

## Individual differences in virtual environments. An experimental research on emotions, behaviour and sense of presence in Second Life

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### Abstract

*The present work explores individual differences of behaviour, interaction, sense of presence and emotional experiencing in the virtual environment of Second Life. First, we evaluated subjects' cognitive style of interaction (from a cognitive-constructivist perspective) – main assessment on the “control” and “insecurity” dimensions. Subjects were then asked to spend some time into Second Life and their behaviour, emotion and sense of Presence were evaluated. Obtained results show that most of the aspects of subjects' personality do not change into a virtual world like Second Life; on the other hand this has been perceived as a relatively safe environment, mostly for high insecure subjects.*

### 1. Introduction

An important research area within the virtual reality framework is the study of the sense of presence, commonly defined as the subjective feeling of “being there” [18], [5]. Several authors have considered immersion as the main source from where the feeling of presence comes out and focalized their attention on the involvement of subjects in highly interactive virtual environments [VR]. Lombard & Ditton [13] defined presence as the “perceptual illusion of non-mediation”: in this perspective “presence is taken to occur when a person misperceives an experience mediated by technology as if it were a direct (that is, non-mediated) one” [5]. Many researches in this field focused on evaluating how the manipulation of different aspects of the VR media can affect the sense of presence [7]. From the situated cognition perspective [5] the feeling of presence is “not determined by physical place to which we are immediately tied by perception, be it natural, artificial, or virtual; instead, it is grounded in a meaningful situation that stretches in the past and faces the future”, enhancing the need of multiple integration among subject's perception, movement, awareness of situation, feelings and action with his culture and knowledge in the perception of the virtual space.

In our opinion in the researches on presence and on VR, an extensive model of personality differences and style of interaction is actually missing. Identity, individual differences, communication and relation are some of the most important topics in the research area of Clinical Psychology, which is the best field to derive useful suggestions about these aspects of human behaviour. The long term aim of our research is to develop a conceptual grid for reading and assessing individual differences and explaining the subjective style of perception, behaviour, interaction and emotional involvement in virtual environments. The short term goal is to provide an explorative study on Second Life [SL], which is the most well-known virtual reality on the web, and which has recently catalyzed the attention of European media.

### 2. The theoretical background: the cognitive-constructive approach

Among the many different descriptors of personality, a good model we can use to face the complexity of human interaction, relational styles and individual differences is the cognitive-constructivist approach and the Personality Organization model [8], [9], [14]. It is a theoretical model stemmed from the tradition of the rational cognitive psychotherapy of Beck and Ellis [3], [6] but deeply modified in the last decades to integrate the contribution of neurosciences, evolutionary, developmental and social psychology. From this point of view, knowledge is not passively received either through the senses or by the way of communication, but it is actively built up by the cognizing subject: the function of cognition is an adaptive tension towards fit or *viability*. Cognition is functional as it organizes subject's experiential world and it is not simply the discovery of an objective ontological reality out of there. Two complementary psychological processes guide the dynamic of personal identity construction: the not mediated experience of being there or *tacit* level of knowledge and the linguistic description of this very same immediate experience or *explicit* knowledge. Only at this second level, with

language mastery and the development of narrative ability, we human beings can explain to ourselves and to the others our lived, immediate experience. This explanation is guided by a basic principle, the *coherence principle* that organizes the ongoing experience so to maintain a stable (*for the subject*) self representation and world representation [1]. One main consequence for the VR experience is that at least part of the VR experience must be guided by the activation of these coherence mechanisms, which is a qualitative perception of “me”, “the environment” and “the others”.

