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Quality of Experience and Satisfaction: A Same Psychological Construct

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Abstract

This paper aims to present and discuss the results of the theoretical revision and measurement strategies of Quality of Experience (QoE) in telecommunication services adopted by The International Telecommunication Union (ITU) and others researchers on the subject; propose conceptual delimitation and measurement of QoE, under the Expectation Disconfirmation Theory that contemplates psychological constructs already established in the literature and by empirical studies; and demonstrate that QoE-related modeling essentially involves psychological constructs and, as such, should be guided by psychological theories consolidated in the literature and be measured by instruments that capture the breadth of these phenomena, constructed and validated by psychometric techniques. Based on the literature review and discussion on theoretical positions, it is concluded that QoE refers to the satisfaction construct. It is a component of the Expectation Disconfirmation Theory; dependent variable within the process in which perceived quality (performance) is moderated by expectation; and a psychological process, as such, must be measured by means of instruments that capture this reality, and by psychological instruments constructed and based on psychometric principles.

Keywords: *Quality of Experience, QoE, Quality of Service, QoS, Satisfaction, Perceived Quality.*

Introduction

The International Telecommunication Union (ITU) is a specialized UN Agency for information and communications technology. Its goal is to present recommendations that enable greater connectivity

worldwide, ensuring to all the fundamental right to communicate, through diverse debates to promote an increase in development of the telecommunications sector. Its activity is divided into three main areas: radio communication, standardization and development. The first aims the management of global satellite orbits and radio spectrum networks, as well as the development of international standards for radio communication systems. The standardization segment brings together experts to formulate recommendations and international standards of quality and telecommunication network infrastructures. And, lastly, the development sector involves studying and promoting means to develop networks accessible to all, as a way to stimulate economic and social development around the globe. Each of the sectors is composed mainly of study groups (SG) formed by experts in various fields dedicated to the discussion of specific subjects. The SG12, concerned with the standardization sector, addresses issues related to the theme "quality", of interest to the present work, among them the concepts of quality of experience (QoE) and quality of service (QoS).

Alves et al. (2017) carried out studies on the conceptualization and methodology of measurement of quality of services, specifically the Quality of Experience (QoE), spread and used worldwide, mainly by Players of the telecommunications market, indicated similarity with other theories already consolidated in Psychology and Communication. It was asked if the theoretical and methodological advances on the QoS / QoE model would contribute, complement or refute existing theories on Consumer Psychology that involve satisfaction and quality of services as connected themes. With this purpose, this ambitious work presents results of analysis of concepts and measurement strategies with respect to the quality observed, experienced and perceived, by users of services, focusing on telecommunications services.

Based on a review of theoretical and empirical concepts and models on quality, as well as measurement methodologies used, the present work aims to:

(a) Present and discuss the results of the theoretical revision and measurement strategies of Quality of Experience (QoE) adopted by ITU and others researchers on the subject.
(b) Propose a "cleaning" and conceptual delimitation and measurement of QoE, under a consumption paradigm that contemplates psychological constructs already established in the literature and by empirical studies.
(c) Demonstrate that QoE-related modeling essentially involves psychological constructs and, as such, should be guided by psychological theories consolidated in the literature and be measured by instruments that capture the breadth of these phenomena, constructed and validated by psychometric techniques.

Methodology

To meet the objectives of this study, the following theoretical and methodological analysis procedures were adopted:

(a) Review the literature and working papers on Quality of Experience (QoE) and Perceived Quality in its conceptual and measurement aspects and on Expectation Disconfirmation Theory, in the field of research on consumer behavior, the process of human motivation and perception.
(b) Promote the discussion about similarities and differences between the QoE model and the Expectation Disconfirmation Theory regarding its theoretical and methodological aspects, especially related to the measurement.
(c) Discuss and provide evidence that the model whose QoE is one of its dimensions involves psychological constructs that correspond to subjective constructs such as User's Satisfaction.
(d) Discuss and provide evidence that the modeling of quality in telecommunications needs to be based on psychological theories and to use instruments and measures developed by psychometric techniques, unconditionally.

The results of this theoretical and methodological review based the discussion and positioning that can be adopted in the investigation of the quality of services, based on the basic psychological processes that explain human behavior, especially consumer behavior, by the ITU and other researchers.

Results

Based on the methodology adopted, the results of the literature review are presented. If in the first two subsections, theoretical and methodological aspects about the modeling that involves QoE are reported and commented; in the third subsection, are presented and discussed, specially, the paradigm and the measure of the disconfirmation of expectations, among others that complement. Finally, we seek to relate aspects of both theoretical models and measurement parameters.

Quality of Experience: conceptualization

The ITU-T (ITU-T Rec. G.1000, 2001; E.800, 2008; P.10/G.100, 2007, 2017) and specific groups of theorists use the conceptual quality model composed by Network Performance (NP), Quality of Service (QoS) and Quality of Experience (QoE)[1]. The use of QoE terminology started to be used from P.10 (ITU-T, 2007) and had as precursors concepts such as QoS Perceived (ITU-T, Rec. G.1000, 2001) and QoS Experienced – QoSE (ITU-T, Rec. E.800, 2008).

