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Music and Technology as Factors of Interdependence in the Mental Health of Students

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Abstract

Since ancient times, music has been an element of people's daily life, so today it is considered a part of companionship, entertainment, relaxation, relaxation and admiration for people. The role of emotions it evokes, the therapeutic effects on mental health, the role of music therapy but also the involvement of artificial intelligence in the production and distribution offer a fertile ground for further research. The aim of the present study is to investigate the music influence in the mental health of a person and generally in the mental health status. Moreover, the role of music therapy will be addressed as well as the crucial role of artificial intelligence in music production and distribution. The type of the research followed was quantitative, using a questionnaire addressed to 177 people. Furthermore, statistical methods are used for the interpretation of the data, and the valid analysis of the findings. The findings highlight the crucial aspect of music and technology in mental health, paving the way for further research in these areas. Overall, the article offers a multidimensional overview regarding the relationship between music, technology and mental health.

Keywords: music, music therapy, mental health, emotional intelligence, artificial intelligence

Introduction

The presence of music in people's daily lives is obvious. In this respect, questions that are worth raising is how can music stimulate people emotionally? How can it affect people mentally? Many studies have shown the positive effects of music and its form of therapy (music therapy). Typical emotions observed when

listening to a melody are joy, calmness, nostalgia, love, sadness, excitement, etc. (Juslin, Sloboda, 2001). Hanslick (2003), points out that the effect of a melody on our mood has been adequately explained by physiology. Music has strong effects on human psychology and can stem from various factors such as rhythm, melodies, lyrics and the overall atmosphere it creates. These effects cover a wide range of emotions and situations. The field of emotional intelligence includes the verbal and nonverbal evaluation of emotion expression, its regulation in self and others, and the utilization of emotional content in problem solving (Salovey, Mayer, 1990). For instance, jazz music presents a complexity in music composition which matches individuals who seek complex and spiritual stimuli (Chamorro-Premuzic, Furnham, 2007). In the evolution of music, artificial intelligence is emerging as a powerful force in the world of music, radically influencing the way sound art is produced, created and perceived (Stephanidis, Antona, Ntoa, 2021).

The aim of the present study is the investigation of the music influence in a person's emotional state but on their mental health in general, the role of music therapy and the contribution of artificial intelligence to music production and distribution. The research questions of the study are as follows:

Question 1. How is the type of music chosen according to the emotional states experienced by the person and how does this contribute to mental health?

Question 2. How does music affect emotional intelligence and what is the role of music therapy?

Question 3. How does artificial intelligence influence the evolution of music production and distribution?

Literature Review

It is worth analyzing to distinguish and define the notions of emotion and music in order to record the character of the emotions caused by the music. According to the American Psychological Association (American Psychological Association, 2020), emotion is "a complex pattern of reactions that includes experiential, behavioral and physiological elements".

According to Cooke (2008) music phrases constitute a special language of emotions, like the one of speech. For Panksepp and Bernatzky (2002) most people who listen to music connect and create bonds with the various situations they experience. The first studies and research on emotions in music are observed in the 19th century, forming the springboard for the existence and subsequent creation of film music around the end of the 1980s (Cohen, 2010). In our attempt to include the notion of mood in music and emotion it is observed by Panksepp and Bernatzky (2002) that the mood is directly affected by the music of the listeners. Of course, this is getting weaker and weaker since everyone's mood is something that the person himself carries while constantly changing.

Researchers talk about the theory of general intelligence, based on the aforementioned intelligence general intelligence is an indicator of the degree of

success of a person in his/her academic career (Neofytou *et al.*, 2006). The first theorists and researchers who talk about emotional intelligence are Wayne Payne in 1985 and later Keith Beasley (Salovey *et al.*, 1989–1990). Mayer *et al.* (2000a), define emotional intelligence as a type of social intelligence that involves one's ability to monitor one's own emotions as well as those of others in order to understand and manipulate emotions to facilitate thinking (Mayer *et al.*, 2000a). According to Bar-On, (2000) and Mayer, Salovey and Caruso (2000b) emotional intelligence can be shaped and developed constantly through the stimuli that the person receives but also through his continuous education.

In Tiffany Field's research (as it is referred in Gottman, 2011) the mental health carried by the parents directly contributes to the development of the central nervous system and emotional intelligence of the infant. The effects of music on humans become apparent from the fetal age both in their physiology and psychology. Research shows that until nowadays music affects: heart rate and pulse, electrodermal reaction, breathing rate, blood pressure, muscle tension, blood volume, skin temperature, gastric movement, pupillary reflexes eye, blood oxygenation, hormonal secretions (Sakalak, 2004).

