

The playing adult steps sideward into another reality, the playing child advances forward to new stages of mastery. I propose the theory that the child's play is the infantile form of the human ability to deal with experience by creating model situations and to master reality by experiment and planning. It is in certain phases of his work that the adult projects past experiences into dimensions which seem manageable. In the laboratory, on the stage, and on the drawing board, he relives the past and thus relives leftover affects; in reconstructing the model situation, he redeems his failures and strengthens his hopes. He anticipates the future from the point of view of a corrected and shared past.

No thinker can do more and no playing child less. As William Blake puts it: "The child's toys and the old man's reasons are the fruits of the two seasons."

—Erik Erikson, *Childhood and Society*\*

## MY CELLO

Tod Machover



\*Source notes for all epigraphs begin on p. 364.

**My mother tells me that** I started music training when I was two. She was my teacher, helping me make music at the piano and find music all over the house. Each week, we set out on expeditions of her devising, discovering household objects that made interesting sounds, that could in turn be combined to create new textures, emotions, and narratives. Then followed the task of making a "picture" of our new composition so that we could recreate it the following week. I learned to invent music from these first principles: sound, structure, score.

As I began to listen to orchestral music (I remember Leonard Bernstein's *Young People's Concerts*), I yearned for an instrument that had the feel of those natural, malleable objects around the house. I wanted my instrument to be able to sing, expressing as much between the notes as on them. The piano, with its special precisions, simply didn't appeal. By the time I was eight, I had chosen the cello, embracing it before learning the details.

Cellos, I found, are the perfect size. Violins are too petite, fingers stepping on fingers; the double bass is a struggle, hands stretched and muscles flexed. But the cello is the size of a human body, reaching the ground as its scroll grazes the top of the head of the seated musician. The cello range is identical to the human voice—that is, the male and female voice combined. The lowest cello note is at the bottom range of a *basso profundo*, and although the cello can actually scream higher than any singer, it has a more normal top range that competes with a *diva coloratura*.

Seated at the cello, my body assumes a calm, natural position—my shoulders relaxed, letting gravity help bow pressure. Yet I can feel the instrument vibrate from head to foot as I draw my bow across its strings, a throb-

bing through my chest, a buzzing through my legs and feet, a tingling to my fingertips. Sensitive to an extraordinary range of touch, cellos respond to the almost motionless gliding of a gentle *legato* as well as to the human crunch of a raspy *sforzato*. The cello is big enough to put up a fight, yet is the largest instrument that you can comfortably carry, or not so comfortably, as I learned when I took it trekking in Nepal and on the New York subway in rush hour.

Unlike the violin that can screech in the hands of beginners, the cello always has a mellow sound and seldom is truly ugly, yet there is an infinite gradation of tone quality and therefore infinite scope for improvement. Because the physical position one takes with the cello is so natural, it is easier to play than the violin and harder than the bass. Both hands and arms are given independence, working in synchrony (something that young players find hard to master) while doing completely different things. The cello is just hard enough, and for me, this gives cellos the right degree of difficulty. And it makes playing cello the perfect companion to thinking. Like walking, playing the cello engages just enough of my mind to suppress internal chatter, leaving me free to imagine.

A similar balance of not too hard/not too easy applies to intonation on the cello, where playing in tune is easier than on the violin (its greater size, quite simply, leaves you more room to find the right note) but still subject to the subtlest inflections. The physicality of the cello is itself slightly irregular, with strings of different thicknesses that vibrate with different degrees of effort, a bridge and fingerboard sloping unevenly under the four strings, and decreased spacing between notes as one goes higher on each string. This means that each



note feels different to play. The piano is designed for potential perfection that seems to challenge players to achieve machine-like accuracy. The imprecisions of the Japanese *shakuhachi* are designed so that the player is never certain of exactly how the instrument will respond. The cello stands between these two, pleasantly controllable, yet with pure perfection always slightly out of reach. Very early I realized that lifetimes had been dedicated to exploring and mastering the cello and that one lifetime could never suffice.

In my own case, under my mother's tutelage, I began with the classics and stayed with them—that is, until the appearance of *Sgt. Pepper* when I was thirteen. That album marked my first musical struggle with my mother, who refused to understand how I could like the Beatles. I moved closer to my father, a pioneer in the field of computer graphics and more comfortable with popular culture. I tried to turn my cello into an instrument for composing and performing rock music: I threw away the bow, turned the instrument sideways and propped it on my lap like a (very big, fat) guitar, clamped headphones around its belly, plugged it into a guitar amp and jammed. I tried the same thing with an electric bass guitar, but it lacked the sonic richness, thick-stringed resistance, wide range, and lightning action of my cello. Soon I was improvising and composing, experimenting with tape recorders, multi-track layering, all with this electrified cello.

I managed to cultivate my classical and rock experiences with the cello separately, safely avoiding their collision. That changed when I was sixteen and began to study with a new cello teacher, Richard (Richie) Bock, who played classical, jazz, and rock. Richie destroyed my complacency about music making, beginning with my assumptions about technique. Instead of focusing on the left hand that played notes and mastered intonation, vibrato, and glissandi, Richie put the right hand and the bow in the foreground. The most important, he

said, was "the part nobody thinks about, the part that comes easy. The bow is where expression comes from, like breathing for a singer." And furthermore, he said *my* bowing was lousy, so bad in fact that I had to start from scratch.

