

# PSIQ - A CBR APPROACH TO THE MENTAL HEALTH AREA

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## ABSTRACT

The paper describes the application area of diagnosis and therapy of mental disorders. A CBR system that assists professionals and relatives in this area is presented.

On the Mental Health area, a certain kind of problems can be fitted in an equal rank, usually designated "behavior disorder" (schizophrenia, alcoholism, etc.). Such cases in which the disease attacks the patient's quotidian behavior directly demand not only clinical care but a constant attendants' supervision (nurses, relatives, etc.). The quick identification of the characteristic behavior symptoms and the training of the attendants and the experts in this area are only some of the items that can be decisive for the total or partial reinstatement of the patient to the society.

The proposal of using the CBR technique in this area aims at offering a training tool to the professional and attendants, as well as a research instrument of the behavior deviations, through the formation of a case base and the respective behavior reports considered suitable.

**Keywords:** Case-based reasoning, behavior disorder, Artificial Intelligence application

## 1. INTRODUCTION

The following describes the application area of diagnosis and therapy of mental disorders. A CBR system that assists professionals and relatives in this area is presented.

On the medical area, more precisely on the physical diseases area, a number of systems were developed (MYCIN, INTERNIST, CASEY, etc.) ([7], [8]), employing several techniques, in attempts to improve the establishment of quick and safe diagnosis.

The PSIQ system, that we propose, is applied on the analysis and generation of solutions for real behavior episodes, using for this purpose a case base containing the theoretical and practical knowledge integrated to the specific knowledge of the professional of the area. In the PSIQ system a case is represented by the formalized description of an episode, added by the professional's diagnosis and the proposed solution to the episode. Several indexes are defined, allowing different retrieval alternatives:

- select cases with the purpose of providing a solution for a new episode
- retrieval with the purpose of research that may help to analyze the different variables involved

Still from this perspective, the system is even able to help in the formulation of generalizations and statistics.

## 2. THE DEMAND OF A SPECIFIC SYSTEM IN THE MENTAL HEALTH AREA

The AI applications in the Medical Science can be classified in two fields: identification and treatment of physical diseases (cardiology, internal medicine, orthopedics, etc.) and mental disorders (psychology, psychiatry, etc.).

Given the specific characteristics of physical diseases, specialized systems were widely used in this field, since the clinical symptoms indexes are easily expressed in numeric values (clinical exams, temperature, blood pressure, heartbeat), making the sanity standard's deviation measurable. Besides, the combination of the symptoms and their respective values, according to rules progressively more defined, is decisive in establishing the final diagnosis, which cannot prescind the physician's direct appreciation and observation.

Several systems were developed employing diverse techniques, in the attempt to improve the quick and safe establishment of a diagnosis (see [7], [8]): MYCIN, INTERNIST-1 /CADUCEUS, MDX, CASEY, MEDIC.

The common features to all these systems are the manipulation of measurable symptoms and the existence, even if implicit, of a rule-based module. Nevertheless, on the mental health field, similar systems haven't been applied, basically for two reasons:

1. Difficulty in establishing symptoms and their values
2. Strong interaction among the symptoms.

The first reason occurs in designing a diagnostic system, because the difficulty in establishing precise values of symptoms; almost all symptoms in this medical field are merely observable, not measurable (e.g., fear, anxiety, aggressiveness, cruelty, shrinking from contact, etc.). This means that the perception of these symptoms itself implies a subjective attitude of the observer (in this case, the psychologist or psychiatrist). The professionals in this area choose to register only the existence or absence of a certain symptom in a patient, at times assigning fuzzy values ("high or medium perceivable sign").

Yet there are attempts to codify the disorders (see [3] and [6]) through specific compendiums. For example, a typical disease like **Schizophrenia** receives the alphanumeric code "F20" in the CID-10 compendium [6], and its several subdivisions are codified on alphanumeric codes, while in the other compendium, the DSM-4 [3], the diseases are classified with five digits. These differences are shown in figure 1.

By observing any of these compendiums, it is easy to verify the possibility of treating almost all of the symptoms as fuzzy variables, with "high-medium-low" values.

