Dalcroze, the body, movement and musicality

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ABSTRACT What forms the basis of musical expressivity? The Swiss composer and music educator, Emile Jaques-Dalcroze, believed that bodily processes, rhythm, and physical motion were the basis of musical expressivity and music pedagogy. We can rephrase his emphasis on the synergy between bodily and musical processes into a question: How does the body contribute to thought and musical understanding, in particular? We review recent theory and research on the bodily and brain basis of musical expression and find ample support for his seminal views. It thus appears that Dalcroze was onto something essential to musical thought and expression.

KEYWORDS: *brain, development, Emile Jaques-Dalcroze, embodied mind, musical expression, musical thought, musical understanding*

Dalcroze and musical expression

INTRODUCTION

What forms the basis of musical expressivity? There have been a number of different responses to this question put forth over the last century or so, but one approach that remains particularly intriguing is that of the Swiss composer, conductor, music educator, and writer, Emile Jaques-Dalcroze (1967[1921], 1930; Abramson, 1980; Abramson and Caldwell, 1992; Haward and Ring, 2001; Odom, 1998). During the early part of the 20th-century, Dalcroze had become increasingly distraught with traditional conservatory training in Europe because he believed that it failed to instill musical expressivity in its students. This was so, according to Dalcroze, because it stressed music as technical mastery of the classical repertoire and ignored the importance of rhythm and the body in musical expression. He likened the consonance and dissonance of musical sounds, instead, to the fluidity and control of human movement by the physical dynamics of the body as well as to the social interactions of human groups.

> No physical movement has any expressive virtue in itself. Expression by gesture depends on a succession of movements and on a constant care for their harmonic, dynamic, and static rhythm. The static is the study of the laws of balance and proportion and the dynamic that of the means of expression . . . Just as in music there are consonant and dissonant chords, so in mimic art we find consonant and dissonant gestures. 'Consonant' movements are produced by the perfect co-ordination between limbs, head, and torso, the fundamental agents of gesture. Exactly the same is the case when it is a question of harmonizing different motive elements of a crowd (Jaques-Dalcroze, 1967[1921]: 127).

This statement is a key element of the Dalcroze approach: Musical expressivity is both embodied – that is, resides in the physical characteristics of the body – and entails physical and social interaction with others. How do extant theories of musical expression accord with Dalcroze's view?

THEORIES OF MUSICAL EXPRESSIVITY

Peter Kivy (2002) has argued for a theory of musical expression that he calls 'enhanced formalism.' On this view, expression in music (at least, instrumental music) is a direct effect of musical form and structure. That is, musical expression of what he calls the 'garden-variety emotions,' for instance, joy and sorrow, is found in the music itself, in the tension, release, and resolution intrinsic to the compositional structure of western classical music. Nonetheless, he maintained in an earlier view now rejected ('contour theory'), that human emotional expression was analogous to the sonic shape of a musical piece, thus arguing that there was a similarity among melody, the body, and human expressive speech. Recent scientific evidence, however, tends to support this earlier view (Patel and Daniele, 2003). Studies of contemporary English and French speakers and late 19th-century and early 20th-century English and French composers suggest that measures of durational variability based on sampling of vowels and musical tones (i.e. nPVI: the difference in duration between pairs of vowels or musical notes relative to the average length of the pair in a speech or musical sample) occur in the same general direction for linguistic utterances and music compositions taken from the same culture. Thus, the authors suggest that vocal prosody or intonation of a composer's native language influences the form or structure of a musical piece. This is so, the authors suggest, because composers most likely internalize rhythmic patterns of language very early in life or incorporate rhythms of folk and popular (sung) songs acquired in childhood in their mature compositions.

