

# *To Involve or not to Involve?*

## *Investigating the Contribution of Innovative Users to Subjective Video QoE Ratings*

Karel Vandenbroucke, Aron-Levi Herregodts, Dimitri Schuurman, Lieven De Marez  
*iMinds-MICT-University of Ghent*  
Ghent, Belgium

**Abstract**— In today's highly competitive and volatile technology market environment, Quality of Experience has become a key differentiator. However, it is unclear how to take human factors into account and how to benefit from involving participants with specific user characteristics in QoE research. Based on an online survey with online video viewers (N=533), we investigated if innovative users, who are thinking ahead of market and who are dissatisfied with current video solutions, rate video quality differently compared to general users. Results show that innovative users, although they are more confronted with video distortions, are not more sensitive in terms of video QoE.

**Keywords**— *Human Factors; Innovativeness; Video QoE*

### I. INTRODUCTION

In today's highly competitive and volatile technology market environment where one must constantly pursue being ahead of the market and tap into users' unfulfilled needs in order to keep innovating, the Quality of (user) Experience has become a key differentiator [1]. In this regard, involving end-users in QoE-aware product development processes is becoming the norm. QoE has been defined as 'the degree of delight or annoyance of the user of an application or service'. Reference is made to the fulfillment of expectations that the user has regarding the utility and/or enjoyment of the application or service, given the user's personality and current state [2]. Whereas much previous work has focused on the users' delights and annoyance on a system level, i.e., QoE optimization from a technological perspective, few research has focused on the human level, which is characterized by the user's personality and current state. However, today it is unclear how to take these human factors into account and more important, how to benefit from involving participants with specific user characteristics in QoE research.

In this work-in-progress paper, we focus on the relation between user innovativeness and online video quality ratings. More specific, we investigate whether innovative users, i.e., users who are thinking ahead of market and are dissatisfied with current video solutions [3], evaluate online video quality differently. The reason for our research interest is that innovative customers face needs before the majority of the market and expect to gain high benefits from the solution to the needs they face [3]. Subsequently, we assume that these users will have higher expectations towards current video quality and that these users can have a significant impact when involved in the development of future QoE-aware services.

### II. RELATED WORK

The influence of user innovativeness in relation with video QoE is rather unexplored terrain. However, gaining insights in this topic might help QoE practitioners to improve future QoE-aware video services. In the field of QoE research, a shift was noticed from a technology-deterministic approach to an encompassing user-centric approach [1]. Whereas participants were conceived as mere passive observers, mostly involved in controlled lab experiments, participants are nowadays increasingly seen as active users studied in real-world, Living Lab settings. In such settings, users' needs and expectations are taken into account, aiming at a better understanding of the holistic concept of QoE [4]. In this context, involving different kinds of users gives a more enriched perspective on the experience, because in this way multiple needs arise that can be taken into account [5]. Although involving end-users in QoE research is becoming the norm, research has shown that not all types of users are equally interesting to investigate [6]. In HCI research, distinction is traditionally made between expert and non-expert users, where the latter are known to rate quality higher and are more focused on general image of services and less on technical impairments. In [7], analysis shows that personality and cultural traits represent 9.3% of variance attributed to human factors, which strongly suggests that human factors play an important role in perceptual multimedia quality. In the context of speech usage, it was shown that attitudes towards technology and mood are related to quality perceptions. Positive mood is linked to positive quality judgements [8]. Authors in [9] classify human QoE influencing factors in low-level factors, related to the physical, emotional and mental constitution of the user, and higher-level factors, related to the understanding of stimuli and associated interpretative processes (e.g. prior experiences and knowledge). As such, in [10] it was shown that users' expectations have a major impact on QoE ratings.

### III. METHODOLOGY

In order to investigate the influence of user innovativeness on quality ratings of online video services as a whole (i.e., not for specific video sequences), a survey questionnaire was developed. Next to aspects concerning online video watching (types and number of devices used to watch video fragments, viewing frequency, occurrence of and tolerance towards distortions, etc.) a number of statements (5-point Likert scales) related to user innovativeness were included. These were based on two dimensions: *Being ahead of market* (i.e., having ideas for new video services, experiencing needs that others don't

have,...) [11] and *Dissatisfaction* (i.e., being dissatisfied with current video solutions) [12]. After pre-testing the questionnaire, it was launched online in December 2015. In total, 533 online video watchers completed the entire survey. 61.5% of them are male and 38.5% female. The mean age of the respondents is 39.94 years (S.D.=14.62). Based on Principal Component Analysis, respondents were scored on the dimensions *Being ahead of market* and *Dissatisfaction*. Hierarchical and K-Means cluster analysis were conducted to cluster respondents, resulting in 4 externally heterogeneous and internally homogenous groups of respondents. One cluster, which we call the *Innovative Users* (N=110), stands out compared to the other 3 because it is the only cluster with positive scores for *Dissatisfaction* (Mean=3.87) and *Being ahead of market* (Mean=3.52). In the analysis, we compare the *Innovative Users* with the *General Users* (N=423), i.e., the other 3 groups combined.

#### IV. RESULTS

##### A. Socio-demographic differences

The *Innovative Users* (N=110) are significantly younger (M(age)=37.3 years, SD=12.8;  $t(531)=-2,125$ ,  $p=0.034$ ) and more masculine (77.3%; ( $\chi^2(1, N=533)=14.498$ ,  $p<0.005$ )) compared to the *General Users* (N=423) (M(age)=40.6 years, SD=14.9; 57.4% males). There were no significant differences between both clusters for level of education, occupational status and household situation.

