Chapter 10
What Is Music for Neuroplasticity?
Combined Value on Infant Development and Inclusion

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ABSTRACT

Neuroplasticity has been increasingly discussed in phylo-ontogenetic terms the last few years, with a rising number of studies and scientific publications demonstrating its importance in the whole life span learning, development, and well-being domains. This chapter, focusing specifically on the neuroplastic changes happening in the infant brain when provoked from music, attempts to discuss the basic features and principals permeating this connection, bringing to the fore their combined value in terms of enriched development and extended social inclusion. The chapter content offers a steppingstone to both academics and practitioners alike, upon which they can update, 'rephrase', and specialize their knowledge in the particular interdisciplinary topic, while further reflecting towards the more sensitive and special in education and development practice contexts.

INTRODUCTION

From our point of view, inclusion means giving every human being an equal opportunity to express himself, be seen, and fulfil his potential regardless of race, sex, age, or disability. In this chapter, we will discuss neuroplasticity and the abilities of the developing brain to react and communicate through music. We will also suggest possible advantages of inclusive musical activities and the importance of their establishment at a young age for all participants, whether they are neurotypical or dealing with

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cognitive or emotional disabilities. We believe that various inclusive learning environments enable to clear a path to the hearts of many people from different backgrounds and, therefore, create new communication channels for those whose voice is not often heard.

BACKGROUND

What is Neuroplasticity?

The brain is a unique organ that demonstrates widespread variability within and across populations, with certain differences being described in structural and functional terms. These differences in the brain are seen to account for variability in behaviour, with anatomical differences observed to lead to difference in empathy, time perception, sensitivity to pain, cognitive capacity, and moral values among others (Gu & Kanai, 2014). Such differences can exist from birth and across the lifespan. One area in brain differences that has gained interest in recent years is the study of neuroplasticity. Neuroplasticity refers to the dynamic physiological changes that occur in the brain resulting from the organism's interaction with the environment. Plasticity of the brain can be best defined as "the brain's ability to create adaptive changes in morphological and network neuronal structure and function of the nervous system, which includes changes in neuronal connectivity, neurogenesis and neurochemical changes" (Sasmita, Kuruvilla & Ling, 2018).

Neuroplasticity has enabled adaptation of organisms and provided an evolutionary advantage (Anderson & Finlay, 2014). Neuroplasticity develops from a delicate interplay between genotype and environment and helps adjust the functioning of neural networks while maintaining homeostasis on changing environments (Butz, Wörgötter & van Ooyen, 2009). Since this process occurs throughout the whole life of an organism in response to external environment, it is also referred as experience dependent or activity induced neuroplasticity (Hamaide, De Groof & Van der Linden, 2016). Study of this extraordinary capacity has helped us throw light on the age-old nature-nurture debate through showing the extent to which the environment influences the biology of an organism.

The concept of neuroplasticity was first introduced by William James, who framed it as the "possession of a structure weak enough to yield to an influence, but strong enough not to yield all at once" (James et al., 1890). Later, Cajal improved the concept suggesting in his cerebral gymnastics hypothesis that the capacity of the brain could be augmented by increasing the number of connections between neurons (DeFelipe, 2006). Another aspect of neuroplasticity was later introduced by Hebb (1949) proposing that cortical neural connections change with experience. For example, if a person loses their vision at a young age, then cortical remapping will take place for the other sensory modalities (Ortiz-Terán et al., 2016). Hebbian plasticity can best be summarized by the notion suggesting that 'cells that fire together will wire together' and is a process that takes place naturally during development of the nervous system as well as in subsequent learning (Fauth & Tetzlaff, 2016).

There is increasing evidence showing that large areas of neuronal systems which although take up energy sources while lying dormant, have high plastic potential and could be helpful in adapting to stress, trauma or disease and can have effects of inducing extraordinary creativity and intellectual capacities in humans such as in the case of savants (Ovsepian, 2019). Neuroplasticity is extensively studied within neurological and neurodegenerative disorders which affect memory, cognition, and motoric functions