The Personality Organizations model identifies four basic personality organizations corresponding to four different strategies of self-coherence construction and four basic kind of emotional self-perception. The original taxonomy used labels referring to the symptoms usually emerging as signals of crisis (phobic, obsessive-compulsive, depressive and eating disorder) therefore amplifying the psychopathological components of the four cognitive styles. Within the framework of the extension of this personality model from psychopathology to common life situations, a different labelling was recently proposed [16]. It suggests that the phobic personality would be better described as *will oriented personality* (easily exemplified by the figure of a leader), the obsessive-compulsive as *rule oriented personality* (a judge) the depressive as *introspection oriented personality* (a philosopher) and finally the eating disorder personality as *external recognition oriented personality* (an actor). Each organisation has its preferred strategies to regulate relations and interactions. These strategies could be better understood using the Interpersonal Motivational Systems (IMS) model [4], [10], [12]. In this model all the interpersonal behavioural strategies, emotional tuning, emotional activation, regulation and awareness, thoughts and feelings emerging in the social exchanges are dependent on the current IMS of the participant. IMS are a set of inherited behaviours and organizing principles, selected and maintained for the evolutionary advantages they gave and give to the human species. IMS are finite in number and the basic are: attachment and caring, agonistic (regulate competition), cooperative and sexual. Another basic motivational system – only partially interpersonal - guides the exploration of novel situations: the feeling of curiosity is the internal signal of the activation of this IMS.

### 3. Individuals and virtual realities

How all the above mentioned personality styles can be mapped onto the VR experiences? Does it make sense to study individual differences in virtual reality environment? Can it be really useful to ground explanations on clinical psychology? Simpler and easier to translate into an experimental procedure are these two questions: are the virtual and the real experience coherent each other? Is the organization of personality model a good predictor of human

behaviour in virtual contexts? A previous research [17] showed discrepancy in subject’s behaviours between real and virtual contexts. The present research provides a more in depth study of the above-mentioned aspects, including the control of two important variables: the evaluation of the sense of presence and of the exploratory style, mainly the curiosity arousal.

## 4. The experiment

### 4.1 Material and Method

A total of 19 graduate and undergraduate students, 5 female and 14 male (mean age 25 years), from *Università degli Studi di Milano* voluntarily took part to the experiment.

In order to study subjects’ behaviour in the virtual environment of Second Life and the correlations with their cognitive style of interaction, it has been designed an experimental setting divided in three steps: (i) personality differences assessment, (ii) experience of Second Life and (iii) quality of SL experience assessment. In step (i) were used three questionnaires:

(a) The Social Interaction Questionnaire (SIQ), to evaluate the *cognitive style of interaction*: subjects were told to imagine being in a new social situation (a party), in an unknown place, with unfamiliar people, similar to the SL experience subjects would have later. 38 questions investigate subjects’ feelings, behaviours, strategies of exploration and interaction, in this real-life scena. The concreteness of the activated memory would make the RL/SL comparison more reliable. Some items are derived from Picardi et al. [15] the only validated measure usually used to assess clinical traits of organization of personality. Unfortunately it is strongly clinical oriented, only partially helpful in not clinical situation and too long. As we needed a measure more focussed on the relational style – and such a measure at the moment doesn’t exist – we had to create our own measure.

(b) A questionnaire to evaluate the emotional quality of the RL social experience by a rating of a list of 16 emotions with a 7-point Likert scale. (1, not felt at all, to 7, very much/always).

(c) The “Curiosity and Exploration Inventory” [11], 7 items, 7-point Likert scale (1, strongly disagree; 7, strongly agree) was added to evaluate subjects’ “curiosity” level.

These questionnaires have been submitted to subjects one-two weeks before the experience in SL. The data has been analyzed with LISREL 8.5, showing a good reproduction of the original model [11] of the Curiosity and Exploration Inventory ( $\chi^2=10.01$ ,  $df=13$ ,  $p=.69$ ,  $RMSEA=.00$ ,  $RMR=.09$ ), while the first section (the one whose purpose was to evaluate the cognitive style of interaction) did not fully work as we expected. Thus we tried to eliminate those items that didn’t significantly load the

