

Brain, behavior, biology, and music: Some research findings and their implications for educational policy

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7343 words

1 January 1998

Arts Education Policy Review

28

Vol. 99, No. 3

English

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As an invited contributor to Arts Education Policy Review, I am pleased to have this opportunity to address a readership directly concerned with educational policy. But I have the mark of the interloper. As a university instructor for more than thirty years, I have some knowledge of education, but it does not extend to preschool and K-12. Nor have I expertise as a practitioner in the arts or as a teacher in arts education. My background is in experimental psychology and the physiology of the nervous system. More specifically, my own laboratory is concerned with the questions of how learning takes place in the brain and how the brain makes memories. The fact that I study mainly the auditory cortex (the highest level of the auditory system) brought me into contact with some of the research literature on music, and I have done some research on the neurophysiology of music.

Several years ago, casual conversations with a colleague led us to conclude that research in music was exceedingly scattered, in terms of both involved disciplines and forums of publication: Music research is addressed by music educators, experimental psychologists, cognitive scientists, evolutionary and comparative biologists, neuroscientists, researchers in several fields of medicine (e.g., pediatrics, neurology, rehabilitation, psychiatry, geriatrics), music therapists, sociologists, anthropologists, and so on. There was poor interdisciplinary communication, and research findings were not being made available in any regular manner to those for whom such information could inform practical considerations, such as policymakers in education and government and, of course, the general public.

The ultimate outcome of these discussions was the establishment of MuSICA, the Music and Science Information Computer Archive (originally named the Music and Brain Information Center). MuSICA is supported by the music industry. It compiles a broad database of citations and abstracts of music research and, twice a year, publishes a newsletter, MuSICA Research Notes (MRN), the contents of which are independent of the source of funding. The interested reader can access the database and read MRN without cost or request hard-copy back issues (via Telnet at mbic@mila.ps.uci.edu or via the Web at <http://www.music.uci.edu>). I am the director of MuSICA and the author of articles in MRN that summarize selected findings in music and behavior. Many of the findings summarized here are reviewed in greater detail in MRN.

As an interloper in arts education policy, I will try to avoid the weaknesses of the outsider while attempting to provide a perspective that broadens the standard domain of concern in the policy of arts education. First, I would like to call attention to some of the relevant findings in music/brain/behavior research, focusing on biological aspects and, more briefly, on music behavior in children and the effects of music education on cognitive development. (I will not be concerned with "intrinsic music research," including the nature of music itself and music pedagogy.) Second, I will discuss three "foundational" problems in arts research and failure to relate research to practice. Finally, I will suggest some actions that should be initiated to enable arts/behavior research to contribute directly both to our understanding of the role of the arts in life and to the application of research findings to educational practice. The goal is to change culture, so that the arts transcend their subordinate status to achieve their appropriate place in education. Necessarily, my perspective will be limited to music, but it is not intended to exclude the other arts.

Brain, Behavior, Biology, and Music

Does music have deep biological roots? The standard treatment of music as the product of culture ignores that possibility. The cultural view seems reasonable because, after all, music is sought as entertainment, and although entertainment is nice, it certainly is not necessary for life. Although an occasional musical genius is born, it is too rare an event to support the conclusion that music in most people has much to do with biological causes.

That commonsense conclusion about music is unconvincing for at least two reasons. First, it confuses cause and effect. That music often has the effect of entertaining does not mean that its cause(s) are only cultural. After all, dining in a restaurant is entertaining, not essential, but that does not mean that the need for food is cultural rather than biological. Second, it assumes that a biological basis for music implies that the full-blown skills of appreciation, composition, and performance must be manifest, as apparently for a Mozart. That view, however, depends on an overly simplistic, false unitary conception of music. All children have the capabilities of appreciating music and of expressing themselves musically at a very early age. Given the correct supportive environment, they could develop those musical abilities to a greater degree than is appreciated, but whether that eventuates does not speak to the issue of biological origins.

Although common sense does not rule out a biological basis for music, is there any evidence that supports some role for biology? A broad scan of the scientific literature suggests a positive answer. I will address four topics, giving a detailed summary of results for some in order to provide a deeper appreciation of the findings: (a) universality, (b) culturally independent competencies of infants, (c) music in animal behavior, and (d) brain substrates.

