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The development of an integrated psychosocial approach to effective usability of 3D Virtual Environments for Cybertherapy

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ABSTRACT

The aim of the paper is to describe a possible direction of development and theoretical model for ergonomic research in the Virtual Reality (VR) field dedicated to psychotherapy applications. Through considerations on the strong points and limitations encountered during two different projects dedicated to the creation of virtual reality environments (VRE) for use in psychotherapy, it comments on the concepts of ecology and context of use. The theoretical perspective proposed intends to highlight the evolution from an *ecology of state* to an *ecology of process*. Given the considerable obstacles connected primarily to the lack of accepted standards for the ergonomic evaluation of 3D environments and the specific nature of the applications and user type in question, ergonomic research will represent an increasingly highly strategic aspect of clinical protocol design and upgrades: a number of closing considerations are dedicated to the operative aspects of ergonomic research and the role of the researcher.

Keywords: *VR Ergonomics, VR usability, Virtual Reality Exposure Therapy.*

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1. Introduction

This contribution illustrates the development of a psychosocial model for analysing the usability and ergonomics of virtual environments used as a support in cognitive behavioural psychotherapy. The evolution of the methodological perspective will be examined through a critical appraisal of the experience conducted within the context of two projects dedicated to VR-supported cognitive behavioural psychotherapy, focussing on the problem statement and the theoretical and research development/maturation process. The theoretical background refers to the ethnometodological approach, a perspective that gives evidence of how people, in specific social situations, are able to solve complex tasks producing shared meanings and achieving their goals during the interactions, in order to make their actions understandable and successful (Galimberti et al., 2004).

VR is now considered a therapeutic tool offering tangible improvements to the efficacy of conventional treatment of specific psychological disorders. Its consequential cost-benefit impact means that fewer resources are required to obtain the same or even better results than those traditionally possible. (Riva, 2005) Computer-generated virtual environment-based psychotherapy, also known as VRET (Virtual Reality Exposure Therapy) consists in enabling the patient to interact with a feared stimulus, seen within a virtual environment containing anxiogenic elements. It goes without say that the adoption of new immersion techniques must offer advantages in order to replace or provide back-up to the tried and tested therapeutic techniques used to treat anxiety-related disorders and phobia. Several authors (Vincelli et al., 2003; Riva, 2005; Krijn, Emmelkamp, Olafsson, & Biemond, 2004; Krijn, 2005), have dealt with cognitive-experiential therapy (CET) as this new methodology is known, which aims to de-condition fear reactions, modify the representation of reality and distorted convictions regarding panic symptoms and reduce anxiety-related symptoms. The innovative aspect of this therapy is the integration of cognitive behavioural techniques with the experiences offered by VR: the wealth of studies that have been conducted on the subject allows us to identify for which pathologies, especially those related to phobia-type disorders, VR-based cognitive therapy is most effective (Krijn, 2005).

2. Problem statement

To date, despite intense, widespread research on both usability and VR, there is no evidence that improvements in the former field could be applied to VR evaluation. To

our knowledge, new VR technology has not yet been adequately closely connected with the important characteristic of usability. All too often, methods designed for the evaluation of the usability of interactive computer applications, and their well-known limitations, are used to evaluate VR. For this reason, we believe it necessary to develop *VR specific* usability evaluation methods and criteria. Sutcliffe and Gault (2004) observed that few evaluation methods have been proposed for assessing the usability of VEs, although field studies by VR designers have demonstrated the need for HCI knowledge and methods. The point has been discussed by several authors: Gabbard and Hix (1997), for instance, attempted to highlight usability problems associated with the use of VR, while Bowman and Hodges (1999), among others, pointed out, among others, that VR system designers cannot rely on the methods developed for standard graphical user interfaces (GUIs) alone, as VR interaction is totally different from that of the latter devices; Kalawsky (1999) adapted checklist evaluation methods, based on Nielsen's heuristics (Nielsen & Mack,1994), to VR. Generally speaking, most studies reviewed by Sutcliffe and Gault (2004) have followed observation and expert interpretation of users' errors or experimental studies reporting performance data and problems in a range of VR technology. Nevertheless, we believe that Gabbard's (Gabbard, Swartz, Richey, & Hix, 1999) statement that researchers interested in VR usability are left to perform ad-hoc assessment or in-house evaluations with little or no scientific basis for their approach, is no longer suited to the current situation. Recent developments in the ergonomics field have provided us with practically all the tools necessary to develop a method for guiding VE usability evaluation.

