Being There: Concepts, effects and measurement
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8 Quality of Experience in Virtual Environments

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Abstract. In this chapter, we present a new theoretical and methodological approach to the study of presence and virtual experience. More specifically, our work aims at analyzing the quality of experience associated with virtual environments (VEs), in its emotional, cognitive and motivational components. Specific research instruments have been developed and widely used to study the quality of subjective experience, emphasizing the active role of individual in selecting environmental information. As concerns studies on virtual reality (VR), this holistic approach allows researchers to investigate the subjective perception of virtual events and settings, thus permitting comparisons across different tasks and environments. In addition, it provides information on personal factors such as the motivational pattern, the degree of perceived immersion in the environment, the relevance of the activity to individual's short and long-term goals.

In the first part of the chapter, we describe how virtual experience has been studied so far and provide the theoretical bases of the proposed approach. Then we present the research tools that we intend to use to analyze the quality of virtual experience: the Experience Sampling Method (ESM) and the Flow Questionnaire (FQ). Finally, we explain how this approach can offer suggestions for research and practice in the development of virtual environments fostering users' engagement and empowerment.

Contents

8.1 Introduction

In recent years a growing number of researchers have begun to investigate the subjective experience persons report when interacting in virtual environments (VEs). However, "subjective experience" is an ambiguous construct that has been debated from the very beginning of psychological investigation. According to William James, "The world of our experience consists at all times of two parts, an objective and a subjective part (....). The objective part is the sum total of whatsoever at any given time we may be thinking of, the subjective part is the inner 'state' in which the thinking comes to pass" [1] (p. 402).

Experience, in James's view, is the result of focusing attention on the content and sequence of conscious events: "(...) Millions of items in the outward order are present to my senses which never properly enter into my experience. Why? Because they have no interest for me. My experience is what I agree to attend to. Only those items which I notice shape my mind – without selective interest, experience is utter chaos" [2] (p. 499). More recently, other authors have also claimed the primacy of attention as a crucial process that regulates states of consciousness. According to Csikszentmihalyi, "ideas, feelings, wishes or sensations can appear in consciousness and therefore become 'real' to the person only when attention is turned to them" [3] (p. 337).

So far, the largest body of psychological research on virtual experience has focused on the concept of *presence*, generally defined as a user's subjective sensation of "being there" in a scene depicted by a medium [4]. Most of the authors point out that presence is an essential, defining aspect of virtual experience. The concept of presence is considered relevant for the design and the evaluation of VR applications and other interactive media.

Some researchers have emphasized the usefulness of presence itself, and its relationship with task performance [5]. Others have pointed out the "ecological" value of presence: In their view, this construct is important because the greater the degree of presence, the greater the chance that participants' behavior in a VE will be similar to their behavior in analogous circumstances in everyday reality [6]. Finally, the study of presence has an intrinsic heuristic value because it could shed light on conscious processes.

We agree that presence is a key factor to understand VR experience, but we also believe that focusing exclusively on this concept could be limiting. Actually, researchers in the VR field are becoming increasingly aware that the virtual experience is a complex subjective phenomenon and its study should take into account all its constituting aspects. Banos and colleagues [7], for example, have emphasized that the concept of reality judgment has received less attention than presence and not much effort has been dedicated to test whether or not both constructs refer to the same domain. Other important aspects have generally been ignored by VR researchers. For example, emotions are an essential part of how people experience the world and their study could have important implications for better conceptual understanding of the virtual experience [8]. Similarly, the question of whether users' experience of VEs is associated with enjoyment and interest has not yet been fully addressed, in spite of the fact that these variables could be relevant to predict the motivation of users to repeat such experience [9].

In this chapter, presence is considered as a part of a process that involves *persons* interacting in both their usual environments *and* in virtual environments. Thus far, most research on presence has been conducted in VR laboratories in order to identify the single determinants of this construct. Thus, for instance, the work of several authors has focused on testing the psycho-physiological correlates of presence [10, 11]. This type of research is essential to the understanding of this phenomenon, but it does not allow to answer the question of what the virtual experience *means* to the people who are having it. To this purpose, we need to know how the experience is related to individuals' thoughts, emotions, motivations and life-goals.