Universality of Music

Behaviors that are closely linked to biology should be universal, that is they should occur across the world, across different cultures. Music satisfies that criterion. The fields of anthropology and ethnomusicology attest to the extremely widespread presence and use of music. Although the uses of music may vary across current and past cultures, music itself is omnipresent. The standard of universality, however, is a necessary rather than a sufficient criterion. That is, the hypothesis that music has a strong biological foundation requires universality, so that a failure to find that situation would be fatal to the hypothesis. The idea that music is universal, however, is also compatible with some sort of cultural commonality.

Infant Competencies

Biologically based behaviors might be revealed early in life before cultural factors achieve a strong influence. Research has shown that preschool children spontaneously exhibit music behaviors, using music in their play and communication. Moreover, recent studies have revealed musical capabilities in infants, neonates, and perhaps even in the prenatal stage. It will be worthwhile to document the findings in some detail because they deal directly with the issue of biological origins of music.

Musical abilities can be determined in the pre-verbal child by careful observation of behavior by a trained experimenter. One effective method is to have an infant sit on its mother's lap, looking ahead at a puppet or similar distractor. Loudspeakers are located to the right and left and next to each is a transparent plastic box which is ordinarily dark. When the infant turns its head toward a loudspeaker, it can be rewarded by illumination of the adjacent box within which an animated toy is activated. A background musical stimulus (as simple as a single note, or more complicated, such as a melody) is played repeatedly from one loudspeaker. At random times, the experimenter pushes a hidden button that instructs a computer to either continue the same stimulus or present a slightly different one. If the infant notices the change from background to the new stimulus, it will turn toward the speaker and be rewarded with the sight of the animated toy. Such studies have shown that infants exhibit musical competencies that are in many ways adult-like. To start, they discriminate differences between similar notes; in fact their frequency acuity is greater than a semitone, the smallest interval used in Western musical compositions.¹

What about melody? Adults perceive melody not by remembering the exact pitches but rather by remembering the relationships between notes. Melodies are characterized by the exact intervals between pitches, but even here adults also pay attention to the pattern of increases and decreases of pitch, the so-called contour of a melody. At eight to eleven months of age, infants do perceive and remember melodic contour. Thus, they use the adultlike listening strategy of attending to global pitch relationships rather than the detailed notes themselves.²

Rhythm and tempo are basic building blocks of music. Adults organize sound sequences by grouping them into discrete phrases. Grouping is known to be a way to enhance auditory memory, as when we try to remember lengthy telephone numbers. Infants, like adults, also mentally segment sequences of sound into "chunks."³ Adults also recognize the same melody independently of how rapidly or slowly it is played. Seven-to-- nine-month-old infants also recognize melodies independently of tempo, showing the same listening strategy as adults. Adults easily detect changes in rhythm; so do infants.⁴

I conclude this section with the topic of musical consonance. When Pythagoras plucked the sections of a taut string that was divided into two unequal parts, he discovered that their relative lengths determined the degree of pleasantness of the resulting two-tone chord. When the two parts were related by simple ratios, such as 2:1 and 3:2, they produced tones that sounded as if they "belonged" together, that is, were "consonant." Conversely, dividing a vibrating string into two parts related by a complex ratio (e.g., 45:32) produced two tones that were regarded as "dissonant."

The biological basis of consonance has been tested in adults, children, and finally, infants, using the following logic. If there is a biological bias for consonant tone pairs (i.e., if they are more distinctive than dissonant pairs), then it should be easier to notice changes from consonant pairs than changes from dissonant tone pairs. In fact, that has been found. Both adults and six-year-old children better discriminate changes from tones having simple ratios to tones with complex ratios than vice versa, supporting the biological hypothesis.⁵ To better reduce putative cultural biases, similar experiments were performed with six-to-nine-- month-old infants. Again, the findings were the same; infants processed consonant intervals better than dissonant intervals.⁶ Moreover, this bias for consonance occurred both for harmonic intervals (two tones presented simultaneously) and for melodic intervals (two tones presented in sequence). The ubiquity of the consonance effect underscores its importance. Thus, consonance and dissonance are not simply determined by culture.

In toto, the findings reveal that infants have surprising capabilities in the way that they perceive and attend to musical stimuli. The "musical infant" not only exists, but it is the normal human infant.

