



How feedback boosts motivation and play in a brain-training game



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ABSTRACT

Games are important vehicles for learning and behavior change as long as players are motivated to continue playing. We study the impact of verbal feedback in stimulating player motivation and future play in a brain-training game. We conducted a 2 (feedback valence: positive vs. negative) \times 3 (feedback type: descriptive, comparative, evaluative) between-subjects experiment ($N = 157$, 69.4% female, $M_{age} = 32.07$). After playing a brain-training game and receiving feedback, we tapped players' need satisfaction, motivation and intention to play the game again. Results demonstrate that evaluative feedback increases, while comparative feedback decreases future game play. Furthermore, negative feedback decreases players' feeling of competence, but also increases immediate game play. Positive feedback, in contrast, satisfies competence and autonomy needs, thereby boosting intrinsic motivation. Negative feedback thus motivates players to repair poor short-term performances, while positive feedback is more powerful in fostering long-term motivation and play.

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1. Introduction

Games are an increasingly important mechanism for educational and behavior-change interventions due to their ability to keep players motivated to play (Baranowski, Buday, Thompson, & Baranowski, 2008; Erhel & Jamet, 2013). However, the mechanisms by which games motivate players to persist in game play are still unclear. While several models of game motivation have been developed, most are typologies of uses and gratifications derived from games (Lucas & Sherry, 2004) common player types (Yee, 2006) or based in usability studies from HCI or persuasive technology (Fogg, 2007). Recently, psychological theories which can explicate motivational processes in other areas of life have been applied successfully to understand how and why people continue playing entertainment games. Namely, Self Determination Theory (SDT) has been used to explicate game enjoyment, desire to play, and role of games in changing player behavior beyond the game world (cf. Przybylski, Rigby, & Ryan, 2010; Deterding, Sicart, Nacke, O'Hara, & Dixon, 2011). According to SDT, the intrinsic appeal of games

is due to their ability to satisfy basic psychological needs for competence, autonomy, and relatedness (Ryan, Rigby, & Przybylski, 2006).

Yet, two challenges still remain in terms of using SDT to understand the motivation to play educational or behavior-change type games. First, although intrinsic motivation is central to games for entertainment, the effects of intrinsic motivation on continued play in education and behavior change games is still not well understood. Second, the particular game elements of educational games which satisfy these basic psychological needs have only begun to be explored (Peng, Lin, Pfeiffer, & Winn, 2012). One element in particular which is critical to education and behavior-change games is feedback, such as verbal or non-verbal messages delivered in-game (Lester, Stone, Converse, Kahler, & Barlow, 1997). The current study, therefore, tests the role of feedback in an educational brain-training game on intrinsic motivation to continue playing, enjoyment of the game, and attitude towards the agent.

Feedback can have differential effects in terms of motivating behaviors, and results testing the effects of feedback in games on motivation have been inconclusive (Lin, Atkinson, Christopherson, Joseph, & Harrison, 2013). After all, feedback can have disparate effects on motivation based on how it is delivered, how the recipient interprets the feedback, and how the behavior is related to the feedback. In the health-behavior domain, *Feedback Intervention Theory* (FIT, Kluger & DeNisi, 1996) has been used to account for these differential effects. Feedback can compare, evaluate, or simply describe performance. These three types of feedback have very

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distinct effects on performance and motivation for health behaviors (cf. Hawkins, Kreuter, Resnicow, Fishbein, & Dijkstra, 2008). To the best of our knowledge, these questions have not yet been explored in the context of educational games.

The current study thus extends the literature on educational and behavior-change games in three ways: by (1) using FIT to understand specific effects of different types of feedback on persistence and motivation within a game environment, (2) by examining the role of FIT in terms of satisfying basic psychological needs in games and (3) by further unraveling the relationship between basic game and motivational processes.

1.1. Games and motivation

Although various scholars have focused on the ways in which games can be used as persuasive behavior-change tools (Baranowski et al., 2008; Peng, Crouse, & Lin, 2013), little research has focused on the how the elements which make games so compelling to play motivate players. The research which does exist has focused on games' ability to induce *intrinsic motivation*, or the motivation to pursue an activity for its own sake (Przybylski et al., 2010; Ryan et al., 2006; Tamborini, Bowman, Eden, Grizzard, & Organ, 2010).

The most comprehensive theory of intrinsic motivation is SDT (Deci & Ryan, 1985, 2000). SDT is a theory of human motivation that posits that individuals are motivated to pursue activities which provide a sense of pleasure and satisfaction even when no external rewards, such as money, are present (Deci & Ryan, 1985). A sub-theory of SDT, called *Cognitive Evaluation Theory* (CET), suggests that this type of intrinsic motivation arises particularly from the satisfaction of psychological needs for autonomy and competence (Ryan & Deci, 2000). The need for autonomy involves the ability to choose for oneself to engage in an activity. Opportunities for choice, use of rewards as informational feedback (rather than to control behavior), and non-controlling instructions have all been shown to enhance autonomy and in turn intrinsic motivation. The need for competence is defined as an individual's inherent desire to feel effective in interacting with the environment (Deci & Ryan, 2000). It is prominent in individuals' propensity to explore and manipulate the environment and to actively seek challenges to extend one's skills.

