

Oral Presentation

# An EEG-based quantitative analysis of the emotional effect of music therapy in advanced cancer patients

Rafael Ramirez\*, Josep Planas, Nuria Escudé, Jordi Mercadé, Cristina Farriols

\*Correspondence: Rafael Ramirez, Music & Machine Learning Lab, DTIC,  
Universitat Pompeu Fabra, Roc Boronat 138, 08018 Barcelona, Spain,  
[rafael.ramirez@upf.edu](mailto:rafael.ramirez@upf.edu)

## Abstract

We present an EEG-based quantitative analysis approach to assess the impact of music therapy in advanced cancer patients. The aim of this study is to quantify the positive emotional effect of music therapy in cancer patients by detecting their emotional state from their brain activity before, during and after music therapy sessions.

Keywords: Music therapy, emotions, brain activity, cancer, EEG

## Background

Music is known to have the power to induce strong emotions and may even improve cognitive, social and emotional abilities. Thus, a variety of clinical conditions are often treated with music therapy. However, there is often a lack of formal research involving quantitative methods to assess the benefits and limitations of music therapy in concrete treatments.

## Aims

The aim of this work is to quantify the emotional effect of music therapy sessions in advanced cancer patients by decoding their emotional state from their brain activity, detected as EEG data, before, during and after the sessions.

## Method

We have conducted a pilot clinical experiment in which music therapy has been applied to patients with advanced cancer and at the same time their brain activity, as electroencephalogram (EEG) data, has been recorded. A control group of patients for which, only company has been provided has been included in the study. Based on our previous work on emotion detection [1], the patients' EEG data has been mapped to emotional indicators, concretely as a coordinate in the arousal-valence plane [2]. The emotional indicators have been analyzed in order to quantify (1) the overall emotional effect of music therapy on the patients compared to controls, and (2) the relative effect of the different music therapy techniques applied during each session.

## Results

During each music therapy session, five conditions have been considered: *I* (initial patient's state before MT starts), *C1* (passive listening), *C2* (active listening), *V* (visualization), and *F* (final patient's state). The analysis of preliminary data has shown a statistically significant positive arousal difference between *I* and *C2* ( $p=0.016$ ) and a significant positive valence difference between *I* and *F* ( $p=0.0009$ ). No significant differences were found on the control group.

## Conclusions

Preliminary results show that music therapy has a positive emotional effect on advanced cancer patients. The analysis of the EEG data shows a significant positive difference of the patients' valence states at the end of the music therapy sessions with respect to their states at the beginning of the sessions. This result can be interpreted as a positive emotional effect of MT in advanced cancer patients.

## References

[1] Ramirez, R., and Vamvakousis, Z. (2012). "Detecting emotion from EEG signals using the emotive epic device," in *Proceedings of the 2012 International Conference on Brain Informatics, LNCS 7670*(Macau: Springer), 175–184.

[2] Russell, J. A., Weiss, A., & Mendelsohn, G. A. (1989). *Affect Grid: A single-item scale of pleasure and arousal*. *Journal of Personality and Social Psychology*, 57, 493–502.

## Authors' (short) Bios

**Rafael Ramirez.** PhD, MSc, BSc. Tenured Associate Professor and Leader of the Music and Machine Learning Lab at the Universitat Pompeu Fabra, Barcelona. BSc in Mathematics from the National Autonomous University of Mexico, and MSc and PhD in Artificial Intelligence from the University of Bristol, UK. He has published more than 100 research articles in peer-reviewed international Journals and Conferences and has given invited seminars across Europe, Asia and America.

**Josep Planas.** Medical Doctor specialized in Oncology at the Palliative Care Unit, Oncology Service, Parc de Salut Mar Barcelona, Spain. Member of the Board of Directors of the International Association for Music & Medicine (IAMM).

**Nuria Escudé.** Music Therapist. Director of the Catalan Institute of Music Therapy and Director of the Master in Music Therapy, Universitat de Barcelona. Member of the Board of Directors of the International Association for Music & Medicine (IAMM).