Learning from professionals: Exploring cognitive rehabilitation strategies for the definition of the functional requirements of a telerehabilitation platform

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A B S T R A C T

In the past few years, the advances in Information and Communication Technology (ICT) led to the development of platforms and applications that aim to support cognitive rehabilitation therapy that contributes to extend patients' treatment at home. In our research we adopted the Human Centered Approach to design a cognitive rehabilitation platform that is able to provide tools and features tailored to the professional needs and strategies and also able to engage patients in their treatment process. In order to explore the clinicians' point of view on the neuropsychological intervention strategies, we applied two different techniques often used in human factors research: the Critical Decision Method to study professionals' strategies with a descriptive perspective, and the Hierarchical Task Analysis to analyze the processes with a normative view. The results of our research showed that the hybrid approach adopted allowed us to have a better focus on the cognitive rehabilitation process and on the professionals' decision making mechanism. This led to a better understanding of functional requirements for supporting clinician's strategic decision making, in terms of personalization of treatments, cognitive exercises settings and feedback customization. In conclusion, our research highlights the value of the CDM to focus deeply on which functionalities professionals require from a cognitive telerehabilitation system and allowed us to design more precisely clinician-patients interactions inside the system compared to prescriptive methods currently used. Our study offers contribution to the comprehension of the rehabilitation processes, suggesting the positive impacts of an "extended" clinic treatment by adopting a flexible and adaptable tool.

1. Introduction

Cognitive rehabilitation could be seen as a process oriented to the assessment and rehabilitation of patient's cognitive impairments, based on a set of diverse therapeutic approaches, ranging from the reinforcement, strengthening and recovering of previously learned patterns of behaviour to the training of patients in order to adapt to their cognitive disabilities and to improve their overall quality of life [1].

The current trend in the cognitive rehabilitation field is to stimulate multiple cognitive functions in order to increase the person's independence in daily activities. The intervention adopted may vary according to some variables, like: patient's neurological lesion, stage of recovery, general cognitive status and responses to the intervention [2]. Despite their efficacy, rehabilitation treatments cannot be extended to all the people who would benefit from them for various reasons, especially due to economic issues and the lack of specialized structures in some countries [3].

The rapid progress in ICT has led to the improvement and diffusion of cognitive telerehabilitation platforms in the last decades, in order to overcome this issues. One of the key features of such systems is the possibility to extend the treatment duration and clinician intervention at the patient's home. In order to guarantee proper treatment efficacy and users' satisfaction, an accurate design of the human-system interaction and users' interaction inside the system is necessary. Therefore methodological perspectives from a Human Factors (HF) perspective for the design of such systems are strongly recommended. Ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance [4].

According to this view, it is important to consider both system technical efficacy and how it fits with the targeted users' needs (in this case

clinicians and patients), as well as the context and daily workplace activities of targeted users [5–9]. According to this perspective, the system design focuses not only on the technical requirements but also on the system usability, crucial aspect of the user experience [10] in order to support long distance interactions between system's users. In order to accomplish this purpose, targeted users features are the starting point of the process, and they are considered in all stages of the process, from the design and development, to the system final release [11]. In particular, the focus should be shifted on users' activities, needs and context of activity [12]. Moreover as Pullin stated [13], design ideas deriving from the experience and creativity of targeted users are an important added value to the system design.

The Human Centered Design (HCD) aims to enhance the design perspective and it is able to lead to the improvement of telerehabilitation platforms, by focusing on the users and designing around their needs and requirements, with the aim of enhancing system's effectiveness and efficiency for the improvement of human well-being, user satisfaction, accessibility and sustainability [10]. The HCD applied to the rehabilitation domains suggests a complex view, starting from the phase of setting a problem that addresses a wider audience, including different categories of users for which the system is designed [14]. Despite this, it is currently debated the role of these different users' perspectives in the design process, especially the clinician one, because most technologies addressing the rehabilitation field didn't consider appropriately the role played by clinicians in the design process [15–17]. As mentioned by How [17], every technology or service addressing the rehabilitation field needs an accurate design, taking in consideration both the technical and the clinical issues. Otherwise the risk is to have solutions not suitable to the actual clinical practice [17].

The clinicians' participation to the design process is somewhat controversial: some claimed that their contribution to the design process is a disjointed perspective from the one of their patients' everyday life [15]; instead, others claimed that the clinicians perspective is unique, for the fact that clinicians have a clear perspective on patients' needs and their overall situation [16]. Because they constantly face high complexity issues, clinicians have access to a large amount of knowledge in terms of technical and non-technical skills, which are fundamental for understanding the patients and engage them in the clinical process [14]. The HCD studies focused on the perspective of clinicians have often analyzed requirements based on interviews, focus groups and usability studies [16, 18–20]. These studies, despite the achievement of good results in terms of overall usability of the final product, have not thoroughly explored what could be the design opportunity deriving from the creativity of clinicians [17].