Quality of Service (QoS) is defined as the "*totality of characteristics of a telecommunications service that bear on its ability to satisfy stated and implied needs of the user of the service*", same definition used by ISO 8402. Although the concept clearly aim to refer to objective aspects of telecommunications systems, networks and services, it also includes subjective aspects by linking the concept with the ability to satisfy user's needs, explicit or not. Thus, clearly this QoS definition goes beyond the mere performance of network elements, which is considered as Network Performance (NP), referring to internal or context stimuli that define the needs and generate motivation in the end user.

In turn, QoE is defined by ITU-T Recommendation P.10/G.100 (ITU-T, 2017) as the degree of delight or annoyance of the user with an application or service. The same recommendation also defines it's influencing factors as the type and characteristics of the application or service, context of use, the user's expectations with respect to the application or service and their fulfillment, the user's cultural background, socioeconomic issues, psychological profiles, emotional state of the user, and other factors.

QoE, by those ITU-T definitions, involve degrees of delight or annoyance, can be understood as a final attitude of the user to the service influenced by expectations, beliefs, values and by social norms (influencing factors). This modeling is closely related to Fishbein and Ajzen's Theory of Rational Action (1975) which proposes that attitudes are permeated by beliefs and assessments and guide behavioral intent.

This definition used by the ITU was inspired by the concept of QoE developed by the European Network on Quality of Experience in Multimedia Systems and Services, Qualinet (COST Action IC 10032). In 2011, The Group started to foster the scientific discussion about the definition of the term QoE and related concepts. As a result of this discussion, the "Qualinet White Paper on Definitions of Quality of Experience" (Le Callet, Möller, Perkis (eds), 2013) was compiled and published in its version 1.2, which presents, among other aspects, definitions and instrumental metrics on QoE. According to this conception, 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. Degree of delight of the user of a service. In

[1] Although the analysis presented in this article focuses on QoE, sometimes references and discussions about the other components of the model were used to allow an integrated understanding of its dynamics.

the context of communication services, it is influenced by content, network, device, application, user expectations and goals, and context of use" (Möller and Raake, 2014, p.18).

Raake and Egger (2014), from the discussion of the processes of perception, human experience and quality attribution, revisited and adapted the concept of QoE according to an up-to-date view that contemplated advances in the area. To define "experiencing", the authors refer to the concept of "perception" as:

"(…) definitions and considerations in the context of QoE, focusing on the perceptual and cognitive processes underlying the quality formation in the perceptual world of the person" (p.12).

"Here, perception is the conscious processing of sensory information the human subject is exposed to. Perception is assumed to involve two subsequent processing stages before a percept finally appears in the perceivers world, namely,

1. Conversion of stimuli via the respective physiologically adequate sensory organs into neural signals.
2. Processing and transmission of these neural signals in the central nervous system up to the cortex, finally resulting in the appearance of specific percepts in the person's perceptual world" (p. 13).

From these conceptions, the authors define experiencing as "the individual stream of perceptions (of feelings, sensory percepts and concepts) that occurs in a particular situation of reference" (p. 13). They follow the widely accepted understanding that experiencing is by characterized hedonic (feelings) and pragmatic (concepts) aspects and not include a quality judgement, that are considered to be the result of additional cognitive processes on top of experience.

Norman (2008)[2], cognitive psychologist, named the user experience with the term UX and defined it as:

"User experience encompasses all aspects of the end-user's interaction with the company, its services, and its products. The first requirement for an exemplary user experience is to meet the exact needs of the customer, without fuss or bother. Next comes simplicity and elegance that produce products that are a joy to own, a joy to use. True user experience goes far beyond giving customers what they say they want, or providing checklist features.

(…) We should also distinguish UX and usability: According to the definition of usability, it is a quality attribute of the UI, covering whether the system is easy to learn, efficient to use, pleasant, and so forth. Again, this is very important, and again total user experience is an even broader concept".

The user experience (UX) characterization presented by Norman (2008) is generalist when it involves all aspects of a user's interaction with the objects or their objective quality. It qualifies an exemplary experience, when the services or products attends the needs and provokes joy or delight in its use. It is referenced as different from usability which is related to interface quality, ease and efficiency of use. The UX definition, according to ISO 9241-210:

"(…) person's perceptions and responses resulting from the use and/or anticipated use of a product, system or service.

NOTE 1 User experience includes all the users' emotions, beliefs, preferences, perceptions, physical and psychological responses, behaviours and accomplishments that occur before, during and after use.

[2] https://www.nngroup.com/articles/definition-user-experience/

NOTE 2 User experience is a consequence of brand image, presentation, functionality, system performance, interactive behavior and assistive capabilities of the interactive system, the user's internal and physical state resulting from prior experiences, attitudes, skills and personality, and the context of use.

NOTE 3 Usability, when interpreted from the perspective of the users' personal goals, can include the kind of perceptual and emotional aspects typically associated with user experience. Usability criteria can be used to assess aspects of user experience" (Terms and definitions, 2.15, ISO 9241-210, p.3).

