Full length article

The dynamic influence of emotions on game-based creativity: An integrated analysis of emotional valence, activation strength, and regulation focus

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A R T I C L E   I N F O

A B S T R A C T

Emotion has been identified as an important predictor of creativity, but little attention has been put on investigating how emotion, especially that considers regulation focus, may dynamically influence male and female students' creativity in game-based situations. To explore the dynamic relationship between various types of emotions and creativity during game playing, 266 college students were included and the Creativity Game-based Evaluation System (CGES) was developed in this study. Four types of emotions integrating perspectives of valence (positive vs. negative), activation (high vs. low), and regulatory focus (prevention vs. promotion) were investigated in this study: the positive-low activation-prevention emotion (P-L-Pre) (calm and relaxed), the positive-high activation-promotion emotion (P-H-Pro) (happy and elated), the negative-high activation-prevention emotion (N-H-Pre) (nervous and anxious), and the negative-high activation-promotion emotion (N-H-Pro) (frustrated and angry). The results revealed that, although there was a slight gender difference in game-based creativity, the prediction patterns of emotions in game-based creativity were very similar among participants with different genders. Specifically, emotions during game playing can better predict creativity than those of the baseline; moreover, the P-H-Pro emotion can facilitate performance on creativity, whereas the N-H-Pro emotion can decrease creativity performance. Thus, providing appropriate challenges to induce highly-activated and promotion-focused positive emotions are critical for the success of games designed to improve creativity.

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1. Introduction

Games have been defined as an immersive, voluntary, and enjoyable activity in which a challenging goal is pursued (Freitas & Oliver, 2006; Kinzie & Joseph, 2008). Many studies have found that educational games can enhance learning motivation and learning outcomes (e.g., Dickey, 2011; Hung, Hwang, Lee, & Su, 2012; Sung & Hwang, 2013). On the other hand, creativity is an important educational goal in this rapidly changing society. Despite substantial research on creativity in recent decades, studies that integrate creativity and games are still limited. Among the game-free creativity research, emotions are one of the most influential factors on creativity performance. However, the findings on how emotions influence creativity are not consistent. Some studies suggest that positive emotions can facilitate creativity (e.g., Forgeard, 2011; Hutton & Sundar, 2010; Isbister, 2011), whereas other studies suggest that negative emotions can enhance creativity (e.g., Hirt, Devers, & McCrea, 2008; Jones & Kelly, 2009). Moreover, some studies claim that in addition to valence (positive vs. negative), the arousal level of emotions is important (De Dreu, Baas, & Nijstad, 2008; Zenasni & Lubart, 2008). More recently, researchers have suggested that valence, activation level, and regulation focus (prevention vs. promotion) all need to be taken into account when exploring the influence of emotions on creativity (Baas, De Dreu, & Nijstad, 2008; Yeh, 2012).

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To date, only a few studies have investigated the relationship of flow experience or enjoyment (positive emotions) and creativity (Boyle, Connolly, & Hainey, 2011; Chang, Wu, Weng, & Sung, 2012); few studies have focused on understanding the relationship between various types of emotions and creativity in game-based learning or their dynamic relationship during game playing, not to mention those explore gender differences. It has been suggested that there are gender difference in creativity performance (Lin, Hsu, Chen, & Wang, 2012; Naderi, Abdullah, Aizan, Sharir, & Kumar, 2009), gaming (Homer, Hayward, Frye, & Plass, 2012; Yang & Chen, 2010), and emotions (Simon, 2014; Tolegenova, Kustubayeva, & Matthews, 2014; Zhao, Zhang, & Zheng, 2014). Thus, this study mainly aimed at exploring the dynamic relationship between various types of emotions and creativity in game-based situations from an integrated perspective of emotions. Meanwhile, gender differences in such a dynamic relationship were also examined.

1.1. Game-based learning and creativity

Numerous definitions of creativity have been proposed (e.g., Kampylis, Berki, & Saariluoma, 2009; Zeng, Proctor, & Salvendy, 2011) over the past six decades. In a review article, Hennessey and Amabile (2010) suggested that creativity involves the development of a novel product, idea, or problem solution that is valuable to the individual and/or the larger social group. Yeh (2011) also proposed that creativity is a process of producing original and valuable products within a specific cultural context. To ensure originality or novelty, some researchers (Dineen, Samuel, & Livesey, 2005) have claimed that appropriateness and convergent thinking, as well as divergent and productive thinking, are necessary for creativity. In cognitive psychology, many researchers use insight problems to test creativity, as it enables researchers to experimentally examine the process of creativity within a relatively short time period (Abraham & Windmann, 2007). Insight problems, which typically include open problems and closed solutions, involve restructuring a problem before the problem can be solved (Abraham & Windmann, 2007). Therefore, this study employed insight problems to measure an individual's creativity during playing games.

