

# PROACTIVE PSYCHOTHERAPY WITH HANDHELD DEVICES

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Abstract: This paper presents a set of components that support psychotherapy processes on mobile and office settings. One provides patients the required access to psychotherapy artefacts, enabling an adequate and tailored aid and motivation for fulfilment of common therapy tasks. Another offers therapists the ability to define and refine the artefacts, in order to present, help and react to the patient according to his/her specific needs and therapy progress. Two other components allow the analysis and annotation of the aforementioned artefacts. All these components run on a PDA base. Evaluation results validated some of the design choices, and indicate future directions and improvements.

## 1 INTRODUCTION

Cognitive Behavioural Therapy (CBT) is a common form of therapy used in the treatment of patients with anxiety and depression disorders. This constructivist therapy relies on the therapists' ability to understand the patient's problems and distorted cognitions, consequently guiding him to replace them with more adequate ones (Mahoney, 2003). The therapist's work includes the main on-consultation activities (e.g. conversation and annotation), the definition of the adequate therapies and the analysis process. On the patient's side, the tasks involve the filling of the various forms, as a therapy, within or outside consultations (e.g. while working, at school, on the way home or whenever stressful situations arise). The resulting data also provides the therapist the information required to analyze and define further therapies and procedures, either on or between sessions.

Thus, the major challenges of the therapy process are: gathering patient's data; defining forms, questionnaires and suitable guidelines for each patient's specific needs; leading patients to perform tasks and register them; and analyze those registers and gathered data. Furthermore, these activities have to be coped with the constant need for patient/therapist collaboration and mobility.

Currently, used paper artefacts obstruct, in various ways, the therapist's work and, in some cases, a more rapid progression of the patients' conditions.

Cross-referenced and structured annotations and expedite analysis, for example, are awkward or time consuming. Also, the passiveness of paper forms prevents the therapist from defining incentives and rewards that could allow patients to pursue their therapies in a more efficient way. These and other problems are recurrent throughout the entire process of diagnosis and therapy. Recently some work emerged on the introduction of technology on the process (Andersson, 2004; Das, 2002, Grasso, 2004; Newman, 2004). However they tend to provide solutions for particular disorders, without therapist control and patient specificity.

In this paper, we present several prototypes which take advantage of the emerging mobile technologies. They were designed to be used during consultation settings or outside, in both patients' and therapists' daily activities. Together, independently or complementing each other, they support the multiple phases of psychotherapy, emphasizing the therapist's central role in the therapy adjustment and the cooperation with his patients. Besides providing both actors with common therapy tools, they aim to bring therapists the possibility to define specific artefacts, choosing their structure, content and even presentation modes. All the components are available in multiple platforms, although this article focuses on the PDA base. They are part of tool-set that is being designed and developed within SCOPE project (Carriço, 2002), involving computer engineers and psychologists. The work described focuses one of SCOPE's contributions: the ability to

create and refine psychotherapy forms that actively react to the patients' usage behaviour, to his/her specific needs, and that can be used throughout the day on any location.

The paper begins with an overview of the related work in this area followed by a description of the main requirements to support the psychotherapy process. The following sections describe our system and the different tools that compose it, as well as the details of the various components, with particular focus on those which intend to support the therapist's work. Afterwards, the evaluation that has been taking place and some of the results that have already been achieved are discussed. Finally, future work is delineated and some conclusions are drawn.

## 2 RELATED WORK

The introduction of new technology to overcome some of the difficulties referred in this paper has recently gained momentum. As in many other areas of the health care domain, they often focus on data gathering or visualization, analysis and especially organizational tasks within the health care domain (Garrard, 2000). Specific software, directed to the psychiatric and psychological use, allows patients to follow particular methods of therapy and even diagnosis (Proudfoot, 2004). Excluding patient solutions that, relying on expedite approaches of diagnosis, have revealed strong human rejection (Das, 2002), studies have demonstrated the effectiveness of the computer role in the process of anxiety and depression therapy (Gega, 2004; Herman, 1998; Otto, 2000, Wright, 1997). However, most of these systems provide either isolated therapist solutions or isolated patient solutions with no therapist control. Moreover, mostly rely on desktop approaches, which are incompatible with most of the really used scenarios, (e.g. work, school, office consultation, etc) (Luff, 1998).

