Chapter 58
Toward an Application to Psychological Disorders Diagnosis

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Abstract Psychological disorders have kept away and incapacitated professionals in different sectors of activities. The most serious problems may be associated with various types of pathologies; however, it appears, more often, as psychotic disorders, mood disorders, anxiety disorders, antisocial personality, multiple personality and addiction, causing a micro level damage to the individual and his/her family and in a macro level to the production system and the country welfare. The lack of early diagnosis has provided reactive measures, and sometimes very late, when the professional is already showing psychological signs of incapacity to work. This study aims to help the early diagnosis of psychological disorders with a hybrid proposal of an expert system that is integrated to structured methodologies in decision support (Multi-Criteria Decision Analysis – MCDA) and knowledge structured representations into production rules and probabilities (Artificial Intelligence – AI).

Keywords Early diagnosis · Expert SINTA · Expert systems · Psychological disorders · Multicriteria

1 Introduction

Although psychological disorders have causes and specific symptoms, the establishment of diagnosis is not so easy to be determined by clinical and laboratory tests, but by analyzing the behavioral responses from a human being facing daily life events. Psychological disorders vary from person to person and also in the severity degree. In the same way as personality, consciousness, and intelligence, the term "abnormal behavior" is difficult to define because of subjectivity inherent to the subject. Major difficulties are encountered when trying to diagnose whether a

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H.R. Arabnia and Q.-N. Tran (eds.), *Software Tools and Algorithms for Biological Systems*, Advances in Experimental Medicine and Biology 696,
DOI 10.1007/978-1-4419-7046-6_58,

person is really suffering from a psychological disorder or not, since the symptoms will manifest small imperceptible signs to both the individual who is suffering the disorder and who lives together.

There are some aggravating factors, which include: first, the resistance offered by a person suffering from psychological disorder to accept the situation, and second, a healthy individual pretending to be suffering from the disorder to get some personal advantages [1].

Aiming to facilitate the understanding of the study given in this article, we present a hybrid model combining the methodology of multi-criteria decision support and expert system. This model will examine the main symptoms and causes of the following types of psychological disorders that have affected the economically active population in the world, covering various industries and professions: psychotic disorders, mood disorders, anxiety disorders, antisocial personality disorder, multiple-personality disorders, and addiction disorders. Afterward, the force relation between symptoms and causes will be established in order to create a hierarchy to set the rules that will be used as a base of knowledge to the expert system to help in the diagnosis in accordance with assigned value to variables representing the symptoms and causes. Important to note that hybrid models have been used to help in decision-making and the search for diagnoses in the health area and others areas, as referenced in previously published articles [2–7].

2 Psychological Disorders

2.1 General Information

For many years, mankind has thought "health" as the absence of hurt. Currently, the perception of "health" is associated with the absence of disease. The World Health Organization (WHO) defines *health* as a state of complete physical, mental and social well being, involving three areas that are interconnected with each other: physical health, psychological health, and social health.

The abnormal behavior consists in disordered emotion, disordered thinking or disordered action models identified by exceptions to a statistical standard distribution, by dysfunction or incapacity, by personal distress, and by the violation of social norms and cultural rules [8].

2.2 Psychological Disorders Discussed in This Article

The Mental Disorders Diagnostic and Statistical Manual, fourth edition (DSM-IV), published in 1994 by the American Psychological Association (APA) was decided to be used in this study, considering that it proportionates a better presentation structure