CET has been applied to explain motivation to play different types of games such as entertainment games (Ryan et al., 2006; Przybylski et al., 2010; Tamborini, Grizzard, Bowman, Reinecke, Lewis, & Eden, 2011) and serious games (Peng et al., 2012). Most research in this area has focused on how particular game mechanics may satisfy psychological needs. For example, Ryan et al. (2006) and Tamborini et al. (2011) focused on how games satisfy basic psychological needs for competence and autonomy via manipulations of difficulty and interface controls, leading to greater intrinsic motivation and affective rewards (e.g., enjoyment) within the game setting. In line with this past research, we predict that:

H1. The extent to which needs for competence and autonomy are satisfied in the game positively predicts intrinsic motivation to play the game, both immediately and in the future.

1.2. Feedback and motivation

Often, game elements are not easy to manipulate or change for the researcher or game designer. One element that may be particularly easy to adapt, and have a significant effect on motivation, is feedback. In computerized learning environments, feedback can be as simple as a confirmation of a correct response (simple feedback) or as difficult as including a lengthy explanation of a

recommendation (elaborate feedback). Elaborate feedback produces larger effects on learning behavior and motivation compared to simple feedback, however, this depends on the learner's attention and ability to correct their action (e.g., Bangert-Drowns, Kulik, Kulik, & Morgan, 1991; Serge, Priest, Durlach, & Johnson, 2013). Some studies revealed that spoken explanatory feedback (i.e., elaborate feedback) provided by agents to guide learners to deeper learning promoted learning more effectively than simple corrective feedback (Moreno, 2004). For written verbal feedback, in contrast, no differences between simple and elaborate feedback were found on user motivation or behavior (Lin et al., 2013).

Studies from the field of health psychology demonstrated that verbal feedback can be linguistically formulated in different ways, and that these differential formulations can be important determinants of feedback performance in health interventions (e.g., Hawkins et al., 2008; Kluger & DeNisi, 1996; Van-Dijk & Kluger, 2004). Kluger and DeNisi (1996) proposed an overarching theory (FIT) to account for the most important differences in feedback effects. FIT proposes that receivers of feedback typically decide to adjust their behavior (or not) by comparing it to a standard or a goal. If a behavior does not match this standard or goal, addressees may decide to adjust their behavior, as long as they are aware of the gap between their actual behavior and their goal or standard. Negative feedback (e.g., *you did poorly*) is thus most effective under a learning goal when addressees aim to increase their performance (Cianci, Klein, & Seijts, 2010) and in situations that are negatively motivated (e.g., failure to meet obligations; Van-Dijk & Kluger, 2004). Under this perspective, negative feedback may be more persuasive than positive feedback (e.g., *you did well*), because negative feedback emphasizes the gap between the desired goal and the actual behavior.

However, positive feedback could also have positive effects on behavior, through need satisfaction and motivation. FIT proposes that goals are organized hierarchically into task-learning goals, task-motivation goals and meta-task processes. As attention is limited, most addressees pay attention to moderate levels of goals (i.e., task motivation; Kluger & DeNisi, 1996). Thus, positive feedback may be more persuasive than negative feedback, because the former provides an affirmation of competence in respondents (Cusella, 1982; Henderlong & Lepper, 2002). Furthermore, a recent addition to FIT also states that control over feedback (i.e., autonomy) is an important predictor of feedback effectiveness (Alder, 2007). Receiving positive (vs. negative) feedback can motivate addressees to voluntarily set higher goals for their tasks, and thereby increasing performance (Krenn, Würth, & Hergovich, 2013; Mumm & Mutlu, 2011). This indicates that positive (vs. negative) feedback could also satisfy a feeling of autonomy in recipients. Furthermore, participants who receive positive feedback during a learning task also complete that task faster than (and at the same level of accuracy as) participants who received negative feedback (Barrow, Mitrovic, Ohlsson, & Grimley, 2008).

Therefore, under these conditions, we predict that written positive feedback in a game may increase feelings of competence and autonomy compared to written negative feedback. This increase in need satisfaction should in turn lead to increased motivation to play the game. This reasoning leads to our next hypothesis:

H2. Positive feedback will positively affect need satisfaction and intrinsic motivation, compared to negative feedback.

Next to differences in valence, the feedback literature also distinguishes different types of feedback types. Three different feedback types are typically identified: (1) Descriptive feedback, which reports back to individuals summing up their attitudes or behavior, either based on participants own input (e.g., *you say that you don't like serious games*) or based on observational data (e.g.,

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