Assessing User Preference of Video Game Controller Button Settings

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Abstract
Only very few studies exist linking preference in controller usage to physiological effects and user experience (UX). While many games already feature different controller layouts, there is a lack of research on whether giving control to participants over their button choices affects their UX in the game. In our study, participants were given two predetermined button configurations for playing FIFA 12. Their preferences were assessed through electroencephalography (EEG) and a Game Experience Questionnaire (GEQ). Our results show no significant difference in EEG intensity between participants using their preferred or non-preferred button settings. Preference also appears to have no significant effect on subjective feelings assessed by the GEQ. We have identified three distinct factors that may have potentially compromised this study. These findings could help to structure future research in this area.

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Video Games; User Experience; Physiological Measurements; Game Controllers; EEG

ACM Classification Keywords
H.5.2. Information interfaces and presentation; K.8.0 [Personal Computing]: General – Games

Introduction
User experience (UX) research is a relatively new area in game development, using Human-Computer Interaction (HCI) methods to optimise game designs. One of the main components of any user experience is the way the user interface works. For video games and the

game console hardware used to interact with them, the UX outside of a game has traditionally revolved around the buttons, sticks, and discs featured on controllers. In particular, the buttons of current video game controllers (e.g., a joypad or gamepad) allow a player's thoughts to be translated and mapped onto physical actions and game interaction.

By engaging in gameplay players are required to play by the games rules. These core rules include the button setting configuration and often feature button layout conventions tied to game genres. We currently do not know whether imposing these constrictions of button conventions and settings play a role in player UX. However, past studies have investigated the influence of control schemes of different consoles on player enjoyment [6, 2] and support user preference for traditional button-driven controls compared to more advanced control schemes. Another experiment using EEG supported the notion of preference for traditional controllers (compared to Wii motion controllers) [7].

A strong proposed influence on UX is the user's perceived preference for a product or technique. For example, Nielsen and Levy [8] found problem solving was greatly improved when participants used a technique *they* preferred over any other. Preference has been shown to influence physiological measures of performance. For example, electroencephalography (EEG) measures brain waves, specifically the change in different band frequencies, which has been used in game research before [4, 7]. EEG measures can reflect mental qualities such as memory workload [3]. They can interpret and show specific brain areas where inactivity has occurred, which may indicate where mental resources are reduced [11]. In our study, we are focusing on alpha (8-12 Hz) and theta (4-7 Hz) frequencies. These two brainwaves are associated with relaxed consciousness and fantasy/ imagination respectively. Pellouchoud et al. [9] found that as cognitive load increases, midline theta increases, but alpha activity lessens. To clarify, when a task grows more complex, an individual's concentration increases, while relaxation levels decrease. Many studies have successfully used physiological measures to assess UX in games [4].

Qualitative measures are useful when analysing an individual's subjective experience. For example, the Game Experience Questionnaire (GEQ) [12]–although still in progress–can be used as a self-reporting method to assess the overall game experience of a player. The questionnaire evaluates 7 UX aspects, *Immersion, Flow, Competence, Tension, Challenge, Positive and Negative Affect,* all pertaining to specific elements in gameplay. The use of GEQ has revealed several positive correlations between physical movements and player experience. Van den Hoogen et al. [12] found a positive association between participants left clicking on a computer mouse (typically known as the firing button), and the amount of physical movement exerted, in the reported player experience.

Experiment

The aim of our experiment was to assess whether allowing users the freedom to play a particular video game using their preferred button settings will enhance their overall UX. If differences between preferred and non-preferred button groupings arise then it would potentially indicate that individual differences play a significant factor in defining gameplay experience. We recognise that procedures are currently in place for the majority of popular video games, in which players can change the button settings to their preferred configuration. However, this still raises the question whether this affects subsequent gameplay.

If our findings confirm that using a preferred button configuration improves a player's overall experience, developers may perceive a benefit to promoting button customisation. Furthermore, players should then be given the knowledge and freedom to tailor their gaming experience to their needs and wants as opposed to the recommendations of the gaming companies. This in-

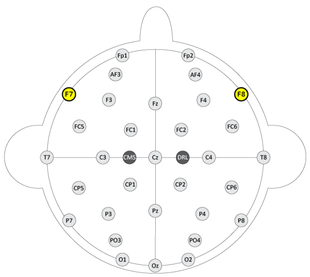

Figure 1. Positive electrodes (position F7 and F8) shown in an example 10/20 electrode system.