expected factors (which were CONTROL and INSECURITY). We obtained, with those operations, a 2-factor model ( $\chi^2=230.17$ ,  $df=207$ ,  $p=.13$ ,  $RMSEA=.049$ ,  $RMR=.16$ ) made by 21 of the original 38 items: 9 loading the CONTROL factor ( $\alpha=.571$ ); 12 loading the INSECURITY factor ( $\alpha=.814$ ). Sure this model has some problems, like the high value of RMR or the moderately satisfying value of the Cronbach's  $\alpha$  for the CONTROL scale, but for the exploratory purposes of this research we can settle for it. We then built scores for CURIOSITY, INSECURITY and CONTROL dividing our sample in two groups for each of these factors (Low-High CURIOSITY; Low-High CONTROL; Low-High INSECURITY), making it possible to compare results from the pre-SL survey and the post-SL survey.

In step (ii) subjects had their experience in SL starting from "Parioli" island, which reproduces famous places in Rome, and is populated mostly by Italian users. No restriction has been given to subjects' freedom to move or behave in SL, as one goal is to understand how people spontaneously act in VR, in order to be able to compare subjects' virtual experience with the results coming from the SIQ. At the end of the experience in SL (step iii), subjects filled in a questionnaire to evaluate:

(a) The sense of Presence by "Reality Judgment and Presence Questionnaire" [2], 18 items, three subscales: "Reality Judgment", "Internal/ External correspondence" and "Attention/ Absorption".

(b) The above mentioned list of 16 emotions;

(c) The subjects' self-description of their SL behaviour (exploration, interactions, conversations and so on), through a 21-items questionnaire (7-point Likert scale ranging from strongly disagree to strongly agree).

## 4.2 Results

The main goal of data analysis were: (a) to check possible differences in the reported SL behaviours between the high-low CONTROL and high-low INSECURITY groups (b) to assess subjects' sense of presence in VR and (c) to investigate the emotion profile and the curiosity level of each group. The following analysis has been made with SPSS 14.0. For what concerns subjects' behaviour, a one-way ANOVA has been conducted to test eventual differences between groups. Significant differences in means have been found for items like "Looking for someone to ask for help about SL functionalities" (CONTROL  $p=.014$ , INSECURITY  $p=.006$ ); "Feeling lost and frightened" (CONTROL  $p=.004$ , INSECURITY  $p=.001$ ); "Prefer not to talk about myself" (CONTROL  $p=.026$ , INSECURITY  $p=.012$ ). The same kind of analysis have been conducted for the emotion checklist, giving results that are coherent with the previous results, as: high-CONTROL subjects experience

significantly lower levels of Calmness ( $p=.001$ ) and Solitude ( $p=.050$ ). High-INSECURITY subjects experience significantly lower levels of Amusement ( $p=.007$ ), Enthusiasm ( $p=.007$ ), Calmness ( $p=.001$ ) and higher levels of Disorientation ( $p=.013$ ). Mean differences has been computed also for behaviours and emotions with high-low CURIOSITY, showing significative differences for Delusion ( $p=.000$ ), Disorientation ( $p=.001$ ), Boredom ( $p=.001$ ). We then checked the relationship between the cognitive style of interaction and the perceived sense of presence. An higher level of CONTROL lowers the possibilities to experience an immersive sense of PRESENCE. This is true for any PRESENCE subscale ("Reality Judgement", "Internal/ External correspondence", and "Attention/Absorption") whose correlations (from now on, any correlation expresses the value of Spearman's rho) with CONTROL are respectively  $-.587$  (significative with  $\alpha=.01$ ),  $-.544$  and  $-.520$  (significative with  $\alpha=.05$ ).

