Towards a new measurement language for Self-Knowledge in Personal-Informatics

Maria A. García-Corretjer
GTM-Grup de recerca en Tecnologies Mèdia, La Salle-Universitat Ramon Llull, Quatre Camins, 30 Barcelona, Spain
mgarcia@salleurl.edu

Sergi Navarro-Aubanell
GTM-Grup de recerca en Tecnologies Mèdia, La Salle-Universitat Ramon Llull, Quatre Camins, 30 Barcelona, Spain
ls27072@salleurl.edu

David Miralles
GTM-Grup de recerca en Tecnologies Mèdia, La Salle-Universitat Ramon Llull, Quatre Camins, 30 Barcelona,Spain
davidme@salleurl.edu

ABSTRACT
This paper proposes a new tool of measurement for Self-Knowledge and monitoring of health. The presented concept leverages on people's self-reflection, empathetic interactions with smart objects, and HCI applications to reach transformative insight and Self-Knowledge. The particular emphasis is on evaluating needed variables within the processes of Personal-Informatics, Self-Reflection, and Realizing Empathy found as gaps in fields contributing to Self-tracking and analysis. After those variables were translated into designed, interactive, smart behaviors, tests were done to verify their initial effectiveness a new method for visualizing and understanding one's own data measurement, encouraging the person to Self-Reflect. The concept is contextualized within a dieting or body regime experience.

ACM Classification Keywords
H.5.2. User Interfaces

Author Keywords
HCI, Visual and Tangible Interface, Tracking Device, Self-Reflection, Empathy

INTRODUCTION
Personal-Informatics (P-I) is a growing sector meant as a tool to collect relevant information for the purpose of Self-Reflection (S-R) resulting in Self-Knowledge [1]. To build a P-I system that supports S-R that guides people towards better decision-making, the extensive literature and research on how emotions play a key and unwavering role in that process has to be acknowledged [11]. As emotions walk hand in hand with cognitive states, they impact greatly how self-evaluation and self-knowledge is perceived and constructed towards a habit change. By accounting for emotions, understanding the process of Realizing Empathy (RE) has become a topic of exploration in the scientific community. RE is believed to give clues as how to design and structure smart and intelligent systems to support humans [14]. Although the process of RE is mostly thought as a relationship between two people, its origins speak about how people have the ability to deeply reflect with and through inanimate objects, events, places, and situations [15]. Although P-I, S-R, and the Process to RE are three different terms with specific definitions, their objectives, steps, elements, and structures all interweave as one whole experience. In this paper we explore how these terms that live within each other can help to transversally better engage people in how they perceive and gain self-knowledge more profoundly and sustainably. In order to anchor these concepts, this paper proposes a new method of self-monitoring using a Light system with a new visual interface language to interpret their own measurements implemented on the health scenario of going through a diet or body regime.

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Personal-Informatics, Self-Reflection, Realizing Empathy
This project encompasses a nuanced collection of literature and related works on each of the subjects mentioned, but in this paper the focus will be on a summarized explanation of how they correlate and impact P-I in a diet health experience. Figure 1 shows these three experiences for better comprehension. The three main constant aspects throughout P-I, S-R, and RE, seen on the first three columns are: their objectives, influential elements, and format. On the fourth column, each experience defines their steps differently, but they all interconnect supporting each other's relevance. For example, in each of the S-R steps, the actions taken within P-I can be reflected, as well as the overall arch in each of the RE steps. All these stages together loop until there is a moment of realization and clarity that defines insight and self-knowledge [5]. Despite the correlations, each experience has more aspects that influence the main overall objective, seen on the furthest right column [1]. As previous studies have emphasized, it is important also for this project to design a system around creating constant opportunities for S-R [7].To do so, the concept developed must support and engage as many of the aspects mentioned in Figure 1 as possible, while respecting the connected iterative steps. In this current project, the test and results support some of the key aspects, particularly ones approached by some fields contributing in P-I sector, mentioned in the next section.

S.-Reflection

Objective	Elements	Format	Steps	Levels
self-knowledge	context	continuos	breakdown	experiential cognition
transform	space	not always in order	inquiry	cogntiive reflection
	congitive	cyclical	transformation	transform reflection
	emotions	evolutionary		Strategies
	content/data			dialogue
				information
				expression

P.- Informatics

Objective	Elements	Format	Steps	Relationship
Self-knowledge	context	cyclical	prepare	ambient
better decisions	space/surroundings	evolutionary	collect	augmented
monitor	cognitive level	maintentance	integrate	cooperative
maintain	emotional state	specific order	reflect	
collect	data presentation		act	

R. Empathy

Objective	Elements	Format	Steps	Mentality
make meaning	space	continuos	respect	humilty
insight	language	not always in order	listen	courage
	attitude	cyclical	consider	curiosity
		evolutionary	act	love
		conversational		trust

Figure 1. Table components of each experience.