Music in Non-Human Animals: Some Evolutionary Considerations

No consideration of the biological roots of human music should ignore the research literature on animals. If music has a strong biological component, then fundamental building blocks of music might be present in animals, and indeed that seems to be the case. Although space limitations preclude a detailed accounting, I can give two examples.

First, the brains of animals abstract the psychological property of "pitch" by performing a harmonic analysis on the raw sound frequency information received by the ear. This has been found in birds, cats, and monkeys.⁷ Second, animal vocalizations termed "singing" have sufficient complexity to be considered at least "proto-music." For example, bird-song is intricate in content and pattern.⁸ And interestingly, bird-song is believed by many scientists to provide the most adequate model for studying the learning processes of human language. Paralleling the case of human language, songbirds also must

hear vocalizations to learn to sing and do so within a critical period of development to attain competency. Additionally, bird-song is used to communicate quite specific information to other birds of the same species. Further, different discrete groups of brain cells in songbirds are responsible for different aspects of learning to sing and producing song, as appears to be the case in humans.⁹ More close to humans, the vocalizations of our primate cousin the gibbon are of sufficient complexity to warrant the term "song" without any great stretch of either the imagination or the language. The songs of male gibbons are organized "within a framework of rules that define regular patterns in the placement and order of note types." When the meaning of such songs was determined behaviorally, it was discovered that the "proper sequential organization of notes is required to encode the meaning of the song."¹⁰

Neither example is intended to suggest that human song evolved directly from either songbirds or gibbons; neither of these taxa comprises our direct ancestors. Rather, such findings suggest that human singing is not unique among species. Some view biological song as a stage in the evolution of language. Thus, Bruce Richman, writing in the journal *Contemporary Anthropology*, notes that many researchers categorize human vocalization into two opposed systems, expressive sounds (e.g., sighing, crying, laughing) and speech. Richman believes that a third type of vocalization lies between them-singing. "Singing and speech seem very different; . . . singing is more expressive of emotions than speech." He further holds that the social functions of singing provide something that speaking does not do. "Group singing gives . . . a strong, direct feeling of social cohesion and solidarity." Finally, he proposes that singing "served as an evolutionary transitional state between primate-like vocalizations and speech."¹¹

Brain Substrates of Music

We arrive finally at the source of all human experiences and actions, the brain. Here, common sense is definitely misleading. Because we all have brains, we seem to assume that we can introspect our ways into understanding how they work. Our own private experience of the world is seamless, a smooth and continuous flow of sensory impressions and perceptions of objects and events, sights, and sounds. Because our experience is so immediate, clear, and effortless, we tend to take it for granted. When we see an object, such as a red ball, we do not experience the shape of the ball separately from its color. And when we hear a violin, we do not perceive its pitch separately from its timbre. The notes in a chord are not heard as several individuals but rather in a more holistic fashion. Although it is possible to learn to pay more attention to one feature of a composition than another, that process does not fractionate the sound into its all of its separate constituents-the building blocks of music such as pitch, contour, interval, harmony, melody, timbre (tone color), and rhythm.

Research suggests that brains are specialized and that each of music's building blocks is processed by a different part of the brain. Our unified experience may be based on the simultaneous activation, by different stimulus, of dimensions of various functional modules in our brains, "informed" by prior learning and more-or-less automatic readout from previously stored information. As the simultaneous activation of these many special-purpose processors would constitute the holistic experience, there is no little neural "person" in our brains who is listening to the music and then telling us what it is.

An increasing amount of research supports the theory that the brain has specialized building blocks used in music. To begin with, although the ear receives sound waves that can be described as physical stimuli, the brain appears to automatically interpret such stimuli in terms of psychology. Thus, the highest level of the human auditory system, the auditory cortex, is organized not to process raw sound frequencies but rather to process a psychological abstraction that is a foundational musical element-pitch.¹²

Additionally, there are individual brain cells that process melodic contour, the pattern of increasing and decreasing notes in music.¹³ Cells have been found in the auditory cortex that seem likely to process specific harmonic relationships, such as the simultaneous presentation of the second and third harmonics of a note.¹⁴ Temporal (including rhythmic) aspects of sound streams also seem to be handled by certain cells in particular parts of the auditory cortex.¹⁵

