domain, the significance of rates of attack marking either the initiation of a span (beat) or a local subdivision forms a major distinction in the composition. Although there are frequent changes of context that will often change a given attack-rate's significance from one function to the other, the metrical context of each section of the piece allows the player to feel the differences based on the changing sense of beat, measure and tempo. The music is responsive to the physiology and mechanics of its playing, and a sensitive player will let the piece guide him or her to an understanding of its workings. A performance alive to those aspects of the piece can provoke a similarly revealing response in its listeners.

This same physiological perspective informs the second movement of Anton Webern's *Variations for Piano,* Op. 27.[19] While the different voices of the canon underlying this movement are clearly delineated rhythmically, there is an additional layer of articulation provided by the elaborate

hand-crossing. It is not merely the sense of visual theatricality that Webern is after; rather, as his remarks to Peter Stadlen reveal, he was intensely aware of this as music to be played, so that the very motion of the hands and arms from note to note would imbue the sounds of the two voices with a sense of their individual continuity, despite the constant changes in dynamics and register.[20] Webern is not merely interested in such and such a note at such and such a dynamic at such and such a point; he is also interested in all of that in the context of the hand having traveled a certain distance, having had to play a different note in a different place at a different dynamic. The fact that some of the distances will impose a flexibility in the tempo, as well as give a certain charge of danger to the execution, seems to me to be as much a part of the piece as the notated pitches, rhythms and dynamics. In this light, Webern's music can be heard in direct relation to the opening of the *Hammerklavier* Sonata.

But that is not all: the hand-crossings serve an important structural role as well. As I and others have detailed elsewhere, the movement employs a two-voice canon whose parts, while crossing constantly, are distinguished by rhythmic placement.[21] Which voice is leading, and how that relates to the underlying row structure, is one of the central issues of the movement. In any given portion of the piece, each hand is projecting a single voice of the canon, but changes of which hand is leading are not coordinated with the changes of which voice is leading, except at a couple of critical spots. The changes of leading hand are reserved for something else. As may be seen in Example 1, the hands switch for the first time just at the return of the opening dyad, preserving the hand position of that dyad, and reserving the widest possible crossing (from the high G to the low B) for m. 13. The hands return to their original relationship at the moment that marks the midpoint of the first half. The next change, at the pickup to m. 9, is the passage that marks the return of what could be called the opening tune.[22] The final change of hands, back to the disposition of the opening, comes with the final dyad of the half, which itself also marks a one-beat premature change of leading voice. During the second half of the piece, the hands maintain the relationship of the opening, until, once again, they switch at the final return of the opening tune. One switch remains, at m. 21, but this, most strikingly, is coordinated with a premature change of leading voice, allowing that moment multiple connections with the rest of the movement.[23] Thus the hand changes articulate major motivic returns, as an additional layer on top of the canonic unfolding. This is just a sampling of some of the structural significance of the physical hand motions written into all three movements of Webern's Op. 27, but I hope it suggests once again how a message from composer to performer can be passed on to the listener, through the way it sculpts the performer's actions.



Example 1

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Music, in large part, is indeed something we do. It is a way we speak to each other, and often how we speak to ourselves. That the mind can be ravished by the patterns we perceive in sounds I would never deny. But how we perceive those sounds, and how we make those sounds, cannot help but carry part of the message. To ignore this is to ignore what, for many of us, brought us here in the first place. The study of music has its own rewards, but it is good to remind oneself occasionally that music's path to the mind is inevitably through the body.

