The Psychology of Performance: Musical Talent and Ability

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Musical Ability: Talent versus Training

There is a well-known story about a woman who asks a New York taxi driver 'How do I get to the Carnegie Hall?' 'Practice lady, practice' is the reply.

To what extent is this true? Is it training and hard graft that produces high levels of musical expertise, or does accomplishment emerge spontaneously as an unfolding of innate ability? The very term 'talent' implies that some people are naturally better musicians than others. In this talk I consider the relative contributions of nature and nurture, of inspiration and perspiration.

The case of Mozart is cited by both sides of the argument. Some say the exceptional ability displayed by Mozart, as both performer and composer, which was apparent by the age of four, could only be accounted for as inborn genius. Others point out that his father Leopold was a music teacher, who perhaps frustrated in his own ambitions, devoted himself to promoting the career of his son. Young Wolfgang was immersed in music from an early age, enjoyed little play with other children and was exploited by his father like a circus freak. If Mozart was born a genius he could also have benefited from being raised in a hothouse environment. The same can be said of the observation that musical genius clusters in families (e.g. the Bachs and Strausses); genes and environment could account for this equally.

Great musicians often distinguish themselves from an early age. Apart from Mozart, Haydn, Beethoven, Mendelssohn, Sullivan and Britten are among those who had begun composing before they were teenagers. But for every child prodigy there is an equally impressive late starter. Gluck spent the first 12 years of his life in a totally unmusical environment and only displayed his talent when he went to school. Wagner set out to be a playwright and not until his teens did he buy a book on harmony with a view to adding music to his dramas. George Gershwin and Leonard Bernstein were raised in homes without pianos and received little support from their families before blossoming into two of America's most outstanding pianist/composers. As a poor child growing up in New Orleans, Louis Armstrong had no access to teachers or training materials and did not even own a cornet till he was 17. Nurturance theories are hard put to account for these accomplishments (as indeed is simple heredity).

Like language, musical ability normally develops early in life. It appears first as melodic babbling around that same time that language is emerging, and as with language follows culturally determined forms. Most babies begin by picking up the sound of simple, memorable words like 'ding-dong'. Then come rhythmic skills, and finally the pitch of tunes. By the age of four, three-quarters of children can sing one line of song more or less correctly, but some continue to have difficulty in learning a tune. Harmonic skills, such as distinguishing consonance and dissonance, come rather later (around age 7 or 8), and certain aspects of rhythm, harmony and general musical appreciation continue to develop well into the teenage years. The order of this progression remains constant though there is variation in the speed of progress.

In order to examine the relative role of heredity and environment it is first necessary to agree ameasure of musical ability. Various tests have been devised over the years, both for research purposes and selection to music colleges. Typical of these are the Seashore Measures of Musical Talent (Seashore et al, 1960), which are commercially available in standardised form. Such tests present pairs of tones for comparison on pitch, loudness and length as well as tests of rhythm, timbre and tonal memory. They show acceptable reliability but only limited validity. For example, they are fairly poor at predicting progress in music college, in fact only marginally better than general IQ tests. This is probably because they assess only basic aural skills rather than the creative musicianship (e.g. composition and appreciation of complex music).

Seashore-type tests show slight correlations with IQ (around .3). The savant phenomenon, where a child exhibits exceptional musical skills along with deficiencies in others (usually poor social communication), illustrates the considerable independence of musical ability from other cognitive abilities. There are no striking sex differences in performance, despite the fact that more boys than girls are 'tone-deaf' (c.f. colour blindness) and most of the great composers are male. The fabled African rhythmic advantage is not observed in Seashore scores and visually disabled people are not consistently superior to the sighted. Scores improve with coaching and musical training, suggesting that they are not fixed by heredity. Tests like the Seashore have the advantage of providing objective scores for research purposes but fail to tap some important components of musical ability and talent.