IN RELATED FIELDS

Current literature in P-I find that intentioned S-R for a deeper, transformative change is impacting throughout time, habit change, and self-knowledge [1].Going forward with designing for S-R, understanding how the different elements and processes are interpreted and managed in disciplines contributing P-I is evaluated. The main fields studied in this respect are: Affective Computing, Persuasive Technologies, Ubiquitous Computing, and HCI. They intend to improve people's relationships with technologies and behaviors by capturing, expressing, and influencing human emotions and cognitive decisions [9, 8].

Affective Computing

Affective Computing [10] is becoming more accurate and helpful in catering to people's emotions in decision making [12], yet the programmed device's and people's emotions remain separate and distinct [7]. In order for the device to be supportive of human emotion and compatible within the process of RE, the device must mirror people's own emotional and cognitive states clearly, otherwise, profound S-R will be inconsistent [11].

Persuasive Technology

Persuasive technology, touches on using specific influential methods, or nudging elements, to guide audiences experience to make better, more efficient decisions by relying on smart automation [4]. While more devices and fields concentrate on optimizing the automated and instinctive aspects of our cognition, this is not relevant for the objective of S-R towards Self-Knowledge [1].

HCI and Ubiquitous Computing

In HCI field, the new tools of communication between people and devices are smart and tangible interfaces being developed. Generally they provide very accurate quantitative information that empowers people's understanding and self-tracking [6]. Yet, much of the data expressed is in numeric values, which can be miss-interpreted or frustrating, specially if contrasting variables not well understood [3]. Therefore, the current numeric language used, is not always intuitive. Another element considered in Ubiquitous Computing is the precise context and space where the data is collected, since it directly affects how people approach their decisions [11]. Although, collecting extensive context data is possible, it has to be "recognized that data can be meaningful in the context it is produced, but may lose meaning when it is removed from that context" [11].

Empathy in Neuroscience for HCI interactions

Recent research in HCI and Neuroscience exploring Empathy, begin to define its process as the ability to predict or mentalize people's behavior, share their experiences, and express affect [15], because of activated mirror neurons in the brain [2]. Neuroscience studies conclude that the process to RE has many levels, depths, conditions, and is a complex process hard to pin-point precisely beyond physiological feedback in different regions of the brain [4]. Despite their advancements,they are concerned with the difficulty of measuring RE quantitatively [4] and controlling the inconsistencies found in dialogue driven test, that have had encouraging results [13]. In this paper it is proposed a new format that could design smart interactions around a deeper, conversational connection to RE [5], while still able to measure its impact.

DESIGN CONSIDERATIONS

Understanding all the previous information the objective is to design an experience that emulates the process of RE, creating constant opportunities for S-R, while respecting the steps within P-I towards self-knowledge. To do so the concerned elements mentioned in the previous section are addressed: context, language, emotional state integration, and measuring the overall process. First, the design should consider the context to remain represented throughout the experience. Secondly, the language should be flexible in order to incorporate a variety of variables while remaining intuitive and simple. Fourth, the dialogue format should integrate emotional reflection, as the person gestures it and the device expresses it back, as well as opportunity to inquiry and self-educate. To represent all these qualities, as well as enabling measurement of these processes, a set of tools from a different sector is proposed: elements in Art and Design. Art and Design elements have specific meanings with measurable qualities [12]. Even though lone elements are inconsistent in meaning, combinations of these elements, like color, shape, light, and intensity provide a specific, universal message, both informative and emotional [12]. This becomes a flexible and intuitive communication tool that can go from basic to intricate, as well as used by sides involved [6]. If each combination of elements can be defined, they are measurable. Beside generating a language, these elements can also help define space, represent a context using aesthetics, materials, and scale. The next step would be to design how the system behaves in order to uphold the process of RE and S-R.

METHODOLOGY AND IMPLEMENTATION

To evaluate the concepts and the design considerations, the project went through a series of stages to develop a proposal to then implement with a test. The first stage was to anchor the overall design considerations and concept in a health tracking, dietary and body regime industry smart product. The

Figure 2. Prototype and LED experience.

second stage was to delve into the sector's literature, as well as directing a series of interviews, ethnographic research with experts, and a group sample of the target public. A number of consistent insights gathered made clear not only the kind of experience the audience had to have with the smart system but also it's physical form and behavioral elements. Among the key insights were: the measurement tool should be a version of measuring tape, to find a substitute for a number interface, and that affective feedback based on their own emotional state motivates people to S-R. The third stage was to conceptualize the designed system with alternative, tangible interfaces: LED light strip, pressure sensitive materials and physical design, and a digital environment, for example a specialized App, to safeguard and support inquiry in the process of use. The final stage was to prepare a test that could assess the insights gathered and examine the direction and the concept's impact. Because of the complexity and layering of the project, the proposal in this paper concentrates on designing for key elements of the over arching concept through the experimental alternative tangible interface rather than all the elements to be developed for the conceptualized system. These key elements are: space, language, and emotional integration in the experience, as it supports the process of S-R and RE within the design. How these elements were hypothesized in the design will be further explained in the following items. You can observe the prototype of the device in Figure 2.