We propose an alternative approach, involving the questions of what goes on in people's minds when they interact with computer-generated, three-dimensional environments and how the content of their consciousness at such times is related to the rest of their goal-oriented behavior. This approach starts from the assumption that the individual, as an autonomous goal-directed system, manifests certain proprieties that are better understood in terms of total system functioning, rather than in terms of systems of lower-level complexity [12]. Conceptually, the purpose of such an approach is to be as "objective" about subjective experience phenomena as possible without compromising the essential personal meaning of the experience [13].

In the first part of the chapter, we summarize how the construct of presence has been studied so far and provide the theoretical bases of the proposed approach. Then we present the research tools that we intend to use to analyze the quality of virtual experience: the Experience Sampling Method (ESM) and the Flow Questionnaire (FQ). Finally, we explain how this approach can offer suggestions for research and practice.

8.2 Presence: definitions, determinants and measurement

Review of the literature reveals different definitions and descriptions of presence. Slater and Usoh [14] described presence as "the (suspension of dis-) belief" of being located in a world other than the physical one (p. 134). Schloerb divided presence into "subjective presence" and "objective presence". Objective presence is "the probability that the specific task is completed successfully" [15]. Subjective presence is the "probability that a person perceives that he or she is physically present in the given environment". In contrast to such a definition, Mantovani and Riva [16] proposed an alternative, nondualistic conception of presence as a social construction. According to this definition, presence in an environment, real or simulated, means that individuals "can perceive themselves, objects and other people not only as situated in an external space but also as immersed in a sociocultural web connecting objects, people, and their interactions" (p. 540). Heeter [17] has argued for three different kinds of presence: "subjective personal presence", "environmental presence" and "social presence". Personal presence is the "extent to which and the reason why you feel like you are in a virtual world" (p. 262). Environmental presence is "the extent to which the environment itself appears to know that you are here and react to you" (p. 263). Social presence is "the extent to which other beings (living or synthetic) also exist in the world and appear to react to you" (p. 265). Lombard and Ditton [18] reviewed several conceptualisations of presence in the literature in the attempt to provide a unifying explication of the construct. According to this analysis, presence can be defined as the "a perceptual illusion of non-mediation" that occurs when a user incorrectly perceives a mediated scene as unmediated.

Other authors have described presence as a "mental manifestation" [19] and an "existential phenomenon" [20]. Literature on presence also includes references to related terms such as "immersion". Immersion has been defined by Witmer and Singer [21] as "a psychological state characterized by perceiving oneself to be enveloped by, included in, and interacting with an environment that provides a continuous stream of stimuli and experiences" (p. 227).

Although the definitions of presence and related terminology vary across authors, there is a broad agreement on the major determinants of this construct (for thorough reviews see [4, 20, 22]).

Lessiter and colleagues [23] divided variables that can determine a user's presence into two general categories: a) media characteristics and b) user characteristics. Media characteristics category has been further partitioned into aspects of a) media form and b) media content [18, 24]. According to this differentiation, *media form* refers to proprieties

of a display medium, such as the extent of sensory information presented, the degree of control a participant has over positioning his/her sensors within the environment, and a user's ability to modify aspects of the environment. *Media content*, on the other hand, refers to the objects, actors and events represented by the medium. *User characteristics* include relevant individual aspects such as users' perceptual, cognitive, motor abilities, prior experience with mediated experiences, the length of their exposure to and/or interaction with the VE, and a willingness to suspend disbelief. Witmer and Singer [21] suggest that allocating sufficient attentional resources to the virtual environment is an important determinant of presence. According to this hypothesis, as users focus more attention on the VE stimuli, they should become more involved in the VE experience, thus attaining increased presence. Finally, social aspects of a virtual environment, such as the interaction between the user and other actors, be they virtual or real, can contribute to determining presence [17, 18].

The different definitions of presence and of its determinants have generated different approaches to its measurement. They have been broadly classified in two groups: subjective reporting and objective corroborative measures [24, 25]. Subjective measures of presence are introspective evaluations of how "present" one feels in a virtual environment.

