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ABSTRACT

The debate of nature versus nurture in musical development is not new. This does not mean that it is a dead discussion. On the contrary, it still raises new questions and research interests in musical development and other fields of science and ethics.

In regard to musical development, the majority of researchers accept the fact that there is no unique explanation for it but an interaction of complex factors, both genetic and environmental. The focus of the discussion shifted from the type of factor – hereditary or environmental – that is responsible for the individual differences to the interactions that occur between the two (Coon and Care, 1989). This interaction is not a straightforward issue to research for musicality involves many traits and interactions, namely physical, physiological, cognitive, and dispositional (Hodges, 2006). Nevertheless, musical ability can be studied rigorously, even when we still struggle to define music.

One of the most interesting and challenging questions raised in this field of psychology is how hereditary and environmental variances occur (Anastasi, 1958). In this work we are more interested in the view that focus on how hereditary and environmental variances occur and its recent developments, instead of focusing on the anachronic opposition between the concepts of nature and nurture.

Keywords: Music, Nature, Nurture, Psychology

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Introduction

The debate of nature versus nurture in musical development is not new. This does not mean that it is a dead discussion. On the contrary, it still raises new questions and research interests in musical development and other fields of science and ethics. For example, if we consider the principle of individualism - the individual is the relevant unit of social analysis – and emphasize the dignity and liberty of each individual, it is inevitable that we consider not only the nature argument but also the nurture one throughout the individual's life. Thus, by identifying and respecting the individual differences among humans (e.g. talents, skills, interests and hard work) and their freedom, it will be possible to have both personal and social benefits.

In regard to musical development, the majority of researchers accept the fact that there is no unique explanation for it but an interaction of complex factors, both genetic and environmental. The focus of the discussion shifted from the type of factor – hereditary or environmental – that is responsible for the individual differences to the interactions that occur between the two (Coon and Care, 1989). This interaction is not a straightforward issue to research for musicality involves many traits and interactions, namely physical, physiological, cognitive, and dispositional (Hodges, 2006). Nevertheless, musical ability can be studied rigorously, even when we still struggle to define music.

One of the most interesting and challenging questions raised in this field of psychology is how hereditary and environmental variances occur (Anastasi, 1958). In this work we are more interested in this view and its recent developments, instead of focusing on the anachronic opposition between the concepts of nature and nurture. Recently, knowledge and technology renewed and reinforced the scientific relevance that justifies studying this topic. If we consider musical development as a lifelong process and its real-life importance, then the impact is even broader and more relevant.

In the first two chapters, the two extremes of the dichotomy nature/nurture and its anachronism in light of current knowledge will be presented. After an introduction on music development theory, the impact of both hereditary and environmental factors will

be analysed (chapter 4 and 5). Finally, we will present the conclusions and further areas of research.

1. Dichotomy nature versus nurture

In 1869, Francis Galton initiated the systematic study of heredity in musical ability and concluded that traits to music geniality were largely inherited (Shuter-Dyson and Gabriel, 1981). Before Galton and Darwin, human traits were divided between innate or acquired and separated by the moment of birth. After Galton (1875) the division shifted to internal (genes) and external (environment). The ulterior genetic studies on musical ability supported the innateness/inheritance view, mainly through pedigree analysis (i.e. family relationships) or questionnaires. These studies were mainly criticized by their lack of consistency in the correlation between musical achievement and background and by looking only to hereditary aspects, ignoring the environmental aspects (Shuter-Dyson and Gabriel, 1981).

It is now recognised that all human attributes are genetically influenced. Therefore, what researchers are currently interested in is the extent to which genes influence musical ability and which molecular mechanisms are involved in their interactions with the environment. A recent gene's discovery, the FOXP2, may be already helping to this discovery because it gives a hint on the idea of having two innate factors for musical capacity, namely one related to temporal sequencing and another to pitch sequencing (Peretz, 2006).