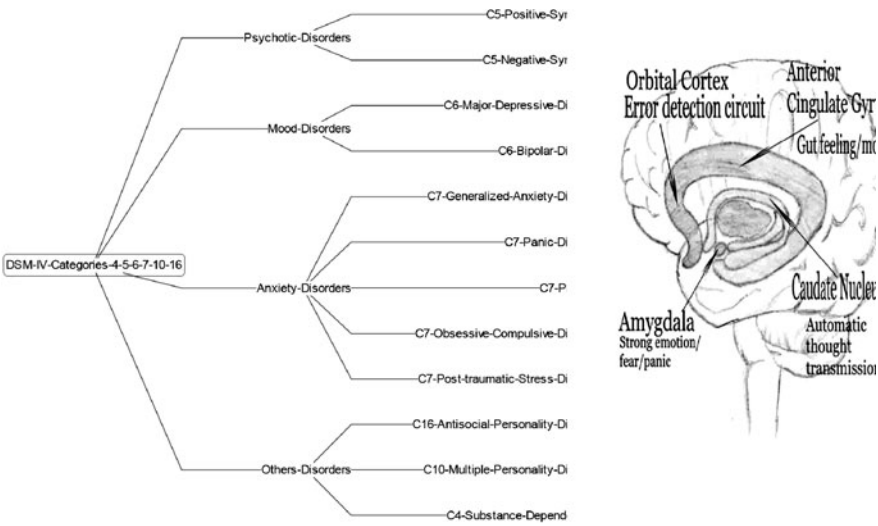

Fig. 1 Major categories of psychological disorders

and the best synthesis capacity without losing the quality and the details of the studied object. The map, described in Fig. 1, generated using the software HIVIEW, version 3.2.0.4, presents the most well-known psychological disorders. The illustration on the right side of Fig. 1 highlights some parts of the human brain where processed synapses are correlated with emotions and feelings evident in the behavior of a person.

2.3 Considerations About the Psychological Disorders Studied in This Article

One of the most drastic consequences for a person who suffers from psychological disorders is the image of incapable made by the society in which he or she lives. As much as the person strives to dispel the negative image formed, the damage is devastating and difficult to reverse, given the ease of lasting image. It is common to observe in a workplace how people react when a teammate suffers from a psychological disorder, even if he or she is being treated by specialists and taking medicines, most of the work team members observe this person with suspicion. A mutilation of a limb, or a severe infection controlled by medication, or even eradicated cancer at early stage provides chances for reinstatement of a person in the social life. However, the stigma of suffering from a severe psychological disorder usually invalidates the individual anywhere in the world, resembles the stigma of the leprosy in individuals, not long time ago. Currently, individuals suffering from leprosy are less stigmatized than individuals who suffer from psychological disorders.

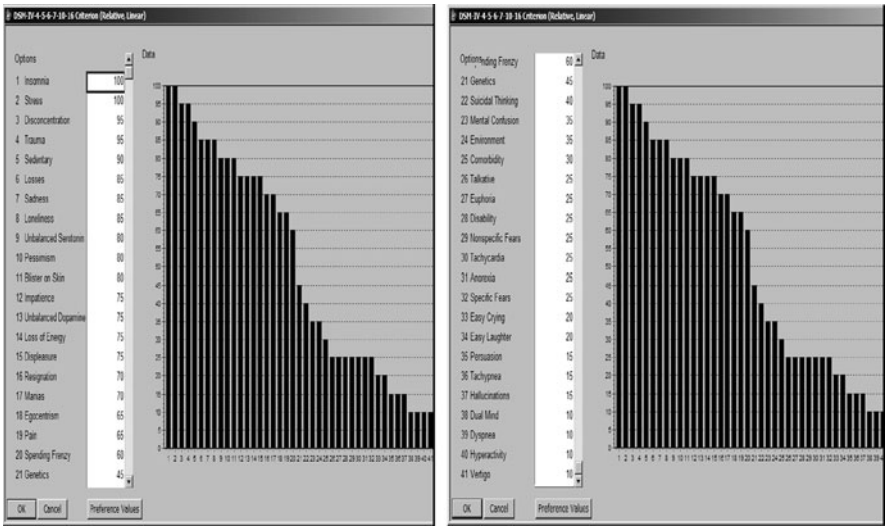

Fig. 2 Main events for the control of psycological disorders

One explanation for this discrimination is the misinformation from the great majority who make up the society, starting from the family of this individual. Based on the premise that it is possible to identify the causes and symptoms of psychological problems, we can try to diagnose these disorders as quickly as possible. For this, in this study were highlighted in Fig. 2 some of the main control events that are correlated with symptoms and causes that show some psychological disorders. For each event was assigned a confidence factor that indicates the weight on the outcome of the diagnosis. Note that these control events and confidence factors will be submitted to the methodology to support decision making with multiple criteria, described in item 3 below, and for the purpose of constructing an array of sense of values representing the differences in attractiveness between the events.