- When it came to design for the space and context of the experience, the physical object has to command space, while considering the contextual needs of the audience: a sense of privacy, inconspicuousness, ergonomic, comfortable, and attractive. To emit privacy yet attractiveness, the design remains compact, abstract, and simple. For comfort and ergonomics, the material chosen was platinum silicone for its softness and durability. Hidden in plain sight,turned off underneath the object, is a retractable strip of LED lights. When stretched out, the object manifests itself, demanding some space for the visual interaction [2]. This device is meant to remain in a specific place chosen by the person, as it has to be charged in a station, making it easy to remain in the context.

- Based on previous research [12], the language design was decided as an LED strip becoming an interactive interface displaying measurement without numbers. The concept concentrates on the attributes of color, intensity, light, and pattern behavior to compose a set of combinations. This makes it able to support a variety of variables and information, from goals to time-lines. Beside quantitative information, lights, colors and behaviors also transmit specific emotional states. The combination of both shown throughout the experience allows for the person to S-R with all elements cohesively.

- To support the cognitive and emotional state of the person throughout the stages and variables present in P-I, S-R, and RE, a careful 5 step designed experience is in place. The interaction steps are conversational, cyclical, and gives the person freedom to change or evolve their goals and intentions. Briefly, the steps include from stating goals and profiles, to the device offering professional guidance and tools on the digital space. Within the experience, the device would detect the handling and amount pressure of the person as asked about their feelings during that day. The object would feedback a visual interpretation of that emotional state as part of the conversation.

  Although the digital space is included in the system's concept, it is a work-in-progress, as well as a more defined strategy for measuring RE process. The test and results will focus more on the effort of developing and evaluating the possible effectiveness of design elements towards a new interactive language, a sense of space, and Empathetic interaction. The experience as a whole is slower and more abstract than the normal measurement devices. These precise attributes of visual abstraction, behavior, and demand for space gives the person the continuous opportunity to S-R and self-motivate towards future actions.

Test

The test examined if: the use of design elements for creating a sense of space with physical attributes, an interactive informative and emotive interface language using LED lights, and a step by step RE conversation structure, creates the opportunity for S-R towards Self-Knowledge. It was presented as a 40-minute, 4-part test with quantitative and qualitative evaluation. Quantitatively we examined their numeric answers as well as their timing, and consistent behavior such as amount of pressing a button. Qualitatively we set the context and observed their overall physical and verbal behavior throughout the test. The sample group was of 23 subjects: 8 female, 15 male, between ages 14 to 60 with varied backgrounds. The first phase contextualized the subjects and the test itself on their current dieting and health monitoring experiences. The second part focused on the relevance of the 5-step RE conversation and the emotional integration to their goals by answering in a scale of 1-5. The third part sought to evaluate the effectiveness of design elements in providing the sense of space and attachment to the object. The fourth section sought to evaluate the designed language: its elements, their meanings individually, combined, and set in a variety of scenarios that reveal progress and emotional feedback.

RESULTS

The first section of the test, though relevant to the context of the project, the focus will remain on the following 3 sections' results. The audience evaluated the second and third part of

the test in a range valuation of 1 (being not relevant) to 5 (very relevant). With a mean of 4.74 (SD 0.49), the second part evaluated the relevance of the RE structure, sharing and visualizing of their own emotions in the designed experience, towards their health goal and S-R. The third part of the test evaluated how the physical design attributes provided a sense of privacy, space, and attractiveness, with a mean result of 4.18 (SD 1.05). While the sense of comfort and attachment with the object resulted in 4,37 (SD 0.99). The final part of the test evaluated how the visual language with lights, colors, and pattern behavior on the LED strip was received and understood by the audience. People felt open and enthusiastic of using the LED light strip as a new tool of measurement with a 4.9 mean (SD 0.30). When evaluating the amount of time people took to understand and reflect on the new language, the average time was of 122 seconds (SD 91). Compared to the average time of 10 second when people introspected the measurement provided (SD 2.5).

DISCUSSION AND CONCLUSIONS

The results on the second part of the test reveal that the designed 5 RE steps experience, supporting both cognitive and emotional cues exchanged for S-R, had a consistent score of 5, with a small variance. Furthermore, the results on the third part of the test showed that the physical attributes did achieve a sense of privacy and comfort needed for the RE experience according to the subjects. Also, on the final part of the test, a majority of subjects understood the designed language, taking their time to reflect and internalize the data with little explanation, and much interest. As an initial step towards a new method and tool of P-I measurement that provides moments for S-R, emulating the process of RE, the results here are reassuring. Although, there are supporting qualitative results as well, the ones mentioned already set a direction and sense of the impact this concept may have on leveraging S-R and RE for P-I devices. They have encouraged the current state of the project in progress as a long-term, quantitative testing, measuring the experiences, evaluating the system, its structure, while considering all the factors and stages mentioned throughout the paper, paving the path towards acquiring Self-Knowledge.

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