Recently, game-based learning has attracted researchers' attention, as it is effective in engaging players in learning (Bayliss, 2007; Prensky, 2003). Games usually include clear objectives, and they often provide tasks with multiple difficulty levels to adapt to the prior knowledge and skills of learners; therefore, games are considered as an effective educational tool (Gentile & Gentile, 2008). As information technology is rapidly developing, games have become interactive; they provide a complete playing environment that motivates learners through fun, challenge, and instant visual feedback (Mitchell & Savill-Smith, 2004).

Although some researchers (Kiili, 2005; MacDonald, Stodel, Farres, Breithaupt, & Gabriel, 2001) have suggested that games can support the learning of creativity, few researchers have developed games for evaluating or enhancing creativity. Faiola, Newlon, Pfaff, and Smyslova (2012) found that game-based learning can enhance learning experience while promoting exploration and creativity. In the same vein, Michalewicz and Michalewicz (2007) found that puzzle-based learning can support problem-solving skills and creative thinking. Thus, games can be employed to enhance the development of creativity and motivate the learner to solve problems through his or her interactions with game scenarios; during the process, the learner may link the abstract concept to the concrete game experience in an attempt to solve a problem (Lenga, Alib, Mahmudb, & Baki, 2010). However, the role of emotions has not been investigated in these game-based studies.

1.2. Emotions and creativity in game-based learning

1.2.1. Emotions and creativity

Among the influential factors on creativity, emotion has been the most widely studied predictor of creativity (Baas et al., 2008). Many studies have examined the relationships between emotions and creativity from the perspective of valence (positive emotions vs. negative emotions). Some findings suggest that a positive emotional state facilitates creativity, as it enhances cognitive flexibility and association network (Baas et al., 2008; Forgeard, 2011; Fredrickson, Cohn, Coffey, Pek, & Finkel, 2008; Hutton & Sundar, 2010; Subramaniam, Kounios, Parrish, & Jung-Beeman, 2009). In contrast, other findings suggest that a negative emotional state enhances creativity, as it indicates that the current situation is problematic and therefore motivates actions to solve the problem (Baruch, Grotberg, & Stutman, 2008; Carlsson, 2002; Hirt et al., 2008; Jones & Kelly, 2009; Zenasni & Lubart, 2009). Other findings suggest that the positive and negative emotions may exist simultaneously and facilitate creativity when the emotion is appropriately used and when the situation is novel (Fong, 2006; Kaufmann & Vosburg, 1997).

Researchers have also investigated the relationship between emotions and creativity from the perspective of arousal. While some findings suggest that highly aroused negative emotions decrease the production of original ideas (Zenasni & Lubart, 2008), other findings suggest that activating moods (e.g., angry, happy) lead to more creativity than deactivating moods (De Dreu et al., 2008).

These inconsistent findings may indicate that examining the relationship between emotions and creativity from the unidimensional (valence or activation level) perspective may oversimplify their relationship. The three-dimensional theory of emotion (Baas et al., 2008) may help to illuminate the complex relationship between emotions and creativity. The three dimensions include hedonic tone (positive vs. negative), level of activation (activating vs. deactivating), and regulatory focus (promotion vs. prevention). According to Baas et al. (2008), emotional states that are related to a promotion focus (e.g., anger, happiness) expand attentional scope and thus facilitate creative performance, whereas emotional states that are associated with a prevention focus (e.g., fear, relaxation) constrict attentional scope and therefore impede creative performance.

According to the social cognitive perspective, self-regulation learning includes three cyclist and interactive phase: (1) forethought: it involves task analysis and self-motivation beliefs; (2) performance: it involves self-control and self-observation; and (3) self-reflection: it involves self-judgment and self-reaction. During the process of self-reaction, feelings of self-satisfaction and emotion may motivate efforts to learn. Self-reaction may also involve adaptive inferences which influence approaches for subsequent learning. Moreover, the self-reflection reactions influence the goal setting, planning, and motivational beliefs regarding further efforts to learn in the forethought phase (Zimmerman, 2011). These arguments explain the importance of including regulation focus in emotions.

1.2.2. Emotions, and game-based creativity

It has been suggested that emotion is related to learning achievement in game-based learning (Chu, Hwang, Tsai, & Tseng, 2010; Fu, Su, & Yu, 2009). The Understanding of players' emotions, such as subjective feelings, anxiety, and enjoyment, has recently attracted attention from researchers (Fu et al., 2009; Jennett et al., 2008). Some researchers (Boyle et al., 2011) have claimed that enjoyment is the main emotion experienced when playing games. Thus, a measure of enjoyment in educational games that assesses eight dimensions of enjoyment has been developed. The measured