Twin comparisons are the best-known way of separating genetic and environmental influences on any attribute and these support the idea that music ability is partly hereditary. Identical twins are more alike than fraternal twins on Seashore type tests but results usually account for less than half of the variance. Heritability might be higher if actual musical accomplishment was measured. Indeed, a more recent study, using a "distorted tunes" task (284 twins judged whether simple, popular melodies contained wrong notes) yielded heritability estimates above 70%. Since tune recognition is a more global musical skill than the simple discrimination tasks of the Seashore test this may be a more valid figure.

There is no doubt that environmental factors contribute to musical ability. The value of training is seen in a study by Hilary Coon and Gregory Carey of the University of Colorado (1989). They divided twin samples into groups with and without music lessons and found that untutored identical twins were more alike than fraternal twins in musical performance (indexed in various ways that went beyond Seashore skills). However, among twins who had received music lessons the identical twins were no more alike. Thus it seems that while inborn talent predisposes to musical ability, formal training can override its effect - at least up to moderate levels of musical performance. In the Coon and Carey study shared family environment appeared as more important overall than shared genes, especially for girls.

Much important work on the origins of musical expertise has been done by John Sloboda at the University of Keele, Staffordshire and Michael Howe of Exeter University. In 1991 they interviewed parents and students (aged 10-18) at a specialist British music school, looking for background circumstances associated with musical achievement. Although many students came from musical families, and had received much supervision and encouragement, those that were most highly accomplished (according to their teachers) often came from less musically active families. What could account for this? Perhaps some of the students with musical parents had taken up music because of family pressure, whereas the high-flyers were more naturally talented and intrinsically motivated. The outstandingly talented teenagers actually had fewer lessons as children and had not practised any more than those who were less accomplished.

Similar conclusions were reached by Sosniak (1990). She interviewed 24 exceptionally able American concert pianists (as well as their parents) and found that they did not necessarily come from musical homes. In half of the homes the parent had either no musical involvement or only a passive (listening) interest in music prior to the time their child began learning the piano. However, the parents were supportive, and it appeared that the first teacher had an important role in generating enthusiasm for piano playing. It did not seem to matter whether the teacher was a top-rate musician, provided they were warm and encouraging, making lessons pleasurable.

Spontaneity and internal factors seem to be particularly critical for high-level performance. Looking at studies of savants with the ability to reproduce musical structures on a piano after hearing them only once, and self-taught distinguished jazz musicians, Sloboda (1990) concluded that formal training is unnecessary for the development of exceptional musical talent - it can even be harmful if it takes the fun out of music. What did seem important was casual and frequent exposure to the musical forms of the culture from an early age, the opportunity to freely explore a musical medium over an extended time-span, and resources for involvement in music (including time, access to instruments and financial and social support).

Sloboda's work suggests that an absence of threat, anxiety and demand in the context of making music is important. Motivation should be intrinsic(coming from within) rather than external (bribes, browbeating, etc.). Exceptional musicians are not necessarily put into formal training at an early age, but they nearly all report having experienced intense positive emotional or aesthetic states ("peak experiences") in response to music from their earliest listening days onwards. Interestingly, these early significant musical experiences were seldom in the context of formal lessons.

Does practice make perfect? Sloboda and Howe's finding that outstanding musicians practise no more than mediocre ones does not mean that practice is a waste of time. Their subjects were highly pre-selected and all of them practised considerably more than children of average achievement. In fact, amount of practice has been shown to relate to musical attainment across a wide range of performance domains. Expert pianists practice about 10 times more than amateurs and by the age of 20, at the start of their performing careers, have put in an average of about 10,000 hours. Yet we should not forget that for some musicians practice may be aimed at perfecting a performance, while for others it represents a struggle to overcome technical difficulties. Also, long hours of practice may be engaged in either because someone is "holding a whip" or because the individual is genuinely self-motivated. Different outcomes might be expected in these different circumstances.

The sheer amount of practice may be less important than its quality. Practice needs to be highly structured with very specific goals. Performers make best use of their time by inventing specific tasks to overcome weaknesses and by monitoring their performance so as to focus their future efforts. Ericsson et al (1993) found that top violinists practised most often between 10am and 2pm and took more naps than violinists of lesser ability (hence rest is important as well as work). Studying practice diaries, Sloboda et al (1996) also found time-of-day effects - the highest achievers showed more consistency in their practice patterns from week to week and practiced more in the morning.