Such methods include subjective evaluation scales [14, 21, 23], equivalence classes [26] and psychophysical methods, such as magnitude estimation, [27] cross-modality matching [28] and paired comparisons [15]. Objective corroborative measures of presence, on the other hand, involve monitoring the impact of a virtual environment on less consciously controlled reactions such as reflexive motor acts or physiological measures such as arousal, muscular tension and cardiovascular behavior [10, 11].

8.3 Subjective experience and psychological selection: Theoretical foundations

We propose to investigate the impact of VR on daily life and subjective experience from a theoretical perspective that stresses the active role of individuals in interacting with their natural and cultural environment. The process of adaptation to the natural environment provided humans with specific biological features, such as the upright position, the opposing thumb and the increase in brain mass that allowed survival and reproduction in any environmental niche. In addition, through the emergence of primary and higher-order consciousness [29, 30], the abilities to think of one's self, and to plan, set and pursue goals greatly expanded the sphere of influence and the survival opportunities of our species.

Thanks to the newly acquired biological features, humans began to build artifacts and behavioral rules, thus to create culture.

While most researchers agree that humans are bio-cultural entities [31], theoretical approaches differ in their emphasis on the role and relevance of natural selection [32, 33], cultural pressures [34, 35], or the interaction between the two systems [36, 37] in shaping human behavior.

Differently from genes that are exclusively stored in the human body, cultural information, or *memes* [38], use two different vehicles for their survival and reproduction [39, 40]: the individual's central nervous system, carrying *intrasomatic* culture acquired through experience and education; the material artifacts, storing *extrasomatic* cultural units. Therefore, memes have an advantage over genes, in that artifacts can outlive humans, becoming the repositories of peoples' diachronic cultural memory [41, 42].

According to bio-cultural theories [43], culture represents an autonomous inheritance system, continuously interacting with biology in the influence on human behavior. Memes' survival and replication rely on a selection process based on cultural criteria and following its own teleonomy. As both inheritance systems use individuals as carriers of information units, competition or cooperation can arise between the two in shaping behavior: In wars,

for example, genes' tendency to survive and reproduce themselves can be overridden by the individual's commitment to pursue his/her own memes' differential transmission and the suppression of the enemy culture [44].

This deterministic approach to human behavior overlooks the role of individuals as active agents. Humans, as living systems, are open self-organizing psychophysical entities, that attain increasing levels of complexity through the exchange of information with the environment [45, 46, 47]. Beside inheriting a genotype, and building their *culturetype* by acquiring cultural information, individuals actively interact with the environment, selecting and differentially replicating throughout their lives a subset of biological and cultural information, in terms of activities, interests, values. A third selection paradigm comes into play: *psychological selection* [40]. By means of the differential investment of attention and psychic resources, the individual selects and organizes the information acquired from his/her context according to an emergent, autonomous criterion, that is the quality of experience. In particular, individuals preferentially engage in opportunities for action associated with a positive, complex and rewarding state of consciousness, called *optimal experience* or *flow* [48, 49].

The basic feature of optimal experience is the perceived balance between high environmental opportunities for action (*challenges*) and adequate personal *skills* in facing them. Additional characteristics are deep concentration, clear rules in and unambiguous feedback from the task at hand, loss of self-consciousness, control on one's actions and environment, positive affect and intrinsic motivation [50-52]. Optimal experience shows constant features at the cross-cultural level, and it can be associated with various daily activities, provided that individuals perceive them as complex opportunities for action in which to invest personal skills [53].

Since optimal experience presents globally positive and rewarding features, people tend to replicate it through the preferential cultivation of associated activities [54]. This leads to the progressive improvement of related skills. As a consequence, in order to maintain the balance between high challenges and skills that characterizes optimal experience, the individual will search for increasingly complex opportunities for action. By virtue of this dynamic process of skills cultivation and challenge increase, optimal experience shapes psychological selection, and ultimately influences individual development through the building of a *life theme*, namely the set of goals and interests a person preferentially pursues and cultivates in his/her life [55].