##### B. Video watching behavior

*Innovative Users* watch video fragments on more devices ( $\chi^2(1, N=533)=10.919$ ,  $p=0.001$ ): 66.4% watches on 4 or more devices (*General Users*: 48.7%). Devices most used on a daily basis are TV (46.6%), Laptop (36.4%) and Smartphone (29.1%). This differs from *General Users* (TV: 37.1%; Laptop: 28.4%; Smartphone: 19.9%). There were no significant differences between both clusters for paying for video services.

##### C. Video distortions

*Innovative Users* notice certain video distortions significantly more than *General Users* (e.g. slow channel switch). However, there are no significant differences between the clusters in level of frustration of video distortions (based on Independent Samples T-test) (See Fig.1). When distortions occur, *Innovative Users* are more interested in what causes problems and when or how they can be solved. Also, these users are more likely to switch to another provider if their current provider would charge a higher fee for better quality.

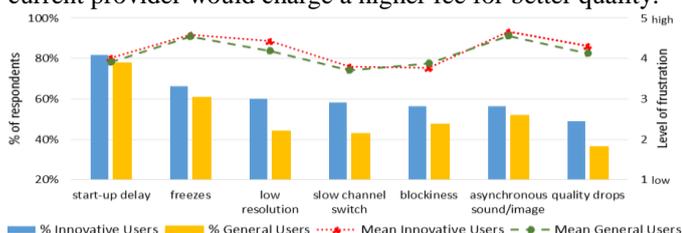


Fig. 1. Occurrence vs level of frustration of video distortions

#### V. DISCUSSION AND CONCLUSION

Although *Innovative Users* don't seem to be more critical towards video distortions compared to *General Users*, they differentiate themselves by being more confronted with distortions. Moreover, *Innovative Users* seem to have a higher interaction with video devices. Therefore, it is useful for practitioners and industry partners to involve these *Innovative Users*, who are thinking ahead of the market and have unfulfilled needs, in optimizing (elements of) QoE-aware video services. Similar results were found in [5]. While this study was not QoE-focused, it supports our rationale that *Innovative Users* can provide an added value in QoE research. Further research should go more in-depth on the added value of involving these *Innovative Users* in QoE research.

#### ACKNOWLEDGEMENT

This work was performed within the iMinds ICON project SHIFT-TV, funded by IWT (Belgium) under project number 140684.

#### REFERENCES

- [1] Redi, J. A., Zhu, Y., de Ridder, H., & Heynderickx, I. (2015). How passive image viewers became active multimedia users. In *Visual Signal Quality Assessment* (pp. 31-72). Springer International Publishing.
- [2] Le Callet, P., Möller, S., & Perkis, A. (Eds.). (2012). *Qualinet White Paper on Definitions of Quality of Experience*, version 1.1, June 3, 2012. Lausanne: European Network on Quality of Experience in Multimedia Systems and Services (COST Action IC 1003).
- [3] Von Hippel, E. (1986). Lead users: a source of novel product concepts. *Management science*, 32(7), 791-805.
- [4] De Moor, K., Ketyko, I., Joseph, W., Deryckere, T., De Marez, L., Martens, L., & Verleye, G. (2010). Proposed framework for evaluating quality of experience in a mobile, testbed-oriented living lab setting. *Mobile Networks and Applications*, 15(3), 378-391.
- [5] Schuurman, D., Coorevits, L., Logghe, S., Vandenbroucke, K., Georges, A., & Baccarne, B. (2015). Co-creation in living labs: exploring the role of user characteristics on innovation contribution. *International Journal of Services Sciences*, 5(3-4), 199-219.
- [6] Quintero, M. R., & Raake, A. (2012). Is taking into account the subjects degree of knowledge and expertise enough when rating quality?. In *Quality of Multimedia Experience (QoMEX), 2012 Fourth International Workshop on* (pp.194-199). IEEE.
- [7] Scott, M. J., Guntuku, S. C., Huan, Y., Lin, W., & Ghinea, G. (2015). Modelling Human Factors in Perceptual Multimedia Quality: On The Role of Personality and Culture. In *Proceedings of the 23rd Annual ACM Conference on Multimedia Conference* (pp. 481-490). ACM.
- [8] Wechsung, I., Schulz, M., Engelbrecht, K. P., Niemann, J., & Möller, S. (2011). All users are (not) equal-the influence of user characteristics on perceived quality, modality choice and performance. In *Proceedings of the Paralinguistic information and its integration in spoken dialogue systems workshop* (pp. 175-186). Springer New York.
- [9] Reiter, U., Brunström, K., De Moor, K., Larabi, M. C., Pereira, M., Pinheiro, A., & Zgank, A. (2014). Factors influencing quality of experience. In *Quality of Experience* (pp. 55-72). Springer International Publishing.
- [10] Sackl, A., Masuch, K., Egger, S., & Schatz, R. (2012). Wireless vs. wireline shootout: Howuser expectations influence quality of experience. In *Quality of Multimedia Experience (QoMEX), 2012 Fourth International Workshop on* (pp. 148-149). IEEE.
- [11] Belz, F. M., & Baumbach, W. (2010). Netnography as a method of lead user identification. *Creativity & Innovation Management*, 19(3), 304-313.
- [12] Spann, M., Ernst, H., Skiera, B., & Soll, J. H. (2009). Identification of Lead Users for Consumer Products via Virtual Stock Markets\*. *Journal of Product Innovation Management*, 26(3), 322-335.