3 Model of Decision-Making Support Proposed

In order to establish a diagnosis in Psychology and Psychiatry, studies, experiments and careful observations of the symptoms that lead to the cause of evident disorder are necessary. A major difficulty in reaching a correct diagnosis is the complexity of highlighted factors, as well as the vast amount of information, that the expert must take into account including cultural, biological, psychosocial issues, information quality, and signs and symptoms common to many diseases. Because of this, the process becomes complicated and it is transformed into a difficult model. The methodology to support multicriteria decision-making has much to add to the Psychology of Health diagnosis processes.

3.1 Description of Multicriteria Methodology to Decision Making

There are three main stages in the decision support [9]: (a) Structuring the problem formulation and the goals identification. (b) Assessment of the alternatives and the criteria; (c) Recommendation: sensitivity and robustness analyses are made to check whether changes in the model parameters affect the final assessment outcome.

The Measuring Attractiveness by a Categorical-Based Evaluation Technique (MACBETH) method is an approach for multicriteria decision support. The research that initiated the method was performed by CA Bana e Costa and J.C. Vansnick in the beginning of the 1990s [10]. This methodology was in response to the question: *How to build a wide range of preferences from a range of options without forcing policy makers to produce their direct numerically preferences?* This approach allows assigning notes to each alternative through a paired comparison. Given the two alternatives, the decision which must be the most attractive in the case, has greater degree of confidence, and in which degree of attractiveness on a scale that has semantic correlation with ordinal scale. The program itself is the analysis of cardinal consistency (transitivity) and semantics (relations between the differences), suggesting in case of inconsistency how to resolve it. Linear programming is suggested a range of notes and intervals as they may change without making the problem inconsistent (PPL unfeasible). It also possibly adjusts the decision graphically and the value of the awarded marks, within the ranges allowed. According to the pioneers of this method, only after this adjustment, with the expert knowledge introduction, it gets characterized as the construction of a cardinal scale of values. The difference in attractiveness is very important in this methodology. For the MACBETH method is important the following reasoning: Given the impacts ij (a) and ij (b) of two potential actions a and b, according to a fundamental point of view FPVj, being judged a more attractive than b, the difference in attractiveness between a and b is judged as "null," "very weak," "weak," "moderate," "strong", "very strong," or "extreme." It introduced a scale formed by different semantic categories in attractiveness; the size is not necessarily equal to facilitate the interaction between the decision maker and analyst. The semantic categories, Ck, $k = 1 \ldots 6$, are represented as follows [11]:

- C1 very weak difference of attractiveness (or between zero and weak) $\rightarrow$ $\mathrm{C1} = [\mathrm{s1},\ \mathrm{s2}]$ and $\mathrm{s1} = 0$
- C2 weak difference of attractiveness $\rightarrow$ $\mathrm{C2} =]\mathrm{s2},\ \mathrm{s3}]$
- C3 moderate difference of attractiveness (or between weak and strong) $\rightarrow$ $\mathrm{C3} =]\mathrm{s3},\ \mathrm{s4}]$
- C4 strong difference of attractiveness $\rightarrow$ $\mathrm{C4} =]\mathrm{s4},\ \mathrm{s5}]$
- C5 strong difference of attractiveness (or between strong and extreme) $\rightarrow$ $\mathrm{C5} =]\mathrm{s5},\ \mathrm{s6}]$
- C6 extreme difference of attractiveness $\rightarrow$ $\mathrm{C6} =]\mathrm{s6}, +[$

To facilitate the expression of absolute judgments of difference in attractiveness between the pairs of alternatives, it is useful to the construction of arrays of value judgments [12].