For months, Richie had me play long-drawn bows over open strings, with no notes played by the left hand at all. I learned to see nuance in cello playing: the constant adjustment of pressure, speed, and angle depending on thickness of string and section of bow; the sweet spot of resonance when the instrument is allowed to vibrate freely; the great beauty that can be found in a simple, constant sound played fully, evenly, purely. By going back to basics, I discovered how to listen carefully and critically, to sense the slightest movement or tension in finger, hand, arm, and back. I learned to meditate in sound. I learned how to practice for real.

By the time I was ready to begin conservatory at Juilliard, I knew I was more interested in composition than performance. Free from thinking of the cello as a profession, I felt I could explore repertoire and my own musical ideas without outside approval. My new teacher, Mosa Havivi, made me rethink what it means to project a musical experience outside of oneself, to hear and feel one's playing as others do. Mosa taught me that I could—and had to—make my own decisions about interpretation and meaning.

As a child musician, the physical intensity of cello playing (a whole body experience, not just a finger activity) had led me to a dissociation of analysis and expression. I performed by ear and feel. Theory was pure abstraction. Now I began to make the conscious connection between thought and touch that had eluded me.

Indeed, there is much in musical education that encourages the dissociation of thought and touch. At Juilliard, Beethoven, a deaf composer, was held up as the ideal composer. Beethoven, the mythology went, was so great that he imagined all his music in his inner ear,



not only being unable to hear it in the external world but also shunning the mundane reality of physical vibrations that would dilute the Platonic ideal of his imagined sounds. What this meant at Juilliard was that no composer would be caught dead in a practice room, or plinking out his or her music on a piano, lest he or she be accused of inadequate ear training, of a sterile musical imagination.

But for me this was impossible: my feeling for composition called upon my intimate relationship with the cello. My musical training has separated sound and touch, thought and feeling, concrete and abstract. My relationship with the cello helped me to bring these things together. While at Juilliard I not only sought ways to hear and touch my music as I was composing it but also I began to imagine instruments that could be adapted to the musical requirements of each new project. So I started working with digital computers, learning Fortran (not a popular thing to do at that time, in that environment) in an attempt to model the sounds I was hearing in my head. I also took a four-month trip to India with my cello, traveling extensively, meeting and listening to some remarkable Indian musicians and playing solo Bach suites for them. I began to appreciate the relativity of the cello and of Western classical music; Bach sounded strange to many people I met, and by the time I came home, the cello sounded monochromatic in pitch and timbre to me. I used my new knowledge of computers to produce sounds and textures that went beyond the cello. And I translated my experience with computers and electronics into new playing techniques and compositional experiments for the cello.

After Juilliard, I went to Paris to work at Pierre Boulez's new Institut de Recherche et Coordination Acoustique/Musique (IRCAM). I arrived at a moment when some of the world's first digital synthesizers were being developed. Here, I found my calling—the design of performance and composition systems that could marry

the precision of programming with the spontaneity of human gesture. When I came to the MIT Media Lab in 1985, I worked with colleagues to invent instruments (I called them Hyperinstruments) that could enhance virtuoso performance as well as new systems (such as *The Brain Opera*) that could introduce music making to the general public. I designed toys to introduce children to music and thought of my mother and our explorations of sound in our home. In the mix of new instruments and musical forms—rhythmic Beatbugs, squeeze Music Shapers, and the sinuous Melody Easel—my inspiration has always remained the cello.

Coming full circle to music and childhood brings me to my own two daughters—Hana, now 12, and Noa, now 8. They are studying music—and although they do like playing Beatbugs and composing with Hyperscore, musical technologies of my invention, Hana is learning violin and Noa piano. I practice with each of them every day, trying to keep what was good about my Mom's coaching. The violin is just different enough from the cello that it keeps me on my toes. How do I teach a slide, a note perfectly in tune, a bow beautifully changed, a phrase delicately shaped, a musical story deeply felt and meaningfully conveyed? How do I share my love of music with my daughters when there is so much tough technique to learn, so much frustration to overcome? How do I reconcile the desire to build computational music toys that convey immediately the excitement and joy of music making with the need for practice and discipline and experience that can only mature over a lifetime?

My daughters' fits and starts with music have helped me to return to the cello with a fresh perspective. These days I do not perform on it often, but I do use the cello to try out new ideas. When a period of musical work is ending and I feel a new one beginning, I like to let my ideas percolate in my imagination, but I also like to touch them, and the cello is my tool for that. I try out new sounds that stimulate my physical memory: when

I hear melodies or intervals, I can feel what my left hand fingers would do to create them. When I am imagining—in the quiet of my study—a full orchestral sonority, my muscles reproduce the gesture as if I were playing it on the cello.

And still, perhaps above all, I play the cello to concentrate, to meditate, to relax. It remains for me the perfect gauge of complexity, of how much an individual human being can shape or master, follow or comprehend. Playing the cello remains the activity that I do best and that I do only for myself. It is the object that is closest to me that I don't share with others, the intermediary I use to reconnect to the forces and feelings that drew me to music in the first place.

**Tod Machover**, composer, inventor and cellist, is Professor of Music and Media at the MIT Media Lab.