CID-10	DSM-4
<b>F20 - Schizophrenia</b>	<b>295 - Schizophrenia and other psychotic disorders</b>
F20.0 Paranoid Schizophrenia	295.30 Paranoid Type
F20.1 Hebephrenic Schizophrenia	295.10 Disorganized Type
F20.2 Catatonic Schizophrenia	295.20 Catatonic Type

Fig. 1 - Differences between codification systems

The second reason arises from the fact that the same symptom can appear in different contexts leading to different diagnosis. For example, in **Paranoid Schizophrenia** (F20.0), there may exist irritability, anger, and psychotic symptoms that are difficult to distinguish from similar features of a **Maniac Episode** (F30.x). Other symptoms like delusions or hallucinations may suggest both **Mental Retardation** (F71.x) or **Schizophrenia** (F20.x) [3].

On the other hand, the professional's formation is built with a wide range of theoretical studies, examination of evidences, analysis of different cases and residences. The preparation of the parents and

attendants, in its best, includes reading and the search for reports of similar cases. In this context, a system using Case-Based Reasoning (CBR) techniques can accelerate and enhance this type of training.

PSIQ stores episodes of behavior cases reported by professionals or relatives, as well as the solutions for each episode, making up a case base to be used as “a source of possible solutions” in the training sessions. Each new episode reported during training is a new input to the PSIQ system, which, after its reasoning, suggests a solution based on solutions of similar episodes found in the base.

The solution suggested by PSIQ should be confronted to that one proposed by the trainee: the definitive version along with the input situation, form a new case to be included in the base.

### 3. AN EPISODE

Before detailing the PSIQ system’s proposition it is necessary to define certain terms, placing them on the current context of a clinic [5].

The initial process usually consists in an interview with the patient or his parents. The collected history is registered **extensively** on file cards. Besides this description of the initial situation, the card contains the indication of the **hypothetical diagnosis**, followed by the **treatment** or **behavioral indication**. The initial appreciation can be updated through later interviews, as well as the establishment of a **definitive diagnosis** or the treatment/behavioral indication. Therefore a card usually has the basic structure presented on figure 2.

SITUATION	DIAGNOSIS	TREATMENT /BEHAVIOR	OBSERVATIONS
initial	hypothetical	initial	SELECTION
update <sub>1</sub>		behavior <sub>1</sub>	cause of the modification
update <sub>2</sub>		behavior <sub>2</sub>	
update <sub>3</sub>	intermediate	behavior <sub>3</sub>	cause of the modification
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update <sub>n</sub>	definitive	behavior <sub>n</sub>	cause of the modification

Fig. 2 - Descriptive card

However one must notice that there were expressions in the descriptions that belong to the CID-10 category list. That led to a change on the card: the initial situation is divided in several **aspects** (psychiatric, neurological, etc.); each aspect is described by the indication of existence or absence of CID-10 **categories** (symptoms), with eventual fuzzy values (few, much, etc.). There is still the hypothetical-diagnosis, the definitive diagnosis, as well as the treatment/behavioral indication. Detected categories can be added to each aspect through later interviews. The modification in the diagnosis and treatment/behavior attributes can still be done. Figure 3 shows the new structure of a card.

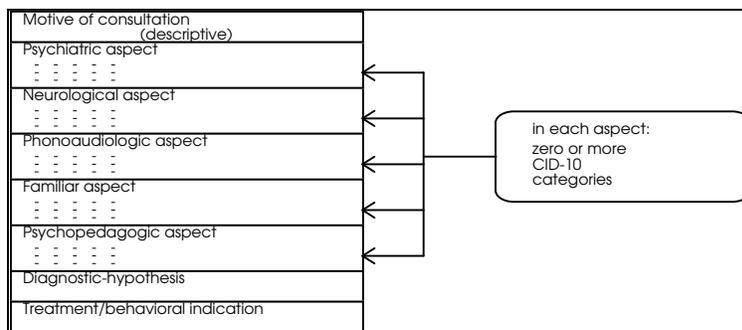


Fig. 3 - Schematic card

Based on this set-up, we can establish that:

- one or more categories describe an aspect
- several aspects define an area
- several areas constitute a diagnosis

A feature that should be noticed is the existence of categories that can appear in different aspects, or even different areas, as shown in figure 4 and in the previous section.

cognitive area:	psychiatric aspect psychopedagogic aspect neurological aspect phonoaudiological aspect
comportamental area:	familiar aspect psychiatric aspect neurological aspect

Fig. 4 - Same aspect in different areas

## 4. THE PSIQ SYSTEM

This section will describe the PSIQ system concerning the CBR technique. The following aspects will be addressed: the representation of a case, ways of retrieval and learning aspects, and the architecture of the system.

