A psychological perspective on a musical genius

(Programme notes for Amadeus, a production of the National Theatre, London)

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Wolfgang Amadeus Mozart is widely considered one of the most outstanding musical talents the world has ever seen. He is the archetype child prodigy and it is certainly true that from an extremely early age his career as both a performer and a composer was prolific.

An anecdotal report of Mozart's extraordinary aural skills is illustrative. In 1770, when he was fourteen, he and his father Leopold visited Rome during Holy Week. They attended the Tenebrae service on Holy Wednesday at the Sistine Chapel in the Vatican. At the time, this was the only place in the world where Gregorio Allegri's *Miserere* could be heard – it was deemed such a uniquely sacred piece that it was forbidden to perform it anywhere else. Even copying the score was considered an excommunicable offence and so we can be sure that Mozart had never heard it before that day.

The *Miserere* is an *a capella* piece for nine voices grouped in two choirs and is about seven minutes long. Despite its complexity and considerable length, Mozart was able to write down the complete score of the piece from memory straight after the service. Two days later he attended the Good Friday service where it was performed again, giving him the chance to confirm that his transcription was correct, save for a few minor details. The story of this feat soon got around and a few months later young Mozart was summoned before the Pope who, far from excommunicating him for making a forbidden copy of the music, made him a knight of the Order of the Golden Spur in recognition of his extraordinary achievement.

The fact that the young Mozart was able to do this is all the more remarkable in light of what we now know about the average person's musical memory. Experimental research shows that most people are actually very bad at remembering even simple melodies when they hear them for the first time. In a seminal experiment in 1985 music psychologists John Sloboda and David Parker found to their own surprise that none of their participants were able to sing back a simple but unfamiliar folk melody with complete accuracy, even after six repetitions.

Bearing that in mind, being able to recall an entire polyphonic piece with nine voices lasting seven minutes seems a truly superhuman ability. And yet research on the cognitive psychology of music from the last few decades has shown that musical training can improve a person's ability in this area. It seems that highly trained musicians are able to recognize particular features of a melody and segment longer pieces into smaller subsections while they are listening. This helps them to encode music in their memory in terms of pre-existing knowledge structures that they have acquired through their training.

They become even more effective at doing this if they are already well-versed in the musical style of the piece and have explicit knowledge of what combinations of notes and underlying harmonies are permissible.

This phenomenon of enhanced memory skill from having relevant expertise or knowledge is very domain-specific but is also found in other areas. Cognitive scientists William Chase and Herbert Simon demonstrated a similar thing with chess masters in a 1973 study – they have an incredible ability to recall chess positions and model different combinations of moves, but an ordinary memory in other respects.

Memory for music is one of the key skills for every performer and composer. Being able to reproduce long and complex pieces largely from memory enables

performing musicians in a live situation to focus on the expressive aspects of music during their performance and makes truly emotional communications with the audience possible. For composers the ability to quickly retrieve new musical ideas from memory and to integrate these ideas with existing structures and compositional templates is a core skill for writing new musical material. Thus, the number of compositional templates that a composer is able to recall from memory and to use in their creative practice can almost be seen as a proxy measure for the degree of their sophistication. In this respect musical memory is a key to composition comparable to the role that verbal memory plays for mastering a second language.

So at least some of an individual's exceptional ability in music comes down to doing an exceptional amount of training. That's not very surprising, and we also know that this was undoubtedly the case with Mozart; by the time he was 14 he had already spent thousands of hours playing and composing music.

But is a large number of practice hours all that is required to to become a great musician? Could any one of us become a Mozart, if we put in the time? Anders Ericsson, a psychologist at the University of Colorado, might argue that we could – in a 1993 study of young violinists he concluded that the main factor in mastering the instrument was putting in 10,000 hours of practice.

But studies on the genetics of musical abilities published in recent years by research groups from Finland, Sweden and from the Department of Twin Research at King's College London, have accumulated evidence that the individual genetic endowment also plays a substantial role in the ability to acquire musical skills. It's simply not the case everyone is equally fast in becoming proficient with a musical instrument, learning to sing or understanding music theory, even if taught by the same teachers and putting the same amount of practice hours in. Putting in a lot of practice can take someone a very long way, but there will always be an unbridgeable gap between them and someone who has trained as hard but is more naturally gifted: as Salieri in *Amadeus* feels all too keenly.

The same differences have been found with many other cognitive skills and in fact, there is plenty of research to show that musical abilities are positively related to general memory capacity, verbal skills a well as to spatial and general intelligence.

So, can we explain away Mozart's genius by saying he was simply a very intelligent person that happened to be born into a musical family who made him practice a lot?

Well there is something else about music that distinguishes it from other cognitive skills. It's not just a case of problem solving. Music touches us emotionally. It has the capacity to generate deep feelings within us; it can make us weep with sadness or with joy. And neuroimaging studies by Canadian researchers Valorie Salimpoor and Robert Zatorre have shown that our brains release the chemical dopamine in a pleasure response to musical stimulation in much the same way they do in response to such basic, primary stimuli as food and sex.

To be a truly great composer means more than mastering the associated technical skills, however impressive an achievement that may be by itself. It means being able to harness those skills to anticipate and shape the emotions of an audience, as Mozart did over and over in his operas, symphonies and masses. It is almost impossible to measure such things in psychological terms,

Here, it seems that Mozart's genius defies scientific explanation.

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