Findings from humans who have suffered damage to the auditory cortex by stroke or by surgery to correct intractable epilepsy are particularly fascinating. For example, damage to the right hemisphere selectively impairs the ability to process timbre.¹⁶ Also, the processing of melody and rhythm can be separated by specific brain lesions. Some patients show impaired discrimination of melodies while they have normal discrimination of rhythms, and vice versa for lesions in different regions.¹⁷ And even different aspects of the processing of temporal information seem to be handled by different parts of the auditory cortex-rhythm by the left hemisphere and beat (meter) by the right.¹⁸

Brain scans in normal people also support the hypothesis that music has a deep biological basis. In a recent study, normal subjects were tested in two passive listening conditions, noise bursts or music matched for sound frequencies, and two active judgment conditions, comparing the pitch of the first two notes of melodies or the first and last notes of melodies.¹⁹ Listening to melodies produced an activation of the right temporal (auditory) hemisphere relative to the left ("language") hemisphere. Comparing tones, which also involved short-term memory, also showed a preferential activation of the right auditory cortical system, plus some other areas of the right hemisphere. These findings indicate that there are specialized neural substrates in the auditory cortex of the right hemisphere that process melodies versus other non-melodic sounds.

Music Behavior of Infants and Children

The music behavior of infants and children is more widely known than the music capacities of infants and the neurobiological findings reviewed above; hence, I will deal with them only briefly here.

First, infants and preschool children imitate musical phrases and songs. Beyond that, they compose and (usually simultaneously) perform original musical phrases. Children ultimately compose and perform their own fairly complex songs.²⁰ During the first year of life, song babbling is evident,²¹ and recognizable spontaneous singing can be observed as

early as six months of age.²² Ries reported that spontaneous singing at seven months of age was quite distinctive.²³ Researchers have identified a developmental sequence. Early singing consists largely of melodic-rhythmic patterns of contour (patterns of higher and lower notes), without accuracy of pitch. Dowling reports that at approximately two years of age, songs usually consist of the repetition of a single brief melodic phrase (e.g., "Hoppy-hoppy run 'round the road"). Complexity increases with age with the addition of more phrases. Recognition of the correct pitch may develop as early as the third year, although singing the correct pitch is usually not present for several years.²⁴

Welch has provided a good review of the development of child song, salient features of which are quoted here.²⁵ After babbling, in which infants often play with "glissandi and groups of musical pitches and phrases in a repetitive fashion.... words and fragments of song text . . . become the focus of attention, followed by certain rhythmic features and, subsequently, the pitch components." The basic learning hierarchy appears to be "Words - Rhythm - Pitch." This develops further: "Pitch Contour - Individual Phrase Stability -- Overall Key Stability." "By the age of five to six years, young children's singing may have acquired many of the features of the significant adult models," writes Welch.

That key features of adult song are present so early does not imply that songs of young childhood are miniature adult songs. Hollace Veldhuis studied the spontaneous singing of four-year-olds in a free-choice activity period in preschool. She reported that the songs had very clear organizational patterns, unlike adult patterns; they generally had a restricted range of pitch intervals but with distinct brief melodies. Veldhuis further explored the situations in which singing occurred. She found that the children's singing was stimulated by objects, such as musical instruments, and by environmental sounds; she also found that singing was often spread through "vocal contagion." Veldhuis noted that singing had clear social functions (e.g., communication and cooperation) for four-year-olds.²⁶ Other detailed observations of naturalistic behavior have documented the spontaneity of singing and other music making in young children. For example, Miller studied three- to-five-year-olds in a preschool setting and found that they freely engage in exploring and manipulating melodic and non-melodic instruments, create songs, and imitate rhythms by bodily movements. The children chant and sing to recorded music, without specific instruction or encouragement.²⁷

I should note that, so often ignored in the emphasis upon language and speech, musical behavior also appears early in life, is spontaneous rather than merely imitative, and is integrated into child play without adult supervision or demands. In contrast to language behavior, music behavior is not specifically reinforced and rewarded by parents and caregivers. What is thus lost in music can be recovered but usually is not.

Extrinsic Effects of Music on Cognitive Development

I conclude this selective overview of music research with a briefer consideration of some of the effects of music on cognitive development and behavior. I am well aware that many in the arts hold that the rationale for including the arts in education should be based only on values intrinsic to the arts. In contrast, there are those who argue that if music and the other arts also promote cognitive development, such findings should also be used to justify arts education. I am among that group. I agree, however, that it is a national disgrace that one should have to justify arts as an integral component of education.