A number of web-based self-help applications and websites are also emerging. For example, the use of an internet-based therapy for depression and anxiety caused by Tinnitus (the presence of sound in the absence of auditory stimulation), in which patients reproduce the face-to-face treatment (Andersson, 2004). Overall, in spite of the common advantages, such as remote assistance and costs lowering, these techniques have many disadvantages (Tate, 2004). Patient disengagement is frequent, as well as patient misinterpretation of the sites' objectives; sites require constant management and monitoring; and email and telephone assistance is often required.

More recently, handheld and overall mobile devices, such as PDAs or TabletPCs, are available, and new applications have appeared. However, they only cover partial steps of the therapy process and do not allow the customization of the patients' tasks or artefacts. The majority is rather simple and allows simple measurements of the severity of pathologies, indicates drug dosage or provides therapists with reference information about diseases or drugs (Grasso, 2004). On the patients' side, some self-control or relaxation procedures are available on hand-held devices (Przeworski, 2004). Here, patients engaged on group therapies using palmtop computers. A palmtop was given to each patient, before the therapy sessions started, and had to be carried by him/her at all times. Alarms sounded several times during the day and questionnaires regarding their anxiety levels were popped. After the therapy sessions started, patients were allowed to access the entire range of features, using the relaxation, cognitive, etc. modules. Palmtops were intensively used during the initial stages of therapy, but their utilization diminished during the rest of therapy, which indicated that palmtops were mainly used to learn and understand the therapeutic procedures. Even so, patients improved their state in less than 6 months. But once again, these applications lack the possibility of adapting each step of the procedure or application to patients' specific needs.

## 3 REQUIREMENTS

Constructivist psychotherapy methods, such as CBT, defend that humans are active participants in their own lives, agents acting and experiencing in the world. Based on this, individuals must be actively involved in their change and unfolding processes, and must be encouraged to be autonomous (Mahoney, 2003). In therapy, the patients are therefore motivated to perform tasks that not only result in an active behaviour, but also permit them to be confronted with their accomplishments. Common tasks include:

- planning activities, registering plans and the activities, registering thoughts and answering questionnaires.

These tasks are performed during the day, intermingled with other daily activities, triggered by them (e. g. a thought requires a thought registration) or at specific times (e.g. at 9 am, plan the day). Accordingly they are performed wherever the patient is. Time, place and task characteristics, while

based on the specific disorder, should naturally depend on the patient's life and severity state.

On the other hand, the problem often resides on leading the patient to do something or be confronted with something he/she does. Therefore, a central role of the therapy is also given to therapists, for their ability to get patients to act and gain conscience of their problems. To accomplish this endeavour the therapist must be able to:

- gather patient data (e.g. what he/she says, or even what gesture was done) and annotate it.
- diagnose the disorder characteristics.
- select and define the therapy procedures and artefacts, motivating the patient and ensuring that that motivation is kept even when the therapist is away.
- get the patient registered data, analyze it thoroughly, eventually comparing it with previous gathered data and annotations.

The therapy cycle completes a tour when therapist-patient conversations take place over the registered data and new events. These cycles (data gathering, diagnosis, prescription, task fulfilment and thorough analysis) actually involve both actors and usually prevail through a long period of time.

As for the patient, the therapist activities are often accomplished in different settings and times of the day. Motivation, data gathering and exchange are naturally mostly done in collaboration with the patient, within consultation sessions. Analysis, data comparison, diagnosis, therapy planning and prescription are usually done elsewhere, although they also occur often within a consultation setting. Therapy planning and prescription, for instance, could be adjusted considering the information just gathered in an on-going consultation session. Moreover, since fulfilment of patient tasks is frequently done or completed in collaboration with the therapist, during sessions, particularly in the initial states of therapy, that information can be of the utmost importance on the following therapy procedure.

### 3.1 Artefact Requirements

Although the procedures and therapists' instruments, in CBT, are well defined, the latter exist mainly in paper. This causes coding and organization problems, obstructs co-referencing and annotation, and most of all, wastes both therapist and patients' time. Furthermore, it prevents therapists from

adapting the existing artefacts to the specific needs of each patient and on motivating him.

The used forms and questionnaires may be composed of hundred of numeric values, or, when of free writing type, unreadable documents, rather difficult to analyze. The notes taken during a single session or a set of sessions are also extremely valuable artefacts to analyze. However, it is difficult to co-relate these annotations, the questionnaires or even sessions they correspond to, especially having in mind that most of them are taken during consultations and without distracting the patient from the conversation or task in hands.