In a related study (Collier, 2002), the musical relevance of positive and negative emotion words to musical expression were evaluated. The study demonstrated that emotion words that did not have a cognitive object (i.e.

emotions that did not require conscious knowledge of their source) were most likely to be expressed in a musical piece. These included joyous, happy, cheerful, and calm positive emotions and sad, depressed, sorrowful, and gloomy negative emotions. The author reasoned that music accomplishes this by activating subcortical emotions that are precognitive and intimately tied to the body and bodily processes and thus do not require conscious access (see later). Indeed, the results have much in common with the well-known phenomenon of physiognomic perception or the attributing of emotional states to inanimate objects whether seen or heard (Seitz and Beilin, 1987). Such perceptual processes are closely tied to the body (Seitz, under review).

Developmental studies bear out the close relationship between bodily movement, speech, and musical sounds (Papousek, 1996; Papousek and Papousek, 1981). For instance, within the first two-and-a-half months of life, euphonic musical sounds emerge from early vowel-like sounds in the young infant and possess nearly identical qualities to harmoniously voiced tones. At one year of age, infants' sung rhythmic sequences are accompanied by rhythmic movements of the body – including allied breathing patterns as well as limb and trump movements – and are closely tied to rhythmic speech patterns. This emerging bodily-linguistic-musical matrix, moreover, is socially influenced by early parent-to-infant speech as well as cross-modal interactions within the parent-infant relationship linking bodily gesture to emerging speech and musical sounds (Papousek and Papousek, 1981; Stern et al., 1985). These musical elements of parent-to-infant speech (e.g. vocal prosody, pitch range and contour, intensity, and tempo) modulate the infant's ongoing behavior and may have evolved in humans because of their adaptive value. Moreover, even prior to the first year of life young infants encode information about musical contour, pitch direction arising from small semitone changes, and beat structure (Trehub, 1987, 2001), and are able to discriminate small timbral differences (Papousek, 1996).

By the second year, spontaneous songs most frequently incorporate unisons, seconds, minor thirds, and fourths and may represent universal pitch classes underlying communication in both music and language (Bernstein, 1976). Later emerging chant-like songs in the third year display both a synchronicity with the child's motor movements and are frequently performed with others indicating the social and imitative nature of both emerging speech and musical sounds including pitch intervals and pitch contour (Papousek, 1996; Papousek and Papousek, 1981).

Nonetheless, other theorists have suggested that music is expressive in the sense that it arouses corresponding feelings in the listener ('arousal theory'), embodies an agent or musical persona that expresses emotions ('persona theory'), has a tendency or predisposition to produce in the listener those very expressive properties ('tendency theory') or that music lacks the capacity to express or denote anything other than pure musical sounds (musical 'formalism') (Kivy, 2002). Even the noted musical theorist, Leonard Meyer

(1956), however, has long maintained that emotions were aroused in the listener when musical expectations inherent in the musical structure were either inhibited or blocked. The Gestalt approach upon which Meyer built his theory of musical expression emphasized parallels between (aural) perception and the Gestalt principles of perceptual organization (e.g. closure, proximity, similarity, and good continuation). The latter represented the basic principles by which the mind/brain organized the external world. Nevertheless, the body played a subsidiary role in Meyer's modified Gestalt theory.

Stephen Davies (1994), however, takes a position similar to Kivy's earlier contour theory. Music doesn't symbolize, describe or represent, according to Davies (1994), rather emotions are presented directly in the musical work through dynamic parallels to human movement, behavior, physiognomy, the human voice, gait, and the like. Like human motion, musical motion is inherent in the work, since the temporal dimension of music revolves around tension and relaxation and is experienced as felt emotions in the listener. While Davies' theory does emphasize the involvement of the body and human movement in musical expression, the problem with his theory and all of the aforementioned theories of musical expression is that they leave out the importance of the centrality of movement and the body in musical expression (see below). We propose that the Dalcroze approach most clearly articulates the role of the body in music pedagogy and musical expression.