These effects cover a wide range of emotions and conditions such as expressiveness of emotions, effect on mood, improvement of concentration, therapeutic action, social connection, enhancement in the fight against stress and depression, improvement of physical recovery, enhancement of brain functions, combat of distraction and overwhelm (MacDonald, Kreutz, Mitchell, 2012).

The relation between music and a person's personality, it is linked to their character and neurotism. Depending on the kind of choice certain aspects of it in both physiology and psychology will also be revealed. For instance, jazz music exhibits a complexity in musical composition that matches individuals who seek complex and spiritual stimuli (Chamorro-Premuzic, Furnham, 2007).

For the International Music Therapy Association, music therapy is defined as the application of music to the needs of individuals for the purpose of mental and physical health (Kartasidou, 2004). Within these definitions that of the American Music Therapy Association could not be missing, where it defines music therapy as the clinical and documented use of musical interventions with the aim of achieving individual goals in a therapeutic relationship where the therapist has completed a validated music therapy program. Music therapy is a form of psychotherapy which uses music as a means of achieving psychological goals. Furthermore, it can be used for the therapy to treat a wide variety of mental disorders, including depression, anxiety, post-traumatic stress disorders (PTSD), schizophrenia, and personality disorders. (Saarikallio, Erkkilä, 2019). Music can be utilized as a means of communication and expression of feelings that may be difficult or impossible to express with words. This can be very important for people with mental disorders who find it difficult to communicate their feelings to others. The aforementioned can be particularly important for people with psychological disor-

ders who find difficulty in expressing their emotions with others. For instance, music can be used by people who deal with depression so as to express their feelings of sadness, hopelessness or isolation. It can also be used by people with anxiety to express their feelings of fear, panic or tension (Koelsch, 2014).

According to Papanikolaou (2011), music therapy is divided into two categories: the interactive one based on musical improvisation and the receptive one, where listening techniques are used. Music therapy is capable of bringing out and helping to express the most hidden and difficult emotions (Koukourakis, 2010).

Music from the perspective of Artificial Intelligence

Modern music production continues to evolve with the rapid development of technologies. Advances in computing power, sophisticated sound processing algorithms, and the use of artificial intelligence have enabled the creation of innovative musical expressions (Yang, Nazir 2022).

Artificial intelligence emerges as a strong force in the world of music, influencing radically the mode of production, creation and perception of the arts of sounds (Stephanidis *et al.*, 2021). Algorithms can analyse the patterns of popular music genres, predict audience preferences, and even create original pieces of music (Hernandez-Olivan, Beltrán Blázquez, 2022). “Artificial Intelligence (AI) refers to systems that exhibit intelligent behavior, analyzing their environment and taking action with some degree of autonomy to achieve specific goals” (European Commission, 2018). The applications of Artificial Intelligence in music production include composition, deciphering, transcribing existing music, and even playing instruments using robotic technology (Stephanidis *et al.*, 2021).

Platforms such as Pandora and Spotify use artificial intelligence algorithms to keep listeners engaged with modern music (Williams, Hodge, Wu, 2020). Artificial Intelligence can also create personalized videos, soundtracks and live event recommendations. Moreover, Artificial Intelligence plays a crucial role in copyright and rights management, a task made more complex by the proliferation of digital content (Venkatesh *et al.*, 2022).

The ethical implications of Artificial Intelligence such as creativity, property rights and its impact on artists and industry professionals will also be a focal point in the near future (Williams *et al.*, 2020).

Research Methodology

1. Method

For this present research, the quantitative research methodology was followed which helped us in its objectivity and effectiveness. According to what was studied in a literature review, primary quantitative research was conducted using Likert scale questionnaires on 177 undergraduates, postgraduates, doctoral candidates, and participants in training programs at the University of Patras (Athanasίου, 2000; Creswell, 2016).

The research tool that was used for the present study was the construction of a questionnaire as it has a flexible, effective and non-particularly expensive way of collecting and analysing inexpensive ways of collecting and analysing data (Athanasidou, 2000; Creswell, 2016).