In a biological approach to the nature of music, Peretz (2006) considered that predispositions for music, together with some specialized cerebral processes could explain musical abilities. By predispositions for music it is meant that humans appear to be born musical. In fact, before they are born, in the last semester before birth, foetus do already respond to sounds in the womb that can be monitored by their heart rate and bodily movements. And shortly after birth, infants can orient towards sounds, recognize the mother's voice and make limited musical timbre judgements at one week (Hodges, 2006).

At the same time, caretakers communicate[1] through singing intuitively to babies, for example to comfort them, to get their attention or share emotions (also called "motherese"). Infants prefer infant-directed singing (Peretz, 2006), however, they can emotionally understand the "motherese" and then use similar sounds to express their mood (Flohr and Hodges, 2006). Some believe this is the very basis of musicality (Malloch and Trevarthen, 2010).

In recent decades the nativist approach has had prevalence over the empiricist perspective. However, if in one extreme the nature of music can be seen as an evolutionary adaptation characterized by natural selection and genes, at the other extreme lies the position that defends that musical abilities are learnt in an environment.

Galton's hereditary argument was criticized, namely in the 1920s by those who believed that musical talent was environmentally acquired, for example, Musell, Lundin and Revesz (Coon and Care, 1989). But it was during the dominance of behaviourism in psychology and the other social sciences in the 1940s and 50s that nurture (empiricist perspective) assumed more influence. Although it is not yet known what is the relative importance of the prenatal stage for long-term musical development, the scenario is different during childhood (Parncutt, 2006). For example, a rich musically home environment is profoundly important in the development of children's musical potential, namely when parents play or sing and when instruments are available (Hallam, 2009; Shuter-Dyson and Gabriel, 1981). There are many evidences in the literature on the influence of the environment, specially transmitted by the caregivers (Michel, Kagan, Kirkpatrick, Shelton, Moore, Freeman - see Shuter-Dyson and Gabriel, 1981). However, it must be noted that parents who begin to provide a musical environment and opportunities in the first two years of the child's life will probably continue to do so. Thus, it is hard to analyse these profiles.

When we refer to nurture, we can think beyond the parent's or, more generally, the family's influence and consider the role of formal and informal music education (e.g. listening to music). So, factors such as understanding teachers and parental tolerance of

[1] We are mentioning that there is a communication because there is a newborn's responsiveness, even for hearing newborns of deaf parents, which can give hints to a biological preparedness (Peretz, 2006).

informal practice might also play a role in the long-term musical development (Parncutt, 2006). Empirical studies have already suggested that musical skill depends almost entirely on the amount and quality of practice. However, this is linked to the motivation to practice long and hard, which may have a considerable genetic-biological component (Parncutt, 2006).

This leads to another aspect of musical development, namely that the general foundations of the naturally acquired musical skills allow a person to achieve the expertise (Sloboda, 1985). The musical expertise, i.e. talent, highlights the importance of practice. However, the extreme monotonic relationship between deliberate practice and the acquired individual performance (e.g. Ericsson and colleagues - see Hallam, 2009) was already challenged by different analysis (Sloboda and Howe; Wagner; Zurcher - see Hallam, 2009). Other possible aspects to explain achievement are teacher's ratings of musical ability, self-esteem, and involvement in extra-music activities (Hallam, 2009). Thus, it seems that to achieve expertise is a much more complex process.

The development of prodigious talent in music involves not only natural abilities but also a great amount of intense, focused and systematic learning and practice from a very young age (McPherson and Williamon, 2006). This is why, according to the authors, a child may be gifted but not talented; however the reverse is not possible. For example, if there is a lack of interest, the potential to manifest the talent cannot occur. It is aptitude and appetite, not one or the other (Ridley, 2003).

The environment where the organism finds itself hugely influences genes (Tallis, 2011). The division between genetic and environmental processes misrepresents how living organisms construct themselves and the underlying complexity that genetic determinists and naïve environmentalists seem to forget.