According to the definition of ISO 9241-210, user experience, also quite generalist, are perceptions and include the psychological responses of various natures: all the users' emotions, beliefs, preferences, perceptions, physical and psychological responses, behaviors and accomplishments that occur before, during and after use. It is important to note that there is a mixture of psychological constructs of various natures.

For example, beliefs and preferences are structuring and characterize previous aspects within a dynamic of the subject's contact with the service and its objective quality; the physical and psychological responses, which are consequential and can be influenced by those antecedents. The note 2, when it states that "the user's internal and physical state resulting from prior experiences, attitudes, skills and personality, and the context of use", allows a clearer visualization of this dynamics. The exploration of the presented concepts should alert the reader to the possibility of the experience being superimposed on the QoE. Although experience is the foundation of QoE, it must take on an additional component, which goes beyond mere experience, but already incorporates a positioning about objective quality that, experienced, would form perceived quality.

It is interesting to note that the work of Raake and Egger (2014) refers to Parasuraman, Zeithaml and Berry's conceptual model of service quality (1985, 1988), which is based on the theory of expectancy disconfirmation in which "Researchers and managers of service firms concur that service quality involves a comparison of expectations with performance" (Parasuraman, Zeithaml & Berry, 1985).

Raake and Egger (2014) cite the Jekosch's definition, so as to exclusively address perception that involves sensory processing of external stimuli: Quality (based on experiencing) results from the 'judgment of the perceived' composition of an entity with respect to its desired composition. "Quality of experiencing is the degree of delight or annoyance of a person during the process of experiencing. It results from the person's evaluation of the fulfillment of his or her expectations and needs with respect to the utility (pragmatic and hedonic) in the light of the person's context, personality and current state" (p. 18).

In the first part of the definition, there is the reference to delight or annoyance, aspects that would have more relation with feelings (hedonism), as it is presented in P.10 (11/2017). In the second part of the definition, in turn, Raake and Egger (2014) overcome hedonic aspects, bringing the pragmatic characteristics as well. This definition of QoE would be related to both hedonistic and pragmatic aspects. It is questioned why these aspects were not presented directly in a single sentence. They also deal with expectations and needs in relation to utility, not only in terms of pragmatic aspects, but referring to a hedonic utility. Is there hedonic utility?

Quality of Experience: measurement

To measure in sciences is to assign numbers to the characteristics of the natural phenomena. When these phenomena are in the field of Psychology, under the concept of latent traits, an effort is made to identify (observable) behaviors that are good representatives of these traits (not observable directly, but only indirectly through theory). This representation occurs through a solid theory which bases the psychological concepts or attributes that defines them operationally in behavioral terms. In addition, as it is in the scope of scientific activity, evidence of validity and reliability must be sought to ensure (or at least to amplify the

probability) that the behavior (answer from the individual to ten items of a scale, for example) effectively represents the trait previously defined by theory, with a low degree of error. With a view these conceptions related to measures in behavioral sciences and taking up some aspects of the conceptualization of QoE presented in the previous section, instruments and measurement in experience and quality of the experience are discussed here. As defined by theorists, QoE is related to delight or annoyance; experience and subjective perception; expectations, psychological profiles and user emotional states; among other aspects. They are clearly traits or psychological constructs and, as such must be linked to solid and well-founded theories and, moreover, must be measured by means of instruments that capture behaviors representative of these latent phenomena, the results of which show evidence of validity and reliability. The literature review presented in this section, with focus on QoE measurement, should be analyzed and discussed in the light of these conceptions.

The ITU-T Rec. P.10 / G.100 (2017) presents features of the QoE measurement or estimation process.

"6.211 QoE assessment
The process of measuring or estimating the QoE for a set of users of an application or a service with a dedicated procedure, and considering the influencing factors (possibly controlled, measured, or simply collected and reported). The output of the process may be a scalar value, multi-dimensional representation of the results, and/or verbal descriptors. All assessments of QoE should be accompanied by the description of the influencing factors that are included. The assessment of QoE can be described as comprehensive when it includes many of the specific factors, for example a majority of the known factors. Therefore, a limited QoE assessment would include only one or a small number of factors".

It should be noted that item 6.211 of Rec. P.10 / G.100 (2017) does not guide which data collection instruments are able to measure QoE, limiting itself to reinforcing the importance of contemplating the influencing factors. For this reason, this item also must be revised to define the proper way to assessment QoE as a psychological construct.

As a general rule, quality measures defined in terms of QoE functionally depend on QoS and user experience. The literature in this area considers that there is a functional relationship, most of a linear nature, between QoS, UX and QoE. Empirically, it is common for the functional relation to present the following form:

$$QoE = f(QoS, UX) \quad (1)$$

QoS= f(jitter, response time, delays, packet loss,…)
UX= f(perception measures, rendering quality, physiological measures, psychological measures,…)

Mitra et al. (2014) reviews the state-of-the-art research in the area of QoE modeling, measurement, and prediction. They also point out that data from subjective measures are usually collected directly from users of the services. The author also points out that, according to ITU-T P.800, in their recommendations, a methodology to measure user's QoE is based on a score called Mean Opinion Score (MOS). MOS is the most widely used method for subjective assessment of voice / video quality, where users evaluate their overall experience on a single scale, which is usually composed of five alternatives, ranging from 1 "bad" to 5 "excellent". According to the author "The human test subjects ranks the alternatives on the categorical scale where the distance between these alternatives cannot be known […] mathematical operations cannot be applied" (Mitra et al., 2014, p.6).