Overall, there is insufficient research on the interactions between arts education and other subjects. But even the sporadically produced findings to date support the view that music education has collateral benefits.

I begin with a study of reading,²⁸ in which the effects of music training were assessed in first grade children. The experimental group received Kodaly training, which uses folk songs and emphasizes melodic and rhythmic elements. The music group exhibited significantly higher reading scores than did a matched non-music control group. Incidentally, the benefits for the music group were not due to better teaching of reading, because students who had the same teacher before, during, and after music training showed greatly improved reading performance. Moreover, continued music training was beneficial; after an additional year of Kodaly training, the experimental group was still superior to the control group. The improvement appears to be mediated by the facilitation of music on the phonemic ("sounding out") stage of learning to read.²⁹ In a study of creativity, Mohanty and Hejmadi³⁰ investigated the effects of various types of training of four- and five-year-olds on learning the names of their body parts and on creativity as assessed by the Torrance Test of Creative Thinking. There were four matched groups: non-training control, verbal instruction in the names and uses of body parts, verbal instructions plus acting out movements, and the music/ dance group in which instructions were given by song and acting out movements was done in the form of a dance. The music/dance group showed the greatest improvement in both learning about body parts and tests of creativity.

Musical training affects the abstract cognitive skill of mentally rotating objects, a means of assessing spatial abilities.³¹ Preschool children received keyboard lessons, and a matched control group received computer lessons. All children were tested using subtests of a standard intelligence test, one of which was a spatial task. The music group was superior to the control group on the test of spatial abilities.

Finally, significant improvements have been obtained in a rare (perhaps unique) study on the effects of a combined music and visual arts curriculum. First-graders improved in math whether they started out with below-average, average, or above-average kindergarten scores. The findings not only reveal the beneficial effects of arts education but also show that an arts curriculum has effects that generalize across all achievement levels, so the arts can be both effective in remediation and in advancing average or better students above grade level. Additionally, the effects extended to the second grade, and the math learning advantage was positively correlated with the number of years of education with the arts curriculum.³²

Some Potential Neurobiological Benefits

In closing this review of research, I want to point out some potential neurobiological benefits of learning and performing

music. Similar benefits may accrue in other arts activities. Let us begin with an emerging neurobiological fact. The functional connections between brain cells (neurons) are their synapses. Active synapses are strengthened; inactive synapses are weakened; indeed, activity can grow new synapses. These processes are best understood during development, but they continue throughout life. Next, consider the major components of the human brain/mind:

- * sensory and perceptual (e.g., auditory, visual, tactile, kinesthetic)
- * cognitive (e.g., symbolic, linguistic, reading)
- * planning movements
- * motor (e.g., fine muscle and gross muscle coordination)
- * feedback and evaluation of behaviors
- * motivational/hedonic (e.g., pleasure)
- * learning
- * memory

Third, and I think the major point here, vocal and instrumental performance engages all of these components. I cannot discuss that point in detail here, but I hope that readers will go through the list and think about everything that one does while playing from a score initially, and from memory later. It would seem that music performance is a pretty complete mind/brain workout.

Summary of Research Findings

The research findings reviewed here can be summarized quite briefly: Music has deep biological and neurological roots, such that the human infant and young child has a predisposition to process, respond to, and finally create musical ideas and music itself. To that, I think one can reasonably add: Music has benefits to intellectual development that transcend music itself. Finally, the learning and performing of music are very likely to be of direct neurobiological benefit.

Music seems to be more a biological imperative than a cultural "add-on." Therefore, its importance in human life is considerably greater than is commonly thought. As research in music expands, we can expect the findings to greatly enlarge our understanding of the roles of music in human development and behavior, and perhaps to provide new insights into our nature. One could argue that research findings are insufficiently justified to find ultimate expression in curricular changes and educational practice. On the other hand, what is the justification for initially being chronically unaware of much arts/brain/ behavior research and later ignoring it anyway? At the least, several issues demand serious consideration, in a balanced forum.

Foundational Problems in Arts Research and Practice

In sketching a route for bringing arts/ brain/behavior research to educational policy, I will address three topics: (a) disciplinary parochialism, (b) the unsatisfactory status of music/behavior research, (c) the failure to capitalize on biological predispositions.