Relevant studies that contributed to our study were the following ones: Bar-On, (1997), Perlovsky, (2010), Nowak and Bennett, (2020), Gabriellsson and Lindström (2001), Gardner, Santos and Schmidt, (2023). The aforementioned studies explore the nature of emotions (emotional intelligence), music and emotions (effects – therapy), and artificial intelligence with its contribution to music production, distribution and development. In this respect, our questionnaire's questions emerged from the findings of the above studies. To be more precise, the questionnaire consists of 18 questions with three demographic data (age, gender, marital status), the remaining questions were divided into questions related to music, mental health and artificial intelligence. As mentioned earlier the data were collected on a Likert scale.

The indicator that proves questionnaire and research's reliability is the Cronbach's alpha coefficient, where it calculates the internal consistency of a test or a scale with values from 0 to 1. The internal consequence describes the degree of relativity that the objects in the research tool have. Research is considered reliable with value greater than 0.7 both overall and in individual groups of questions that govern it (Field, 2009). In that case, the internal consistency coefficient ranged at the limit of 0.7. It is also worth mentioning that a pilot study was carried out so as to design the final form of the questionnaire. The present study was given to three experts with relevant research background knowledge and work in order to evaluate the appropriateness of the research questions while a pilot application followed in terms of the final form of the questionnaire.

2. Selection of data

For the implementation of the statistical analysis, the questions from question 1 (age group) to 3 (marital status) are considered as demographic characteristics and general data.

The research sample consisted of 26% (n = 46) men and 74% (n = 131) women who were the majority of the sample. The sample of age groups of the research was divided as follows: from 18–25 years old made up the largest percentage of the whole 47.5% (n = 84), while the age group from 26–45 years old followed with 37.3% (n = 66) and finally from 46 and over with 15.3% (n = 27). As far as the marital status of the sample is concerned, the majority were unmarried with 70,1% (n = 124), divorced with 4,0% (n = 7) and finally married with 26,0% (n = 46). The research axes of the present study are related to:

1. The assessment of the importance of music for the sample population as well as the daily interface that exists with music.

2. Music therapy, people' ability of emotional intelligence and the levels of mental health that people think they have according to their own assessment.

3. The examination of the knowledge of Artificial Intelligence as well as the ways and means by which this technology affects the production and distribution of music.

Table 1. Descriptive statistics for the sample data (Mean, Standard Deviation, and Median)

	N	Missing	Mean	Median	Mode	SD	Minimum	Maximum
4. Do you choose the type of music according to your mood?	177	0	3.825	4	4.00	1.070	1	5
5. How do you choose a song:	177	0	2.661	3	3.00	0.729	1	3
6. Do you play a musical instrument?	177	0	0.294	0	0.00	0.457	0	1
7. Do you think that music contributes to changing a person's mental mood / health?	177	0	4.525	5	5.00	0.565	2	5
8. To what extent can music help in the treatment of people with mental problems?	177	0	4.198	4	4.00	0.776	1	5
9. Do you know the role of music therapy?	177	0	3.034	3	3.00	1.167	1	5
10. How important do you consider the ability to recognize and understand other people's feelings?	177	0	4.610	5	5.00	0.594	3	5
11. How often do you recognize and express your own feelings?	177	0	1.215	2	2.00	0.959	0	3
12. How much does emotional intelligence influence the decisions you make on a personal and professional level?	177	0	3.938	4	4.00	0.854	1	5
13. How much do you think music affects emotional intelligence?	177	0	3.915	4	4.00	0.818	1	5
14. Do you know what Artificial Intelligence is?	177	0	3.887	4	4.00	1.016	1	5
15. Have you used apps that incorporate Artificial Intelligence?	177	0	2.661	3	1.00	1.335	1	5
16. To what extent do you think Artificial Intelligence affects music?	177	0	3.232	3	3.00	0.952	1	5
17. Could Artificial Intelligence replace the way we listen and share music?	177	0	2.915	3	4.00	1.157	1	5
18. Do you think that Artificial Intelligence can contribute to improving mental health?	176	1	2.938	3.00	3.00	1.127	1	5

The analysis of the table above reveals interesting observations on the participants' relationship with music, their emotional intelligence and artificial intelligence.

First, we observe that most participants choose the type of music according to their mood, as indicated by a mean of 3.825 and a median of 4. However, the choice of a particular song appears less defined, with a mean of 2.661 and a median of 3. Of note is also the fact that few participants play a musical instrument, as it is stated by the low mean of 0.294 and median of 0.