The importance of the content of practice, as opposed to time spent, is highlighted in a study by Aaron Williamon and Elizabeth Valentine (2000). They monitored 22 pianists as they prepared assignments by J.S.Bach, recording all practice sessions on cassette tape. Final recitals were also recorded and judged for quality by experts. Pianists employing longer practice segments in the middle stages of preparation produced better performances. Why should this be so? Debriefing indicated that the early phases of rehearsal were concerned with overcoming technical difficulties, e.g., establishing fingering and getting up to tempo. Towards the end of practice, pianists were anticipating the upcoming performance or practising playing from memory. In the middle phases they had largely overcome note-to-note difficulties and were in the process of developing their own interpretation. Longer segments in the middle stage suggested an earlier release from technical difficulties, hence more time to refine musicality.

The assumption that music lessons with a specialist teacher are beneficial is so widespread that few empirical studies have been undertaken to evaluate it. Those that have (e.g. Coon and Carey 1989, Morrongiello 1992) confirm that children with training have an edge over their untrained peers on various music perception tasks and performance skills. Ages 5-9 seem particularly propitious for music training - being the earliest time at which a child can profit from verbal instructions, master rhythmic, melodic and harmonic skills and acquire an understanding of notation (Shuter-Dyson and Gabriel 1981). However, the contribution of formal training to the emergence of exceptional (original and creative) music-making is less clear. The work of Sloboda suggests that rigid lessons can inhibit creativity, and Bamberger (1982) has described the frequent breakdown in the performance of child prodigies as their own fresh, internally generated ideas confront outer rules and traditional musical systems. Apparently, musical competence and genius do not necessarily follow the same developmental paths.

Early training in singing can produce short-term improvement, but it is less clear that the advantage so gained is carried forward into adulthood. Training may simply accelerate progress towards the same ceiling of ability. Some gains are likely to be permanent, such as control over the vocal apparatus, familiarity with culturally typical intervals and melodies and a general appreciation of music as an art form. But how essential singing lessons are to the development of vocal prowess is open to question because it is difficult to untangle the effects of maturation and experience from the specific contribution of the teacher. Many top opera singers came late to the profession after discovery of a natural, untrained voice.

Certain singing teachers gain great reputations, but a kind of circularity often develops; the teacher's reputation helps them attract good students, which further enhances their reputation. A kind of folie a deux (joint delusion) sometimes develops between teacher and student, the student being persuaded that progress is good mainly because the teacher intermittently says so. The opinions of outside critics are mutually scorned. There may also be a Svengali effect, whereby the student performs brilliantly in the teacher's studio but cannot transfer the skill to situations where the teacher's encouragement is absent. No doubt some singing teachers do good for some students, but others are detrimental, instilling unrealistic ideas, spurious techniques and practice regimes that fatigue the voice, occasionally leading to permanent damage to the vocal cord.

The difficulty in assessing the value of musical training is that of separating cause and effect. Talented people find their way into training and there is then a tendency to attribute their talent to that training. Usually, there is some interaction between the two, with a musical education helping the student to reach full potential. There is also the advantage that teachers and music colleges provide a stimulating environment that lives and breathes music and offers practical knowledge, such as what type of instrument to buy and how to clean it, and professional hints like where to find jobs and auditions.

Against that, is the danger that a musical establishment can induce conformity which stultifies highly original talent. They may be unable to recognize great creativity because their standards of excellence are backward-looking. Chopin was taught that it was taboo for pianists to use their thumb on black notes, but only by defying this rule was he able to produce such stunning, innovative piano works. Harpo Marx was self-taught to the extent that his first mistake was to sit the wrong side of the instrument; despite this he developed his own very personal technique and became a superbly accomplished harpist. The Milan Conservatoire is still red-faced for having refused admission to Giuseppe Verdi on grounds of "insufficient talent".