### 4.1 REPRESENTATION OF A CASE

Three types of information will represent each case in the PSIQ system, as shown in figure 5: the **situation**, the **diagnosis** and the **treatment/behavior**. The **situation** is formed by several **areas**, each **area** containing the **aspects** by which it is defined, and each **aspect**, the **categories** described during interviews. The **diagnosis** initially contains the hypothetical-diagnostic; considering that up to now there has not been registered the need to store modifications in this attribute, only the diagnosis considered in that phase of interviews will always be registered. The **treatment/behavior** will be a descriptive attribute, containing indications that concern directly to the patient, as well as necessary suggestions to the parents of how to deal with the patient. This attribute could also contain descriptions of relevant details of the initial interview (e.g., familiar environment, a particular situation about the onset of the disorder, a fact that initiated a crisis, etc.). The **situation** is described, therefore, by a list of lists or by a structure.

<i>situation:</i>	area <sub>i</sub>			
	... aspect <sub>ij-1</sub>	aspect <sub>ij</sub>		aspect <sub>ij+1</sub>
	.....	category <sub>ijk-1</sub>	category <sub>ijk...</sub>	category <sub>ijn</sub> .....
<i>diagnosis:</i>	code	description		
<i>treatment/ behavior:</i>				

Fig. 5 - Representation of a case

Similar to the PADTEX [1] system, each case of the case base must generate an input to a strategic base (see Section 4.4), which will record the reasoning by which the inclusion of a specific **category** in some aspect determines a change on the **diagnosis** and/or **treatment/behavior**. So, each input of the strategic base will have two main attributes: **date** and **occurrence**. Initially, it will contain the date of the first interview and the hypothetical-diagnostic. Later, as it is needed, there will be

recorded the new dates, the changes made in the case, and the reason why this changes were made. The figure 6 shows an example of an input in the strategic base and its content.

		case X
Date	Occurrence	
01-01-93	300.01 Panic disorder without Agoraphobia	
10-01-93	<ul style="list-style-type: none"> <li>• Frequent use of benzodiazepine related.</li> <li>• Substituting 300.01 by 304.10 (Sedative, Hypnotic, or Anxiolytic Dependence)</li> <li>• Depressive crisis risk</li> </ul>	

Fig. 6 - An input to the Strategic Base

## 4.2 RETRIEVAL OF CASES

The PSIQ system has several retrieval indexes that can be used according to the desired type of query, as shown in figure 7.

To allow this kind of flexibility, it is suggested the indexing of the case base through an index-array, containing a code and an index list which can be a category list or diagnosis list, depending on the code.

By this way, the similarity is obtained through the number of common categories/diagnosis among the cases of the base and the input situation.

CODE	LIST CONTENTS	QUERY EXAMPLE
0	category codes	What is the recommended behavior for a violent person, with suicidal antecedents?
1	diagnosis code	What are the most characteristic features of a schizophrenic patient?

Fig. 7 - Structure of the index-array

## 4.3 LEARNING IN PSIQ

The learning step is very easy to implement in a CBR system, mostly in applications with easy adaptations. Due to its simplicity, a solution similar to the PATDEX [1] system's was chosen: the new situations retrieve cases with a higher degree of similarity, suggesting a solution based on these cases. The decision of applying the suggested solution or adapting it in several points is an exclusive responsibility of the user:

- if the suggested solution is completely accepted, the retrieved case is considered identical to the input situation.
- if there is an adaptation on the solution, the new case (input situation + solution) should be included in the case base, generating an input to the strategic base with the explanation of the adaptation.

On this way, the case base and the strategic base will be updated and new cases will be available for future recovery in new situations. Every case in the case base should have a record of the last date that the case was retrieved. Consequently, cases that were not accessed during long periods of time can eventually be excluded from the case base. This characteristic will control the growing of the case base, keeping only the most accessed cases, and avoiding the need of big storing areas.

However, there exist some very unusual, special diseases, that occur at very low populational rate; for these cases, the default exclusion possibility is not to be used. For this reason, each case should have an attribute of the storage **priority**:

priority = 0: special case - do not permit exclusion without the direct confirmation of the user;  
priority = 1: common case - default operations permitted.

#### 4.4 THE ARCHITECTURE

After these considerations, it is possible to show the interconnection of the modules required for the PSIQ system: language, case base, strategic base and table of categories.

**LANGUAGE TREATMENT** - this module is responsible for identifying keywords that describe a category. This module is a natural language processor, trying to identify some expressions to replace them by the correspondent category.

