Experiential Qualities and Quality of Experience in Storytelling, and Their Measurability

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Abstract

In this paper, we first argue that "experiential quality" and "Quality of Experience" are synonymous concepts, bridging the gap of quality assessment between design and storytelling with multimedia systems. We then survey the literature where experiential qualities play a significant role in interaction design and storytelling. Finally, we summarize the available measurements of experiential qualities and categorize them into four dimensions, namely, qualitative vs. quantitative, subjective vs. objective, design-based measures vs. neuropsychological-based measures, and systems approach vs. human factors approach, with a hope of further inferring and improving the measurability and predictability of "experiential qualities" and including this in future QoE assessment methodologies for sensor based digital storytelling in future studies.

Index Terms: Experiential Qualities, Quality of Experience, Storytelling, Measurability

1. Experiential Quality and Quality of Experience: Their Definitions

Experiential quality is a term extensively discussed in phenomenological aesthetics, architectural and spatial design, interaction design and consumer product design and branding, and its link with storytelling is gaining increasing attention in recent studies. Widely discussed as it is, "experiential quality" is rarely defined in the literature, not even vaguely. However, "Quality of Experience" (QoE) has a commonly accepted definition by the Qualinet white paper [1]: "*QoE is the degree of delight or annoyance of the user of an application or service. It results from the fulfillment of his or her expectations with respect to the utility and/or enjoyment of the application or service in the light of the user's personality and current state*."

2. Experiential Quality and Quality of Experience: Their Relations

In this paper, we argue that "Experiential Quality" is synonymous with "Quality of Experience" in the area of storytelling and multimedia systems design, based on the following arguments:

a. ***Both concepts are mediated by "experience".*** Experience is the extent to which "nature" is reflected in our perceptual and cognitive processes, immediately followed by subjective and affective appraisals. According to Hassenzahl [2], good experience while interacting with the computing systems is "*the consequence of fulfilling the human needs for autonomy, competency, stimulation (self-oriented), relatedness, and popularity (others-oriented) through interacting with the product or service (i.e.., hedonic quality)*." These qualities are exactly experiential qualities, while they are determining the system's Quality of Experience. In Dewey's seminal work "Art as Experience", experience is depicted as follows [3]: *"An experience has its own individualizing quality. An experience is individual and singular; each has its own beginning and end, its own plot, and its own singular quality that pervades the entire experience."* Experience is an umbrella that encompasses a full repertoire of experiential qualities, each having its own characteristics, internal values, and application domains. And the Quality of (such an) Experience can be potentially precisely characterized by these experiential qualities, an effort promising, fledgling yet regretfully less explored. Both definitions have emphasized that "experience" has a "quality", be it emotional, aesthetic or intellectual (cognitive). Whether this "quality" is termed as "experiential quality" or "quality of experience" is of minor importance - what we do care about is how we could tangibly describe and measure these qualities in terms of their relation to experience, which is otherwise difficult to sense, capture, interpret and interact with in a concrete manner due to its ephemeral nature.

b. ***Both concepts are mediated by "perception".*** "Experiential quality", in the philosophical sense, refers to "Qualia", the "phenomenal consciousness" that is involved in the perception, sensation, and emotion [4]. "Experiential qualities", or "Qualia", are "phenomenal properties" - the intrinsic and non-intentional properties of objects. In phenomenological philosophy of consciousness, mental states are seen as having a few subjective properties: qualia, sensational properties, phenomenal properties, experience, etc.. Traditionally, verbal reports of bodily sensations such as perceptual experiences are used as vehicles to cognitively accessing thoughts or as the representational content of thoughts [5]. According to Husserl [6], however, the phenomenal aspect of experience is not limited to sensory or even emotional states, but also characterize conscious thought. Husserl argues that conscious thoughts have *experiential qualities* and that episodes of conscious thought are *experiential* episodes. To elucidate, every phenomenally conscious state, be it a perception, an emotion, a recollection, an abstract belief, and so forth, has a certain subjective

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character, a certain phenomenal quality, corresponding to what it is likely to live through or undergo that state. That is called the *experiential quality* of consciousness [5]. Kreitler [7] suggests that one of the properties of consciousness is its experiential quality. Tart [8] calls this "the Gestalt feel" of the whole state. Kreitler further elaborates that experiential quality could include, for example, a sense of ordinariness or of bizarreness or nonreality, of coherence or fragmentation, or of stability or flimsiness [7].