In this process, of course, cultural influences come into play. However, the subjective representation of environmental opportunities for action, the perceived quality of daily life and the creative interaction of the individual with the environment through self-determined motives and goals are the very key components of psychological selection [56, 57].

8.4 Quality of experience and presence in virtual reality

Presence stands out as one essential component of VR. In spite of the different theoretical and philosophical stances [58, 59], researchers seem to agree on three common features of the construct: (1) presence requires involvement into the virtual environment; hence the effectiveness of VEs is linked to the sense of presence reported by users; (2) presence is defined as a subjective experience; (3) presence is a multi-dimensional construct. Starting from this premise, efforts to operationalize presence have primarily focused on some perceptual and cognitive components, and on associated physiological responses, assessing them through self-reports and physiological tests.

According to the above-described theoretical approach, we propose an analysis of the experience associated with VR that investigates at the same time the cognitive, motivational, and affective components. We will focus on the following questions: Can

presence be a component of a specific kind of experience, a peculiar configuration of affective, cognitive and motivational features? Is this association stable in different situations and with different samples of participants? Are there common features between the experience involving presence and optimal experience?

Many studies have been carried out on the quality of experience associated with mass media, primarily television [60-63] and, more recently, with new technologies such as the internet [64]. Results show that television captures the attention of viewers independently of its content and long-term relevance for personal development. Watching TV, people feel more relaxed than usual, but less concentrated, active and satisfied. They perceive low challenges and high personal skills, a condition typical of relaxation and boredom. In situations of apathy and disengagement, TV viewing has been proved to exert a *parachute effect* in that it focuses individuals' attention, preventing destructuration in consciousness and complete loss of involvement and motivation to act [65]. However, television's added value does not primarily rest on the medium itself, but on its contents, and on the meaning individuals attach to them. The distinction between medium and content in relation to the associated quality of experience has also been drawn in recent studies on the web use.

Among the various activities that can be performed in the web (navigation, information retrieval, playing games), only those that are functional to some personal goals or interests are associated with optimal experience [64, 66].

Research thus far conducted highlights some crucial characteristics of VR that suggest its potential effectiveness in fostering optimal experiences : (a) *Opportunities for action* - In the virtual environment situations and tasks can be designed involving a wide range of human gestures and of perceptual and cognitive functions. The complexity of tasks can be gradually modified so that the individual can start to face the simplest situations and step towards more difficult ones (b) *Skills* – The tasks presented in the virtual environment can require specific skills, such as cognitive and practical ones, that can be refined and gradually increased during the sessions (c) *Feedback* – VR systems can offer a multimodal feedback to individuals' actions and behavior (d) *Control* – Individuals can experience control of the situation while interacting in the virtual world, and using their abilities. In other words, VR offers challenges that can be gradually increased, simultaneously allowing the individual to gradually improve his/her skills: Therefore, it can be a potential source of optimal experience. In this dynamic process the feedback the person receives from VR, and the control perceived during the session also come into play.

8.5 Methods and procedures

In studying people's daily life and associated quality of experience, researchers have adopted different methodological approaches, ranging from direct observation, time budget diaries to self-reports (for a review see [67]). For the investigation of VR, we will use two procedures: the Experience Sampling Method [68] and the Flow Questionnaire [48, 69].

Experience Sampling Method (ESM) – The urge to study the subjective experience of persons interacting in natural environments, thus ensuring ecological validity [70], and the dissatisfaction with traditional methods based on retrospective recall of behavior and experience [71, 72] led to the development of ESM. This procedure is based on repeated on-line assessments of the external situation and personal states of consciousness, as real daily events and situations occur. It taps how people daily invest their attention and resources, what they do, what they think of, and how patterns in subjective experience relate to life conditions [73].

Individuals taking part in ESM studies carry with them an electronic beeper. Different devices have been used, such as "doctor pagers" [74, 75], wrist terminals [76, 77], and electronic notebooks [66]. Beepers are programmed to send acoustic signals (beeps) at

fixed or random times, according to the research goals [78]. Fixed schedules are advisable when the use of a time-related statistical analysis is planned, such as time-series analysis, and Markov processes. However, with fixed schedules participants easily recognize the periodicity, and this generates anticipatory behaviors, thoughts, and emotions. Random techniques usually reduce the likelihood of signal anticipation. In truly random schedules, however, long between-beep intervals may demotivate the participants. Another option is stratified random schedules, in which one or more beeps are randomly generated within each time block of the target sample period, thus maintaining individuals' motivation and avoiding anticipation.