Paper artefacts obstruct patients' tasks as well. Questionnaires that need to be filled can be very extensive and with questions that may not be suitable for the patient in question. The free-text forms, generally preferred by the patients, because of their flexibility on writing and expressing their feelings, may cause distress as well, since, at times, the patient might not know how to express his sensations or problems in an organized and understandable way, increasing the anxiety levels. These problems suggested the following requirements:

- Minimize the effort and time spent taking, organizing and correlating annotations.
- Provide the therapist means to easily adapt the existing artefacts (e.g. forms, questionnaires and activity plans) to the specificity of patients or even create new ones.
- Offer the therapist ways to easily select and define rewards, filling facilitators (hints), help (on procedures and filling), and criteria that triggers them.
- Engender artefacts that can react to the patients' entered data and scheduled events, offering aids and rewards.
- Enable the analysis of patient completed questionnaires and forms, as well as therapist annotations.

### 3.2 Architectural Requirements

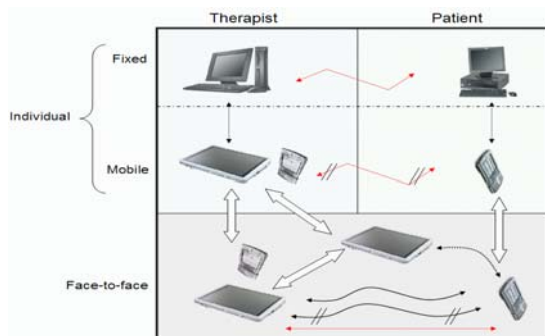
One of the major challenges of the psychotherapy activities is that they can be done anytime and anyplace, sometimes individually and other times in collaboration. Resources and interaction requirements depend on the situation. Moreover, throughout the process data is created or gathered that must be kept available and moved through the

different settings as needed. On consultation settings, for instance, actors exchange information, through conversations or defined and filled artefacts. All these clearly impose constraints, hardly handled by a paper based approach, which nevertheless must be considered on the definition of a technological solution. The following requirements are suggested:

- Enable the therapist to perform deep thorough analysis, on large amounts of data, but also permit to define prescription and simple analysis on the different settings of its daily activities.
- Provide means with no fixed or physical constraints that allow patients to accomplishing their tasks during their daily life.
- Offer ways that do not interfere with the face-to-face consultation processes and yet support different forms of collaborative work.
- Provide simple ways to transfer artefact definitions and information from its completion, between actors, and also to move information and articulate its access trough the different settings.

## 4 SCOPE

SCOPE (Supporting Cognition Outlines on Psychological Evaluation) is a project that aims at providing computational support to psychological therapy through all the steps of the process. It ranges from: (1) analysis, diagnosis and prescription tools, which the therapist uses without the patients' company; to (2) patients' homework registering tools, used without the therapist presence; through (3) a set of tools that they use in co-presence, and that include all of the above activities. Naturally, the characteristics of the face-to-face setting tools are different from those used individually, as they should not interfere with the collaborative process.



**Figure 1: SCOPE overall setting and scenarios.**

Figure 1 depicts the general settings of SCOPE: one presumes a full resource environment (called fixed) that usually comprehends a PC, possibly a patient record server, and peripherals (e.g. printer); another (referred to as mobile) copes with the mobility requirement with variable resource capabilities and may be supported by a laptop or a handheld device; and the last covers the co-presence situations (named face-to-face), where TabletPC and handheld solutions are envisioned. The first two presume, primarily, an individual stand where therapist and patient work isolated from each other - collaboration through a network is also possible but it is the subject of JoinTS, a continuation of SCOPE.

On these settings, some scenarios can be envisioned resulting in one or more applications. In general, each application may operate in stand alone mode, possibly integrating a classic paper based therapy procedure. On the other hand, applications can be articulated with each other, covering most of the therapy activities. Integration is accomplished through a shared database, exchanging artifacts and data through a synchronization process (represented by a strait-dashed line in the figure), or through direct communication (a curved arrowed line). Note that direct communication also occurs between therapist and patient in the face-to-face setting. Applications can also be configured (depicted by a fat arrowed symbol) to become more adequate to a specific usage scenario.

## 5 THERAPIST APPLICATIONS

This section presents a more detailed description of the components of the SCOPE tool-set that pertain to the therapist. It focuses on the PDA platform, although variants of the tools are also available for the TabletPC and desktop computer platforms. The PDA versions were developed in Java, using MIDP 1.0, and were tested on PalmOS and Pocket PCs. Nevertheless, running the prototypes on mobile phones or other devices that have a Java Virtual Machine (JVM) installed should be straightforward. A version with MIDP 2.0 was initially developed, but (known) problems arose with functionalities ill-implemented on the corresponding JVM for PDAs.