Rosenberg suggests that composition of experiences leads to the production of "experiential quality of consciousness", where microphysical intrinsic qualities become macrophysical experiential qualities [9]. Krueger [10] argues by quoting James [11] that consciousness is intrinsically experiential. The fact that conscious states are both made continuous with one another and collectively unified within our personal experience of them is precisely what provides consciousness with its felt experiential quality. Development psychologists believe that emotions are important motivational / experiential phenomena that give impetus and directedness to perceptual and cognitive processes and to motor acts. Emotion is assumed to give consciousness a particular experiential quality and maintain its purposeful flow [12]. In summary, consciousness is "an experiential quality that may accompany (psychological) functions", such as perception or memory, that otherwise "can proceed outside of awareness" [13].

"Qualia depend not just on functional states, but also on the specific physical properties of the system that realizes the functional states [4]." This is very close to the definition of Quality of Experience. QoE is the perceptual satisfaction of the multimedia services. By "perceptual", it means QoE is evaluated or judged through "Qualia", the "phenomenal brain", where emotions (delight or annoyance, expectations, enjoyment, to pick up several key words from the definition of QoE) play a pivotal role.

c. ***Both concepts are mediated by "quality".*** Broadly speaking, "experiential quality" has several quality dimensions which are derived from its intrinsic functional requirements, such as the spatial quality, atmospheric quality, aesthetic quality, affective quality, ergonomic quality, technical quality, symbolic quality, etc.. These quality dimensions have all aligned with the QoE models which are evaluated from the human, technology, and contextual perspectives. Particularly in immersive storytelling experience, Zhang et al. argue that "experiential qualities" form an indispensible part of the overall QoE measurement framework [14].

d. ***Both concepts are mediated by the use of "digital artefacts".*** The quality of experience, or experiential quality, is only contextualized, externalized, or materialized in the process of users interacting with digital artefacts. There is no other way of exhibiting these experiential qualities if there is nothing to interact with and if we do not consider human factors in the computing system. The QoE of interacting with digital artefacts, particularly with media products (instantiated by games, music players, mobile phones, digital broadcast media, websites, and cross-media entertainment), is strongly influenced by their experiential qualities. Löwgren [15] lists a few examples of how the experiential qualities could be derived from the spatio-temporal nature of the digital design materials, for instance, how the noticeable latency of media delivery in mobile phone gives the impression of the device's brittleness and unreliability; How the transition in animation has rendered a sense of solidity and impact to the entire media project; Or how the fine-grained loop of anticipation and visuo-tactile feedback fosters a sense of curiosity about the data presented in a dynamic query. Vyas et al. [16] argue that experiential practices such as exploring and playing with digital artefacts are part-and-parcel of design practices and other creative industries in general. Digital artefacts could enable the activation of the cognitive domains of the neural system such as memory and attention, and allow the users to place considerable sentimental values on them which are derived from their experiential qualities.

3. Experiential Qualities in Interaction Design and Storytelling

3.1 Experiential qualities in interaction design:

Löwgren proposes "*Pliability*" as an experiential and aesthetic quality of interaction design, a notion that is characterized by "the degree to which interaction feels involving, malleable, and tightly coupled, and hence to what degree it facilitates exploration and serendipity in use" [17]. In addition, Löwgren also propose another experiential concept --"*Fluency*"-- as an important quality in augmented spaces. Augmented spaces include the mass- and personal media streams in everyday life experience [18], where fluency refers to "the degree of gracefulness with which the users deals with multiple demands for their attention and action. [15]" Designing for fluency entails that the digital media convey information in *peripheral* and *calm* ways -- finding the middle ground between foreground and background where information representation and provision is less intrusive yet fully readable for the audience who engage with it [15].