As stated by Polanyi [21], it is possible to divide the individual body of knowledge in two types: on one side there is a more explicit and objective component, consisting of the theoretical knowledge and contextual analysis processes, on the other side there is the procedural or tacit knowledge, which is difficult to express verbally. Studies on the processes of knowledge and problem solving skills, such as those in the human factors field, have focused much more on the first component [22–27] rather than the second. This latter component however is of particular importance, especially in the clinical setting [28–30], as the exercise of the profession relies on this type of knowledge [29,30], for the fact that it supports the clinician in formulating the diagnosis and in understanding the patient [30–34]. Considered the tacit dimension of this type of knowledge, mostly acquired through years of practice [31–34], the elicitation of clinician experience is needed. Considered that the body of knowledge that the clinicians use to understand and interact with the patient is strictly linked to their expertise and difficult to be verbally expressed [35], it appears essential the need of adopting specific techniques in order to gather all the processes linked to what defines that kind of knowledge. To reach this goal and in consistency with a common view in the Human Factors research [36], a twofold perspective has been used: the first one is normative, allowing to understand how the clinician-patient system should work and describing the work process as

a whole on a procedural point of view; the second perspective is descriptive and aims to gather how the system currently works, in terms of workers actual practice, re-enacting the unprescribed behaviors and eliciting what for the clinicians is obvious and tacit, and that actively compose their expertise [37]. The descriptive perspective allows to deepen the decision flow of the professionals during the rehabilitation process, contextualizing it in the complex interaction between what is prescribed and what is adaptively performed. Our research tries to bring a contribution to the discussion mentioned before by examining the strategies adopted in the cognitive rehabilitation process by the professionals, in particular those adopted to support the engagement of the patient in the rehabilitation process. Our aim is to analyze these strategies and to identify those strategic features that could be transferred inside a cognitive rehabilitation platform in order to both support the patient in the long distance intervention and to support the clinician in his decision making.

In this way we aim to lay the foundations for designing a digital platform, enabling clinicians to manage the cognitive treatments and to cooperate by remote with the patients. Our aim is to provide a platform compliant with how professionals form their strategies, easy to use, flexible and adaptable to the specific clinical needs, both of patients and professionals.

2. Method

2.1. The Critical Decision Method

The HCD approach both quantitative and qualitative methods to collect information from the real context and users. Methods like interviews, focus groups, product evaluations are commonly used to identify design solutions inspired to clinicians' body of knowledge [17]. Nevertheless, we decided to realize a deeper analysis on how this knowledge is expressed in the cognitive treatment process in order to include into the system design further aspects, such as professionals' problem solving approaches, at the base of treatment strategies devising [28,29,38].

One approach to achieve this goal is to focus on the professional's decision making in the cognitive rehabilitation process. In other words, it is not enough to understand how a cognitive rehabilitation session should work from a theoretical perspective. It is more valuable to understand how the professional put in practice his knowledge in all phases of the treatment, handling the specific situation, because the professional is responsible of establishing the proper treatment plan, of engaging and motivating the patients in the rehabilitation treatment. In order to investigate this particular aspect, we started from a Cognitive Task Analysis (CTA), a family of techniques commonly used in the Human Factors. The Task Analysis methods traditionally describe how a task is accomplished, by a detailed description of the steps required to achieve the main goal in terms of behaviour, described in terms of performed actions in predefined processes [39]. Cognitive Task Analysis instead is more specific, as it is '*the extension of traditional task analysis techniques to yield information about the knowledge, thought processes, and goal structures that underlie observable task performance*' [40]. As Wei & Salvendy [41] pointed out, the traditional Task Analysis technique (TA) usually considers the process from a descriptive point of view, by emphasizing the steps of action required to carry out the desired task; in other terms by focusing more on the behaviour of the operator. On the other hand CTA adopts a normative point of view, by focusing more on the skills and the expertise required to carry out the desired task. CTA helps to highlight knowledge structures and information processing strategies involved in a task performance. The CTA emphasizes the basic knowledge needed to perform the whole job: its organization and the interrelations among concepts or knowledge elements [41]. Based on a single sequence of behaviours, the traditional Task Analysis leads to a sequential description of action. It represent a limitation especially when the same task can be performed in a variety of ways. In contrast, the CTA aims to identify the