ESM sessions usually last for one week, and participants receive five to eight signals a day during waking hours. According to ESM literature, this design is effective in portraying participants' daily life and experience, and in maintaining individuals' compliance [73, 79, 80]. Again, the time length and the number of beeps directly depend on the purposes of the study. In a research on parental roles, for example, primiparous couples were followed before and after delivery during eight ESM sessions, starting from the tenth week of pregnancy until the sixth month after childbirth [81].

In addition to the beeper, participants are given a booklet of ESM forms (ESF). Whenever they receive an acoustic signal, they are expected to fill out a form. This procedure is rather quick since it takes about 2 minutes to complete a sheet. The ESF contains open-ended questions investigating situational variables such as place, activities carried out, social context, and subjective variables such as the content of thought, what was at stake in the activity, perceived goals, and physical conditions. The ESF also contains 0-12 Likert-type scales investigating the quality of experience in its various components: affect (e.g. happy, cheerful, sociable, friendly), motivation (e.g. wish doing the activity, free, involved) activation (e.g. alert, active, strong) and cognitive efficiency (e.g. concentration, unselfconsciousness, clear ideas). Two more Likert-type scales investigate participants' perceived levels of challenges and skills in the activity carried out when beeped [74].

Thanks to repeated sampling, after a standard ESM session (one week with 5 beeps per day), 35 sheets are collected for each participant, thus providing a rich databank on the quality of daily experience of each individual. ESFs completed after 20 minutes from signal receipt are discarded from analysis, thus avoiding distortions associated with retrospective recall [67]. Collected data are then stored for analysis. Answers to the open-ended questions are coded and grouped into broad content categories according to their function [82]. Scaled variables are transformed into *z*-scores.

ESM data can be organized in two ways. In the beep-level analysis, the unit of data organization is the self-report. After standardization, each variable will have as many *z*-scores as are the ESFs. In the subject-level analysis, the unit of data organization is the individual. In this case, after the scores of each variable are standardized for each individual, aggregated values (mean *z*-scores) are calculated. Through this process, *N* is no longer the number of self-reports but the number of participants [80].

The validity and reliability of the instrument have been widely investigated. As concerns ESM reliability, by means of split-half method and comparisons with other instruments (such as time budget), studies have shown ESM sampling accuracy in portraying individuals' daily life [83], the stability of activity estimates and of psychological states [73], individual consistency over the week [84] and over two years [85]. As concerns ESM validity, studies have shown that ESM reports of psychological states covary in expected ways with the values of physical conditions [86], and situational factors, such as activity [62, 87], location [74] and social context [88]. In addition, researchers have found correlations between participants' responses on ESM and their scores on other psychometric tools such as Maddi's Alienation Test [89], Rosenberg Self-Esteem Scale [90], and Intrinsic Enjoyment and Boredom Coping Scales [91]. Finally,

ESM differentiates between groups expected to be different, such as schizophrenic and non-schizophrenic patients [92], bulimic and regularly eating women [93], gifted and average mathematics students [94].

Thanks to its robust methodological foundations and to its ecological validity, ESM has been used to investigate experience fluctuations in the natural environment in various research areas, such as developmental psychology [74, 75, 95, 96], psychopathology [79, 97], sport psychology [98, 99], and cross-cultural psychology [100].

In order to assess the influence of perceived challenges and skills on the global quality of experience, the *Experience Fluctuation Model* was developed for the analysis of ESM data [101]. The model is built on the Cartesian plane, with challenges on the y-axis and skills on the x-axis (Figure 8.1), and it comprises eight 45° sectors, called *channels*. Each channel represents a defined range of ratios between challenges and skills. Given repeated ESM sampling, values of challenges and skills are standardized ($M = 0$, $SD = 1$). Thus, the center of the model - that is the origin of the axes - is zero and corresponds to the aggregated subjective mean.