Alongside pliability and fluency, Löwgren has proposed another two concepts to articulate interaction aesthetics: rhythm and dramaturgical structure. Rhythm refers to human propensity towards rhythmical patterns and temporal predicability. Löwgren suggests that a certain hypnotic and addictive pleasure may be found in the rhythmic repetition of a motor sequence in a micro-automatic fashion without breakdowns [19]. Dramaturgical structure means the designing of interactive system could borrow from the classic Aristotelian proposition of exposition, complication, climax and resolution [20]. Dramaturgical structure could also be revealed in the moment when there is a deliberate distortion or deviation of the expected use function of the design artifacts, and at the end the user achieves a sense of surprise, thrill and discovery. This phenomenon is termed as "*parafunctionality*", an important experiential quality in interaction design [19].

Besides the experiential qualities aforementioned, Löwgren & Stolterman also propose a series of other experiential qualities of digital artifacts [21]. For instance, *transparency* (the degree of opaque a digital artifact is displayed in the design space), *personal connectedness* (the ability of digital artifacts as communication media to mediate closeness over a physical or temporal distance and to support user's location-based awareness), *control/autonomy* (the degree to which digital artifacts act as autonomous agents or actors in an interactive system), and *playability* and *seductivity* (the ability of digital artifacts to engage with, captivate, and entice users to interact with the system through intrinsic motivation and emotional / experiential promise). These basic experiential qualities evoke and derive other experiential qualities such as *anticipation*, *relevance* and *usefulness*, *ambiguity*, *surprise*, *immersion*, *elegance*, *efficiency*, *social action space*, *identity*, etc..

3.2 Experiential qualities in storytelling:

In digital storytelling, Roth et al. explicitly propose a conceptual framework of five dimensions of experiential qualities in interactive digital storytelling, which are: curious, suspense, aesthetic pleasantness, self-enhancement, and optimal task engagement ('flow') [22]. Klimmt et al. go into even greater details in outlining the experiential qualities in digital storytelling, where there are 13 aspects involved: usability of system, correspondence with system performance and own expectations, presence, character believability, effectance, autonomy, curiosity, suspense, flow, aesthetic pleasantness, enjoyment, emotional state, and role adoption / identification [23, 24].

In transmedia storytelling, Jenkins [25] has identified seven experiential qualities in transmedia storytelling, namely, spreadability / drillability, continuity / multiplicity, immersion / extractability, world-building, seriality, subjectivity, and performance. Pratten [26] has proposed seven tenets of future story worlds, namely, pervasive, persistent, participatory, personalized, connected, inclusive, and cloud-based. Rutledge [27] suggests the creation of an experiential consumption chain of engagement in transmedia storytelling, through: attraction, discovery, experience and exploration. Pratten [28] suggests five best practices in transmedia entertainment and marketing, which are all closely related to experiential qualities. They are: plan for discoverability, plan for retention, ignite the core, plan for participation, and satisfy a range of appetites. Pratten further proposes an Audience Experience Framework [29] by creating engagement through intrinsic motivations. This framework is evaluated through five layers: engagement & concentration, learning & challenge, energy & tension, shared experience & atmosphere, and personal resonance & emotional connection. Pratten argues that fandom interacts with the story world to satisfy several experiential human needs: significance (special, important, unique), certainty (comfort & control), variety (surprise), connection (love), growth (learning, mastery), and contribution (giving back).

4. The measurability and predictability of "experiential qualities" in storytelling

Unlike QoE, which can be to some extent quantitatively measured through webmetrics and data analytics by ISPs, "experiential qualities" are largely tacit qualities. By tacit we mean that generally speaking they cannot be directly measured but are potentially inferred by the measurements of a series of relevant variables.