THE DALCROZE APPROACH TO MUSICAL EXPRESSION

The Dalcroze approach has many 'embodied' facets, but it is principally organized around motor anacruses. Both music and movement involve motor preparation (anacrusis), action (crusis), and reaction (metacrusis). That is, 'a single phase, the first a preparation of the second, the second the inevitable result of the first' (Jaques-Dalcroze, 1967[1921]). This is so because the heart of rhythmic movement is duration (agogism), intensity (dynamics), and space.

> (1) Rhythm is movement, (2) movement is essentially physical, (3) all movement requires space and time, (4) physical experience forms musical consciousness, (5) improvement of physical means results in clearness of perception, (6) improvement of movements in time ensures the consciousness of musical rhythm, just as improvement of movements in space ensures consciousness of plastic rhythm (Jaques-Dalcroze, 1930: 208–9).

This last comment by Dalcroze is intriguing because he was, in essence, arguing that physical movement formed the basis of musical consciousness, that is, tonal and rhythmic imagery. Jaques-Dalcroze felt that through the interplay of the natural rhythm of the body with musical aesthetics, artistic emotion was created. He believed that the sensations that movements to music evoked created mental imagery.

> The sensations afforded by the natural rhythms of our bodies strengthen our instinct for rhythm and create rhythmic consciousness. It is through this instinct and this consciousness, blended with the aesthetic sense, that we experience complete artistic emotions (Jaques-Dalcroze, 1930: 183).

Insofar as music and movement are inherently social activities, according to Dalcroze, musicians deepen their understanding and mastery of polyrhythm, polymeter, and polyphony through interactive group activities. The overall goal of the Dalcroze method is to replace arrhythmia and errhythmia – the inattention to, or misapprehension of, duration and intensity in music, respectively – with eurhythmia or smooth, uninterrupted, and flowing sounds (Abramson and Caldwell, 1992). The latter is dependent on the body and gesture since eurthymia originates in continuous or 'harmonized gestures.' The Dalcroze method accomplishes this by harnessing the inherent rhythm of the body.

> Human gesture and its orchestration conform to elementary principles of nature – dynamic, rhythmic, and agogic (Jaques-Dalcroze, 1967[1921]: 121).

The orchestration of the body involves the concatenation of bodily gestures, the juxtaposition and opposition of bodily movements in relation to emotional attitudes, as well as the use of immobility (i.e. rest) and silence. According to Dalcroze, rhythmic movement underlies solfège (i.e. a solmization system or syllables sung to pitches) and ear training and both form the musical basis of instrumentality. There are many ways to accomplish this pedagogically, however.

The Dalcroze method

RHYTHMICS

At the Dalcroze School in New York, various techniques are used to orchestrate bodily gestures and engage musical expressivity. For example, early on students will toss bean bags or balls across the floor in rhythm, respond to high and low sounds by responding with high and low movements of the body, tap on the piano to different rhythms in unison, clap their hands together while making lower leg movements in different meters, sing and move with the whole body, as well as partner each other in duos and trios. These movement, musical, and dance exercises are collectively called 'rhythmics.' Such exercises assist students in developing a sense of rhythm that infuses the whole body with rhythmic awareness in their engagement with an instrument or through the voice – not just locally in the hands or feet – and abets students internalizing the bodily basis of musical understanding, such as the relation of pitch to height or multiple bodily levels of rhythmic awareness. In addition, consonant with Dalcroze's social approach to musical pedagogy, many of these exercises are done with diverse social configurations and in multiple interactions with other musicians.

RHYTHMIC SOLFÈGE

Subsequently, students will engage the hands with the voice and then hands with voice and feet in musical imitation or in reaction to the piano; sing individually and then collectively in single and double canons; bounce tennis balls in different rhythms on the floor and then to each other on the crusis to music (piano); integrate voice, hands and feet in dance-like movements; and so on. Collectively, these musical exercises combine rhythmics with solfège or what Dalcroze called 'rhythmic solfège.' Such corporal maneuvers integrate multiple limb movements with melody and rhythm, integrate physical movement of the body and voice with accent and rhythm, and accomplish this through assorted group arrangements and social interactions.