According to challenges/skills ratio, the standardized values of the other experiential variables change following a well-defined fluctuation pattern [51]. Specific experiential states, determined through the values of all the ESM variables, have been associated with the four main channels: In Channel 2, characterized by a balance between high challenges and high skills, *optimal experience* is reported. In channel 4, skills are higher and challenges lower than subjective mean: The associated experience is *relaxation*. Channel 6, characterized by low challenges and low skills, is associated with *apathy*. In channel 8, skills are lower and challenges higher than subjective mean: The associated experience has been labeled *anxiety*. The remaining channels represent intermediate experiential states, and are therefore referred to as *transition channels* [77].

This model has proved to be a useful tool for studying the quality of experience associated with daily activities and contexts, for the analysis of how experience fluctuates within or between situations, and for detecting typical patterns of experience fluctuation characterizing individuals.

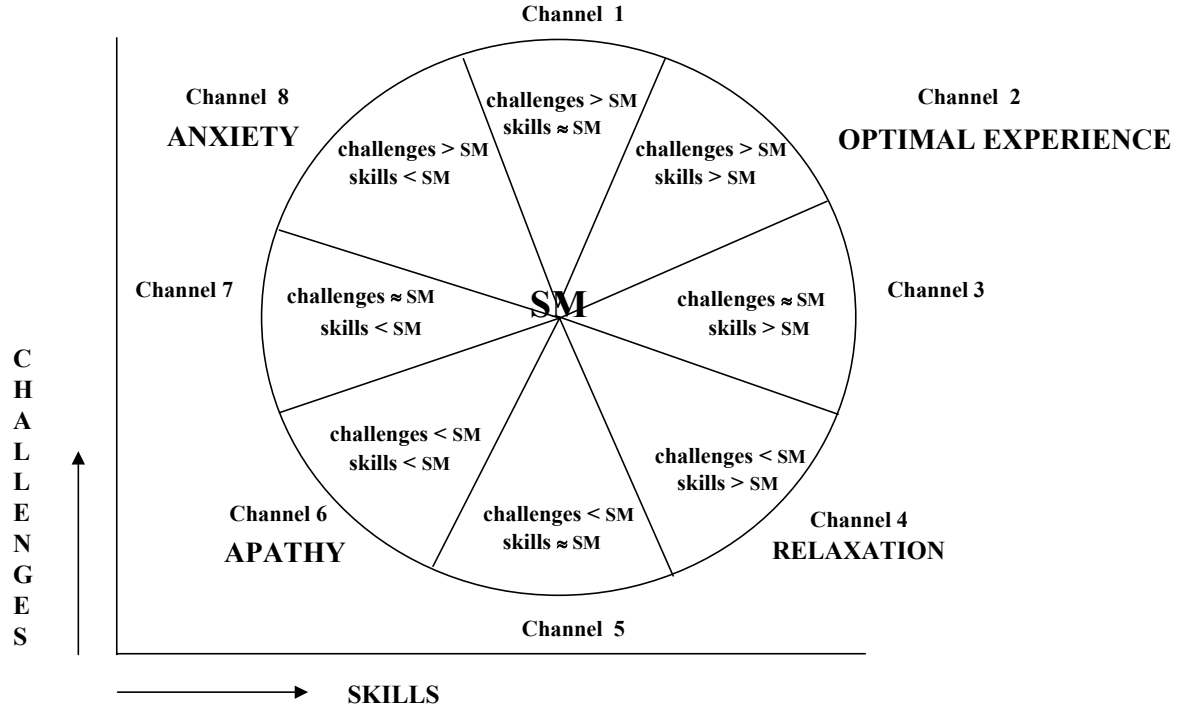

Figure 8.1 The Experience Fluctuation Model (SM = Subjective mean).

