Towards the Use of Psychological Variables in User Profiling

Ricardo Luiz
ricardo.luiz@ydreams.com

Marilia Felismino
marilia.felismino@ydreams.com

Edifício YDreams,
Madan Parque - Sul, P-2825-149 Caparica, Portugal

Marta Castela
martavcastela@gmail.com

Pedro Marques
pedro.a.r.marques@gmail.com

Faculdade de Psicologia e de Ciências da Educação,
Alameda da Universidade, P-1649-013 Lisboa, Portugal

ABSTRACT

The scope of this study is the development of a questionnaire that can assess psychological variables relevant in the context of human-technology interaction. The final goal would be to use these variables as a basis for user-profiling tasks in the specific case of YDreams' Showroom. In this sense, we propose three variables – computer self-efficacy, computer anxiety and interaction with avatars – that can be relevant in the prediction of the interaction between humans and novel technologies, such as YDreams' interactive installations based on Augmented Reality. The possibility of extracting these variables indirectly (that is, without the questionnaire) through different tasks and/or time latencies is explored, and some examples are proposed. The questionnaire was developed for the specific case of YDreams' Showroom, but this method could be applied more widely to the field of human-computer interaction (HCI), and therefore used in different contexts.

INTRODUCTION

This project was developed by YDreams, SA in collaboration with the Faculty of Psychology of the University of Lisbon. YDreams is a global company that is redefining the concept of interactivity, with a focus on the exciting field of Augmented Reality technologies. Over the last few years, YDreams has been developing full-scale interactive environments (from stores to museum exhibitions), products and intellectual property, combining technology and design. This company has a showroom that is frequently visited by customers, schools and media, among others. These visits are guided by salespeople that present the same interactive installations presented there but in a random order for all visits. As the users are naturally different from each other, the aim of this project is to study the best way to create an immersive environment in the showroom that adapts the visit according to the different user types, in order to maximize their satisfaction. To achieve that, there are several areas of research that are being studied and applied, such as storytelling, user modeling, artificial intelligence, augmented reality, emotive agents, among other. This paper presents a component of the user modeling research.

The scope of this study is the development of a questionnaire used to assess psychological variables relevant in the context of human-technology interaction, for further use in user-profiling tasks. The questionnaire was developed for the specific case of YDreams Showroom.

The role of the questionnaire would be to extract psychological variables to be used as a tool in user profiling. As such, we started by looking for relevant variables inspired by the theory of reasoned action [1], namely, variables that could predict behavioural intention, and therefore could be assessed (since we can't assess behavioural intention itself). The chosen theoretical guideline was Venkatesh's [7] model of perceived ease of use. This model was adapted from TAM – Technology Acceptance Model – and considers a perspective of anchoring and adjustment in the conception and change of perceptions of ease of use through time. The model of perceived ease of use argues that people will create their perceptions of the ease of use of a system based on different anchors that relate to their general beliefs about computers and their use. For that purpose, they propose the existence

of the following anchors: computer self-efficacy (CSE), computer anxiety (CA), computer playfulness (CP) and perception of external control [5]. Venkatesh suggests that anchors guide the initial judgment but experience with the system will lead to an adjustment, on the basis of the usability of the system, and on perceived enjoyment [5]. Regardless of this, the role of computer self-efficacy and perceived external control remains pretty strong, even after experience with the system [5].

Trying to adapt the Technology Acceptance Model (TAM) [6,7] from the technology implementation in organizational settings framework to a tour in a showroom of novel technological applications (including Augmented Reality), we selected the variables that would fit the best into this new context and in future user-profiling applications: computer self-efficacy (**CSE**), computer anxiety (**CA**) and computer playfulness (**CP**). Due to our intention of integrating an AR virtual agent/avatar as a tour guide in the Showroom visits, we also added an "Interaction with an Avatar" (**IA**) scale to the questionnaire. To do so, we adapted two scales of the Nomura, Kanda, Suzuki & Kato's Human-Robot Interaction questionnaire [3], due to the similarities between robots and AR-based avatars: there is a general reluctance in people's willingness to interact with AR avatars and robots alike, as both are perceived as novel communicational entities [3]. From Nomura and colleagues' scales (NARS - Negative Attitudes toward Robots Scale and RAS - Robot anxiety Scale) we selected, adapted and translated the items that seemed to fit better in our approach, ending up with our own "interaction with avatars" (**IA**) scale.

METHOD

The questionnaire was built using a 6 degree Likert scale to assess the subjects rating of all items of the **CA**, **CSE** and **IA** variables. The **CA** scale had 5 items, the **CSE** scale consisted on 10 items and the **IA** had 12 items. The **CSE** and the **IA** scales had substantially more items due to the novelty of their use and adaptation to the language and the context of the study. This section was available online at "http://spreadsheets.google.com/viewform?formkey=dGt6aE5ma0c3YVc0ZTVaQ1NSR242Tnc6MA". The **CP** scale consisted on a 7 items approach and was addressed online as well but as you argue ahead this as deleted from the original questionnaire so is no longer available. The scale was simpler (yes/no) and context driven so subjects didn't have to change from one assess criteria to another thus creating some unnecessary noise in the data. This **CP** scale was translated and adapted from the original from Venkatesh [5] "The following questions ask you how you would characterize yourself when you use computers: spontaneous, unimaginative, flexible, creative, playful, unoriginal, uninventive...".

We addressed the online questionnaire via email to 62 persons, 17 of them working in YDreams (which we considered to be "high technological proficiency" users, as opposed to the other 45 subjects, which we considered to be "normal technological proficiency").