4.1 Qualitative vs. quantitative

Qualitative methods include ethnographic studies, structured and/or semi-structured interviews, subjective oral reports, observations, focus groups, questionnaires, etc.. These methods aim at allowing the participants to tangibly describe their subjective experiences while interacting with digital storytelling projects. These subjective reports will then go through content analysis, sentiment analysis, and text mining to suggest any patterns in "experiential qualities", such as the participants' emotional ups and downs while experiencing the storytelling. If the peak values in their emotional arousal map with the structure of the story, we can infer that this is an immersive experience.

Looking at its conceptual coverage, "experiential quality" is a somewhat interchangeable, or at least overlapping concept with "usability". For "usability", we already have developed a whole set of rather mature quantitative measurements. For instance, for usability testing, we can find instructions in the *Handbook of Human Factors and Ergonomics* [30]; for practical guidance on collecting metrics in usability tests, we can find answers in *A Practical Guide to Measuring Usability* [31] and *Measuring the User Experience* [32]. There are numerous ways to assess the usability of the storytelling system quantitatively, for instance, impact scores can be assigned by the users to assess the impact of a usability problem, such as the degree of delight or annoyance a storytelling system delivers, then the observed percentage frequency of occurrence of problem can be computed with the degree of seriousness of the problem (impact scores) to achieve quantitative results [30].

4.2 Subjective vs. objective

"Experience" or "qualia" is by nature subjective. "By first-person events we mean the lived experience associated with cognitive and mental events. Sometimes terms such as ‘phenomenal consciousness’ and even ‘qualia’ are also used, but it is natural to speak of ‘conscious experience’ or simply ‘experience’. These terms imply here that the process being studied (vision, pain, memory, imagination, etc.) appears as relevant and manifest for a ‘self’ or ‘subject’ that can provide an account; they have a ‘subjective’ side" [33]. Subjective oral reports and questionnaires are examples of subjective measurements where participants give ratings or narrative descriptions of their first-person experience and judgment of the quality of storytelling.

Subjective measurements such as first-person account or report can be a biased outcome as it heavily relies on a person's situated experience which is not only unstable but is also error-prone and difficult to generalize. Objective measurements are a handy complement to the subjective measurements that offset their disadvantages and generate new parameters. Briefly, objective measurements deal with the users' bodily "manifestations" of experience but not the subjective account of experience in itself, such as the recent advances in physiological computing and neuro-imaging techniques to measure immersion and presence.

Subjective and objective measurements of experience are developed with the advancement of computational neuroscience, particularly in the area of artificial intelligence and machine learning methods. Mature methods in neural networks have developed computational models to describe and simulate neuronal electrophysiology, synaptic plasticity, and neuronal morphology. Bayesian, information-theoretic, statistical-physics and machine learning methods are deployed to decipher spatial-temporal patterns of spikes and to describe the laws of neural plasticity, along with abstract and realistic, competitive and associative network models, supervised and reinforcement learning models, etc. all these have successfully mapped onto the brain to describe and measure experience [34].

4.3 Design-based measures vs. neuropsychological-based measures

There are varied ways to measure user experience from the design perspective. Apart from the qualitative and quantitative methods introduced above, design paradigm encapsulates ***system prototyping*** where "heuristics" are de facto standards that determine a number of best practices in interaction styles, page layout, and visual design; ***expert review*** where performance of the storytelling system are systematically rated and evaluated by a panel of experts; ***participatory design or co-design*** where users actively involve in some or all stages of the design process to ensure the design outputs meet their expectations and are of good usability; ***eye-tracking*** to precisely measure where users gaze at while interacting with a storytelling system; ***diary / camera studies*** to measure users' longitudinal activities using video recording devices on a voluntary self-reporting basis; ***unmoderated remote panel studies*** for think-aloud protocols over several usability options conducted against video recording background which could be played back for repeated analysis and review.