3. Reference projects

The two projects considered are:

- VEPSY Updated "Telemedicine and Portable Environments in Clinical Psychology" (European Project – IST 2000 – 25323)
- NeuroTIV "Immersive Virtual Telepresence Managed Care for the Assessment and Rehabilitation in Neuropsychology and Clinical Psychology" (Italian National Research Project 2004-2007, funded by the Italian Ministry of University and Research –FIRB MIUR 2001)

4. VEPSY Updated Project: a first step towards an 'ecological context of use

As exhaustively reported by Galimberti and colleagues (Galimberti et al., 2004), on the basis of tasks assigned in the framework of the VEPSY Updated Project conducted at our research unit (Licent – Laboratory of Communicative Interaction Studies and New Technologies, Catholic University of Milan), we did not orient usability analysis on telepresence evaluation. This task was accomplished by clinical units, whereas we focus on the functional features of VEs (Virtual Environments). Our main goal was to obtain usability evaluation of processes of VR use as performed by 'real' users in 'real contexts of use'. For this reason, having completed a *functional analysis* of VEs, we performed a sort of '*fine tuning'* of VR scenarios.

As the VEPSY environments are designed for clinical use, in order to fulfil our goals, further steps were necessary after basic functional evaluation:

- To establish a minimum threshold of ergonomic acceptability to be used for every VEPSY VR module, on the basis of specific indicators identified and reported in the Guidelines prepared at the beginning of the project.
- To develop a new method of ergonomic and usability evaluation taking into account the requirements needed by the specific typologies of end users:
  - Psychotherapists
  - Patients affected by specific psychopathologies
- To integrate the results on the basis of the observations that emerged after *Large Clinical Trials*: this implied a direct comparison and interaction with the clinical group.

The possibility to arrange a research setting taking into account the cultural context of use, the bargaining nature of interaction and its intrinsic 'opaqueness', represented the main methodological objective of this first study. In particular, an ethnomethodological perspective was adopted.

As stated by Zucchermaglio (2002),

> Ethnography is one of the most suitable methods for entering communities by interpreting the meanings that are relevant for members in building up and interpreting the social world, looking for them in the discursive interactions and in public inter-subjectively accessible behaviour. The validity of ethnographic research does not lie in the objectivity of the description, but rather in the level of authenticity, plausibility and reliability provided by the descriptions also to the subjects observed (...). For the understanding of social situations, we must stress

the importance of the categories of meaning performatively used by people involved in those specific situations.

Licent research unit carried out ergonomic evaluation of two of the four VEPSY modules in 3 Phases:

- **Panic Disorder and Agoraphobia modules**: in ***Phase 1,*** *guidelines on heuristic basis* were prepared in order to have an effective evaluation tool. Afterwards, usability tests (observations) were carried out on generic users.
- **Eating Disorder modules**: in ***Phase 2*****,** *basic functional requirements were verified*, referring to the results obtained in *Phase 1*. Usability tests (observations) were subsequently carried out on a different sample for comparison with *Phase 1*, considering psychologists and non-psychologists.
- **Eating Disorder modules**: in ***Phase 3***, *semi-structured interviews* were carried out on psychotherapists involved in the clinical trials of the modules considered.

Phase	Specific goals	Specific objects	S Samples	Results	Analysis context
1	Functional Characteristics analysis	Panic Disorders Modules	AGeneric users n=33	Non-specific Ethnomethods	Generic contextualisation
2	Fine tuning	Eating Disorders Modules	BPsychologists /generic users n= 16	Specific Ethnomethods	Finalised contextualisation
3	Integration	Panic Disorders Eating Disorders Modules	CPsychologists involved in clinical trials n=4	Professional Ethnomethods	Lived experience

Table 1: Summary of the VEPSY Updated research framework

To fulfil our goal we had to shift our attention from VEs themselves to the relationships between users and VEs, focusing on how these relationships take shape

in their real context of use. To approach the most ecological context of use, we used the LPP (Legitimate Peripheral Participation) model: "This model considers the knowledge acquisition in progression terms – from the periphery to the centre - in the participation activities of the *communities of practice"* (Zucchermaglio, 2002).

The study was therefore broken down into three phases, each one characterised by:

- specific aims;
- specific objects (i.e. two VEs typologies for different psychological disorders);
- samples reflecting non-specific, specific and professional ethnomethods;
- generic, finalised and lived experience analysis contexts.