With these responses, we analysed the questionnaire to figure if all the scales were working as separate and consistent components and therefore were a good measure of what they proposed to measure.

RESULTS

We started by performing a factor analysis in order to ascertain if the questionnaire items saturated in the corresponding dimension/variable and to what degree they did so. The factor analysis showed that items from computer self-efficacy, computer anxiety and interaction of avatars loaded in separate components. In contrast, computer playfulness items' didn't show such a consistency in its saturation within the factors. In addition, we calculated the Cronbach alphas of the original scales and found that all shown high values, except for the Cronbach alpha for computer playfulness, that was significantly lower than that of the other scales (see Table 1). Because of this, this scale was deleted from the questionnaire. This variable seemed very promising, but really didn't work in our study. In future studies it would be interesting to try to tap this variable in a different way.

	CSE	CA	CP	IA
Cronbach's alphas	.89	.85	.72	.91

Table 1. Cronbach's alphas results of all scales.

We also performed a 4 factor analysis (**CA**, **CP**, **CSE** and **IA**) that allowed us to collect the most relevant items for each factor and afterwards we correlated the items of the scales to cross check them between groups (normal/Ydreamers). The results allowed us in general to choose 3 or 4 items per scale (**CA**, **CSE** and **IA**) after the deleting of the **CP** from the analysis. On a trial 5 factor analysis we were presented with the possibility of a fraction in the **IA** scale that suggested evidence that confronting and having to interact "physically" with an avatar and having to communicate with it are 2 different approaches with somehow separated psychological representations. Due to lack of time we weren't able to research on this finding any further.

In summary, computer self-efficacy, computer anxiety and interaction of avatars became clear different components in the factor analysis and showed high Cronbach's alphas, proving to be good measures of what they propose to measure.

CONCLUSIONS AND FUTURE WORK

In this study we managed to find robust measures of psychological variables that are valuable in the broad context of the human interaction with novel interactive installations mediated by avatar-like virtual guides. These

measures will help predicting ease of use and satisfaction with technological applications and are prone to be transferred to more indirect (and also simple and elegant) ways of data gathering.

Although it is well-known that psychological variables have been extensively used in affective computing [2] or even in user profiling itself [for an example with personality variables see 4], the use of specific cognitive and attitudinal variables directly involved in user's satisfaction and perceived ease of use of specific applications (in our case, YDreams' showroom interactive installations) is an important innovation as a tool to enhance user experience.

With a validated version of the questionnaire, our goal would be to find and validate tasks that could assess these variables through an indirect manner. In that sense, it would be required to think of applications or aspects of them that could somehow tap these psychological variables. Regarding computer self-efficacy, we thought that giving subjects the possibility of watching a demo before a task could somehow relate to this variable. In this sense, a person with high self-efficacy would have a lower probability of choosing to watch the demo, while a person with low self-efficacy would have a higher probability of choosing to watch the demo.

Concerning the interaction with avatars (IA) variable, there is a possibility that it could be tapped by trying to get the user to respond to an instruction of the avatar. By measuring the time latency between the instruction and the user's action it might be possible to get information about the user's ability to understand the avatar as a member of an interaction, which is capable of communication and understanding it's context.

Regarding computer anxiety, it might be hard to tap this variable with some sort of physiological measure without being too intrusive. Nevertheless, hesitation could be an indicator of it, in the sense that some specific time latencies might be a good clue to it. In addition, overall performance could also work as a clue to this variable, in the sense that if a subject feels more anxious that might compromise he's performance. In fact, overall performance could be thought of as a combination of the influence of all variables (and others not considered, of course). In this sense, a high overall performance could be an indicator of: high self-efficacy, low anxiety, and good interaction with avatars.

With this next step, it would be possible to minimize user's physical and conscious input of information. To do this, the theoretical rationale of the variables should always be followed and the technological applications should be scrutinized so that characteristics that allow the tapping of these psychological constructs (opportunities to measure reaction times, difficulty level selection, need for demonstration/help videos, etc.) can be exploited.

As future work, this kind of user information could be used to feed algorithms for adaptive learning environments, providing the user with a personalized response from the environment and virtual agents without being intrusive and without the need for physiological measures.

REFERENCES

1. Ajzen, I. From intentions to actions: A theory of planned behavior. In J. Kuhl & J. Beckman (Eds.), *Action-control: From cognition to behavior*, (1985), Heidelberg, Germany, 11-39.
2. Hudlicka, E. Affective Computing for Game Design. In *Proc. GAMEON-NA*, 2008, McGill University, (2008), 5-12.
3. Nomura, T., Kanda, T., Suzuki, T., & Kato, K. Prediction of human behavior in human-robot interaction using psychological scales for anxiety and negative attitudes toward robots. *Transactions on Robotics, 24* (2008), 442-451.
4. Nunes, M., Cerri, S. & Blanc, N. Towards User Psychological Profile. In *Proc. VIII Simpósio sobre Fatores Humanos em Sistemas Computacionais IHC* (2008), 196-203.
5. Venkatesh, V. Determinants of Perceived Ease of Use: Integrating Perceived Behavioral Control, Computer Anxiety and Enjoyment into the Technology Acceptance Model. *Information Systems Research, 11* (2000), 342-365.
6. Venkatesh, V., & Bala, H. Technology Acceptance Model 3 and a Research Agenda on Interventions., *Decision Sciences, 39* (2008), 273-315.
7. Venkatesh, V. & Davis, F.D. "A model of the antecedents of perceived ease of use: Development and test". *Decision Sciences, 27* (1996), 451-481.