Exemplifying the understanding and the way of working with the concept of QoE, Harmam et al. (2008, p. 4) present a functional model that estimates QoE from a function involving UX and QoS. Thus:

$$QoE = \lambda . QoS + (1 - \lambda) . UX \; ; \lambda \in [0,1] \quad (2)$$

If we interpret this function in a more descriptive way, it can be considered that the QoE would be the result of the experience of a subject to the technical attributes of the service. Thus, λ represents a parameter that can be empirically estimated. Considering the various possibilities deriving from the QoS points and the user experience, it is said that QoE would be the result of a linear combination of these two variables. Obviously if λ assume value equal to or very close to unity, QoE would depend only on QoS, which would be, from the conceptual point of view presented previously, unrealistic to do without user experience to characterize QoE. Möller and Raake (2014) point out that: "It must be noted that the engineering, computer science and networking communities sometimes still use QoE in a misleading way in terms of technological aspects that are likely to impact QoE as perceived by users, without actually assessing or quantifying QoE or the QoE impact" (p.12).

Seufert et al. (2014), observing the QoE under the web, subdivided it into two dimensions: perception and technique. Describing only the first dimension, the influence factors described in the study were the waiting time (measured by delays and length of waiting time), video quality measured by means of image resolution, video adaptation, which is clearly noticeable the relationship of these factors of influence with more technical aspects of the product, but closer to the sensory experience of the user.

According to the applied QoE studies, the degree of user experience is associated to parameters related to sensory perception, such as rendering[3] quality, user immersion degree, usability. The QoE measures, especially when studied in the scope of telecommunications, refer to the physical characteristics and their interaction with the physiology of the users and their judgment is the quality resulting from the users' perception through their senses (Möller & Raake, 2014, p.89).

In the case of the user experience, a work by Laugwitz, Held and Schrepp (2008) apud Falavigna (2015), which translated 221 items called user experience questionnaire (UEQ). Falavigna points out that "[...] the questionnaire should contain items that directly measure visual attractiveness as well as product quality in the hedonic and ergonomic (pragmatic) aspects" (p.21).

At this moment, it is necessary to question whether it is possible to overcome aspects related to usability and sensory *per se*, and move towards measures that highlight characteristics such as aesthetics, reliability and creativity, because these attributes only come to exist from the perception of the human being and measured by means of psychological scales. The answer to this question will depend more detailed study of the psychological theory used by Falavigna (2015), since we are dealing with QoE that involves a series of constructs of this nature, as well as evidences that presented to guarantee a good degree of validity and accuracy of the results obtained.

It is observed, through a review of the literature that, in general, modeling usually takes into account, for QoS, network parameters, packet loss or system degradation, at the equipment or network level.

For QoE, observed the attempt to measure the user's opinion about the quality of some service or equipment. Normally, by measuring the user's reaction to classifying the service or equipment such as "bad", "good" or "excellent". It should be noted that those efforts to assess aspects closer to the user, their perception, expectations and needs (remembering that they are constructs used in the various definitions and characterizations of QoE), are close to capturing reactions through the set of meanings (vision, hearing, touch, etc.).

[3] It is a process of digital treatment of images and sounds that consumes many resources of the processors. Basically, it is the incorporation of resources to software such as subtitles, effects, among others in "raw" digital material like images, videos or audios. This process essentially applies to 2D and 3D modeling programs, as well as audio and video.

And it becomes very incipient when there are no clear definitions of psychological constructs, after all there is no way to measure without knowing what is being measured, by means of instruments that do not capture the peculiarities of this latent phenomenon, and do not present studies that demonstrate its degree of validity and reliability.

Al-Shehri et al. (2017) when dealing with metrics in QoE, still classifies into two types. In his words "(…) the objective QoE metrics use data, algorithms, and models to infer the user satisfactions. The data may be provided by applications or by the network protocol layers including the AQoS and NQoS measurements" (p.25). They still considered that the objective modeling of system quality is attractive for its low implementation requirements, adaptivity, and ability to operate in real-time settings, and it is used extensively by the network operators, codec engineers and the application developers.