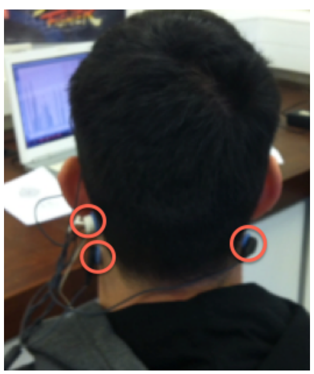

Figure 2. Negative electrodes and ground electrode

sight may persuade designers to provide a greater service allowing players to comfortably modify their own buttons efficiently. It was expected that participants with their preferred button settings would have a reduced cognitive load, leading to a more relaxed cognitive state.

Participants

Sixteen male participants (female participants were excluded to enable valid gender-specific physiological comparisons) were recruited from the department mailing list and campus bulletin boards based on the criterion of having some experience in playing FIFA 12 on the XBOX 360. This was done to ensure they already had a preference of game controller button settings. They were selected on a first come, first served basis, and provided they met the required criterion. Participants' ages ranged from 20–36 years (SD = 3.91).

Apparatus & Measures

The study required participants to wear a NeXus-4 portable biofeedback device to record EEG signals. Participants were asked to play two games of football on FIFA 12 using the Xbox 360, one using their preferred button settings, one without. Participants were also asked to answer two identical questionnaires (GEQ) following each game. During the pilot study, a *test participant* was prepared with four EEG and ground electrodes. Before the procedure could be analysed, the positions of the EEG electrodes were checked to identify whether a clear and strong EEG reading was detectable. Three different frontal areas of the forehead were tested, in which the participant performed a series of movement and concentration tests. For example, closing their eyes for a set amount of time or blinking exercises.

Findings from the pilot test indicated that placing the frontal electrodes too close to the eyebrows resulted in excessive eye muscle movement producing artefacts in the EEG signal. It was decided the clearest signal for the F7 and F8 positions were directly above the centre of the eyebrows (F7 closer to AF3 and F8 closer to AF4), equidistant from the eyebrow and hairline (Figure 1). It was suggested the participant should be rest initially at the beginning of the study, to allow the EEG signal to become constant at a relaxed state providing a baseline for the study. Markers were set on the software to represent the start and end of gameplay (approximately 10 minutes apart). There was a noticeable difference in both theta and alpha waves when playing the video game compared to the relaxed state.

Procedure

Participants were invited to sit in an ecologically valid room (decorated like it would be in a typical home). This included a sofa, coffee table and a large TV connected to an XBOX 360. At this point participants were given an information sheet briefly detailing the equipment involved and what they were required to undertake. If participants wished to continue, a consent form was provided for them to read and sign.

The skin was cleaned in preparation for the electrodes (using EEG skin prepping gel), and two electrodes (Snap-on) were attached to either side of the participant's forehead in locations F7 and F8 (Figure 1). A further two (negative) electrodes were placed on the back of the neck and a final ground electrode was placed behind the participant's ear (Figure 3). Participants were instructed to rest for a few minutes while baseline readings were taken.

After the initial rest period, instructions were given for participants to play the two games of football on FIFA 12. The match time was set to 4 minutes per half with the home and away teams being kept uniform across both matches and for all participants. The difficulty level was set to semi–professional, this being the medium challenge setting. After the first match, participants were given a 5-minute break to answer the GEQ.

Subsequently participants then undertook the second match, then again were given a GEQ to complete.

Results

Inferential statistics were analysed using a t-test. *Alpha* amplitudes were not significantly different between participants playing FIFA 12 using their preferred (M = 23.54, SE = 1.92) or non-preferred (M = 23.94, SE = 1.88) button settings, $t(14)=-1.21$, $p>0.05$. *Theta* amplitudes were not significantly different whether participants played FIFA 12 using their preferred (M=33.66, SE = 2.87) or non preferred (M = 34.72, SE = 3.20) button settings, $t(14) = -1.31$, $p > 0.05$. Table 1 (left) shows that for all GEQ components the scores were not significantly different between the preferred and non-preferred button group.

Regular Vs. Non Regular Players

A further analysis was completed on those participants who had been regularly exposed to playing FIFA 12. This was to gather information regarding whether practise might have an effect on cognitive load between the two conditions. Supporting evidence and the significance of practise effects are elaborated on in the discussion. Regular participants were identified based on the criterion that they would have played FIFA 12 on the XBOX 360 either occasionally (several times a month) or frequently (more than once a week). Contrastingly, non-regular players were classified on the criterion of rarely (less than once a month) playing FIFA 12 on the XBOX 360. Based on this distinction, 7 participants were identified as viable to be statistically analysed. A repeated measures t-test confirmed that there was no significant difference in alpha amplitudes between preferred (M = 21.97, SE = 2.67) and non-preferred (M= 22.65, SE = 2.28) conditions, $t(7) = -1.54$, $p > 0.05$. Similarly, mean theta amplitudes did not differ significantly between participants preferred (M= 29.43, SE = 2.23) and non-preferred (M= 30.41, SE = 3.40) conditions, $t(7) = -0.92$, $p > 0.05$.