Specific tools

Classic usability evaluation methods such as functional analysis aided by expert heuristic evaluation supported by ad hoc guidelines and user-based tests were supported by two specific ethnomethodological tools: *micro-narration* and *interviews*, used in phase 2 and in phase 3, respectively. Within the framework of the paradigmatic change under consideration, a relevant role is played by the narrative concept of knowledge and culture.

Narration can be considered both an adequate tool for recovering shared practices, in particular, through recollection, and also a useful tool for creating a group culture, i.e. suggesting a repertory of meanings establishing what it is important to observe in connection with consolidated habits. In the different phases of the analysis, micro-narration and interviews were presented to subjects in order to recover information related to the co-interaction with the artefact and with the co-construction of meanings in a specific professional community.

Micro-narration: users were supplied with specific information helping them to interact *"as if"* they were in the real context. For example: basic information about the specific VR protocol and about the therapeutic setting was given to the psychologists tested. They were informed that "the purpose of the environments is not the creation of a perfect reproduction of the real world: patients and therapists involved are aware of the fact that the effectiveness of the tool for the patient does not depend on the perfect accuracy of certain specific elements but rather on the feeling of presence perceived that could be very different from that of a person without pathologies". Non-

psychologist users were asked not to consider VEs as videogames and the potential applications of the environments considered were explained to them.

Semi-structured interviews: in-depth interviews with the clinical group (psychotherapists involved in the clinical trials) were carried out in order to move towards an ecological context of use. In the specific case, the investigation focused on 4 main areas with reference to ergonomic aspects:

- In context use of the VEs for psychotherapy sessions.
- Expectations of the therapeutic protocol.
- Usability (local interaction with the artefact, interpretation of the situation and context definition).
- Towards a culture of use (possible future application of the VEPSY modules; critical aspects for training activities etc.).

5. NeuroTIV Project: reasons for a clinical-ergonomic analysis

From the ergonomic point of view, the VEPSY Updated project allowed us to conceive the experience of artefacts' use as immersed in a social and goal-driven context and to stress the component of ambiguity inherent to everyday situations. At the same time, the need for a more context-situated analysis strongly emerged in order to better understand possible discrepancies between standard clinical protocol application and the real use of the VR scenarios by therapists and patients during therapy sessions. For example, some of the IT systems' drawbacks and errors proved to be a 'plus' within the context of the therapeutic framework, such as the case of the graphic appeal, which did not seem to influence the effectiveness of VR therapy at all (Galimberti et al. 2004).

VR scenarios serve to speed up access to the personal experience of patients affected by specific psychopathologies and the representation of the stimuli functional to the activation of this process does not need to fulfil requirements connected with the realism of the experience intended the physical characteristics of VEs: in this sense, emphasis shifts from quality of image to freedom of movement, from the graphic perfection of the system to the actions of actors in the environment (Gabbard & Hix, 1997). Through a correct interaction between the therapist and the patient it is possible

to anticipate and avoid orientation and navigation problems. The use of devices is simplified and the system is accessible.

It can be claimed that the criteria adopted to analyse VEPSY modules allowed us to achieve the following:

- Recognize the mediated character of every experience of presence
- Conceive the experience of artefacts' use as immersed in a social and goal-driven context
- Stress the ambiguity component inherent to everyday situations
- Demonstrate how cultural dimensions affect the effective use of VEs

On the other hand, for both ethical reasons and with reference to specific goals and roles assigned to the partners in the VEPSY Updated project, the ergonomic research unit did not participate in clinical trials, and the need for a detailed exploration of therapist – patient interaction was therefore felt very strongly. This is - in our opinion - the key to a new and more effective approach to the ergonomic analysis in real context.

Design and clinical practice were kept separate to a certain extent and therefore in the NeuroTIV project great efforts were made to overcome this limit by keeping the design phases and the fine-tuning of the environments strictly connected to the clinical applications and requirements.

The ergonomic evaluation was included in the design process from the very beginning of the project in a preventive ergonomics perspective. This because we think that the attempt to meet clinical and technological requirements are two aspects of the same design process that cannot be considered separately.One fundamental aspect of the NeuroTIV research is the possibility to use outpatients as subjects for user-tests rather than for video-recorded interaction analysis alone.