Flow Questionnaire (FQ) – This instrument was specifically devised for the study of optimal experience. It is a one-time measure investigating the occurrence of optimal experience in participants' lives, its psychological characteristics and the associated activities and situations [48]. The extended version of FQ developed by Italian researchers [69, 102] has been widely applied: Data collected from over 4000 participants make up the biggest cross-cultural FQ databank currently available. FQ comprises three parts: In the first one, participants are asked to read three quotations describing optimal experience, and to report whether such a state of consciousness ever occurred in their lives. If so, they are invited to report associated situations or activities, and to describe the related quality of experience on 0-8 Likert scales, measuring cognitive, motivational, affective components, as well as perceived challenges and skills. Beside the activities associated with optimal experience, researchers often investigate additional target activities, and ask participants to trace the associated experience on the scales. In a study on mass media, for example, respondents had to rate the experience related to TV viewing [60]. Other open-ended questions investigate the phenomenology of optimal experience, in terms of personal and environmental factors influencing its onset and maintenance. In the second part of FQ, questions aim at obtaining deeper insight into individuals' psychological selection: Common thoughts, pleasant thoughts, wishes and preferred activities are investigated.

Finally, the third part has been added by Italian researchers in order to analyze the experience opposite to the optimal one, called apathy or *anti-flow*, characterized by disengagement, passiveness, loss of concentration and motivation.

8.6 Quality of experience and VR: implications for research and practice

In our opinion, the theoretical approach and procedures described in this chapter can be fruitfully applied in the field of VR technology.

1) From the theoretical point of view, the investigation on presence could benefit from a global analysis of the quality of experience in its cognitive, affective and motivational components. Thus far, depending on the authors and their sense of what creates VR, emphasis has separately been placed on different aspects of presence [8]. A holistic analysis taking into account the multi-dimensional structure of subjective experience would allow researchers to put together all the pieces of the puzzle, providing new insight into the construct of presence and its connection with specific experiential profiles.

2) Beside descriptive purposes, the analysis of the experience associated with VR could provide explicative information on (a) the use of this new technology in daily life, (b) its effects on the global quality of daily experience and on the individual's pattern of interaction with the environment, (c) its role in fostering or hindering individual development in the long term. Moreover, the impact of participants' age, culture, exposure to new technologies, pattern of media use in daily life, and educational level on the quality of experience associated with VR should be investigated.

3) From the methodological perspective, ESM represents a highly reliable and ecologically-valid tool for assessing the experience associated with VR and for shedding light on the phenomenology of presence. Previous studies have shown that each daily activity is characterized by a typical experiential profile, that can be detected by means of ESM and that can influence the long-term commitment of individuals to activity cultivation [96]. Further, ESM allows for comparisons between

the experience associated with VR and with other mass media. Virtually any comparison between VR and individual's daily activities and contexts can be drawn, thus providing information on the impact of VR on daily life, and how VR sets into everyday routine.

4) Data gathered through ESM and FQ could shed light on the association of VR with optimal experience. Previous studies have shown that optimal experience can be associated with any activity provided that complex opportunities for action are perceived. In VR challenges can be represented by the use of related devices, by the virtual situations to be explored and the tasks to be performed, or by both. Moreover, the optimal experiences associated with different activities show different configurations in terms of mean values of ESM variables: For example, a recent study showed that adolescents reported optimal experience both during structured leisure activities and during classwork. However, intrinsic motivation in the situation of optimal experience scored significantly higher during leisure than during schoolwork, even though in both activities the variable's values were above the subjective mean [96]. These differences in the quality of optimal experience should be investigated in relation to different VR environments, task complexity, sensory paths involved.

5) As concerns applications, several studies show the usefulness of VR especially in the fields of medicine, and physical and psychological rehabilitation. Currently, two studies coupling virtual technologies and ESM measurements are under way: one with a sample of medical students, and another one with people with motor disabilities.

   a. The first study aims at exploring the quality of experience associated with VEs in order to develop learning tools for medical education. Beside formal, non-formal and individual learning modes, VR can expand and supplement teaching strategies of subjects such as anatomy, surgery and physiology. The possibility to simulate and/or interact with medical material (say plunging into the human body, or following the course of veins and nerves) could be a meaningful learning opportunity [103], provided that students enjoy it and perceive it as a significant challenge. A good didactic program should take into account educational goals and, at the same time, favor the autonomy, gratification, and active participation of the students in the learning process. The investigation consists in one ESM session during a typical university week, comprising formal and non-formal learning activities. In addition, students undergo two VR sessions: Immediately after the exposure to VEs, participants are asked to complete an ESF. They also fill out FQ and ITC-Sense of Presence Inventory [23]: These instruments allow for comparison between presence and the quality of experience reported in VR sessions, be it optimal or not.

