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Effects of Haptic Feedback on Gaming Experiences: A Case Study for Players and Spectators in FPS Games

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I. Introduction

Haptic feedback is widely used to enhance user experience across various game genres, including first-person shooters (FPS) and role-playing games (RPG). In FPS games especially, tactile stimuli simulating weapon effects, such as gunfire or explosions, can significantly boost immersion, realism, and enjoyment. However, they may also increase cognitive load, potentially degrading the overall experience.

These effects can vary depending on the user's engagement role—whether actively playing or passively observing, such as watching e-sports [1]. Therefore, it is essential to investigate how haptic feedback affects experience and technology acceptance in FPS games, considering the user's role.

This study investigates how haptic feedback affects different user roles—players and spectators—in gaming experiences, based on the Technology Acceptance Model (TAM).

Originally proposed by Davis [2], TAM explains usage behavior through perceived ease of use and usefulness, which influence users' attitudes toward using the technology and their intention to use it. TAM is widely used for evaluating the acceptance of new technologies across various domains.

In gaming contexts, TAM has been applied to explore users' behavioral intention in adopting interactive systems such as VR and mobile games [3]. Building on this, we examine effects across user roles of haptic feedback and evaluate its impact through two main pathways: hedonic and cognitive, within a TAM-based framework.

II. Research Model

We developed a research model by extending the traditional TAM to evaluate how haptic feedback influences users' intention to use an FPS game across different user roles—players and spectators—as illustrated in Fig. 2. The model considers the interrelationships among haptic feedback (HAPTIC), immersion (IM), perceived enjoyment (PE), perceived usefulness (PU), cognitive concentration (CC), cognitive load (CL), attitude toward using (ATT), and intention to use (IU). Based on this model, we formulated the following hypotheses:

- H1: HAPTIC positively affects IM and CC.
- H2: IM positively affects PE
- H3: PE positively affects PU.

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Fig. 1. (Left) Game interface used in the experiment. (Right) A custom haptic mouse equipped with three haptic actuators.

- H4: PU positively affects ATT.
- H5: CC negatively affects CL.
- H6: CL negatively affects ATT.
- H7: ATT positively affects IU.

According to the model, HAPTIC indirectly impacts IU through two pathways: a hedonic pathway involving IM, PE, and PU, and a cognitive pathway involving CC and CL.

III. Methods

A. Participants

Sixty participants (36M and 24F; mean age: 21.6 $\pm$ 3.3) took part in the experiment. None reported any sensorimotor abnormalities. The experiment was approved by the Institutional Review Board (PIRB-2024-E005). Each participant received USD 14 as compensation.

B. Experimental Apparatus and Conditions

We implemented an FPS game environment using Aimlabs, a popular FPS training platform. In the game, a user controls a character to attack AI-controlled enemies, while continuously spawning enemies attempt to attack the user character. For haptic effects, we used a custom haptic mouse with three vibrotactile actuators (LRA type; HapCoil-One, Tactile Labs) to ensure strong tactile sensations. The haptic effects were triggered by a gunshot sound produced when the user fires, amplified through an audio system.

The experiment followed a within-subjects design with two factors: Haptic Effect (present/absent) and User Role (player/spectator). All participants experienced each of the four conditions in a counterbalanced order.

C. Procedure

Before the experiment, participants completed a brief pre-questionnaire on their prior gaming and haptic experiences. They then participated in a practice session to familiarize themselves with the FPS game, followed by the main session. In the main session, participants took on two roles: in the