As PDAs offer a small screen and limited data input possibilities, challenges increase when designing user centred applications for such platforms. Focused, simple user interface were designed, where data input is facilitated as much as possible. Lists and drop box menus are available for use (upon therapist decision) when filling or creating an

artefact, reducing greatly the need to write data on the application. Lists length were condensed and contextualized.

## 5.1 ScoNOTES - Annotating

Using ScoNOTES the therapist is able to gather information and comment on previously gathered one. From the working patient record, the therapist selects ScoNOTES and simply writes text. The resulting annotations are registered with the creation dates and become automatically accessible from the patient's record. This necessarily simple process is particularly adequate for consultation settings. In this context, the default free-text entry is set to the cursive writing alternative (bitmap).

On an off-consultation setting, ScoNOTES enables the (re)organization of annotations and the creation of more detailed and structured ones. These, in fact, may provide a source of meta-information for every sort of data or artefact that exists in the therapy process. Keywords can be included, themes are reinforced and text entry fields are preferably character-based. New annotations are associated with patients as well, but can be further correlated with every other artefact, including other annotations.

## 5.2 ScoFORMS – Creating Artefacts

ScoFORMS includes three flavours of the same tool: ScoQUE, ScoTIVITY and ScoTHOUGHTS. Each provides therapists a way to create a specific form used in CBT, namely questionnaires, activity registering artefacts and thought record forms.

**ScoQUE** allows therapists to fetch, change or create questions, and build questionnaires adequate to specific patients and pathologies (Figure 3). A pool of standard questions is always available, as well as all those previously created by the therapist. Different navigation arrangements (e.g. theme, severity) and direct keyword search are supported for question selection. The sequence of questions, or its repetition, is decided when constructing a questionnaire. Standard and stereotyped questionnaires are kept and available for reuse.

Each question has associated an answering type (e.g. keyword, text), a set of help topics and a default interaction element (e.g. gauge, text-box). For each question on a particular questionnaire, the therapist is allowed to change the interaction element or combine it with alternative ones, from a set of compatible options. For example, a drop-box instead

of a free-text entry or in conjunction with it, as a hint for the patient, is a common choice. Also, the presence or absence of one or more help topics can be adjusted, as well as the total amount of hints and help topics available for a questionnaire. Overall, the therapist is able to customize the questionnaire and the questionnaire's user interface, adapting it to the patient's capabilities.

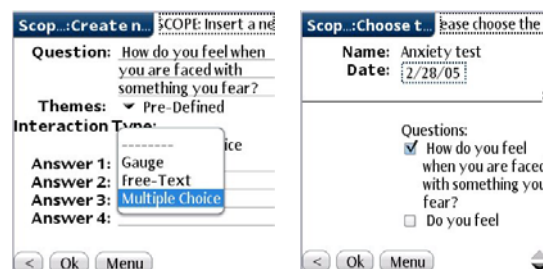


Figure 2: Building questionnaires with ScoFORMS

Figure 2, on the left, shows the ScoQUE interface for selecting questions for a questionnaire. Previously, the questions were inserted into the system, using another interface. On the right, the therapist is choosing a particular answering type, namely a multiple choice. The following step is naturally to define the selectable answers.

Finally, the therapist may also decide if and at what points the patient should get synopsis, score feedback, warnings, incentive words or congratulations. The way these are presented and combined with the patient answers is also configurable. For example, after a task completion, an incentive may appear as a sentence or a graphic depicting the patient's. The application's behaviour can also be configured to act according to the patients' choices, detecting whether the patient is answering the questions automatically or if he concentrated in his task. Detection mechanisms range from the amount of words used in an answer to the time spent to answer it. Warnings are prompted with anomalous situations.

**ScoTIVITY** and **ScoTHOUGHTS** allow the creation of artefacts for registering activities and activity plans and thoughts. In general, these flavours are a subset of ScoQUE, as the units (questions) are usually centred on text-entries, within a simple pre-defined structure (e.g. a classification of thought plus a free-text entry). Nonetheless, ScoTIVITY introduces alarms as an activity reminder or planner, and ScoTHOUGHTS assumes units as templates, i.e. a thoughts-form is often a single unit that will be instantiated every time the patient registers a thought. Therapists may also configure help, reports and rewards. A common

criterion for rewards is the number of registered thoughts.