HARMONY AND IMPROVISATION

In the last stage of Dalcroze training, students combine rhythm and solfège with harmony in instrumental improvisation, usually on the piano. Thus, each of these stages of the Dalcroze method join together rhythm (i.e. patterns of musical beats), meter (i.e. musical motion or pulse with regularly occurring accents), tempo or beat (e.g. musical pace, accelerando, ritardando), phrasing (nuances in the articulation of melodic groupings), shading (e.g. appoggiatura), volume (e.g. diminuendo, crescendo, fortissimo), as well as musical accent and direction (e.g. legato, staccato). Each of these musical and bodily exercises serves to connect the hands, voice, limbs, and body with all of these core elements of music. For instance, accent commingles pitch space (i.e. pitch relations) with musical duration and volume enabling the Dalcroze student to bind together motorically many of the major elements of music.

Criticisms of the Dalcroze method

Dalcroze's approach, nevertheless, has been faulted for placing too much emphasis on rhythm and limb movement and ignoring such motor and perceptible elements as breathing patterns, musculature of the lower back and torso (e.g. the latissimus dorsi that draws the arms inward, downward, and backward), vestibular sensitivity (i.e. sensitivity to gravity, vibrational phenomena, and linear and rotational motion), and synoptic abilities (i.e. synesthesia between the visual and auditory modalities; see later), among others (Repp, 1993). Dalcroze was attentive, however, to breathing and its integration with rhythm and the body and made extensive use of breathing patterns in his teaching early on (Odom, 1998).

Similarly, dance movement emphasizing the lower back and torso was incorporated into the Dalcroze approach. Dance-like movement included walking in rhythm and in accent to the music as well as the use of conducting gestures and pantomime, skipping, jumping, and running – all inspired by the early choreography of Isadora Duncan, Loie Fuller, Mary Wigman, and Grete Wiesenthal. Indeed, Dalcroze and the Dalcroze approach inspired generations of dancers and musicians, particularly in Europe. Christoph Gluck's *Orpheus and Eurydice*, which was presented at the Hellerau Studio Theater in Germany in 1912, was motivated by the Dalcroze approach. Many 20th-century modern choreographers such as Ruth St. Denis, Doris Humphrey, Bessie Schonberg, and Meredith Monk, among others, were inspired by Dalcroze. His method has found its way into various theatrical and operatic performances and over the last 50 years has influenced music education worldwide with over 30 Dalcroze institutes now in existence (Haward and Ring, 2001; Odom, 1998).

Barring Dalcroze's putative insensitivity to vestibular and synoptic abilities (see below), there does seem to exist a synchronicity or synergy between bodily and musical processes. The question is, how does the body contribute to musical expression? Or, how does the body contribute to thought and musical understanding, in particular? In this latter sense, it appears that Dalcroze was onto something essential to musical thought and expression.

The bodily basis of musical expressivity

Repp (1993) maintains that there is a parallelism between musical and bodily processes, that is, between intensity (dynamics) and duration (agogics). He suggests that melodic, rhythmic, and harmonic motion arise from different sources within the brain/body axis and differ both between individuals and within atypical disease states. For instance, rhythm gives rise to melodic forms because sequences of tones form natural musical phrases (i.e. meter, tempo, and timing). A rhythm carried out in 'threes' has a different melodic feel from a rhythm executed in 'twos.' More to the point, dividing up the beat into two quarter notes followed by two eight notes affects the melody differently from dividing up the measure into two quarter notes separated by two eight notes or some other combination. In the first case, the melody has the characteristic of a waltz; in the second case it has a more minuet-like quality. The essential point is that small changes in meter and rhythm affect the overall melodic structure of the music. Indeed Meyer (1956), who otherwise argued that rhythm was more dependent on mental ability than bodily processes, accorded some importance to the body in music perception and production. Scientific studies of the brain support these observations. Recent evidence indicates that the cerebellum, a motor structure thought to be involved in rhythm and timing, is also involved in harmony, melody, and in cognate *cognitive* domains (Seitz, 2000). For example, musicians who sight read a musical score while detecting melodic and harmonic errors activated cerebellar structures (Parsons, 2001).