2. From which one to how much of each

In the early twentieth century the nature versus nurture debate was initiated in similar terms to those we are living today (Rausher, 2009). Nature and nurture cannot be separated but the idea of separable ends of a dichotomy reflects the perennial dispute

over the relative strength of one factor over the other. There is a multi-directional and multi-dimensional nature of effects between nature and nurture that are mutually reinforcing. Genes are both cause and consequence of musical development. However, the complex interaction between the physical body and experience that underlies the development of psychological traits tends to be simplified and the nature/nurture dichotomy persists in some fields. For instance, in musical potential (McPherson and Hallam, 2009).

The genuine empirical question about the extent of the malleability or the constancy of human nature undoubtedly exists, but conclusive findings are at this stage undermined by complex interactions between environment and genes. Additionally, the different aspects of an individual's development highlights the interactive rather than additive, reciprocal influence of gene combinations with environmental stimulation (McPherson and Hallam, 2009).

Now scholars are interested in how much variability in a trait within a specific population is associated with variability in nature and how much is associated with variability in nurture (e.g. McPherson and Hallam, 2009). New technologies, such as positron emission tomography (PET), functional magnetic resonance imaging (fMRI) or magnetoencephalographic (MEG) technique are enabling a new approach to the debate, abandoning the historical opposition of nature or nurture (Rauscher, 2009). Nevertheless, new technologies and quantitative genetics face several limitations in addressing the complex gene-environment interactions and answering what the relative weight of each factor as causes in the development of traits and, more specifically, musical development.

3. Musical developmental theory

No one would mistake a human for a chimpanzee despite the similarity of both genomes and this is explained by the role of the human's genes and how the development of the cellular environment switches on and off particular genes. This key factor occurs in the cell system but it is also responsive to events in the outside environment. The metabolic control processes that affect development manifest early in

life. Epigenetics or, more specifically, prenatal epigenesis of behaviour are fields which demonstrate the way parenting and other environmental factors transform genes. Epigenetics refers to processes that 'tag' the genome but are not part of the DNA structure itself and it is also called the "socialized gene" and emphasizes the plasticity rather than the immutability of the organism.

As already mentioned in chapter one, the musical skills are, in part, learnt before birth. Foetus becomes familiar with internal sounds of the mother's body and reacts to physical and emotional states (Parncutt, 2006).

Piaget's children's thinking theory substantially contributed to the research on musical development. He was interested in the origins and development of children's thinking (Genetic epistemology) and based his theory on the biological idea of adaptation to the environment, which occurs through assimilation and accommodation (Hargreaves, 1986). This means, when assimilating children use the already formed mental schemas to interpret and act on the environment and in the accommodation process, the interaction with the world make the child's schemas change. So, the acquisition of logical thinking occurs through this principle of equilibrium.

Piaget believed that there is a universally shared sequence of cognitive stages, which occur when the accommodation takes place while the child learns a particular skill and when the time is right these accommodations 'colonize' other areas of endeavour (Hargreaves, 1986). This means that the intellectual abilities at a particular age determine the type of learning we are capable of at that age.

Adapting Piaget's theory to the musical development, on the one hand we may find invariant sequences of musical development, dependant upon the types of musical activities, which might possibly be linked to general changes in other cognitive domains. On the other hand, there is also the possibility of finding early aspects of musical development, solely pointing to specific music abilities, and not to any other domains (Sloboda, 1985).

If we consider musical development as a lifelong process, and not only the cohort between 0 – 11 years old that Piaget studied, then the impact of the nature of music is even broader. For instance, it might also affect geriatric health since it was already studied that music might have a positive effect on cognitive functioning, such as

memory, mobilisation and social behaviour (Gembris, 2006).