**CASE BASE** - this module records the cases (situation + solution + diagnosis).

**STRATEGIC BASE** - it consists of modifications of categories, diagnosis and treatment/behavior.

**TABLE OF CATEGORIES** - it contains the codes for the categories; whenever is possible, a category list will be preceded by a diagnosis code.

Figure 8 shows the interaction of the several modules described.

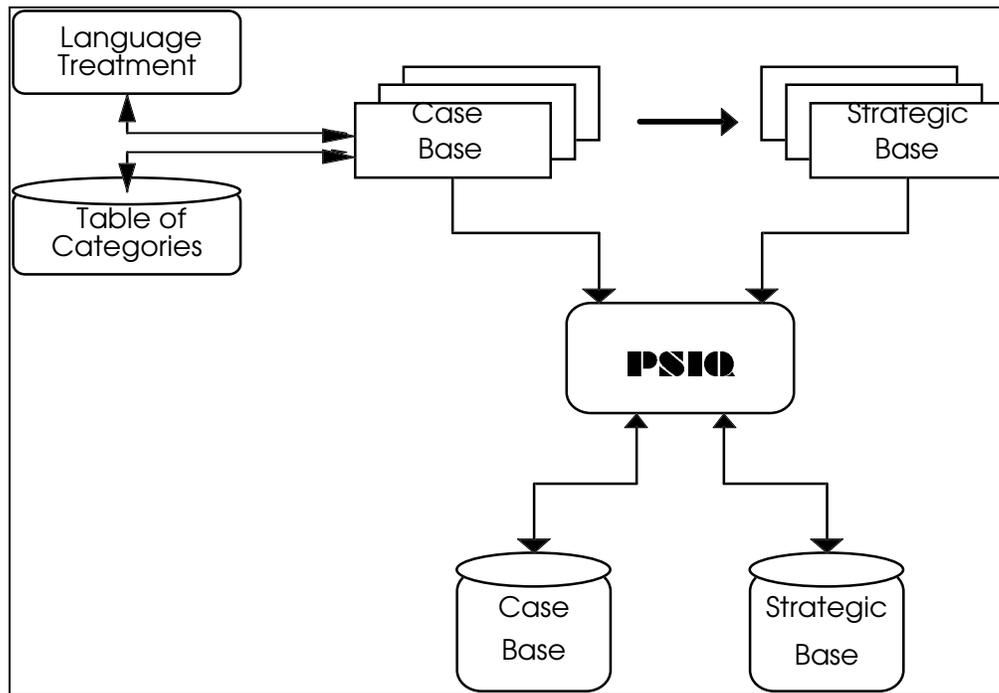


Fig. 8 - PSIQ System

The PSIQ system receives an initial episode as an input, activating the LANGUAGE TREATMENT, which delivers the situation's schematic card. During the retrieval process, the system accesses the CASE BASE and the STRATEGIC BASE, and forms the solution for the input situation. This solution is submitted to the user, who can indicate changes. Once the solution is accepted, the new case (formed by the situation), the initial diagnosis and the accepted solution are included in the CASE BASE. During the process of the constitution of a new case, the correspondent input to the STRATEGIC BASE is generated, but it can be updated during the patient's treatment phase.

## 5. CONCLUSION

This paper presented a design of a CBR system to be used to train people who supervise patients with behavior disorders.

In supervising behavior disorders, the importance of former experience is more emphasized: we know how to deal more properly with a problem if, somehow, we already have a model of behavior to base upon. For this reason, the selected technique was the CBR.

To “actually” develop the described system, additional research in psychiatric clinics and alternatives to improve the recuperation of the cases must be addressed.

However, as verified in clinics, a system implemented according to the presented project will be very useful to the psychiatric area, especially for the possibilities of research and training.

In the psychiatric area, there are not so many applications of Artificial Intelligence as diagnostic reasoners or other specific applications. The main reason is the lack of standardization in the terminology, as well as the excess of merely descriptive situations. The language treatment module suggested in the project could be the most suitable way to surpass these obstacles. This is the reason why its definition demands deeper studies and research, as it is being done actually on the PSIQ system.

The PSIQ system will also be available as an auxiliary tool to the diagnostic process, through the development of a CATEGORIZATION TREATMENT module to replace the TABLE OF CATEGORIES. This module would be responsible for gathering the categories in order to establish a diagnosis; it could be implemented as a decision tree, containing the interactions with other categories.

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