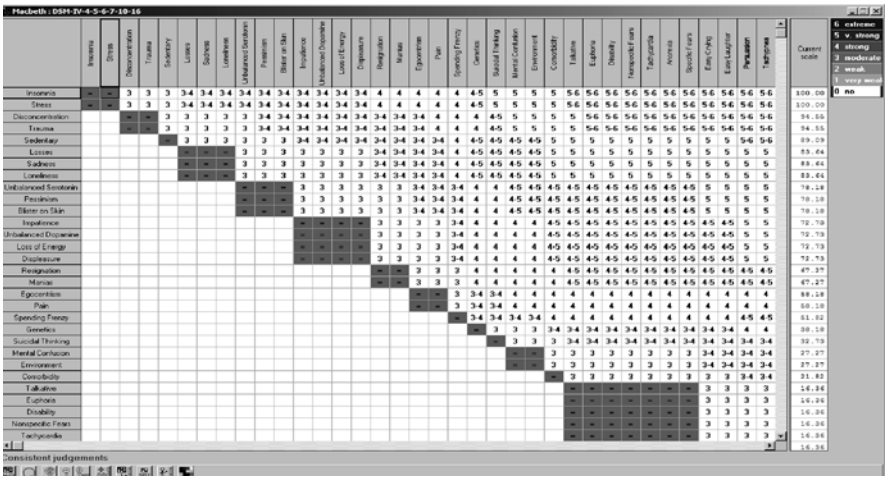

Fig. 3 Matrix of value-judgment and current scale

3.2 Results After Submitting the Events of Control

After submitting the events to the methodology to support decision making, implemented through software HIVIEW, which also runs MACBETH method, the control events cited in Fig. 2 were adjusted in order to compose the matrix of the main constant value in Fig. 3, which allows the visualization of the degree of attraction between the events and the Current Scale of confidence factors, and indicates that the results are consistent appearing "Consistent Judgments." The proposed model in this article suggests that the control events and confidence factors listed in Fig. 3 be exported to the Expert SINTA tool, to compose the knowledge base of an expert system to help the obsessive–compulsive disorder diagnosis.

4 Expert Systems

Expert systems are computer programs that offer solutions to certain problems in the same way that human experts offer solutions under the same conditions. The software Expert SINTA was created by a group of scholars at the Federal University of Ceará (UFC), and the State University of Ceará (UECE), called *Group SINTA* (**S**istemas **INT**eligentes **A**plicados or Applied Intelligent Systems) [13]. This is a computational tool that uses artificial intelligence (AI) techniques for automatic generation of expert systems. It uses a knowledge representation model based on production rules and probabilities, with the main objective of simplifying the construction work of expert systems through the use of a shared machine inference, the automatic construction of screens and menus, treatment of probabilistic rules

production, and the use of sensitive explanations to the context of the knowledge base modeled. An expert system based on this type of model is very useful in classification problems. Some of the Expert SINTA main features are: use of backward chaining; use of confidence factors; tools for debugging; possibility to include online help for each knowledge base. As previously mentioned, the control events and confidence factors in psychological disorders are initially presented in Fig. 2, and subsequently analyzed and compared with each other, to calculate the difference in the degree of attractiveness for the construction and trial of the value matrix, generated by the MACBETH method, as shown in Fig. 3. After that, the information is compiled for, finally, feeding the Expert SINTA to the construction of expert system.

The process of building the expert system is composed of the following steps: (a) Registration of general information and goals of the knowledge base; (b) Registration for each event in Fig. 2 as a variable in the future specialist system; (c) Registration and definition to the objectives variables, which will point the diagnosis, with their level of confidence; (d) Construction of the user interfaces of the specialist system; (e) Construction of logical rules; (f) Definition to the best sequence for the logical rules; (g) Testing and execution of the specialist system; (h) Analysis of results, using log of execution provided by the expert system.

5 Conclusion and Future Works

Many intelligent techniques have been incorporated into the decision-making process. These techniques are based on technology of AI, such as expert systems, neural networks, intelligent agents, case-based reasoning, Fuzzy Logic and Genetic Algorithms. Despite these technological advances, much still needs to be done for the automation of decision-making processes, especially when it involves the multicriteria analysis. This article is part of a study intended to contribute to the development of an algorithm designed to automate the proposal for a connection between a methodology to support multicriteria decision-making and a program of construction of expert systems. Also provides a knowledge base expert system to aid in early diagnosis of psychological disorders. The information generated in the analysis of multicriteria methodology will be used in the algorithm in order to turn them into variables with the respective degrees of confidence, which will be processed by the inference engine of the expert system that will use this information to diagnose and incorporate them into its knowledge base or discard them. The test realized in this article attempts to show a hybrid model, using a connection manually. So it tries to present the feasibility of integration between the technologies mentioned: methodology to support multicriteria decision-making and expert system. With this proposal, we hope to help in the quality of automated diagnostics.

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