MELODIC GESTURES

As it turns out, there are optimal temporal shapes for melodic gestures, that is, brief sequences of notes executed as a single expressive unit (Repp, 1992).

For example, professional pianists invariably provide an expressive temporal shape to a singular musical motif in Schumann's 'Träumerei' and such an expressive musical phrase is often defined by a change in tempo – marked off as action units – as are phonological phrases in speech. Such phrases can be mathematically modeled as a family of parabolic functions that experienced musical listeners prefer to musical phrases that don't possess these expressive features (Repp, 1992). However, these melodic gestures are flexible and context-dependent and can be modified through ongoing interaction with other musicians.

MUSICAL DYNAMICS AND TEMPO

Thus, musical expression and physical motion appear to share similar underlying properties. For example, tempo change is governed by analogy to physical movement – dynamics and tempo are intimately coupled (i.e. 'The faster the louder, the slower the softer,' Todd, 1992: 3540). A typical musical phrase possesses a crescendo–decrescendo shape and this shape is tightly yoked to physical movement. The perception and performance of tempo is linked to physical dynamics and gives rise to an internal sense of motion. This internal sense of motion, according to Todd (1992), is organized in the same way as the musical phrase in the performer's mind – in a hierarchical manner. Moreover, this internal sense of motion originates in the vestibular system and induces a sense of self-motion.

Clarke (2001), however, maintains that it is not just internal self-motion that links motor actions to musical expression, but also relative motion that inheres in the timbral, temporal, and dynamic aspects of the music itself. Damasio (1996) has proposed that the bodily basis of emotional expression originates in both a 'body loop' and an 'as if' loop. The former would be modulated by brain and bodily systems that process actual physical movement arising in the kinesthetic and vestibular senses, whereas the latter would arise from one's memories and experiences of those very same processes. Kinesthesia or proprioception includes (usually unconscious) knowledge of activity and position of the joints, muscular force and effort, timing of contractions, as well as body image (Gandevia, 2001). Indeed, Cox (2001) points out that this process might involve both overt and covert imitation of visual and auditory sources in what he calls the 'mimetic hypothesis.' We thus understand and relate expressively to music because of our own previous experiences in making similar sounds and engaging in similar movements as a result of correspondences (largely unconscious) arising among our kinesthetic, visual, and auditory experiences. These correspondences, moreover, are based on cross-domain mappings. Cross-domain mappings, or the ability to integrate information across different sensory modalities, enable us to perceive intensity, spatial location, tempo, and rhythmic structure in an amodal manner. These abilities, moreover, appear to be innate or develop early and rapidly in human development (Lewkowicz, 2000).

Nonetheless, from a Darwinian perspective our internal sense of self-motion may have evolved in early hominids to deal with sounds in the environment and may have further co-evolved in modern humans to promote the physical embodiment of elementary physical principles of mechanics (Todd, 1992). Evelyn Glennie, a deaf percussionist, is able to play music through her ability to feel and adjust to the nuances of vibrations of musical instruments, the floorscape, and cognate materials (Glennie, 2001). This ability, in fact, appears to be part of our natural biological makeup. Human fetuses rapidly habituate to vibroacoustic stimuli at both ten minutes and 24 hours after presentation (between 20–9000 Hz at 74 dB), suggesting both short-term and long-term memory in humans for vibroacoustic phenomena (van Hetersen et al., 2000).