The ability to name notes and keys apparently without reference to previously heard notes or to produce a specified note on demand is called absolute pitch. This is extremely rare but more common among trained musicians. About 1 in 4 conductors have absolute pitch, compared with about 1 in 400 singers (Alexander 1971). Not all great musicians have absolute pitch - Tchaikovsky and Wagner are among those who did not. Furthermore, AP is not essential; there is little evidence that it contributes to other musical skills such as the ability to improvise or judge relative pitch.

There are times when AP is a nuisance. A singer who has learned a song in a particular key and then has to sing it with a piano tuned down a semitone is usually not much bothered because he/she sings from relative pitch anyway. But the singer with AP is caught in conflict between the original key and that heard in the accompaniment. The result is that he or she may mix the two, sing sharp, or be otherwise unsettled. Pianists with AP may be similarly thrown by the discrepancy between what they see on the score and what they hear. Gerald Moore expressed great relief when his absolute pitch facility faded with age.

Two examples serve to illustrate the mixed blessing of absolute pitch. When soprano Kirsten Flagstad suffered a serious ear ailment that rendered her virtually deaf, she was able to carry on singing major roles at the Metropolitan Opera for more than a year, using only her own AP and visual contact with the conductor. On the other hand, a prominent mezzo-soprano with AP singing a difficult piece with unaccompanied choir fell apart completely when the choir drifted flat (as they frequently do) because she was unable to follow their shifting key.

The origin of AP is not well understood. Colour-tone synaesthesia might explain the ability in a few instances. Among composers who reported seeing colours on hearing music are Liszt, Schriabin and Rimsky-Korsakov. But synaesthesia is rare and explains few cases. Similarly, a few individuals have a permanent ringing in their ears (tinnitus) of a fixed tone, providing them with an internal "tuning fork" against which to compare other pitches; but this is also rare is perhaps better described aspseudo-absolute pitch (Ward and Burns 1982).

Most individuals with AP show the facility early in life and its acquisition might occur at a particular age of "readiness" similar to that of language learning. Sergeant (1969) found a striking connection between the occurrence of AP and early musical training. Of music students who had taken lessons before age four, 93 per cent showed AP, while none of those who started after the age of 14 showed the ability. Sergeant also found that AP was better for instruments with which the student was familiar, and those that had been studied earlier. However, some children who start lessons early never acquire AP, while others develop it in their late teens. Training methods that use fixed reference points (e.g. remembering the A and referring other notes to that) show some degree of success. But there are degrees of AP and many who claim to have it maintain it tenuously. Fatigue, illness and a long absence from music often disrupt pitch-naming and as people get older their internal pitch tends to get higher (Vernon 1977).

A recent suggestion is that AP may be normal in babies but lost later on as intervals and tunes become more important. Professor Jenny Safran at the University of Wisconsin, Madison, found that the brains of 8-month-old infants contained neurons which fired uniquely for particular pitches (as in songbirds) but in adult brains responses to transposed note sequences showed equivalence (The Times, 21/2/2001). Hence AP may be an inherent ability that is retained by a minority of people (especially those learning music at very young age).

Some musicians maintain that particular keys induce particular moods or "colours". It is claimed, for example, that D major is "martial and brilliant", G minor is "grief-laden", C major is "noble, open and affirmative", D minor "stormy", D flat major "warm", and so on. But while compositional practice may have followed conventions of this kind (and major/minor differences are not disputed), pitch cannot be critical because standards have changed over the years. In other words, D major cannot sound brilliant because a keynote of 290Hz inherently suggests this. Bach, Haydn, Beethoven and others who established that association in their compositions were actually writing to a different D. Up until about 1820, pitch was variable but typically at least a semitone lower than today's standard of A = 440 Hz. The associations between key and mood must therefore be learned, rather than intrinsic properties of the sound frequencies.