### 5.3 ScoTHERAPY – Patient’s tool

ScoTHERAPY is the tool that materializes the artefacts to be filled by the patients. Its primary goal is to provide a way to quickly answer questionnaires, register thoughts and activities, or plan activities, as part of a therapeutic process. Overall, it is driven by a simple, easy to use interface that can provide access to aids, such as supportive hints, choice lists, help, reporting and rewarding. These aids can be disabled on face-to-face setting scenarios, allowing the therapist to actively intervene on the task fulfilment, or enabled on the patient individual scenarios. On the latter, it is up to the therapist to define when, where and what kind of aids are available. For example, after registering three positive thoughts the patient may be presented with a congratulations message, or, at a later therapy stage, the patient may only have access to hint choice-lists on five of the most complex tasks. Another common usage is to pop a hint when a patient is taking too much time to answer a question.

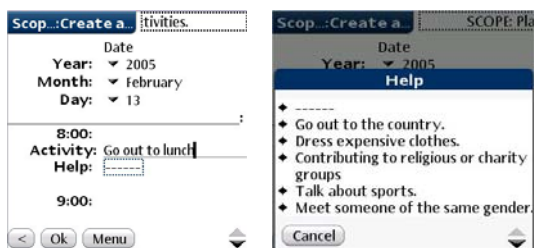


Figure 3: Filling activities with ScoTHERAPY.

Figure 3 shows an activity registry on the left and the corresponding help screen on the right. If allowed by the therapist, the patient may, in future activity planning, access activities’ specifications that he/she entered on a previous activity filling task. For example, consider a user that on a specific day plans a new activity like "Go out to lunch", writing it down on a text-box. Consider also that the therapist allowed that patient to access a dropdown-box of activity hints. Then, on the next activity planning task, the patient may find "Go out to lunch" on that dropdown-box. This, naturally, reduces the time and effort spent in this task.

The artefacts handled by ScoTHERAPY are transferred between therapist and patient devices as needed. Therapists usually export the forms specifications, eventually containing data from a previous shared-scenario session. Therapists import

the patients' filled data, eventually containing new items in choice lists (e.g. recurring activities). Currently the transfer is done using Bluetooth and PalmOS synchronization tools, through a PC or TabletPC. Alternatively ScoTHERAPY can print results when inserted in a more classic process.

### 5.4 ScopALYSIS – Analysis

ScopALYSIS provides a set of components for the analysis of patient data. Its capabilities range from simple scoring analysis on a questionnaire, usually applied during consultation, to more complex ones, more adequate to after sessions. Rearranging the scoring criteria (e.g. based on questions relevance) or determining score evolution over multiple questionnaires are common usage examples. On thought and activity records ScopALYSIS is able to find recurrent themes and keywords or determine word frequency (Figure 4). Its corpus can also be extended to annotations, thus building on meta-information introduced by the therapist.

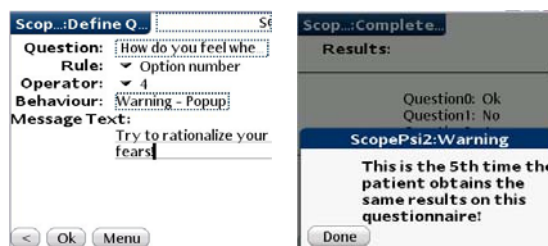


Figure 4: Defining warning rules with ScopALYSIS.

Visualization of the analysis results can be done through tables or simple graphics, as selected by the therapist. On larger device' platforms, diagrammatic (graph based) presentations are available. Filtering of results is also possible.

ScopALYSIS is articulated with all the remaining SCOPE tools. With ScoTHERAPY it provides a way to explicitly work the patient's data. A limited version is integrated with the patients' view of ScoTHERAPY, mostly as a presentation component. To ScoFORMS, ScopALYSIS provides the components to define rewards including reward triggers (metrics and targets) and presentations. Finally, ScopALYSIS is also connected with ScoNOTES since the therapist may wish to comment on analysis results that can be kept along with patients' data.

## 6 DESIGN AND EVALUATION

This project followed a contextual design approach (Beyer, 1998). During early stage design, interviews and meetings with different psychologists were made. Documentation and videos (Davidson, 2000) describing the therapy and showing real therapy examples were thoroughly studied. Information flows, activities, artefacts, physical settings and cultural issues along with major breaks (complaints, etc.) were identified, leading to the construction of two low-fidelity prototypes.