Disciplinary Parochialism

Two disciplines are most directly concerned with arts and behavior-education and experimental psychology/ cognitive sciences. That is not to say that arts and music educators cannot or do not produce research of equal quality; but for the sake of exposition, I will keep the dichotomy while recognizing that shades of gray exist. Let us call the first group the Es and the second group the Xs. By interest, education, and practice, the bulk of the Es and Xs differ. It seems fairly obvious that the Es and the Xs seldom interact or appear to read each other's literature. Efforts, such as the MuSICA database may provide a small link but cannot by themselves really build substantive enduring bridges.

My assumption is that arts and music education are too important, too complex, and too multidisciplinary to have the Es and the Xs continue on their separate ways. Of course, there are many reasons for this state of affairs. But are there any justifications? Both sides are culpable. Are theory, research, and practice supposed to be unrelated? If they should inform one another, and thus ultimately inform policy and education implementation, then both sides-in fact all interested parties-must work together.

Unsatisfactory Status of Music/Behavior Research

I take as a cardinal assumption that good research is vital to progress in any subject or field of inquiry, no less in education in general and arts education in particular. Of course, effectively implementing the implications drawn from research findings is probably far more difficult than arriving at a reasonable consensus of interpretation and desired action based on research, the latter seldom being immediately decisive. But it is both research quality and quantity that are of paramount importance. The need for the highest quality research should not be controversial. Quantity is necessary because single findings do not usually have a significant effect on behavior, including policy decisions. Rather, the most effective model is one of "multiple convergent findings." I refer to a number of good studies that overlap, rather than replicate-all of which point to the same conclusions and possible courses of action.

My overall impression of research on the effects of music education on cognitive processes and other important aspects of child development is that both quantity and quality are lacking. Both the Es and the Xs have failed to vigorously attack this problem area, although there are instances of recent successes, reviewed above. In particular, the effects of music education on cognitive and social development have been sporadic and of uneven quality over a long period of time. I do realize that it is often difficult to accomplish effective research programs in school settings. But I do not think that can completely account for the present state of affairs. Most music/ behavior research seems neither very exciting nor highly informed by findings from related disciplines.

Moreover, an astounding amount of such research remains unknown or confined to a small coterie of doctoral candidates and faculty committees. To give an example (admittedly not known to be universal), I recently reviewed a large number of pre-1980 dissertations on the topic of the effects of music experience or training on academic performance, mainly in primary school children. I located thirty-one dissertations, twenty-nine of which had not been published as of 1996. That's 94 percent not published. Accordingly, their findings are virtually unknown today and apparently have had little influence.

The reasons for failing to publish are numerous. For example, some doctorates do not plan on doing any more research and have no professional incentive to publish. For some, the doctorate may simply serve to enhance promotion or a move up the administrative chain. Others may simply be too busy. Fear of committing themselves in print and being wrong is another reason. Or findings might not be good enough to publish: If so, that raises questions about doctoral standards. But in fact, a reading of these dissertations finds many that (at least from my perspective) should have been published. Is there not a responsibility to publish the worthy ones, to share findings and insights, so laboriously achieved, with the larger community? Is the dissertation research and writing simply an academic hurdle for certification? If so, how can it be defended?

We all know that there is too much to read and too much to know. But self-- censorship of research findings is hardly in anyone's interest, providing that the quality is there. I would only point out that a single unpublished finding could be a keystone in another researcher's efforts. Of course, better and more interesting and important research needs to be done. Attacking central problems needs to be promoted, and if feasible, demanded.

Failure to Capitalize on Biological Predispositions

Given that infants and young children "do" music spontaneously, the failure to encourage that behavior (as opposed to the enormous amount of reinforcement given to speaking) not only misses a great opportunity but promotes withering of children's interest in going beyond their own raw level. Thus, when some children later take up music instruction, teachers are already working with remediation.

It is interesting that many preschools do promote the use of music and music making and include them as a serious part of their curricula. But there seems to be little continuity of curricula between preschool and kindergarten/first grade, at least with regard to arts education. True, the two levels of education are usually operated by different types of organizations. But why should that prevent better coordination? Is there a turf war, lack of interest, learned helplessness? There are always practical difficulties. But they should not preclude a nationwide attempt to deal with the problem.

Some Implications

I take the material reviewed above to imply that some basic changes in certain aspects of arts education are needed. I present two recommendations.