How is music represented in the brain? In most right-handed persons the left hemisphere is dominant, dealing with verbal, analytic and executive functions, while the right hemisphere has a more visual, spatial, emotional, holistic and intuitive mode of operation. Music perception, composition and performance depend heavily on pattern processing and emotion, and so are widely held to be right hemisphere activities.

Patients with left hemisphere damage often show little impairment of musical ability or appreciation. Gott (1973) describes a patient whose left hemisphere had been completely removed due to a malignant tumour. Asked the meaning of the word "spangled" she proceeded to give a complete rendition of God Bless America, saying "that is what it is". She liked singing, could do so quite well (usually with appropriate words) and used it as a mode of communication where normal speech was not available to her. The observation that many stammerers show no impediment when singing, sometimes used as an approach to management of the disability, confirms the division of speech and music as left and right hemisphere functions respectively. With modern brain-scanning techniques (PET and fMRI) these differences can be directly observed. When listening to music most people show more energy consumption on the right side of the brain, whereas speech processing shows greater activation on the left.

The left hemisphere, however, does have a part to play in musical processing. Verbally aphasic patients show impairment of those aspects of music that connect with the symbolic function of language, e.g., naming of chords and remembering lyrics (Marin 1982). A case in point is that of a 40-year-old professional violinist who suffered a left-hemisphere stroke (evidenced by verbal difficulty and right body paralysis). His pitch discrimination remained intact and he could still play and sing correctly but he lost his AP and could no longer recognize or identify a work, its composer or its style (Wertheim and Botez 1961). Thus certain 'linguistic'

aspects of music require an intact left hemisphere, even though the "shape" aspects of music (melody and harmony) are right focussed.

The lateralization of music processing is more clear-cut for musically unsophisticated people than for the musically trained (Gordon 1983). Apparently, through long years of training and immersion in their art, expert musicians progressively bring their dominant (left) hemisphere to bear upon musical analysis and performance, in addition to whatever is happening on the right. Eventually, their whole brain is involved in their music, not just the right hemisphere. Because the right ear feeds primarily to the left side of the brain, and vice versa, it is possible to compare the musical abilities of the two sides of the brain by presenting different sound stimuli to the two ears, separately or simultaneously, through headphones. This is called dichotic listening, and studies using this paradigm confirm that musical training results in a shift towards a right-ear (left-brain) advantage due to the trained musicians making greater use of analytical strategies (Bever and Chiarello 1974; Burton et al. 1989). Musical training thus seems to contribute a language-like system for coding and describing the auditory sensations that are basic to music.

Highly developed musical skills are registered as anatomical changes in the brain. For example, violin playing requires fine coordination of the left-hand fingers - hence expert violinists have two or three times as much cerebral cortex devoted to their left fingers as non-violinists (Elbert et al 1995). The need for violinists to co-ordinate their two hands also result in the development of a larger connection between the two sides of the brain dealing with motor coordination compared with non-violinists (Schlaug et al 1995). Such studies illustrate the basic plasticity of the brain but also show that the effects of music practice become "hard-wired" over time. Altenmuller and Gruhn (2001) observed progressive development of neuronal links between sensory-motor and auditory areas of the brain, resulting in the kind of connections whereby a pianist's fingers move more or less automatically when listening to piano music played by a colleague or even when simply imagining sounds.

A useful device for analysis of keyboard performances is the Musical Instrument Digital Interface (MIDI; Salmon and Newmark 1989). This is a development of the Moog Synthesizer which enables a performance to be digitally coded by computer so that detailed analyses of it can subsequently be made. Variables stored by the computer include the duration, pitch, loudness and timbre of notes and the time intervals between them. In the latest version of MIDI, a performance can be stored on compact disc and replayed on an acoustic piano with the exact timings and key weightings as when it was first played.

An obvious application of MIDI is in the editing of performances. It permits errors to be corrected as well as other "clean up" operations equivalent to word processing. But its capacity to describe individual differences in performance skills in statistical terms gives it enormous scope as a research and remedial aid. Ordinary sound recording gives an exact record of a musical performance, and some simple operations such as slowing down the playback are possible. The advantage of MIDI is that numerical scores can be produced on subtle aspects of the performance, such as the degree of overlap in the sounding of adjacent notes played legato. Salmon and Newark show how individual differences in variables like this can be related to the skill and experience of the pianist.