Table 1. QoE Subjective Metrics

Subjective metric	Features	Application
Mean Opinion Score (MOS) [P.800 ITU-T]	Numerical QoE using subjective tests (Absolute category rating scale), but ignores other important aspects (e.g. degree of interactivity).	Video and Audio
Double Stimulus Continuous Quality Scale (DSCQS) [ITU-R BT.500-11]	Index of video quality which is less sensitive to context, but also inefficient for real-time evaluations	Pictures, TV, video stream, multimedia
Single Stimulus Continuous Quality Evaluation (SSCQE)	More representative quality estimates for quality monitoring applications	TV, video stream, and multimedia
Absolute Category (ACR), optionally with Hidden Ref. Removal (HRR)	Efficient, reliable and standardized method permitting great number of test conditions in a single test period	Video streaming
Double Stimulus Impairment Scale (DSIS) [ITU-R BT.500-11]	Paired evaluation: unimpaired reference video against impaired video	Pictures and video
Single Stimulus Continuous Quality Evaluation (SSCQE) [ITU-R BT.500-11]	Use of a slider device with no standard video	Video
Single Stimulus (SS) [ITU-R BT.500-13]	Also referred as Absolute Category Rating (ACR)	Video
Just Noticeable Difference (JND) Scale	Series of comparison tests on two samples while intensity in one sample increases or decreases	Video
Maximum Likelihood Differ. Scaling (MLDS)	Relative difference in quality to represent the utility of the tested parameter on visual quality	Images and video

On the other hand, the QoE metrics of a subjective nature, the author points out, are difficult to calculate due to the difficulty of monitoring in real time and its evaluation tends to be more time consuming, although it points to a trend that both the operators of network as content providers are focusing on subjective QoE metrics estimates, which in the perspective of this work would be good news (Al-Shehri et al., 2017, p.24). The authors performed a survey of the metrics and their characteristics for the subjective estimation criteria of the QoE (Table 1).

Seemingly, at least in the form that is usually found in the literature, QoE has been measured by instruments that capture QoS information. They are instruments that, at the maximum approximation of the human being, try to approach in a more focused way in the knowledge or usability of the service. There is still a great distance from the measure of perception, expectations, needs, satisfaction, among other psychological constructs, which are the foundation of the QoE concept. Hamam et al. (2008) points out that the physiological and psychological measures belong to a set that indicates the state of the user. While the former relates to direct biological measures, the latter reflects feedback from the user of the service or product.

The measurements used for QoE seem to reflect much more the sensory experiences that are ascertained through instruments as applications than to estimate the actual user experience, with all the psychological characteristics assumed by the quality of the experience. It proposes an evolution of the QoE measure for the use of psychological instruments, such as scales, constructed and validated by means of psychometric techniques in order to be able to more effectively tune the psychological traits involved in their conceptualizations. Additionally, taking advantage of the results obtained through a literature review, as well as proposing that the latent features involved in the QoE definitions be effectively considered, suggests another composite and more adequate function to describe the relationship between UX and QoS.

$$QoE = UX[QoS(Ph_n;Ps_n)] \quad (3)$$

Where Ps_n describes all variables of a psychological nature and Ph_n represents those that have relation to the physiological or sense.

Note that the dependency relation of the QoE measure becomes much clearer, because as already demonstrated, there is no possibility to determine a value of QoE without considering the relation with the user of the service, having a measure closer to This one. Thus, there is no way to fail to consider psychological variables, which in addition to the notably sensorial aspects, also compose human perception, as a level of immersion, interactivity and even the level of emotions.

A Paradigm of Consumer Behavior and Expectation Disconfirmation

In light of the presented ITU's conceptualizations and by researcher like Le Callet, Möller, Perkis, Egger and Raake (2013), other quality models that go beyond the scope of telecommunications but remain related to consumer practices and consumer psychology theories, have been revisited to understand the convergence between them and bring clarification to this theoretical field.

Psychological constructs such as expectations, perceived quality and satisfaction, terms used in the QoE framework, are anchored in the sphere of studies of consumer behavior, which has been defined as acquisition, consumption and disposition of products, services, time and ideas through decision-making units (Jacoby, 1975, 1976; Alves, 2005). It can be said that here is the ontology of a line of research that aims to bring well-being to any and every market ecosystem, specifically decision-making are the structuring axis of competition-level market policies. The perception of quality is inserted in the sphere of human perception: (a) it is a basic psychological process and it translates stimuli into meanings; (b) is structuring the paradigm of expectancy disconfirmation.

Perception structures the relationship of the individual to the world, starting with external objects. It involves information processing, active and selected process, in which the attention of the individual is activated with the competition of a series of other stimuli of the environment. This processing is composed of three phases that translate stimuli into meanings according to the exclusive experiences of each subject: exposure, attention and interpretation (Solomon, 2018, p.108).

People are embedded in a world that overflows sensations and systematically react to them, looks at some stimuli and ignores others. Thus the characteristics of the products that consumers choose to pay attention to often are different from the attributes that the suppliers would like them to be.

The human being adds his vision to things by attributing values and meanings that are consistent with their own experiences, impressions, and desires. In this way, it is necessary to understand that there is a process of absorption of information and sensations on the part of the individuals to interpret the surrounding world. The human brain receives sensory inputs that are raw data that initiate the perceptual process. The sensations that people experience are the result of context effect and, therefore, subtly influence what individuals think about the product they have acquired. Thus, research about consumer have been pointing to interesting findings, for example: a consumer may present a more critical evaluation of a particular product when it is in a particular condition, and a less rigorous evaluation in another condition. The stimuli we perceive are often ambiguous, so it is up to the individual to determine their meaning from their previous experiences, expectations, and needs.