MUSICAL PLATONISM

Some have even claimed that there is a musical Platonism (Grey et al., 2001; Tramo, 2001). For instance, children as young as three years display a stereotypical set of positive emotions to the major scale and a contrary set of negative emotions to the minor scale (Kastner and Crowder, 1990). These universal features of music have their origins in the major diatonic triad according to the conductor and composer, Leonard Bernstein (Bernstein, 1976), and such analogues as musical pitch and temporal structure may be widespread, if not universal, across musical cultures (Pressing, 1983). For instance, it has been suggested that the expressive characteristics of modern jazz personified in the pentatonic scale arose from its appropriation of the classical western diatonic one and its attendant musical expressive properties (Hodeir, 1975[1956]). These universal features of 'grouping, meter, duration, contour, and timbral similarity,' moreover, are shared by both language and music and have been explicitly recognized in the prosodic structure of modern poetry (Lerdahl, 2001: 337).

Music and musical expression, however, are found in many species, including birds and whales who communicate with each other through musical sounds. Such biophony or 'animal orchestras' form a unique sound grouping within a given biome (Grey et al., 2001). Indeed, the authors claim that the study of humans and other species suggests that there is no explicit musical center in the brain. Instead, various areas of the brain form a set of concentric rings that process musical sounds (i.e. core, belt, and parabelt). While the core is found in the auditory cortex, the belt consists of the thalamus where lower musical processing areas are found, whereas the parabelt or higher musical processing areas would include the frontal, parietal, and temporal cortices. Under this scheme, timing of neural activity in the core would control musical pitch, timing of successive neural action potentials in the belt would structure musical consonance (or dissonance), and the processing of intervallic relationships in the parabelt (i.e. pitch intervals such as the third or octave) would activate neural excitation maps spread across the higher cortices.

This scheme is somewhat more variegated than the trion model of the cortex that purportedly underlies the so-called 'Mozart Effect' (Leng et al., 1990). That is, the enhancement of spatial-temporal reasoning abilities by exposure to music (Rauscher and Shaw, 1998). Although some recent studies have supported the long-term (but not short-term) enhancement of non-musical cognitive domains as a result of receiving formal music instruction, the causal evidence is weak (Schellenberg, 2001). Nonetheless, Mountcastle originally suggested that the columnar structure of neurons comprising six orientational minicolumns was the basic neural structure or 'network' of the primate visual cortex (Mountcastle, 1978). Leng et al. (1990) then suggested that the periodicity in firing patterns of these columnar structures in unison was the fundamental code of the brain for all higher cortical functions including music. As the Grey et al. (2001) model indicates, such a simple rubric of musical cognition is inadequate because musical functions (e.g. melody, tempo, and harmony) are carried out in different parts of the brain by diverse cortical and subcortical structures under widely different external eliciting conditions. For example, children with Williams Syndrome have preserved musical and rhythmic skills and relatively strong linguistic abilities, but are poor in most other cognitive areas (e.g. visuospatial abilities), suggesting underlying localization of brain functions (Levitin and Bellugi, 1998). Moreover, these diverse brain regions are connected to perceptual and motor systems that provide the foundation for musical expression. Musical correction and feedback are a case in point.

MUSICAL CORRECTION AND FEEDBACK

Error correction and feedback of ongoing musical playing takes place by way of the body, occurring through aural, visual, haptic, and proprioceptive feedback (Pressing, 1988). Finely tuned motor and perceptual programs underlie pitch relations; note placement; musical dynamics, articulation, and form; as well as timbre, musical texture, and musical (emotional) expression. Motor elements, too, underlie tonal imagery. For instance, Pike (1974) maintains that musical imagery is kinesthetically based and creates complimentary feeling states in the individual that include various cognitive and affective expectations, satisfactions or disappointments, experiences of tension and release, and so on. Recent evidence indicates that the supplementary motor area (SMA) may be the cerebral substrate for musical imagery indicating the close connection between music and movement (Halpern, 2001).