What constitutes a good performance? One research approach is to have an accomplished pianist play a piece first "musically" and then "unmusically". MIDI analysis of the difference between the two performances reveals that the 'unmusical' rendition is an accurate but mechanical delivery of the written notes without expression. 'Expression' translates as an emphasis on notes and phrases which build tension and anticipation (Azar, 1996). Since musical emotion derives from dissonance and its resolution, there is a sense in which a dissonant note is a "wrong"

note. What makes it musical is that the error is deliberate. Musical form involves signals that the composer and performer know that the note is "wrong" - that it is a deliberate error. For example, the composer will point up the dissonant chord by building, repeating or otherwise emphasizing it. Performers likewise emphasize "wrong" notes by playing them louder or extending their duration. It is this underscoring of unexpected sequences that marks a performance as musical rather than mechanical or pedestrian.

I have suggested that certain personality traits predispose to musicianship. My own research finds that musicians (particularly classical and instrumental) tend to be introvert relative to other performers and the general population. This is perhaps because introversion promotes private, imaginative thought, and practising and composing require long periods of solitary work. No doubt there are other types of musician (pop/rock singers and jazz performers) who tend to be more extravert. There are also variations within classical musicians (e.g. brass players tend to be more extravert than string players).

It has also been observed that creativity and genius have genetic links with the 'loose' (hence original) associations characteristic of schizophrenia. Mood disorders may also contribute, providing painful experiences that can be expressed through music, or manic energy to promote creative outpourings. Drugs like cocaine and LSD have often been seen as inspiration for rock and jazz musicians. The work of Kay Jamison and others suggests that about half of great composers suffered significant psychopathology of one sort or another (including bipolar mood disorder, schizophrenia, autism spectrum disorder, antisocial personality disorder, and addiction). It is not unreasonable to suppose that such disorders could have powered or inspired the work of writers such as Tchaikovsky, Beethoven and Schumann to some degree. Self-belief to the point of arrogance can also be useful, c.f., the willingness of Chopin to break the known rules of piano fingering, the grandiosity of Wagner, or Gershwin's insertion of jazz idiom into classical music. Such individuals did not follow convention slavishly but pushed the boundaries of art. We need to be cautious that genetic engineering and modern psychiatric drug treatments do not block the emergence of creative impulses.

I conclude by highlighting the differences between the creative(compositional) aspects of musical ability and executive (performance) skills. Many of the arguments between the 'constitutionalists' and the 'environmentalists', as well as conflicting research results, can be resolved in the light of this distinction. While both inborn talent and training are clearly important, the former seems to contribute more to the exceptional and creative aspects of music, while the latter seems to be pre-eminent in determining moderate and executive musical functions (e.g. learning how to play an instrument to a fair degree of competence).

Early childhood training, support and encouragement from teachers and parents, hard work and determination can all help to build solid musicianship and promote success in music college and in a musical career. However, at the highest levels of creativity, freedom from preconceptions, burning ambition (perhaps to the extent of clinical obsessionality or mania) 'off the wall' thinking, and arrogant defiance of established rules seem to be useful. These rare, mysterious 'gifts', which may also be regarded as 'abnormalities', are deeply implanted in constitutional personality and cognitive style. Musical genius does do not necessary derive from a musical family and cannot easily be taught - it seems to emerge, unpredictably and unstoppably, from within.

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References and Further Reading

References cited above may be located either through Google Scholar or through the following key texts:

Wilson, G.D. (2002) Psychology for Performing Artists (Second Edition). London: Whurr (now part of John Wiley).

Williamon, A. (Ed) (2005) Strategies and Techniques to Enhance Performance. New York: Oxford University Press.

Parncutt, R. and McPherson, G.E. (Eds) (2002) The Science and Psychology of Music Performance: Creative Strategies for Teaching and Learning.