There are various categorizations of neuroimaging modalities based on the differences in input and output signals, embedment methods ((non-)invasiveness) or translation algorithms.

i) *Electroencephalography (EEG):* This is by far the most common and widely used recording modality. It is a non-invasive method which uses electrodes placed on the scalp to capture very weak electronic signals produced during the synaptic excitations of the dendrites in neurons. These very weak neuron signals captured by electrodes then go though amplifiers, analog-to-digital converter and recorder to be digitized and saved in the storage and/or display devices such as personal computers. A typical EEG measurement system consists of three types of electrodes: the active, reference and ground electrode(s), which together measure the voltage difference between the active electrodes and the reference electrodes. The signals under investigation in EEG are classified according to their frequencies, namely, delta (δ) (below 4Hz), theta (θ) (4Hz to 8 Hz), alpha (α) (8Hz to 12Hz), beta (β) (12Hz to 30 Hz), and gamma (γ) (30Hz to 100Hz).

ii) *Magnetoencephalography (MEG):* It is a non-invasive imaging technique which measures the intracellular magnetic activity of dendrites. The superconducting quantum interferences devices are extremely sensitive at detecting magnetic disturbances produced by neural activity. MEG produces signals that are of higher spatiotemporal resolution than EEG. Despite this, MEG is too expensive to be adapted to every operation, thus is a less often used modality than EEG.

iii) *Electrocorticography (ECoG):* It measures the signals from the cerebral cortex by implanting an electrode grid through craniotomy. Though it provides higher spatiotemporal resolution and much more stable signals than EEG, it's an invasive method which might entail substantial health hazards. Several previous experiments show that ECoG-based applications could allow users to control flexible cursor actions.

iv) *Intracortical Neuron Recording:* It measures the neural signals inside the grey matter of the brain. Microelectrode arrays are placed inside the cortex to capture spike signals and local field potentials from neurons. In particular, Utah Intracortical Electrode Array (UIEA) has been reported as a suitable means of providing simultaneous and proportional control of a large number of external devices [35].

v) *Functional Magnetic Resonance Imaging (fMRI):* It is a non-invasive neuroimaging technique which detects changes in local cerebral blood volume, cerebral blood flow and oxygenation levels during neural activation by means of electromagnetic fields [36]. Thanks to the recent development of real-time fMRI, this neuroimaging technique has shown great potential and vast improvement in the measurements of experience.

vi) *Near Infrared Spectroscopy (NIRS):* It is an optical spectroscopy method that employs infrared light to characterize noninvasively acquired fluctuations in cerebral metabolism during neural activity. This neuroimaging modality might be a good alternative to EEG, as neither conductive gel nor corrosive electrodes are required [37].

vii) *Functional Transcranial Doppler Sonography (fTCD)*: It allows the non-invasive and uncomplicated registration of intracranial blood flow parameters under defined conditions of stimulation. The high temporal resolution provided by fTCD allows the recording of the dynamic component of cerebral blood perfusion by continuously measuring the cerebral blood flow velocity in the basal cerebral arteries [38]. fTCD has the potential to actively modulate spatially-localized neuronal activity as Brain Computer Interface [39].

4.4 Systems approach vs. human factors approach

Experiential quality is potentially influenced by many system factors, for instance, the size of the touch-screen, the effect of the challenge and the player's expertise, realism and behavior, one's perception of time, graphical fidelity and task fidelity, affective attention, ambient panorama, shared and collaborative environment, user interface design (e.g. 3D stereo and vibrotactile feedback), etc.

From the human factors perspective, a lot of studies are inspired by the seminal efforts of Schachter and Singer [40], Fossati [41], Russell [42], Dolan [43] and Coull [44], who have established links between i) physiological arousal and emotional states; ii) the neural correlates of emotional processing; iii) the psychological construction of emotion; iv) emotion, cognition and behavior; v) the neural correlates of arousal. All these among others have established a coherent eco-system of inter-related concepts and their measurements in physiology, emotion (affect), cognition, neuropsychology, and behavior. These provide hints on how we could leverage measureable parameters such as physiological, neuropsychological and behavioral data to infer the emotional and cognitive states of an immersive experience.

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