Table 1. GEQ significance table

GEQ components	Preferred Median	Non - preferred Median	Wilcoxon Signed Rank test (W) (two tailed)
Immersion	2	2.5	W=1.5, p>0.05
Flow	3	3	W=13.5, p>0.05
Competence	2	1.5	W=22.5, p>0.05
Tension	2	1.5	W=22, p>0.05
Challenge	2	2	W=6, p>0.05
Positive Affect	3	3	W=2.5, p>0.05
Negative Affect	0.5	0.5	W=6.5, p>0.05

Discussion

The results suggest that button preferences do not significantly influence EEG activity. Additionally, there was no separation between button preference and GEQ score. In an attempt to understand why the results did not support the initial prediction, we have identified three factors that may have compromised the study:

- The discrepancy between button groupings
- Task Difficulty
- Type II Errors

The first potential limitation was the minimal change between the buttons for set A to B: Further analysis was conducted to split the participants into regular and non-regular game players to test whether this was the case. Regular players of FIFA 12 were classified as individuals who should be affected by mere exposure. The theory of mere exposure suggests that preferences are formed from repeated exposure to stimuli over time without rational interruption from the conscious mind [14]. This repetition may be a result of an individual actively practicing an event. If this assumption is correct, individuals who play FIFA 12 on a regular basis should have a larger cognitive capacity allowing them to effectively manage and reduce the load needed to play the game using the default (set A) buttons.

Furthermore, due to the domain-specific nature of learning, users are unlikely to apply a learnt motor or cognitive skill to another similar task other than the task practiced [10]. Based upon the domain-specific theory, the skills learnt from regularly playing FIFA 12 using only one specific set of buttons should not be transferrable to the other set (i.e. between set A and set B). Results from the further analysis indicate that skills were shared across the two button conditions. This may indicate the possibility that the discrepancy in changes between settings was so small that differences in cognitive activity were unlikely to emerge.

Another possible explanation is FIFA 12 may not have been sufficiently cognitively challenging to show differences between the preferred and non-preferred conditions. That is, FIFA 12 may be insufficiently demanding of a player's attention to affect their ability to competently interact with the button settings? Video gaming requires players to use divided attention. Divided attention is the splitting of cognitive resources between two or more stimuli. In relation to gaming, attention is required in viewing and processing gameplay (receiving instructions) while also needing to press the corresponding buttons to execute actions in the game. Divided attention is split into different processes that determine a user's performance on a task. These include, task difficulty, task practice and task similarity [1]. Ward [13] demonstrates that accuracy/performance decreases in divided attention as difficulty of a scenario increases. When a game becomes more difficult a player may need to divide their attention unevenly between the receiving of instructions and pressing of buttons. Therefore, when gameplay is more challenging, additional concentration may be needed to remain focused on incoming stimuli on the screen. Individuals will actively attend to information that is predominately relevant or important at a specific point in time. This is understood as selectivity, and was described by Levine [5] as the 'brain's channel selector'. This selection process is directed by the frontal lobes of the brain, where F7 and F8 are placed in the 10/20-electrode system. In playing FIFA 12, due to the more sedate nature of the game, players may have been able to attend to the buttons without suffering a decrease in visual concentration of on screen gameplay. This could indicate that if gameplay were more demanding of attention, with the increased difficulty of the non-preferred condition, cognitive load would be effectively heightened.

To evaluate whether the gameplay had an effect on alpha and theta levels, our future work will use a First Person Shooter (FPS) game. Action games have been revealed to place heavy demands on players, requiring them to constantly attend to a multitude of stimuli and distractors. Due to the ever-changing environment, players need to constantly attend to selecting the appropriate response to follow this through.

Conclusion

In summary, no significant difference of either objective or subjective measures of UX was found between players' preferred and non-preferred controller button settings. The results initially suggested that cognitive load did not change between the two test conditions, which led to no noticeable difference in EEG amplitudes. Moreover, subjective experience was consistent across the conditions, indicating that players did not perceive a change in difficulty arising from the alteration of the button settings. We have discussed why we believe the study possibly failed to find our initial predictions. We have highlighted below the procedures that should be implemented to rectify these problems.

- Button groupings should be radically different between conditions, with multiple combinations being tested several times over an elongated period.

- A wider variety of games should be used in conjunction, especially games that require prolonged and intense focus.
- A larger participant sample should be used.

Overall it cannot be reliably concluded that preference will or will not improve subjective and objective experience until we explore the limitations of the study.

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