Further research on this topic can help finding new avenues to improve clinician's work with their patients. For instance, Greenwood and Parasuraman (2012) suggested that further research of the interaction between genetics and environment might help understanding how the impact of external factors on age-related cognitive decline differs between individuals. The authors noted that there are still few studies examining this issue and that the APOE gene is the main gene that has been examined mainly due to its association with Alzheimer's disease. Lastly, they also showed evidence that the brain ability to adapt to and benefit from experience is heightened by certain types of cognitive training (e.g. education), by aerobic exercise, and by certain diets.

4. Exceptional musical behaviours

Recognizing the consequences of extreme early cognitive environments (e.g. congenital blindness or intense autism) can throw the nature/nurture debate into new relief. Absolute pitch (AP), for example, is a symptom developed by 40% of children born with little or no sight in the first two to three years of life, which suggests "an environmental effect operating within a general (though not universal) genetic predisposition" (Ockelford, 2012: 9).

Thus, this human cognitive ability is a good example of nature/nurture interaction; one of the cleanest examples that demonstrate this interaction (Zatorre, 2003) and which contrasts to the absence of such traits, for example "congenital amusia", that can also be inherited.

The role of genetic instructions has been studied in those with absolute pitch (AP) and evidence for the importance of genes has been found. However, early learning and musical training are important and without them development of AP is highly unlikely (Hodges, 2006; Chin, 2003).

Researchers acknowledge the importance of music training in childhood for the development of AP. Nevertheless, since cognitive style can be genetically influenced, the development of AP must integrate a cognitive (music training before the age of 6 – the 'preoperational period' of Piaget) and a genetic explanation (predisposition to

interpreting the world with an analytic cognitive style). McPherson and Hallam (2009) also presented diverse reasons to explain how environmental forces dynamically interact with innate potentials at critical moments in a child's development.

Zatorre (2003) identified a number of cognitive impairments, which are based on genetic factors and, consequentially, provide insights into the heritability of musicality. The author referred to the musical savants who despite some severe cognitive limitations, may demonstrate extraordinary performance skills; the Williams syndrome patients who whilst mentally asymmetric and frequently displaying a tendency for music and language, have strong deficits in other cognitive domains; and prodigies that not having a cognitive impairment still provide evidence of heritability. These exceptional behaviours regarding musicality are fruit of the interaction between learning experience and particular neural structures apparently strongly influenced by genetic instructions.

5. Is there music in the brain?

We have already presented evidence suggesting the existence of music predispositions. Nevertheless, infant's brain plasticity may have an impact on these abilities. During the first decade of life the brain is more plastic and malleable than in adulthood and its connections come from environmental influences or an interaction of heredity and environmental influences (Flohr, and Hodges, 2006). For example, the simple exposure to music may create connections and networks that are adjusted to its needs and that are independent from inborn mechanism (Peretz, 2006). Besides, between the age of 2 – 8 there is a "synaptic pruning": the brain makes more connections than it needs and then the level of synapses decreases, by deleting the unused or less used connections (Flohr, and Hodges, 2006).

The relevancy of neuroplasticity in other scientific fields may help understanding the impact of gene-environment interactions, namely neuroplasticity, for musical development. Brüne (2012) and Wurzman and Giordano (2012) underscored the importance of environmental variables in determining developmental outcomes in psychiatric nosology - and "the potential for more dynamic interactions between genes

and culture with respect to psychological function and dysfunction." (Wurzman and Giordano, 2012: 1). Plasticity suggests the need to reconsider the dichotomy nature/nurture and how complex are the biological and behavioural issues and how these interactions affect musical development.

6. Conclusion and further research

Arguments about the nature/nurture dichotomy potentially threaten hard-won territories in science. Although the issues here exhibited are complex and far from settled, empirical research does suggest that the human mind comes pre-wired in important ways. However, the more plausible explanation is that musical development is the result of a range of gene combinations interacting with environmental stimulation. If we hear the sound of a drum, we cannot assign a certain percentage of the cause of the sound to the drummer, and another percentage to the drum (Keller, 2010).