The opportunity of improving the realism of VR environments, to give a concrete example, will therefore be suitably verified with the panel of therapists, who are, in turn, expert "users" and reference targets. In the interest of a more efficacious use of virtual reality in a therapeutic context, the planning of in-depth training on the use and technological operation of VR artefacts would also appear essential. Each individual element and input emerging from a qualitative analysis of this kind will therefore be verified and tested with the ultimate aim of making it possible to improve both the

environments and the clinical protocols currently used (Vincelli, Choi, Molinari, Wiederhold, & Riva, 2000).

5.1 Ecology of State and Ecology of Process

As highlighted by Cantamesse and Menti (2002), ergonomics has a somewhat vast field of application: from the design of everyday items to user-computer and user-computer-user interaction. Psychology and especially Social Psychology has played an important role in the evolution of the ergonomics towards a *preventive* rather than a *corrective* function. The adoption of the concept of *preventative ergonomics* also led to the introduction of the principle whereby human or machine error in any case takes place within a relational context, in which attention is centred on the relationship between people, environment and instrument used. From this point on, 'IT artefacts' are considered "as experience transformers": the task becomes part of a broader scenario. The achievement of an ecology, that we can define "ecology of state", in the ergonomics research field, becomes a priority.

Having established that the ecology level reached in the first study was the highest possible in that specific situation, for the second it was decided to 'force' the limits encountered previously by applying an analysis model that privileges the possibility of coming closer to the situation of use, partly through a theoretical context flexible enough to allow the application of more specific analysis instruments and procedures.

From an *ecology of state*-oriented perspective we attempted to shift the focus to the concept of *ecology of process*. We believe this to be a key step towards truly grasping the specific nature of the context and at the same time, in order to have a satisfactory research base on which to 'graft' and through which to interpret the data produced.

Ecology of state in turn includes ecology of context, which has been exhaustively defined and conceptualised by different research streams such as the Situated Action Theory, Activity Theory, Distributed Cognition and Scenario-based design (Spagnolli Gamberini, Cottone, & Mantovani, 2004) and an *ecology of situation* characterised by the consideration of the interaction in which the term refers to both the set of interactions as a whole and in their specific nature. In this sense, we can say with certainty that the *ecology of state* was respected in the first study.

The *ecology of process* concept represents a further step towards an improved ecological framework by introducing the value of the *dialogical perspective.* The dialogical importance promoted at each level of the phases of analysis becomes the key to a deeper and more fluid understanding of the assumptions and meaning that

guide, first and foremost, actions and interactions *between* therapists and patients. On a higher analysis level, the dialogical perspective allows a new, more flexible way of producing and interpreting data originating separately from therapists, patients and expert researchers/evaluators. Lastly, by considering a third level, we can conclude that the entire system design process is inspired by a dialogical persspective in that it aims to effectively and non-rigidly integrate the stages of design, analysis in context of use, ergonomic evaluation, creation of the VR system and final work on the clinical protocol in use.

As regards the type of data produced, the reference to the *ecology of process* may be broken down as follows:

Focus of attention	**Type of data produced**		**Interaction level**
	Interactional non-mediated data (video recordings)	***Reported mediated data (questionnaires, interviews, focus groups)***	
Therapists	Observation of therapists' use of VEs Data concerning therapist-patient interactions during VE experience	Data reported by therapists	Personal experience of VE use Situated interaction between users (therapist-patient)
Patients	Observation of the patients' use of VEs Data concerning patient-therapist interaction during VE experience	Data reported by patients	Personal experience of VE use Situated interaction between users (therapist-patient)

Table 2: Typology of data produced within an *ecology of process* perspective

The focus of attention shifts from therapist to patient from time to time, but does so within a concept of ongoing comparison and data integration, results of analysis and, lastly, results of the product, meaning the proposed modifications to the environments that may lead to a substantial change in the therapeutic experience.

In order to give a concrete example, one aspect that the researchers faced in the first project was the cultural background of the same therapists involved in the research. A simple 'functional requirements collection' (a basic step in all ergonomic studies) proved to be unsatisfactory for several reasons.