The interaction of the consumer with products and services, which have particular properties, is related to hedonic consumption, in which multisensorial, fanciful and affective aspects are involved in the experience of buying (Babin et al., 1994;Bakirtas et al., 2015). This definition provides the understanding that consuming is a pleasurable activity and counteracting the concept of utilitarian purchases, in which rational processes are involved. Returning to Solomon's arguments (2018), in general, consumers react to the characteristics (stimuli) of services and products based on the scheme or set of beliefs. The pre-activation of certain properties of a stimulus evokes a scheme, which favors the comparison of this stimulus with other similar ones which the consumer has already had contact. Identifying and evoke the correct scheme is crucial for the market, as they determine what criteria will be used to meet the expectation and proceed with a post-purchase evaluation about the product. This process can be determinant of positive disconfirmation from the perception of quality.

Also, it seems reasonable to apply Vroom's (1964) model of expectation to consumer behavior by the number of alternatives that the individual can adopt in relation to brands or products that he can buy. A consumer may, for example, choose between a number of service plans, although he already expects to opt for one that is cheaper. Hansen (1969) found that desired outcomes and perceived expectations are predictors of both stated preferences and consumer choices in purchase simulation situation. Returning to the definitions of QoE presented by ITU-T and theorists such as Raake and Möller (2014), they incorporate the significance of the stimulus, through subjective perception, the multiplicity of Vroom's behavioral options and attitude orienting the behavioral intention of Theory of the Rational Action of Fishbein and Ajzen (1975), based on individual beliefs and evaluations. Each individual forms an attitude, influenced by expectations, beliefs, values and social norms (influencing factors) and, on the basis of these, behaves.

It is important to emphasize that consumers tend to evaluate the quality of services in different ways because they come from different cultures and have formed their own values and needs. Therefore, research with different demographics, from different social classes, ages, sexes, cultures, among others, becomes essential. In the 80's, the attempt to define a paradigm for service quality led to the operationalization of pioneering works in the area. A series of empirical experiments were conducted at the end of the last century and at the beginning of the current (Grönroos, 1984; Parasuraman et al., 1985, 1988, 1994a, 1994b; Brown & Swartz, 1989; Eiglier et al., 1989; Carman, 1990; Bolton & Drew, 1991a, 1991b; Nguyen, 1991; Cronin & Taylor, 1992, 1994; Boulding et al., 1993; Tears, 1993, 1994; Ballantyne et al., 1994; Taylor & Baker, 1994). Zeithaml (1988) and, more recently, Alves (2005) and Morgeson III, Sharma and Hult (2015) emphasize that service quality influences consumer choice behavior and is inserted in the satisfaction paradigm, dependent variable of the consumption process. At the aggregate level of the company, it becomes a competitive strategy (Garvin, 1987; Keizer, 1988).

Engel, Blackwell and Miniard (2000) define satisfaction as post-consumer assessment that a chosen alternative at least meets or exceeds consumer expectations. The user evaluates if the product, after consuming it, was as good as expected. When the result falls short of their expectations produces dissatisfaction, annoyance, displeasure occurs. Schwartz (2004) considers satisfaction as happiness or contentment.

Satisfaction is a result of acquisition of a service or product. This result has its origin in the comparison of the rewards of the buyers and the costs of the purchase in relation to the anticipation of the consequences. Operationally, satisfaction is similar to an attitude (already discussed in this article when the position of Fishbein and Ajzen (1975)has been presented) that can be accessed as the sum of satisfaction with various attributes of the product or service. These positions by Fishbein, Ajzen (1975) Engel, Blackwell, Miniard (2000) and Shwartz (2004) lead us to consider that delight or annoyance, components of the definition of QoE used by ITU-T, is the final attitude of the process of acquisition a good or service, or is satisfaction, a result of the modulation between expectations and performance perceived by the user in front of the attributes of the service or the product.

Some models have been proposed and confirmed in the literature as being illustrative of satisfaction and loyalty, for example, and perceived quality has appeared as a predictor (independent variable) of satisfaction. We find in the literature the position of Churchill and Surprenant (1982) on post-purchase evaluation inserted in the consumer process, in which the consumer satisfaction model encompasses four distinct constructs: expectations, performance, disconfirmation and satisfaction.

"Expectations are the probabilistic beliefs of an attribute's occurrence, fundamental for the formation of attitudes, in addition to serving as a level of adaptation for subsequent decisions of satisfaction. Performance is the comparison standard through which disconfirmation is accessed. Disconfirmation arises from the discrepancy between initial expectations and current performance. Therefore, the magnitude effect of disconfirmation produces satisfaction or dissatisfaction.

Disconfirmation is determined by the difference between expectations and performance, which has a dominant effect on the satisfaction construct, albeit in tandem with affective and motivational factors.
Satisfaction arises from the comparison of buyer's rewards and costs of purchase in relation to the anticipation of post-decision consequences, being the sum of satisfaction and several product or service attributes" (Adapted from Alves, 2005).

Rodrigues (2000), in a detailed analysis of the concept of quality, argues that the distinction between objective quality and perceived quality is fundamental. According to the author, the understanding of perceived quality is supported by a process of comparison between consumer expectations and perception of service performance. In turn, the objective quality is related to technical superiority. Thus, the measurement of superiority is compared to one criterion (Garvin, 1983, 1987).

