Towards real-time behavioral indicators of player experiences: Pressure patterns and postural responses

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Introduction
The current paper sets out to describe a first exploration of behavioral expressions that could serve as real-time indicators of experiences related to playing digital games. In this paper, we focus primarily on pressure patterns exerted on a physical control device, and postural responses. Based on this exploration, we present our progress in developing a set of behavior-based measures of such player experiences and their validation through an experimental study.

Behavioral indicators of flow, frustration and boredom
Enjoyment is arguably the single most important motivation for people to play digital games. It is a factor that game developers would like to understand more fully in order to optimize game design [6]. In his pioneering work, Csikszentmihalyi [1,2] found that many elements of enjoyment are universal. During optimal experiences, people are completely absorbed by an activity, losing track of time and a preoccupation with self. Through striking the balance between a person’s skills and the challenges an activity offers, that person may arrive in a psychological state known as flow. Although Csikszentmihalyi's work on flow suggests it is quite a rare experience, it certainly is a state that rings familiar to players of digital games. Flow may gradually increase over the course of the game in a homeostatic positive feedback loop, until either the challenge becomes too great (resulting in frustration) or the player's skill outpaces the challenges the game can offer (leading to boredom). Being able to measure in real-time when a game is becoming unacceptably boring or frustrating is likely to contribute to a more optimal player experience, as such information can be provided directly to the game engine, allowing it to adjust the game dynamically to the player’s psychological state.

Behavioral responses exhibited during gameplay, such as postural movements, gestures, facial expressions, or pressure exerted on interface devices, constitute a potentially promising class of measures in this regard. Mota and Picard [4] have, for instance, demonstrated that postural patterns can be indicative of learner interest. They developed a system to recognize postural patterns and associated affective states in real time, in forward-backward and sideways movement can be sensed. Complementing these systems we also employed a 3-axis Phidgets accelerometer measuring tilt and acceleration of participants’ upper body in both the frontal and lateral plane. In addition, observational coding of sitting position was done, based on video recordings of each participant. Moreover, several self-report measures were applied (GEQ; SAM; FlowGrid) in order to ensure that the behavioral data could be sensibly interpreted, and to check convergent validity of the behavioral indicators with such self-report data.

The results show a consistent pattern between self report, observed behavioral indicators and automatically captured measurements. The self report measures indicate frustration for the hard level, balanced play for the moderate level, and less engagement at the easy level. In line with literature and our hypotheses, behavioral measures for movement (e.g. accelerometer data and observational coding of movement) and force (e.g. on the mouse) appeared to be indicative of frustration in the hard level. More specifically, mean accelerometer data was highest in the hard level indicating stronger movement. Similarly, data from both the automatic chair and observational coding show the range in forward-backward movement to be significantly higher in the hard level as compared to the other two levels. The force measurements of the mouse show that participants applied more force on the mouse buttons (both maximum and mean over the level) in the hard level, an effect consistent with previous findings [7]. Our findings further show maximum force on the mouse and range in sitting position to be correlated with the self-report measurement of frustration, providing additional, convergent validity for the measurement of frustration through these behaviors.

To conclude, the first analysis of our results bode well for the applicability of behavioral indicators to measuring player experiences in relation to digital games. However, our pressure and posture measures appear to be particularly sensitive to frustration but not so much to boredom. This may be due to our manipulation strength, the sensitivity of our set
of measures, the relation between boredom and behavior, or a combination of these factors. This issue will be addressed through further analysis of our current findings, and future experiments.

References