Firstly, the therapist's theoretical background and 'therapy style' can strongly influence his/her evaluation of VR environments in both a positive and negative way. For example, there is a significant difference between when therapists consider the VR environment as a simple stimulus to help patients remember their personal experience without intending to fully exploit the characteristics of the immersion experience and when they intend to guide patient navigation by proposing a sort of narrative-path and co-discovering possible difficulties together with their patients. This aspect cannot be solved by referring to the clinical protocol as it of course leaves therapists free as far as their personal relational style is concerned. However, in this case, there is a high risk of designing VREs tailored to suit the 'vision' of a specific therapist. Secondly, therapists often have to deal with the considerable problem posed by the technical faults of pilot versions of VR environments. This can seriously affect therapy, so strategies to maintain the patient's attention focused on general therapy aims by using different techniques to increase the sense of presence in the feared situation are of course applied by therapists when necessary. Thirdly, the level of confidence in the potential of technology and the different opinions that therapists, patients, researchers and IT designers have on technology and VR, can play an important role in every phase of the project and great attention must be paid to this issue.

These are just some examples of problems that the adoption of an ecology of process perspective can help to overcome through a continuous integration of patients' and therapists' experiences (both considered as expert users) and their reciprocal representations. In particular, a flexible approach to the research allowed by a continuous and controlled shift of attention from therapists to patients, from outcomes of mediated and non-mediated data produced and from an individual representation of the level of interaction to a situated perspective could help us to build a more functional model.

5.2 The VR design process

Starting from the evaluation of the critical level with reference to the usability indicators usually applied, such as, for example, heuristic evaluation adapted to 3D

environments (Sutcliffe et al., 2004), the investigation of the real context of use is the fundamental step that can effectively contribute to the optimisation of the whole designing processes together with the effective integration of existing methods and the improvement of usability evaluation tools that are still too vague for VR applications.

One of the aims of the NeuroTIV research project is the development and production of highly complex multi-media interactive software.

This requires a formal approach to the development process that correctly integrates the following activities:

- requirement management;
- analysis;
- design;
- codification;
- testing.

The structuring of an iterative process in this sense is guided not by a rigid sequence of predefined phases, but by systematic management of project risks, in order to achieve a progressive reduction. This choice allowed the group to deal with the technological evolution of resources, characterised by exponential speed, but above all to manage dynamic requisites in their definition phase, thus offering a guideline and method for keeping track of the changes.

With specific reference to the second phase of the design cycle (see figure below), the ergonomic analysis should reach its highest level of ecology of process: the evaluation will be based on the analysis of therapist-patient interactions (8 sessions for each of the 9 patients, for a total 72 sessions) and outpatient tests (12 subjects). Focus groups and separate in-depth interviews will be carried out with independent therapists involved in the project.

The first level analysis, conducted with the support of the Atlas.The first level of analysis, will be conducted with the support of the Atlas Ti 4.2 software for quali-quantitative analysis, is aimed at investigating pratice habits for the use of VR in the framework of the therapeutic protocol, with special focus on VR scenarios and their ergonomic aspects.Ti 4.2 software for qualitative and quantitative analysis and is aimed at investigating practice habits for VR use within the framework of the therapeutic protocol, with special focus on VR scenarios and their ergonomic aspects. On the other hand, in the user-based tests, outpatients are considered as ‘expert users’:Conversely, in the user-based tests outpatients are considered as ‘expert users’: their contribution is relevant in order to evaluate and improve the structure and

the navigability of VR scenarios.their contribution helps in evaluating and improving the structure and navigability of VR scenarios.