Comparing the QoS / QoE model with definitions presented by Rodrigues (2000), which does not work with these terminologies, we can see similarities between QoS and objective quality, essentially focused on the attributes and technical objectives of the services; and between QoE and perceived quality, based on the perception that the user subjectively constructs on the objective aspects of the service.

Thus, the perception of the quality of services follows the expectation disconfirmation paradigm applied in consumer satisfaction studies (Rosa, 2001; Rodrigues, 2000). However, it is important to note that the criterion of predictive expectations is adopted for satisfaction studies, that is, expectations are predictive of satisfaction when confirmed.

The study "Regulatory legal framework and research on the behavior of consumers of telecommunications services in Latin America" (ITU, 2015) of the Telecommunication Development Bureau (BDT) of the ITU

was built with the objective to provide an analysis of best practices with regard to the consumer of telecommunications services in 20 Latin American countries under three important aspects: legal protection and consumer protection framework, regulatory framework on quality of service, perceived quality and consumer satisfaction. This study contemplated quality perceived by the user in his experience with the service as a basis for the diagnosis of quality regulatory models.

Another aspect to be considered regards metrics and information-seeking procedures at the individual level. Only the individual who acquires a product or service can provide the disconfirmation of a perception, since it is in fact a basic psychological process that translates stimuli into meaning. Thus, the more representation of the stimulus one has, the better one can interpret it.

In a quality assessment, the consumer needs to realize how much benefit the acquisition is adding to their expectation. This process is at the individual level and occurs solely in them. The measurement of these constructs and subjective and psychological processes occurs only by means of psychological instruments specifically constructed and based on psychometric principles and parameters.

In fact, since the 1980s, consumer research has contributed to the development of a series of instruments, mainly psychological scales, and a set of multivariate data analysis methods that allow to associate the various constructs and their inter- related by causal sequences. Some papers signed by Parasuraman et al. (1994b) and Morgeson III, Sharma and Hult (2015) are examples of the development and use of psychological scales or multivariate analytical methods in the field of research with the consumer.

Studies that relate QoE to Perceived Quality

The paper "*Quality in Telecommunications Services: Theoretical Contributions and Recommendations for the ITU*", de Alves et al. (2017), provides the rationale for the Disconfirmation Theory (Oliver, 1977, 1980; Churchill & Surprenant, 1982) and demonstrates that QoE has the same conceptualization of Perceived Quality, the both constructs are based on the user's perception of the service provided and may differ from one user to the other. Therefore, it should be defined and evaluated with consumers by means of research with built instruments and results validated by psychometric techniques. The concepts of QoS and QoE have already been discussed in the various work items of the ITU-T Study Group 12 issues and in the QSDG activities. As a recent example of these discussions we have the ITU Workshop on Telecommunications Service Quality4, what happened at the Rio de Janeiro, Brazil, 27 - 29 November 2017.

In this Workshop, the session entitled "*Reviewing QoS and QoE definitions and concepts*" aimed to discuss key concepts, requirements and trends in QoS and QoE, as well as to analyze their evolution over time and the challenges associated with delivering better service quality to the end users. According to presentations delivered in this session, expert speakers approached that QoS does not reflected user's perception (QoE), and proposals for conceptual differentiation between QoS and QoE were presented. The proposals states that QoE refers to Perceived Quality that should be measured by surveys (based on psychological scales) and is independent variable and predictor of satisfaction. The results of the studies showed the need to solve the conceptual confusion about QoE within the ITU and the telecommunication sector, the adoption of a solid theoretical basis, the use of techniques for elaborating and validating questionnaires, conducting multivariate analyzes and of the constitution of interpretable indicators that consider the multidimensionality of the psychological phenomena involved in the user satisfaction paradigm.

In the same line, at the panel "Surveying user satisfaction and perceived quality", four studies placed Perceived Quality as a construct that depends on solid theoretical foundations, is a predictor of satisfaction,

[4] https://www.itu.int/en/ITU-T/Workshops-and-Seminars/qos/201711/Pages/default.aspx

impact on decision making and that must be measured by means of researches, anchored in the use of psychometric techniques for measuring validity and reliability of the results obtained.

However, even based on information obtained through other presentations carried out within the scope of the aforementioned Workshop, today there are several technical and objective market solutions proposing to measure QoE through KPI data collection from the end users perspective. Systematically, they deal with user experience, a construct of a fundamentally psychological nature, without theoretical foundations that conceptualize the latent trait and do not delimit the field and the theoretical position to which it is anchored. Still, psychometric techniques are not being used for the constitution of data collection instruments. Also, they don't use surveys, do not perform multivariate analyzes for the constitution of indicators, nor do they present evidence that the results obtained show good validity and accuracy.

It may be questioned what is being measured when the market vendors present "*QoE results"*, without delimiting and using these incorporated theoretical and methodological foundations. Further, it is possible to ask the impact of the use of these declared "*QoE results*", without parameters that evidence its validity and reliability. In fact, are these measurement solutions commercially called as QoE measurement tools effectively measuring QoE, or are they measuring end-to-end QoS through objective assessment? Answers to these questions must be given by means of the QoS and QoE ITU-T's definition.