NOTES

1. Koestenbaum 1993 offers some superb observations about the physicality of singing and how listeners resonate with it.
2. I am grateful to Kendall Walton for a conversation on this point.
3. This viewpoint underlies much of Emile Jacques-Dalcroze's Eurhythmics technique. The connections between physical motion and music-making are also worked out in an analytical framework in Pierce 1994.
4. This point is made in Lerdahl and Jackendoff 1983, and is implicit in Cooper and Meyer 1960.
5. See Brower 1993 for a discussion of memory and rhythmic perception.
6. The last bar of Ravel's *La Valse* creates an unnerving sense of being brought to earth through the use of a brutal replacement of the delirious triple meter by four beats in the same timespan.
7. This is covered in Lakoff 1987.
8. I am grateful both to Nancy Florida for pointing out the scaling words used for gamelan music, and to Larry Zbikowski for drawing my attention to Barker 1989 for the information about Greek theory.
9. This turns out not always to be the case. In trying this out at home I found that while it worked for me, it did not work for another member of the household, who, however, can sing more than a full octave above the traditional soprano high C. This, I assume, is an exceptional case.
10. For example, if our way of producing sound involved rigid tubes that alowed an easy production of partials, then next-easiest-note would not necessarily be a step away. Furthermore, if our hearing did not recognize octave equivalency as a 'close' relationship, what might sound 'good' together could well be sounds that were registrally proximate, or perhaps sounds that were not the same pitch, but represented the same position in the overtone series. The combination of these two posibilities would produce a very different set of criteria for making music!
11. Such extensions and the role of metaphor therein are being examined by a number of theorists who have taken the work of Mark Johnson (1987) as a starting point. A recent panel at the Society for Music Theory's National Conference in Baton Rouge (1996) included presentations on Johnson by Janna Saslaw, Candace Brower, Steve Larson, Marianne Kielian-Gilbert, Larry Zbikowski and myself. The work of Marion Guck (starting with Guck 1980) explores the role of metaphor in musical understanding, spread over a wide range of topics. Fred Maus (1988) has also explored musical understanding in terms of human action in a somewhat different way.
12. I want to be careful to allay any impression that I might feel that one or another kind of music making is more or less 'natural.' The human mind and body are enormously flexible, and highly adaptive to different kinds of interpretations of stimuli. For example, while the diatonic collection and the major scale can be derived from the overtone series, and while we may play and sing much tonal music using just intonation, we are also able to hear and understand equal temperament as a representation of just intervals. Equal temperament, however, also carries its own possibilities for musical structure that are not possible with just intonation. Thus, while I might reflect on the ways certain kinds of musical structures emerge from certain physiological constraints, that does not mean that I

believe they are the only structures that might so arise, or that those particular constraints are the only things conditioning the creation of music.

13. This too can be extended with a little thought experiment, which can also illustrate further the point that the human mind is highly adaptive. With not much work one could construct an electronic instrument which could be controlled by squeezing either a rigid ball or a soft ball. The difference here would be between control by muscle tension, or muscle position. The control could be applied in various ways. For instance, control could be of pitch, or of volume, and it could be rigged so that higher tension (or more closed position) could be either positively or negatively correlated with either frequency or volume. Which hand controls pitch or volume could be an additional variable, or one could extend the instrument to be controlled by any set of muscles. With this setup, one could construct a number of different instruments, each of which would have different characteristics. Pitch could be a matter of position or tension, just as could volume, and high and low and loud and soft could be variously correlated with tension and relaxation. Each musical space so constructed would be different, but I believe that each could be learnable. It is interesting to imagine an instrument in which making a soft descending scale would depend on an increase of muscle tension, and the sorts of music one would want to make on it. I am indebted to Dr. Jere Mead of the Harvard School of Public Health for a number of conversations on these issues.
14. In the nineteenth century, Franz Liszt designed an alternative keyboard for the piano that has been adapted both by free-bass accordianists and by some piano manufacturers. By laying out pitches in a diamond pattern, the keyboard makes certain large leaps and stretches much easier for smaller hands. I have seen a performance of works of Chopin on such an instrument, and while the music-making was wonderful, I found it strange to see hand motions I would more readily associate with a court stenographer being used to produce the sixteenth-note double octave figuration in the third *Ballade*. Liszt's keyboard radically challenges the realm of virtuosity on the piano by changing the range of what is effortful.
15. These appear in Walton 1997.
16. It is interesting to note, however, that Chinese caligraphy depends on a sense of the physical action of its making to be best understood. I am indebted to Nancy Rao for an interesting conversation on this. I expect that such appreciation could well apply to a great deal of visual art.
17. The 'air guitar' is probably the widest-played instrument in the country.
18. A more extended analysis of the pitch and rhythmic structure of this work may be found in Mead 1994, along with a general description of Babbitt's compositional techniques.
19. This movement has received a lot of analytical attention. See Babbitt 1960, Bailey 1991, Koivisto 1996, Lewin 1962 and 1993, Mead 1993, Nolan 1989. Wason 1987, and Westergaard 1963.
20. See Wason 1987 for a discussion of Stadlen's performance edition.
21. See especially Lewin 1962, Lewin 1993, Nolan 1989 and Westergaard 1963.
22. See both Lewin 1993 and Koivisto 1996.
23. See Mead 1993.

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