The analysis of the correlation between the emotions perceived in SL and quality of presence is significant: the stronger the emotions felt during the experience, the higher the level of presence. "Internal/External Correspondence" and "Attention/Absorption" significantly correlate with Involvement (respectively  $.792$  and  $.878$ , with  $\alpha=.01$ ), Disappointment ( $-.562$  and  $-.539$ , with  $\alpha=.05$ ), Enthusiasm ( $-.822$  and  $-.806$ , with  $\alpha=.01$ ), Solitude ( $-.740$  with  $\alpha=.01$  and  $-.521$ , with  $\alpha=.05$ ), Interest ( $-.680$  and  $-.721$ , with  $\alpha=.01$ ), Calmness ( $-.741$  and  $-.688$ , with  $\alpha=.01$ ). "Internal/External Correspondence" also correlate with Awkwardness ( $-.565$ , with  $\alpha=.05$ ) and Disorientation ( $-.539$ , with  $\alpha=.05$ ) and Amusement ( $.666$ , with  $\alpha=.01$ ); while "Attention/Absorption" also with Shame ( $-.470$ , with  $\alpha=.05$ ). Enthusiasm ( $.509$ , with  $\alpha=.05$ ) and Involvement ( $.636$ , with  $\alpha=.01$ ) are the only emotions correlating with "Realism".

Overall, subjects with either a higher sense of CONTROL or a higher INSECURITY reported to feel alone more than the other subjects. This feeling of loneliness deserves a deeper investigation. On the other hand, no differences, as one should expect indeed, has been found among groups for items like "I mostly felt free and safe", or "I liked to start interacting with someone, but I wasn't brave enough". None of the differences in perceived emotions reported after the SL experience were significative in the pre-SL checklist.

## 5. Conclusion

The first question "does it make sense to study personality differences?" received an absolutely positive answer. Yes, there are personality differences connected to a different quality of virtual reality experience. It is possible to explore them and it would be probably possible to develop also useful assessing tools. Certainly it is not possible to use

the existing questionnaires just as they are, but a research to develop proper tools is absolutely needed.

An interesting finding of our research concerns the variations in the sense of Presence. The discover that (i) a higher need for Control lowers the overall quality of the virtual reality experience, mostly the sense of Presence, and (ii) the finding that this affects the overall emotional experience, which seems less rich both for subjects with high Control and high Insecurity, can help us to better analyse the concept itself of presence, not mentioning the possible future concrete applications for interface development.

Many differences in perceived emotion pre/post SL experience were found. This is maybe due to the fact that subjects' awareness of how they actually feel in RL (pre-SL checklist requires to recall) may not be as accurate as their awareness of how they just felt in SL (post-SL checklist), and that's to be taken into account in future researches.

The question about the facilitating effect of the virtual environment received a positive answer, also if these results are not statistically significant - but subjects were few and a bigger sample would probably produce adequate statistic results. The reduction of the emotions of shame and sense of solitude in the subjects that have high Insecurity score can be interpreted as they had what we can call a *positive corrective emotional experience* which probably means that the virtual world was perceived as a facilitating and relatively safe environment and that they felt free to express themselves differently from the real world interactions. The issues of identity, anonymity or anxiety are not new in the field of the computer mediated interaction and in VR research areas; the novelty, we think, is the procedure, the assessment instruments and the general model behind our experiment.

Not surprisingly, given that the experimental situation was structured as the discover of a new place, some of the statistically significant differences in the emotions reported by the subjects concerned the spectrum of the emotions - enthusiasm, calmness, solitude, amusement - commonly connected to the exploratory/curiosity system.

For that concern the personality assessment strategy, the factor analysis the SIQ shows sound link with the general theory on personality presented in section 2. The distinction control/security is, for example, easily detected in the rule oriented personality and in the will oriented personality. Obviously these instrument need to be improved by further refinement and, even though our findings support and enrich the data obtained in a previous research [17], the factor structure and the reliability of SIQ - the pre-SL experience questionnaire - have to be better tested with a larger and more representative sample of subjects.

From the Virtual Reality perspective, we think that this kind of collaborative research, mixing different professional competencies - e.g. clinical psychologists used to work with individual differences and experts in computer science -

could be a good and recommendable strategy for the future in this field.

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