Evidence from Functional Neuroimaging of Game Elements and User Engagement in Online Gaming Application

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In the highly competitive online gaming market, gaining user game engagement, i.e., the act of users being involved in playing with an online gaming application is a vital factor for success in attracting and retaining customer base. Bulk of the prior studies has predominantly applied self-report data to measure the user game engagement. In this study, we deployed pluralistic methods to refine the measurement of the game engagement, including self-report survey, electroencephalography (EEG) technique, and in-depth interviews. To contextualize into our gaming setting, we reviewed the extant game literature and proposed two cognitive-related game elements, namely the game complexity and the game familiarity, to manipulate and measure the user game engagement.

The game complexity refers to the extent to which the human cognitive capacity should be allocated when playing game, while the game familiarity defines the context (i.e., setting) in which the game is played. This research is empirically tested through two consecutive studies. In the first study, we use the electroencephalography (EEG) technique and self-report survey to quantitatively probe the neural activities of user game engagement and cognitive performance with the manipulation of the two focal cognitive-related game elements. Parallel, neural activities data involving real consumers has also been collected and analyzed from both desktop and mobile device platforms.

The findings are summarized in the following statements: 1) the lower level of game complexity will result in lower cognitive working memory load and the higher level of game engagement; 2) the higher level of game familiarity will result in lower cognitive working memory load and higher level of game engagement. The results also indicate that the mobile device platform could exemplify the difference of game engagement between high game familiarity and low game familiarity being detected in the presence of high game complexity condition. We then conduct the in-depth interviews to triangulate the previous findings with semi-structure questionnaires. We argue that different types of cognitive-related game elements could have joint impact on user game engagement and working memory load. More specifically, the user game engagement and working memory load are negatively correlated. We conceive and demonstrate that the cognitive-related game element do invoke specific routes of neural activities to affect users' working memory load. Furthermore, we find different levels of cognitive-related game elements combinations have dissimilar impact on the users' working memory load.

The findings from this research could inform research and practice in two key ways. First, this paper complements the extant studies on game engagement by theoretical conceptualize and empirically compare the engagement measure from multilateral perspectives. Second, with respect to the context of gaming, this paper theorizes and demonstrates how cognitive-related game elements can be operationally assessed to affect user gaming behavior. By doing so, this paper also shows the neurophysiological research method can complement the traditional self-report method and observe the unobtrusive cognitive activities.