By adopting an open-minded view on this subject it will be possible to improve the complex models of gene-environment interactions and better identifying what, how, and why complex variables may be relevant to enhance understanding on those factors that increase brain plasticity upon exposure to environmental stimulus and where they may present an evolutionary advantage or disadvantage for musical development.

Recent research has tried to identify the environmental factors that positively or negatively influence musical development (McPerson and Hallam, 2009).

Munafò and Flint (2011) suggested a set of possible and relevant future research questions that also fits the subject of nature/nurture in musical development. The authors studied the genetic architecture of human personality, however the ongoing discussion applies to musical development and its complex trait analysis. For example, how should these studies incorporate environmental effects? And could variability (in small or large number) produce (large or small) effects? How Anastasi (1958) pointed out there is still the need to understand how hereditary and environmental factors influence musical development and behavioural differences. This means that it is important to identify the mechanisms through which genotypes are transformed into phenotypes (Bronfenbrenner and Ceci, 1994). These authors suggested a new model

that allowed the study of organism-environment interaction – the proximal processes – and analysed their magnitude and behaviour. For that they suggest a bio ecological model where is represented an interaction between organism and environment and where intervening and empirically assessable mechanisms connect the inner and the outer in a bidirectional way over time. Elmer (2011) referred to the organism capacity to reproduce and adapt to the environment as the principle of self-organization that Piaget called principle of equilibrium. This principle is also known as dynamic systems theory, which enables the study of complex systems with many interacting components as an ongoing process of self-organization. These models of developmental dynamics give researchers the possibility of studying the early emergence of behavioural phenotypes; enables the analysis of the complex dynamic process of development and how it is influenced by both internal and external factors. Human behaviour is continuously and dynamically over time determined by multiple interactive factors (e.g. in developmental disorders, Fidler et al., 2012). A more dynamic approach of musical development based on emergent phenomena of behaviour will represent new challenges and will bring both theoretical and methodological issues, however this approach can build on the important work already produced and may find answers regarding human musical development.

An open-minded view is also needed in the philosophic discussion about human nature. A well-functioning society needs to respect each person's right to liberty and the freedom to realize one's full potential - "Individuality is a product of aptitude reinforced by appetite" (Ridley, 2003: 260). Thus, a spontaneous order may arise in society because individuals should be able to coordinate their actions with the actions of others in order to achieve their purposes and flourish.

References

Anastasi, A. (1958), “Heredity, environment, and the question "how?"”, Psychological Review, Vol. 65, No. 4, 1958

Bronfenbrenner, U. & Ceci, S.J., (1994), “Nature-nurture reconceptualized in developmental perspective: a bioecological model”, Psychological review, 101(4), pp. 568–586

Chin, C. (2003), “The development of absolute pitch: a theory concerning the roles of music training at an early developmental age and individual cognitive style”, Psychology of Music, vol. 31, No. :2, pp. 155-171, April 2003

Coon, H. and Care, G.(1989), “Genetic and Environmental Determinants of Musical Ability in Twins”, Behavior Genetics, Vol. 19, No. 2, 1989

Elmer, S. (2011), “Human singing: Towards a developmental theory”, Psychomusicology: Music, Mind & Brain. 2011, Vol. 21, No.1 & 2

Fidler, D., Lunkenheimer, E. and Hahn, L. (2011), “Emerging Behavioral Phenotypes and Dynamic Systems Theory”, in International Review of Research in Developmental Disabilities, Academic Press, 2011, Volume 40eds. Fidler, D.