Education Trials for Music and the Arts

Not enough is known about how music and arts education relate to other areas of education (e.g., reading, writing, mathematics, languages, social studies, history, science) and indeed to child development overall, and that has to be addressed in a focused, systematic, and rigorous manner: I suggest "educational trials."

The concept of "educational trials" is based on the term "clinical trials," which reflects the controlled studies conducted under the auspices of the Food and Drug Administration (FDA) to evaluate the effectiveness of a new drug. The operative phrase is "controlled studies": without them, one cannot evaluate the effectiveness of the drug. Were the FDA to rely only on anecdotal reports, or fervent individual claims, most of us would be wasting our money on ineffective medicines, be made ill from dangerous ones, or be ill because there existed few effective treatments.

What kind of "educational trials" and what kind of "medicines"? Acknowledging the very obvious danger of pushing a metaphor too far, I make a modest suggestion: Treat arts education as the "treatment" under examination. Do not ignore the arts and their benefits within their own areas; do not justify them only on the basis of their effectiveness in "treating" other school subjects; do not relegate them to permanent second-- class status. Rather, additionally determine the extent to which music and other arts education interact with, and can be used to promote, learning in other subjects and development in other areas, such as individual and social awareness and adjustment.

How can that be achieved? To begin with, promote the initiation and continuance of interactions between appropriate cognitive scientists in colleges and universities and local public school administrations and teachers (see also below). Have school superintendents and school boards support pilot programs that have protocols for selected studies with built-in evaluative procedures. Involve parents, caregivers, families. Bring theory, from academia, and practice, in the front lines of the schools, together in an equal partnership on a large scale, across geographical regions, cultures and subcultures, urban and rural areas, and so on.

Is it possible? Is it too costly? What about the endless details? Which specific questions should be asked? How can we get an overburdened, underfunded public education system to try something so different? There are numerous other questions. Does the "trials" idea go too far into the land of the hopelessly naive, passing directly from the Ivory Tower without even a side trip to the land of educational reality? There will be no answers unless there are efforts to give educational trials in the arts serious consideration.

Getting Together, Working Together

The Es and the Xs need to talk directly to each other so they can work together. Each needs to understand the other's context, point of view, assumptions, problems, and opportunities. If that is happening effectively in some isolated situations, I hope that the participants will work actively to enlarge their efforts, perhaps through national organizations. But I am dubious that the current professional organizations should be the means by which collaborations can be sponsored and sustained: There is too long a tradition of doing otherwise.

A potential route is to have Es and Xs at the same colleges or universities, and Es in the public school systems in the same towns and cities simply initiate direct contact. It will have to start with someone calling someone else. Small working groups may wish to formulate agendas, draft practical working documents, and so forth. The spread of this activity could be rapid, given e-mail and the fact that the activities are not costly. A central clearinghouse for such activities could easily be set up, Web page and all. Meetings could be held, and perhaps a national coalition organization might be formed.

The main need now is initiative. There are many Xs who care deeply about arts education but simply are unconnected to the realities of K-12. Many are looking for a way not only to test their ideas and findings in practice but also to change education for the better. I am continually amazed by the number of Xs who have had arts education, and want to apply their investigative expertise, but don't know any Es with whom they could collaborate in theory and in practice. Talk to each other. Educate each other. There is much to gain.

Looking Ahead

I am quite hopeful about the future of arts education. But I must admit that my optimism is based more on the coming generations of researchers and educators than it is on my generation and that next in line. Old habits are hard to break: My brain is not as ready to accept new ways as those of my graduate students. Age and tradition have their values—for example, a broad perspective. They also have their disadvantages, one of which is creeping cynicism.

A remedy would be a new species of arts educator. Skilled and accomplished in their own arts discipline, proficient practitioners who fully grasp both the intellectual and emotional struggles and the rewards of arts experiences, the next generation should also be schooled in the contemporary science of behavior and relevant psychobiology.

Let me assure you that it is quite possible to gain an adequate grasp of, and even an emotional appreciation for, scientific approaches to the brain and behavior, a subclass of which is arts education, without diminishing in any way the arts view of life. This duality in a single brain not only fails to diminish the one for the other but, I deeply believe, enriches both. Unless and until we far more fully comprehend the psychobiological sources of the arts and their multifaceted places in development and life span, education will not achieve the ideals that are daily espoused but seldom reached. This view may seem grandiose, but it may also be correct.

Notes

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