It is noticed that some of the findings presented by Alves et al. (2017) and by panelists of this Workshop were taken up and reaffirmed in this article, mainly, regarding the similarity of the QoS / QoE model with design of the expectation disconfirmation paradigm and the need to use instruments that capture the psychological constructs involved. However, it is already perceived that this article has brought, and will be discussed in the next section of the document, evidences that bring QoE closer to the satisfaction construct, an attitude that is the result of the disconfirmation between perceived quality and expectation.

Discussion and Conclusion

When the concepts and characteristics of QoE presented by ITU and researchers such as Le Callet, Möller, Perkis (2013) Egger and Raake (2014) involve: delight or annoyance of an application or service; from experience and subjective perception (anchored in perception theory); that may be influenced by user expectations, cultural background of the user, socioeconomic issues, psychological profiles and user emotional states; we find a series of fundamentally psychological constructs or phenomena.

Since the conceptualization and dynamics of this model involve constructs and psychological processes in a relationship of consumption with a focus on quality, it is essential that it be incorporated the theoretical framework and empirical studies historically consolidated and from areas such as Psychology of the Consumer. It is observed that the theoretical and empirical advances of Grönroos, Parasuraman, Brown and Swartz, Eiglier, Zeithaml, Alves and Morgeson III, Sharma and Hult, to name a few, that structured a whole area of research, were practically disregarded by the developers and users of the QoS / QoE modeling line.

If we analyze in detail the conceptualization and dynamics proposed for QoE, which involves subjective perception, expectations and delight or annoyance of users of services or products, a surprising similarity is observed to several studies carried out by theorists who deal with consumer behavior and who work with the Expectation Disconfirmation Theory. For both models, it is clear: (i) the user's contact with the objective attributes of the services; (ii) subjects with their expectations, needs, values, particular beliefs, under specific contexts; (iii) that make use of the basic psychological process called perception for the formation of position regarding subjective quality; (iv) resulting in a degree of satisfaction with them. It is emphasized that the similarity of these models, their concepts and dynamics, is very explicit. It is emphasized that the similarity of these models, their concepts and dynamics, is very explicit. The reason for proposing a service quality theory involving QoS / QoE with a whole new set of concepts for similar

phenomena, as well as relationships among them, is already being discussed, and there is already a paradigm effectively established in the area.

The deepening of the study focused on the conceptualization of QoE has brought significant advances to its understanding. If Alves et al. (2017) advanced when they argued that QoE should be understood as perceived quality, the theoretical evidences presented and discussed here have indicated that QoE is defined as satisfaction with services or products. The result of the post-consumer evaluation, which reflects how much the performance (perceived quality) of the service or product (objective quality) meets the user's expectations, considering their values, beliefs, needs, other biological, social, cultural, and economic characteristics.

Another aspect that should be discussed is the instrumentation used to measure QoE results. It is considered here that the instrumental arsenal used by the ITU and by the groups of researchers mentioned above are fundamentally based on sensory measures and technical elements to estimate QoE, often linked to applications and devices, are not able to measure, in the breadth of complexity of psychological constructions (and their various dimensions): expectations, subjective perception (anchored in perception theory) and satisfaction (delight or annoyance). To measure these aspects, it is fundamental to use instruments that capture the reality and the peculiarities of these psychological phenomena, such as psychological scales.

Also, as they deal with variables of different natures and that are related, it is fundamental that use experimental modeling or quasi-experimental allow to test their causal relation and the influence of the contextual aspects in this dynamic, through multivariate statistical techniques, for example, structural equation models. As important as it is, for a responsible use of the results obtained through instruments of satisfaction assessment and other constructs to decision making, present evidence of validity and reliability, and Psychology has a range of instruments to provide them.

Based on the literature review and discussion on theoretical positions, Quality of Experience (QoE) refers to satisfaction, contemplating a theoretical and methodological framework already produced and empirically tested. Thus, some QoE caracteristcs are:

(a) It is a construct component of the Expectation Disconfirmation Theory (Oliver, 1977, 1980; Churchill and Surprenant, 1982);
(b) It is a dependent variable within the process in which perceived quality (performance) is moderated by expectation; and
(c) It is a psychological process and as such must be measured by means of instruments that capture this reality, psychological instruments constructed and based on psychometric principles.

Thus, the following definition is proposed:

Quality of Experience (QoE) - QoE is a subjective construct that can be expressed by the user's satisfaction with the service or the product, result of the comparison process between the user's expectations and user's quality perception. QoE can be validly measured only through research, using psychological methods.

It is emphasized that satisfaction is a construct that involves measurement of results that, in turn, is predicted by perceived quality, which involves measure of tendency. By monitoring perceived quality, it maximizes well-being. However, the presentation of concepts that are independent and unlinked of an explanatory model of consumption behavior can not produce the desired management of the consumption process by regulators. Finally, it is necessary that these debates be within the science of human behavior. It is understood that, if the ITU does not migrate its theoretical framework on this subject, in particular, to the

field of behavioral sciences, it will have enormous difficulty in undoing the conceptual diatribe that was installed there.

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