One mimics a PDA and the other a TabletPC. They are composed of a wooden frame where cards, representing screens, can be replaced. The screens are sketches of the applications later refined and implemented on the software prototypes. Card-sets representing the patient and the therapist tools were created for PDA and TabletPC and refined in consequence of successive evaluation sessions.

Low-fidelity prototypes of both platforms were evaluated under a Wizard of Oz approach. Three psychologists, two of them with clinical know-how and 10 other individuals with different education backgrounds, assessed the prototypes. The first group provided a more thorough, domain oriented, evaluation. The latter group was focused on sequence and screen arrangements, as well as on the use of such artefacts during interview conversations. The therapy original paper forms were also provided and procedures explained.

Results were quite encouraging. Psychologists specially welcomed the ability to exchange forms with the patient in a digital format, still maintaining the facility to share and collaborate in the filling process. The customization of forms was particularly well received, as well as the disappearance of breakdowns such as interruptions to get printed forms and fetch previous session results, and editing difficulties during the co-filling process. For the therapist components, the TabletPC versions were preferred due to the small screen size of PDAs when visualizing large amounts of information and introducing data. The psychologists' evaluation of the patients' application was also positive although some rearrangements were suggested for ease of use. The requirement of customizing the patient reward subsystem emerged from this design phase.

The non-expert group, particularly applied to the patients' tools, also triggered the adjustment of some components. Multiple choice questionnaires were very easy to fill whereas free-text forms raised some usage concerns. However, when confronted with the paper original version, users clearly chose the

prototypes, particularly the PDA one. In simulated therapy sessions the prototypes were not found more intrusive than paper.

The high-fidelity software prototypes were tested with the same group of users that tested the low-fidelity ones, plus computer engineering students and a group of 3 users with no experience in using handheld devices. The main focus of these last two groups was directed to interaction, usage and design. The patient application was actually used during a couple of days to perform specific form filling tasks. Measurements were made and usability questionnaires responded during each session. Overall the three groups found the software prototypes very promising.

Apart from the original expert group, another experienced clinical psychotherapist has evaluated the improved versions of the software prototypes. He contributed with suggestions of new evolutions and recent therapy practices that can extend SCOPE's coverage. The introduction of a positive/negative classifying field on thought records emerged from this evaluation. Moreover, the ability to provide a hierarchically organized selection of thoughts and emotions was also suggested. Interestingly, only minor changes on ScoFORMS were required to accommodate these needs.

Currently the prototypes are being used on an academic experimental setting (within a psychotherapy course) and with real scenarios. On the later, clinicians and patients are using the prototypes on individual settings as well as real consultations.

## 7 CONCLUSIONS

The use of technology in health care is evolving quite rapidly. Psychotherapy, in particular, is one of the most promising areas for technology application, especially for its hand-held and collaborative requirements. However, even if some applications exist, they are rigid, focussed only on the therapy itself and not considering the actors specificities, not integrated and often missing the context it should serve. The work described in this paper aims to overcome these difficulties and support psychotherapy through all the process.

The paper focuses on the PDA versions of a set of components that cover therapist annotation, prescription and analysis tasks. The first one addresses fast and structured annotation. A second central component provides the therapist with the

ability to define the artefacts used in the patient tasks and the characteristics of his "substitute" as a patient aid, i.e., the therapist is able to define the contents and the look and feel of the forms to be filled by the patient and to establish what, when and how the aids will be available or presented to the patient. The paper also describes the tool that enables the patient to fill the artefacts and the therapist to browse the patient's data. The last component pertains to the analysis of the patient data. Overall these tools cover most of the therapists' activities on a therapeutic process, including the assisted filling of forms, wherever they take place, proactively reacting to the patients' behaviour and evolution. This mobility and ubiquity and the ability given to the therapist to create and adjust active artefacts, enhancing psychotherapy, are the major contributions of the SCOPE project.

The work done so far has been validated, in its various stages, by a strict collaboration with several professionals and researchers in psychotherapy. They have consistently provided useful input and opinions, guaranteeing the developed prototypes' value, and providing coherent directions for evolution. A quite interesting observation is that when new specific therapies were suggested, for example weight and pain control, the creation of the corresponding artefacts is easily accomplished with ScoFORMS and its usage easily handled with ScoTHERAPY.

Finally, new functionalities are planned to be included in SCOPE. For example, voice interaction with the mobile device, the use of different media like videos or audio files explaining certain procedures; alarms that alert patients or even their therapists of specific situations; are being studied. A new version of SCOPE, which encompasses real-time message passing and shared/private spaces, is also being developed.

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