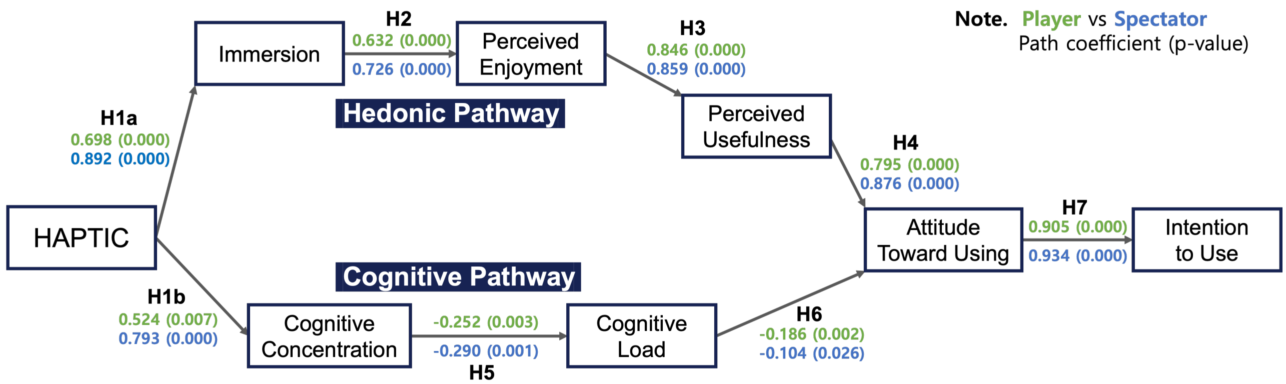

Fig. 2. Analysis results of the research model. Green values indicate path coefficients and p-values for the player group, while blue values represent those for the spectator group.

player role, they focused on shooting accuracy and score, while in the spectator role, they watched the gameplay like an e-sports match. After each condition, they completed a 7-point Likert-scale questionnaire assessing their experience across variables such as IM, PE, CC, CL, PU, ATT, and IU.

D. Data Analysis

To examine relationships among variables in the research model, we conducted Partial Least Squares Structural Equation Modeling (PLS-SEM). Path coefficients and p-values were estimated via bootstrapping. Only variables with Cronbach's alpha of 0.7 or higher were included to ensure internal consistency and reliability. Additionally, the research model was separately analyzed for the player and spectator groups.

IV. Results

A. Player Group

For the player group, all paths were statistically significant ($p < .05$), as shown in Fig. 2. For the hedonic pathway, HAPTIC positively influenced IM ($\beta = 0.698$). IM increased PE ($\beta = 0.632$), which enhanced PU ($\beta = 0.846$), sequentially. For the cognitive pathway, HAPTIC positively influenced on CC ($\beta = 0.524$), while CC had a negative effect on CL ($\beta = -0.252$). PU positively influenced ATT ($\beta = 0.795$), whereas CL had a negative effect ($\beta = -0.186$). Finally, ATT strongly influenced IU ($\beta = 0.905$).

B. Spectator Group

For the spectator group, all paths were also statistically significant ($p < .05$). HAPTIC positively affected IM ($\beta = 0.892$) along the hedonic pathway. IM increased PE ($\beta = 0.726$), leading to higher PU ($\beta = 0.859$). In the cognitive pathway, HAPTIC positively influenced CC ($\beta = 0.793$). CC negatively affected CL ($\beta = -0.290$), which had a weak negative effect on ATT ($\beta = -0.104$). PU strongly influenced ATT ($\beta = 0.876$), which in turn influenced IU ($\beta = 0.934$).

V. Discussion and Future Work

We can derive different effects of haptic feedback on the user's role through two pathways. Based on the hedonic pathway, the overall path coefficients are higher in the spectator group than in the player group. This suggests that hedonic factors, related to immersion and enjoyment, have a stronger positive impact on spectators. Given this, we believe that haptic feedback could significantly enhance the hedonic aspects of the spectators' experience.

The cognitive pathway revealed that the effect of haptic feedback on cognitive concentration (CC) is weaker in the player group than in the spectator group, resulting in a relatively smaller reduction in cognitive load (CL) for players. This can be supported by a post-interview, which found that haptic feedback may have disrupted players' gameplay and shooting accuracy, helping to explain the weaker effect of the cognitive pathway in the player group.

Although the exact reason for the difference in haptic effects between the two groups is not determined, we conjecture that haptic feedback creates distinct technology acceptance flows and significantly enhances the gaming experience in the spectator role compared to the player role.

To further validate these findings, future studies may apply alternative analysis methods, such as ANOVA or hierarchical regression, to cross-validate the relationships observed in the current model. In addition, this research can be extended to other game genres that widely use haptic feedback, such as virtual reality (VR) games or racing games. Finally, it could be investigated not only vibration, but also other types of haptic feedback such as impact, thermal, and force feedback.

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