   b. The second study aims at assessing the quality of experience associated with VR use in rehabilitation of people with motor disabilities. VR is raising enormous interest in the biomedical context thanks to its potential role as assistive technology. As widely demonstrated, the protracted use of any technology in the rehabilitation process is strictly related to the satisfaction the individual perceives with the technology itself [104]. Satisfaction depends on the environment the person lives in, on the characteristics of the assistive device, and on the individual, in terms of skills and personality traits. Therefore, it is crucial for therapists and physicians to adequately match people and technologies within a

specific clinical protocol. In this study, we will administer the Matching Person and Technology instruments (MPT) developed to analyze the outcomes of assistive technology use on the quality of life [105]. In addition, through ESM and FQ we will investigate the quality of experience associated with the use of VR (in comparison with the other daily activities, including the use of other media and IT instruments), the impact of these technologies on the quality of life, and the individual's commitment to the long-term cultivation of the related activities.

8.7 Conclusions

The impact of media and new technologies on human behavior is controversial, from the perspective of (a) personal development and psychological selection, and (b) individual participation and integration in the cultural context. As was the case of computer and web use over the last decade, the new virtual technologies are spreading rapidly, calling for researchers' responsible attention to the phenomenon and to its implications for users. As stated by Kubey and Csikszentmihalyi [63], "maintaining control over one's media habits is more of a challenge today, than it has ever been" (p.68).

On the one hand, the use of computer and IT devices promotes the development of specific skills and competencies, at the same time exposing people to a huge amount of easily available information. Memes can be quickly and effectively acquired in a complex network where interconnections between cultural information units can be discovered and exploited to progressively broaden previous knowledge. VR allows users to live events and situations otherwise impossible to occur, such as visualizing and planning the phases and results of surgical operations, or moving a paretic limb in conditions of hemiplegia.

Quadriplegic persons or terminal patients can enormously benefit from VR sessions by being exposed to stimuli and exploration opportunities they could never experiment in the real life [106, 107]. The opportunity to work at home while being steadily in contact with the workplace represents a substantial resource for parents of preschool children and people with physical impairments, promoting their participation in culture and productive life and supporting their skill cultivation as well as psychological selection.

On the other hand, the easy availability of information and social contacts without needing to leave one's own room can cause isolation, hinder the building of interpersonal relationships, and produce distortion in the quality and features of the selected information.

The acquisition of memes through the filter of technology cannot replace the basic role of social interactions and direct experience. E-learning can be a useful way to expand educational opportunities, but the effectiveness of good teachers in facilitating students' achievements and motivation to learn is a primary component of the education process [108]. Authentic rehabilitation of people with disabilities implies their active participation in the cultural context, their exposure to opportunities for action and development, their freedom to select opportunities they perceive as the most challenging and meaningful ones from the subjective point of view [109]. This can only be obtained through direct experience of the real world.

Culture, as stated above, is a complex inheritance system carried by human and extrasomatic vehicles, and new technologies belong to the latter group. They draw individuals' attention both as artifacts and as information carriers. They are based on a peculiar fruition pattern that sometimes makes the medium appealing per se, regardless of its contents and related impact on the psychological selection and social integration of the users. The highly interactive structure of IT and VR devices facilitates users' involvement and absorption: This mechanism does not depend upon the quality and relevance of the processed information, it is rather a feature of the medium itself. Studies on the quality of

experience associated with new technologies are especially necessary in that they can help detect experience fluctuations based both on structural characteristics and on content differences. This would allow researchers, technology designers, clinicians and educators to develop VR-based projects and intervention programs taking into account the users' opportunity to report rewarding and challenging experiences, and the quality and complexity of information thereby conveyed, in terms of its relevance for individual and cultural development.

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