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The Above-average Effect and Its Implications on Feedback Design for Educational Game Systems

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Abstract: This study proposes a data-driven feedback mechanism for an educational game system to address the discrepancy arising from the cognitive dissonance between perceived and actual performance on cognitive tasks during learning. By making the dissonance visible, the feedback mechanism enables the students to stay informed of their ongoing performance in comparison with that of their peers, thus motivated to respond with actions correspondingly and constructively.

Keywords: above-average effect, feedback, motivation, peer comparison, behavioral change, game design

1. Introduction

The above-average effect is a widely recognized cognitive bias that describes a tendency in which one overestimates his/her positive qualities or abilities while underestimating the negative ones (Alicke & Olesya, 2005; Aronson, Wilson, Akert 2010; Carlson, 2013). This cognitive bias is omnipresent in cognitive scenarios across all age groups. An elementary student, for instance, may have a fairly accurate evaluation about his/her pecking order in the classroom with respect to academic performance, as he/she may have gained this knowledge through various channels such as academic leaderboards, or teachers' evaluative comments. However, the same student is unlikely to assess his/her other qualities not explicitly quantifiable with equal accuracy. In these self-evaluative situations, the absence of an explicit frame of reference contributes to the tendency of holding a more favorable comparative view on themselves, resulting in a falsely inflated self-image, hence a dissonance between ones' perceived capability and actual performance.

This study aims to design a feedback mechanism for an educational game system that provides the student with a constant feed of information about their ongoing performance, as well as that of the peers, so that the student stays informed of his/her performance in comparison with the peers. It also aims at fostering the students' informed decision-making and guiding their subsequent behaviors based on the cognitive dissonance uncovered by the feedback message. Based on real-time analysis of performance data of the entire class, the feedback mechanism generates messages of player's status on-the-fly. Upon completion of any given task, a message pops up, briefly summarizing the student's performance on that particular task, as well as the average performance of the entire class. In this way, the student's dissonance between their perceived capability and actual performance is made visible. It is hypothesized that when the students are informed of their performance in relation to that of the peers, they are more

likely to respond correspondingly to narrow the dissonance between perceived capability and actual performance in comparison with the class average.

2. Theoretical framework

2.1 Cognitive dissonance

Cognitive dissonance describes a situation when one is confronted by new information that conflicts with existing beliefs, ideas, or values (Harmon-Jones, 2002). Numerous studies exist in the literature pertinent to cognitive dissonance, and strategies addressing the issue are widely mixed in the literature. Some studies have highlighted the cause of its occurrence, attributing it to factors associated with flaws in human reasoning (Dunning, Heath, & Suls, 2004). Other research emphasizes the role of dissonance on behavioral changes induced by social comparison (Buunk et al., 1990). A more recent study (Bounoua et al., 2011) used two well-established social comparison paradigms to integrate and extend prior research from the achievement goal and social comparison literatures. Carlson (2013) suggests that the construct of mindfulness, defined as paying attention to one's current experience in a non-evaluative way, may serve as a path to self-knowledge.

In contrast to research that stresses on the negative effects, other psychologists have incorporated cognitive dissonance into learning models, notably constructivist models. Along this line of study, educational interventions have been designed to foster dissonance (as opposed to suppress it) in students by increasing their awareness of conflicts between prior beliefs and new information and then providing or guiding students to new, correct explanations that will resolve the conflicts (Guzzetti, Snyder, Glass, & Gamas, 1993).

Combining the strategies introduced above, this study seeks to leverage the constructive power of cognitive dissonance by incorporating it to surface the conflicts of cognition from under one's consciousness, and make the dissonance visible, thus manageable.

2.2 Feedback

Feedback mechanisms are incorporated in game design to promote human-computer interaction, as well as users' participation and sustain continued interests in learning activities (Prensky, 1996; Shute, 2011). Kulhavy and Wager (1993) introduced the concept of a "feedback triad," arguing that, by providing information for learners to validate or change a previous response, feedback may motivate users' to increase response rate, and reinforce a message that would automatically connect responses to prior stimuli. Because of its motivational properties, feedback is therefore employed in game systems to regulate player's behaviors (Kulhavy & Wager, 1993; Ávila, Chiviacowsky, Wulf, & Lewthwaite, 2012).

Figure 1. Feedback triad

While feedback provided by game systems can be impactful in shaping students' perception and guiding their behavior, how the students react to feedback may also shed light on the design of game systems. This study exams both ends of the spectrum, i.e., how feedback is perceived and accepted by students, and how students respond to feedback upon reception.

3. Implications on game design

In conventional stand-alone learning systems, learners' performance data are typically isolated, static, and socially decontextualized, making comparisons of actual performance on a given task against perceived performance technically infeasible. In contrast, online game-based learning systems are characterized of its connectivity and real-time data streams with respect to learners' performance, enabling easy comparisons between perceived and actual performance, or between one's individual performances against those of the peers. Such comparative information may be particularly helpful for those under-prepared learners, i.e., those who over-estimate their capability, but fall below the average. Therefore, for the learners to stay informed of their performance in relation to the peers, a feedback mechanism should be implemented to make such comparisons explicitly visible.

In addition, to guide the learners' subsequent actions following comparison, options for action should be provided to the students to alter the amount of effort investment in respond to the result of the comparison, e.g., to invest more efforts on the given task, or to give up trying,

4. Stereotype of system implementation

In implementation, the proposed feedback mechanism generates a message upon completion of any given task, summarizing the student's performance in relation to the others', and the average performance of the class. In this way, the dissonance which exists subconsciously becomes visible and tangible. The message in Fig. 2 shows a snapshot of a feedback message captured at the end of a task completion. Based on real-time data analysis of the overall performance of the entire class, the feedback mechanism provides a constant feed of information about the average performance of the class, enabling the students to stay informed of their performances in relation to their peers. In addition, options for actions are offered to guide the student to respond with subsequent actions (e.g., to continue collecting more stars, or to give up trying and do something else).

Figure 2. A stereotype of a feedback message showing the discrepancy between the actual performance and the class average (highlighted in red) with options for responsive actions

5. Expected contribution

The study identifies the existence of the above-average effect in learning contexts, a cognitive bias that is extensively prevalent in cognitive psychology. In addressing the cognitive dissonance arising from the discrepancy between perceived and actual performance on a wide range of cognitive tasks and affective states during learning, this study proposes a data-driven feedback mechanism that is based on real-time analysis on students' performance to guide decisions. The proposed mechanism can be incorporated into the design of educational game systems at large. By making the dissonance visible, the feedback mechanism enables the students to stay informed of their ongoing performance in comparison with that of their peers, and thus respond to the dissonance correspondingly and constructively.

This study expects to contribute to the existing literature by taking a design approach to unleash the power of cognitive dissonance to induce greater effort investment from, and to the benefit of, the students, as opposed to suppressing dissonance from occurring, as has been the emphasis of numerous previous studies.

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