As far as the sector of emotional intelligence is concerned, participants show a moderate ability to recognize and express emotions, with a mean of 1.215 and a median of 2. On the contrary, the impact of music on mood and mental health is particularly highly valued, with a mean of 4.525 and a median of 5, which shows the positive perception of music in people's lives. In addition, many people believe in music's ability to heal mental problems, with a mean of 4.198 and a median of 4. Regarding music therapy knowledge, participants have a moderate awareness, as indicated by mean 3.034 and median 3.

Understanding participants' emotions is considered extremely important with a mean of 4.610 and a median of 5, while emotional intelligence seems to play an important role in their decisions, with a mean of 3.938 and a median of 4. At the same time, music is estimated to have a significant effect on emotional intelligence, with an average of 3.915.

In the sector of Artificial Intelligence, participants present a sufficient level of knowledge with a mean of 3.887 and a median of 4, but little experience in using applications incorporating artificial intelligence, as shown by a mean of 2.661. The impact of artificial intelligence on music is moderately rated, with a mean of 3.232 and a median of 3, while there seems to be an idea that artificial intelligence might affect the way we listen to and share music, although not to a large extent, with a mean of 2.915. Finally, the belief that Artificial Intelligence can improve mental health status is moderate with a mean of 2.938 and a median of 3, indicating a restrained optimism of the participants.

Overall, the standard deviations ranged from 0.457 to 1.335, indicating the variability of participants' views on the various research topics.

3. Results

Regarding the first research question which refers to these answers, it appears that 71.1% of the respondents choose the music they listen to depending on the emotional state they experience at the time of the choice. The above percentage results from the sum of the answers "Quite" and "Very", while if this percentage is added to the people who answered "Average" then it follows that 87.5% choose the type of music they listen based on the emotional of the situation, in the majority of choices (at least 3 out of 5 times).

Based on the result of the correlation, it is found that the more time someone spends listening to music, the more carefully they choose their music based on the emotional state they are experiencing ($r_s(175) = 0.691$, $p\text{-value} < 0.01$). Regarding the second part of the first research question, the aim is to evaluate the contribution of music to the level of mental health that characterizes a person. Taking into consideration the answers we can clearly state that approximately 90% consider music as a fairly or very important dimension of influence on mental health.

As far as the second research question is concerned, the influence of music is examined in terms of sharpening people's emotional intelligence but also evaluating the role of music therapy in improving the living conditions and emotions experienced by a person.

According to the quantitative data obtained for this question, 75% consider the effect of music on emotional arousal as high or very high.

According to the statistically significant prices, we observe that there is a small correlation ($r_s(175) = 0.164$, $p\text{-value} < 0.05$) between the frequency of expressing personal feelings and the opinion about the influence of music in terms of aggravating emotional intelligence. At the same time, we realize that there is a medium strength effect between how important participants consider the ability to recognize and understand other people's emotions and how much they believe music affects emotional intelligence ($r_s(175) = 0.376$, $p\text{-value} < 0.01$).

Regarding the third research question, we find out that all the correlation coefficients calculated are statistically significant, as they note p -values less than 0.05. More specifically, the findings are summarized as follows:

1. There is a medium to high correlation ($r_s(175) = 0.545$, $p\text{-value} < 0.01$) between participants' use and understanding of the evolving capabilities of AI applications for music production and sharing and how important the development of such applications and their use is perceived to be for mental health difficulties.

2. There is a medium impact ($r_s(175) = 0.33$, $p\text{-value} < 0.01$) regarding the level of AI's influence in music and the degree of importance of corresponding applications for dealing with mental health problems.

3. Finally, strengthless seem to be the correlations between whether participants know or have been in contact with an Artificial Intelligence application and how important they consider their contribution to mental health programs, the Spearman correlation values are equal to 0.148 and 0.276 respectively.