The musician and neuropsychologist Manfred Clynes proposed, moreover, that movement and musical sounds convey equivalent gestic or 'sentic' form (Clynes, 1989). That is, underlying neural states contribute to gestural and postural expression and modulate ongoing musical expression such as phases of acceleration and deceleration and musical length and duration. To be sure, the American composer, Aaron Copland, contended that rhythm gave shape to the emotions (Copland, 1952) and Igor Stravinsky, the Russian composer, suggested that music was essentially a succession of motor impulses that converged towards a state of musical repose (Stravinsky, 1942). Moreover, the musician's intimate bodily relation with a musical instrument is instructive here.

MUSICAL EXPRESSIVITY AND INSTRUMENTALITY

There is a powerful interdependence between the body and its engagement with a particular musical instrument in musical expression (Sloboda, 1996). In the act of playing an instrument, expressive devices affect the microstructure of timing, timbre, loudness, and other musical elements by foregrounding musical structure. Expressive devices such as musical shape and location of rhythmic, harmonic, and melodic-thematic material are stored in the musical structure by analogy to nonmusical domains, that is, by way of cross-domain analogies between music and the body (Sloboda, 1996). They are nonmusical domains because they are external to the music and music structure itself (see above). These nonmusical domains include bodily and physical motion; gesture, posture, and facial expression; and speech and vocal prosody.

For instance, structural parallels occur in musical compositions when the organization of melody, rhythm or musical form in one musical parameter is analogous to another. For example, in Stravinsky's *L'Histoire du soldat*, the formal and rhythmic organization of contrasting musical sections at the beginning of 'The Soldier's March' parallels the organization of pitch relations and each element of these musical correspondences arises from nonmusical domains (see Kielian-Gilbert, 1990 for a detailed analysis). In jazz improvisation, too, musicians bootstrap expressive characteristics by analogy to bodily and physical motion (Seitz, 2001). These elemental analogical relations are constituted by perceptual (i.e. analogies to physical qualities), enactive (i.e. analogies to physical movement), physiognomic (i.e. analogies to emotions) and synesthetic (i.e. analogies to the senses) experiences that the improviser draws in the service of musical expression (Seitz, 1997, under review). These individual expressive abilities, however, are shaped by culture and socialization.

CULTURE AND MUSICAL EXPRESSION

Expressive abilities differ according to individual levels of expertise and may also differ among individuals because of gender and idiosyncratic cultural preferences in coding the expressive identity and musical location of sonic qualities (Sloboda, 1996). Intended expressive outcomes are cognitively monitored by the vocalist or instrumentalist and, as a result, are continually modified and updated. For instance, in scored music, expressive contour is fitted to preexisting musical sequences, whereas in improvised music, notes are chosen *in situ* along with their expressive contour. Expressive body movements communicate emotion by way of the application of well-developed emotional reactivity to prevailing aural customs. Conversely, technically competent performances by computers of the classical repertoire are typically 'dull and lifeless' (Sloboda and Davidson, 1996: 173). The use of body in jazz improvisation wonderfully illustrates this point.

David Sudnow (1978) has captured the growth and development of the improvising jazz musician: the beginning left-hand control of chordal harmony followed by coordinated ballistic movements of the arm, hand, and fingers combines these chords into meaningful sequences. Following these initial attempts, hand and coordinated ballistic movements are concatenated so as to bind melodies to their accompanying chordal harmony. In a subsequent step, the improvising jazz musician selects and anticipates individual notes thereby coordinating melody with bodily rhythm. That is, 'Get the time into the fingers, hands, shoulders, everywhere' (Sudnow, 1978: 103). In a final step, the jazz improviser becomes more relaxed and unhurried, recognizing that almost any note can be used to achieve a musical effect (Sloboda, 1985; Sudnow, 1978). Yet, importantly, audience members are affected by the expressive qualities of the musician's body when viewed from afar.