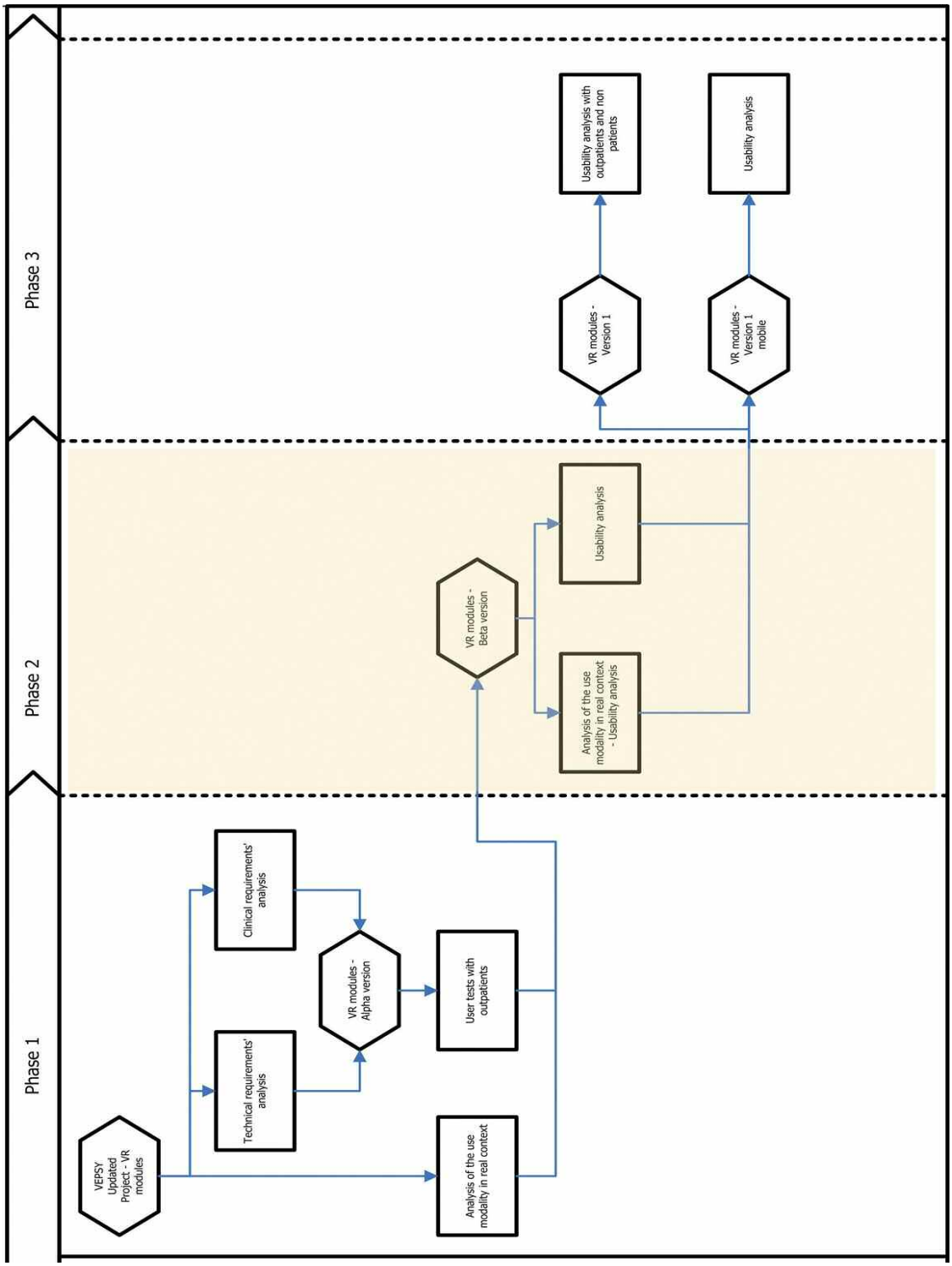

Figure1: NeuroTIV: VR modules' design process

A preliminary analysis required the definition of 14 macro-categories (for a total of 56 codes), obtained from literature and the texts themselves, based on the inter-subjective evaluation of 5 independent judges. These categories relate to:

- characteristics of environments used for the specific pathology;
- actions possible within the VE;
- interacting players;
- representations and descriptions;
- reference to technical and therapeutic aspects;
- comparison with the real environment and past experiences;
- navigation instructions;
- states of mind;
- locus of control.

As regards VE implementation, the efficacy of certain specific functions related to the following areas will be studied:

Area 1: Usability of the environments

This area concerns the identification of usability basic defects in a classic sense. The main methods applied were the *functional analysis aided by expert heuristic evaluation* and *user-based tests*. This aspect was particularly challenging because, at present, there are very few guidelines specific to VR user interfaces. To overcome this problem *Guidelines on heuristic basis* were prepared in order to have an effective evaluation tool (Galimberti et al., 2004) The heuristics used in this study are derived from Nielsen (Nielsen et al.,1994; Nielsen 2000). Usability tests on generic users were also carried out.

Area 2: Interaction within the VR environment

A separate area is dedicated to aspects connected to interaction in the VR environments, as the aim was not only to verify the correct technical operation of functions already or about to be implemented (which would strictly speaking belong to the usability area), but above all to understand what level of environment interactions may be judged necessary and satisfactory for therapeutic purposes, and for what reasons (characteristics of avatars: 2D vs. 3D, use of the emotive facial expression channel, verbal interaction with avatars, sound realism)

Area 3: Narration

It was decided to investigate the usefulness of including introductory pre-sequences or narrative sequences inside the environments, based for example on the formulation of tasks to be performed or compulsory routes, in order to complement the conventional therapist-guided exploration method with the aim of supporting the patient during the imagination/recollection process. Again, verbal interaction with avatars could represent a crucial issue.