Discussion – Conclusion

Significant points that were addressed in our study were the role of music in the development and expressiveness of emotional intelligence. More specifically, we touched upon topics such as the ability to recognize, understand and manage emotions. Of note is also the therapeutical power of music when it comes

to mental health, emphasizing on how music can affect mood, the expression of emotions and studying how the emergence of technology and especially artificial intelligence has changed music production and distribution, as well as the effects it can have on people's lives. More specifically, regarding the music choice and mood, the convergence of the research with the research of Panksepp and Bernatzky (2002) was evident, where, as they argue, the mood is directly influenced by the music of the listeners. Similarly, Hanslick (2003), points out that the effect of a melody on our mood has been adequately explained by the physiology of the human organism. The contribution of music to the individual's mental mood was consistent with all our literature reviews, while in dealing with mental problems our research showed that the largest percentage agreed with 45.8%. Although, there was uncertainty regarding the aforementioned. The studies of Zheng *et al.* (2021), Troubat *et al.* (2021) and Fancourt and Perkins (2018), reveal the direct action that music has in combating stress and depression. As also research by Boyd-Brewer (2003) and Choi, Lee and Lim (2008) refer to the improvement of physical recovery and the enhancement of brain functions respectively, brought about by music.

The role of music therapy for the research sample was shared in various percentages, a fact that shows the connection and knowledge that participants have with this type of therapy. From a bibliographical point of view, the beginnings of music therapy as well as its therapeutic properties have been evident throughout time and since ancient times, just like the history of music. According to Karafas (2005), music affects the physiology as well as the psychosynthesis of a person. Regarding the emotional intelligence, participants mostly show that they are influenced for the decisions they make in the various issues of everyday life (personal, professional) and this is logical as it is proven in the research of Goleman (1998), where there are certain abilities that are emotional intelligence by dividing them into two categories.

Of note is the condition where survey participants were asked about their knowledge of artificial intelligence and 44.1% said "Very". This is contradicted when in the next question asking if they have used apps that incorporate artificial intelligence only 17.5% said "Very". The aforementioned is contradicted when in the next question asking if they have used apps that incorporate artificial intelligence only 17.5% said "Very". They should definitely, after knowing the concept of artificial intelligence, realize that most applications and programs that use AI, they incorporate it. According to the literature review, platforms such as Pandora and Spotify use artificial intelligence algorithms to keep listeners engaged with updated music (Williams *et al.*, 2020).

Regarding the last three questions that were addressed to the participants of the research (16. *How much do you think AI affects music?* 17. *Could AI replace the way we listen to and share music?* 18. *Do you think AI can help improve*

mental health?) a variety was observed in the responses and the percentages obtained. The literature review does not directly answer these as it is an evolving topic that requires continuous and thorough study. However, the ethical implications of AI, such as creativity, property rights, and its impact on artists and industry professionals, will be a focal point (Williams *et al.*, 2020).

With reference to the first research question, the research respondents showed that music is important to them, while the reasons for listening to music outweighed entertainment, relaxation, expression and finally relaxation. The largest percentage showed that they choose the type of music according to the lyrics and music that characterize it. Regarding the first research question, the survey respondents showed music is important to them, while the reasons for listening to music outweighed entertainment, relaxation, expression and finally relaxation. The largest percentage showed that they choose the type of music according to the lyrics and music that characterize it. Thus, the person participates more actively in the musical process, leading him/her to connect with the emotional states he/she experiences. The contribution and change of the individual's mental health and mood is determined to be very important for the participants. In these terms, music and emotion interact both directly and indirectly. For each individual this interaction may be different depending on time, space, exposure and lived situation.

Regarding the second research question, it appears that music is linked and can influence a participants' emotional intelligence. Participants showed that the influence of emotional intelligence on the decisions of everyday issues (personal, professional) is enough. On the other hand, the role of music therapy was not so evident as well as the answers given by the people had a diversity regarding the distribution of percentages. The aforementioned distribution of percentages may indicate a confusion that individuals had about this form of therapy, its knowledge, relationship and role. A small percentage of participants had a clear view of exactly what music therapy is and what its implications are for mental health.

In the third research question, the number of participants showed that they know what artificial intelligence is, of course it contradicts when only 11.3% answered that they have used applications that integrate it. The participants agreed however to the fact that the impact of Artificial Intelligence in music is medium to high, the same applies regarding the production, distribution and the contribution of music. The stronger the belief that Artificial Intelligence will replace the way we listen to and share music, the stronger the contribution of these technologies to the treatment of mental health problems.

Research's conclusions highlight the importance of music and technology in mental health, suggesting further research in those fields. Overall, the present research offers a multidimensional look at the relationship between music, technology and mental health.

Research Limitations – Further Suggestions

Suggestions for future research could be to conduct interviews with music and mental health experts, where a more specific and specialized view on the subject would be revealed. Another proposal is the creation of a psycho-educational music therapy program for children or teenagers in order to manage and deal with mental problems (e.g. severe anxiety, depression).

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