MUSIC AND VISUAL EXPRESSION

Visual expression by way of the musician's body conveys expressive effect to the audience. Indeed, the presence or absence of a communicative context (i.e. live versus recorded performance) can redound to the musician's expressive quality (Davidson, 1993, 1995). For instance, bodily movement by instrumentalists and vocalists adds a layer of musical dimension that permits multiple interpretative experiences for the listener (Davidson, 2001a, 2001b). Expressive gesture in performance is conveyed, *inter alia*, by head nods and shakes, upper body wiggles, and forward and backward surges of the whole body (Clarke and Davidson, 1998). These movements can be classified using the criteria of nonverbal communication: 'Regulators' (i.e. movements that maintain and regulate audience reactions), 'adaptors' (i.e. movements that serve to establish intimacy), 'illustrators' (i.e. movements that exemplify the literal content of the music or text), 'display rules' (movements that amplify, de-amplify or blend culturally based emotional responses), and 'emblems' (i.e. movements that have a direct spoken analogy) (Ekman and Friesen, 1969). To be sure, the Englishman, John Curwen, in the 19th century, introduced the tonic sol-fa system in order to teach musical pitch and rhythm to the musically uneducated in which movement (i.e. hand signs) was intimately yoked to vocalization (i.e. intoned syllables) (Rainbow, 2001).

Conducting, too, so prominent in the western classical tradition, is used to considerable expressive effect with regard to both those being conducted as well as those occupied in listening to a performance. In conducting, the right hand beats out the time often with the aid of a baton, which serves to clarify and magnify the gestures of the hand. The left hand cues the entries and exits of individual musicians, suggests musical line and dynamics, articulates the ebb and flow of musical volume and duration, as well as shaping the overall contour of the music (Spitzer et al., 2001). Thus, gestures of the hands and body convey musical dynamics, integrating one's bodily experience of music with one's thoughts and emotions.

Integrating the musical body and musical mind

The role of the body in musical thought and expression is central to the essence and effectiveness of the Dalcroze pedagogical method. We reviewed multiple lines of evidence from the study of music, the body, and the brain that point to the centrality of movement and the body in musical expression. Emile Jaques-Dalcroze presaged many of these views in the early 20th-century in both his methods of teaching and his theoretical approach to music. Musical dynamics and tempo, melodic 'gestures,' musical correction and feedback, instrumentality, audience effects, and the consequences of socialization and culture on music acquisition deeply implicate the body in musical expression.

Thought and expression, as we have argued in regard to dance and other artistic and non-artistic domains, is fundamentally an embodied activity (Seitz, 2000, 2001, 2002, under review). A number of observers have suggested that movement is predominant in all forms of human intellective activity (e.g. Rudolf Laban), that thinking is a 'skilled' behavior (e.g. Fredrick Bartlett), that dance as well as many aspects of music originate in a distinct bodily kinesthetic 'intelligence' (e.g. Howard Gardner), that the physical body is essential to quantitative understanding including comprehension of meter and rhythm (e.g. George Lakoff), that gesture and speech are inextricably intertwined (e.g. Michael Corballis), and that mental practice alone improves physical dexterity – not only in sports – but in all artistic and musical activities (Seitz, 2000, 2001). Certainly, pedagogical practices such as the Dalcroze, Kodaly, Orff, and Suzuki methods capitalize on the fact that the basic elements of music (i.e. rhythm, musical dynamics, pitch and melody, and sonority) can be most effectively taught through physical motion using such devices as rhythm, rhythmic solfège, and improvisation (Jaques-Dalcroze, 1930).

In music, all of its major elements – melody, melodic contour, rhythm and phrasing, cadence points, accents, microvariations in timing and dynamics, and harmony, among others – are informed by, and draw on, bodily processes. That is why Dalcroze's seminal understanding of the role of the body and movement in music and musical pedagogy is so important to musicians, musical educators, and psychologists today.

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