Flohr, J. & Hodges, D. (2006), “Music and Neuroscience”, in Colwell, R. ed., *MENC Handbook of Musical Cognition and Development*, Oxford University Press, 2006

Galton, F. (1875), “The History of Twins, As A Criterion Of The Relative Powers of Nature And Nurture”, Reprinted in International Journal of Epidemiology , 41 (4), pp. 905–911, 2012

Gembris, H. (2006), “The Development of Musical Abilities”, in Colwell, R. ed., *MENC Handbook of Musical Cognition and Development*, Oxford University Press, 2006

Greenwood, P. & Parasuraman, R. (2012), “Nurturing the Older Brain and Mind, The MIT Press, 2012

Hargreaves, D. (1986), *The Developmental Psychology of Music*, Cambridge University Press, 1986

Hargreaves, D. (1996), “The development of artistic and musical competence”, in *Musical Beginnings: Origins and Development of Musical Competence,* ed. Deliege, I. and Sloboda, J., Oxford University Press, 1996

Hodges, D. (2006), “The musical brain”, in McPherson, G. ed., *The Child as Musician: A Handbook of Musical Development, ed.*, Oxford University Press, 2006

Howe, M, Davidson, J. and Sloboda J. (1998), “ Innate talents: Reality or myth?”, Behavioral And Brain Sciences (1998) 21, pp. 399–442

Keller, E. F. (2010), *The Mirage of a Space between Nature and Nurture*, Duke University Press, 2010

Malloch, S. and Colwyn, T. (2010), "Musicality: Communicating the vitality and interests of life", in Malloch, S. and Trevarthen. C. ed., *Communicative musicality: exploring the basis of human companionship*, New York : Oxford University Press, 2010

McPherson, G. and Williamon, A. (2006), "Giftedness and talent", in McPherson, G. ed., *The Child as Musician: A Handbook of Musical Development, ed.*, Oxford University Press, 2006

Miller, L. (2005), "What the Savant Syndrome Can Tell Us about the Nature and Nurture of Talent", Journal for the Education of the Gifted, 28: 3-4, p.361-373 Mar 2005

Munafò, M.and Flint, J. (2011)," Dissecting the genetic architecture of human personality", Trends in Cognitive Sciences, September 2011, Vol. 15, Issue 9, pp. 395-400

Ockelford, A. (2012), "Commentary: Special Abilities, special Needs" in McPherson. G. and Graham, W. ed. *The Oxford Handbook of Music Education*, volume 2, Oxford University Press, 2012

Parncutt, R. (2009), "Prenatal development and the phylogeny and ontology", in Hallam, S., Cross, I. and Thaut, M. ed., *The Oxford Handbook of Music Psychology*, Oxford University Press, 2009

Parncutt, R. (2006), Prenatal development, in McPherson, G. ed., *The Child as Musician: A Handbook of Musical Development, ed.*, Oxford University Press, 2006

Peretz, I. (2006), "The nature of music from a biological perspective", Cognition 100 (2006) 1–32

Rauscher, F. (2009) "The impact of music instruction on other skills", in Hallam, S., Cross, I. and Thaut, M. ed., *The Oxford Handbook of Music Psychology*, Oxford University Press, 2009

Ridley, Matt (2003), *Nature via Nurture: Genes, Experience, and What Makes Us Human*,HarperCollinsPublishers, 2003

Sell, A., "Evolved Cognitive Adaptations", in Vonk, J. and Shackelford, T. ed., *The Oxford Handbook of Comparative Evolutionary Psychology*, Oxford Library of Psychology, 2012

Shuter-Dyson, R. and Gabriel, C. (1981), *The Psychology of Musical Ability*, second edition, Methuen, 1981

Sloboda, J. (1985), *The Musical Mind: The Cognitive Psychology of Music*, Oxford University Press, 1985

Tallis, R. (2011), *Aping Mankind: Neuromania, Darwinitis and the Misrepresentation of Humanity*, Acumen, 2011

Trehub, S. (2003), "The developmental origins of musicality, Nature Neuroscience, 6(7): 669-673, July 2003

Wurzman, R. and Giordano, J. (2012), "Differential susceptibility to plasticity: a 'missing link' between gene-culture co-evolution and neuropsychiatric spectrum disorders?", BMC Medicine 2012, 10:37

Zatorre, R. (2003), "Absolute pitch: a model for understanding the influence of genes and development on neural and cognitive function", Nature Neuroscience, 6(7):692-5, July 2003