Clustering techniques for patients suffering Acquired Brain Injury in Neuro Personal Trainer

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1. INTRODUCTION

The study of the effectiveness of the cognitive rehabilitation processes and the identification of cognitive profiles, in order to define comparable populations, is a controversial area, but concurrently it is strongly needed in order to improve therapies.

There is limited evidence about cognitive rehabilitation efficacy. Many of the trials conclude that in spite of an apparent clinical good response, differences do not show statistical significance. The common feature in all these trials is heterogeneity among populations. In this situation, observational studies on very well controlled cohort of studies, together with innovative methods in knowledge extraction, could provide methodological insights for the design of more accurate comparative trials. Some correlation studies between neuropsychological tests and patient's capacities have been carried out [1][2] and also correlation between tests and morphological changes in the brain [3].

The procedure's efficacy depends on three main factors: the affectation profile, the scheduled tasks and the execution results. The relationship between them makes up the cognitive rehabilitation as a discipline, but its structure is not properly defined.

In this work we present a clustering method used in Neuro Personal Trainer (NPT) to group patients into cognitive profiles using data mining techniques. The system uses these clusters to personalize treatments, using the patient's assigned cluster to select which tasks are more suitable for its concrete needs, by comparing the results obtained in the past by patients with the same profile.

2. METHODS

NPT [4][5] is a telemedicine cognitive rehabilitation system, offering to therapists a powerful tool for managing, monitor and evaluate therapies more efficiently, based on computerized tasks assigned to rehabilitation sessions that patients execute.

When a patient suffers an Acquired Brain Injury (ABI), the result of the neuropsychological exploration tests let us know the affectation grade of every cognitive function: attention (sustained, selective and divided), memory (visual, verbal and working) and executive functions (scheduling, inhibition, flexibility, sequencing and categorization).

Every exploration battery item corresponds to a concrete cognitive subfunction. The alteration of one subfunction turns on an alteration of the higher function. This higher alteration also provokes a global affectation profile. Thus, in order to study the efficacy in the procedures an identification of

the different profiles is needed and, after that, to define if there is an improvement on a subfunction level, on a function level, or on a global level.

To elaborate the affectation profiles a normalization process is carried out. The different tests results are put on the range 0 to 4, from no affectation, minor, moderate, severe to very severe. This normalization process not only considers the tests results itself, but also the patient's age and study level, because these two demographic data influence the patient's cognitive capacities.

3. RESULTS

Once the normalized tests results are in the system, clinical criteria for every subfunction, function and global affectation are applied. The identification of these initial affectation profiles allows NPT to group patients into clusters.

This clustering procedure is able to identify groups of patients on a non-supervised manner, implementing the Expectation Maximization (EM) clustering technique using Weka tool. This probabilistic clustering technique is based on a statistical model called mixture, and gives us the probability for each patient to belong each cluster.

Nowadays, the system has 608 patients with a cognitive profile assigned in the database; in total, the system has grouped all these patients into 9 different clusters, what means 9 kind of related patients.

4. CONCLUSIONS

The clustering process used in NPT groups patients with similar characteristics, taking into account the patient's initial neuropsychological exploration, age and study level. Once a patient has a cognitive profile assigned, using data mining techniques, the system makes use of the historical information related to every patient's execution results and their improvement after completing the treatment to determine which tasks are more suitable to each patient. By analyzing which tasks have worked fine in the past for patients with the same cognitive profile, the therapist can easily choose the more suitable tasks for each treatment.

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