Area 4: Information on VR-based therapy

This area contains all the information provided by the subject relating to experiences, representations and expectations regarding VR therapy.

6. Discussion

Since the very beginning of the NeuroTIV project significant elements have been introduced in the VR environments to allow a more effective interaction from the therapeutic point of view. These modifications follow two directions: the *improvement of the interaction*, from one side, and the improvement of the *perceived correspondence between the real and the virtual world.* With specific reference to this second aspect, we agree with the O'Neill (2005) position which stresses out the importance of 'agency' in order "for a virtual space to become an inhabitable place": in this sense great efforts are necessary to design VR environments allowing a good balance between the need of the patient to explore and act autonomously and the primary role played by the therapist who guides and supports the patient in the navigation, co-discovering and co-constructing with him/her possible representations and meanings. Another crucial aspect is represented by the opportunity offered by the technology to mix the material and non material dimensions recognizing that "the mediated Place is simultaneously physical, cognitive and cultural" (Spagnolli & Gamberini, 2005). The identification of the right elements, narrative paths and, more in detail, of meaningful cues for the specific purposes of the VR environments under preparation is a really interesting challenge both for therapists and designers.

The specific type of object and, above all, the specific nature of the users (therapists and patients) pose considerable problems regarding the ecological validity of the

research. Following an evolutional-type path conducted within the scope of two research projects, of which one is still in progress, we aimed to highlight certain theoretical and methodological key points, including the need for an approach that is increasingly close to the actual context of use within an ecology of process perspective, faced with an ecology of context that would appear to be no longer sufficient to support and opportunely motivate subsequent design choices. The research needs to be validated on a larger scale - even if qualitative methods are applied in this case - and the development of assessment tools deriving from different disciplines can be of great help.

In NeuroTIV, the functions regarding ergonomic research and the technical creation of VR environments, which were previously separate, were definitively integrated into the work group. The design and VR environments implementation unit is composed of expert programmers and electronic engineers coordinated by a psychologist with expertise in new technologies and computer design. In turn, the researchers assumed a more constructive role towards therapists: it is not a case of gathering requisites and evaluating functions from a primarily technical standpoint, but of suggesting and testing together what can be substantial changes (3D avatars, addition of the expressive emotive channel, introduction of narrative paths inside the environments) that could also significantly influence the clinical protocol.

7. Conclusions

With this paper we attempted to trace a possible path of intervention regarding difficulties that ergonomic research in the VR field, and in particular that referring to clinical psychotherapeutic applications, still encounters due to the lack of accepted standards for evaluation tools.

From an operative research standpoint, it is unfortunately true that, to date, no standard VR systems have been developed for the various pathologies and even officially acknowledged standard clinical protocols are few and far between (Riva, 2005). In order to attempt to take a step forward in this direction, it would appear essential to involve therapists in studies. As we have seen, the possibility of analysing the methods of use and the interactions created by clinicians with different theoretical backgrounds, expectations and representations is extremely important.

Another aspect that emerged is the change in perspective towards the subjects involved: patients and therapists are now considered as equally expert users – each one in his/her own field of competence. The possibility of conducting user-based tests not only on users with disorders, but also on outpatients, and having planned various points at which researchers can come into direct contact with patients (for example by assisting the therapist in the technical arrangement of the setting at the beginning and end of the session, or by being on hand at all times to gather patients' comments or observations) considerably extended the boundaries of interaction within the work team. A good researcher, especially when dealing with qualitative analysis, must take full advantage of these moments of active participation.

Lastly, we believe it important to include a consideration on the specific role of the ergonomic researcher: this expertise is all too frequently relegated to a merely 'technical and technological' context, or restricted to design cycle phases, which is likely to considerably reduce the efficacy and quality of the entire project. This provides the stimulus to seek a role that becomes increasingly context-specific and that fosters exchange and dialogue: in the case in question, with the decision to better define the clinical – ergonomic value of the research, we attempted to highlight the impossibility of separating the competences of expert users (clinicians, first and foremost) from those of ergonomic researchers and lastly the IT experts and programmers, in a constructive, albeit not obstacle-free, commitment to the creation of a design culture 'expanded' to all levels of activity.

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