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The Influence of Background Music of Video Games on Immersion

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Abstract

The background music has been proved to be an indispensable part in every successful video game. At the same time, all the video game designers and players hope video games could be as immersive as possible. Present research aimed to make an investigation about the role of video games background music in the influence of players' subjective immersion. Eighty participants were employed according to their game experience to join the experiment. All of them were assigned in pairs to finish a same video game synchronously with local area network. One was with earphone while the other not. After 20 minutes' gameplay, they needed to complete three missions (questionnaire, task after game and time distortion) with the purpose of detecting their immersion during video game. The results showed that the participants with background music got significant higher scores from questionnaire, performed worse in after-game task and expressed more serious time distortion than those participants without hearing background music. But these changes just happened to low gamers in the questionnaire and time distortion. Besides, correlations were made to find that only the questionnaire scores and time distortion were significantly related. These results of present research showed that background music did increase participants' immersion. But this improvement was likely just happened in low gamers.

Keywords: Video games; Background music; Game experience; Immersion

Introduction

Despite various differences existed in game design and appearance, most successful computer games have one important element in common: the ability to draw players in. This experience is referred to as "immersion", a term commonly used by gamers and reviewers [1]. Player immersion may be said to be the holy grail of video game design. In this highly intensive state, one is fully absorbed within the activity, and often loses one's sense of time and gains powerful gratification [2]. Nowadays, the players are not expected to just sit and watch to make passive reaction according to game content. Instead, they prefer becoming an active participant. Any kind of popular video game must lead to an immersive gameplay experience that can have particularly powerful hold on player's actions and attention.

The background music, referring to all the sound (including music and sound effect) appeared in the video game in this study, has long been acknowledged to be an indispensible part of modern video game [3-5]. It usually is used to communicate aspect of the narrative, convey emotion, and enrich the experience of the player [6]. Despite the interactive possibilities offered by background music of video game, few studies have explored its role empirically in the experience of the players [6,7].

Present research aimed at making an investigation at the effect of video game background music on players' immersion state. In order to remedy the weaknesses of previous research, this study made improvements at least at following two aspects. On one hand, a classic fighting game, KOF (The King of Fighters) 1997, was chosen as the material. It is an attractive two-person fighting game with the background music playing a critical part in it. It can be played through local area network, offering an advantage to make a subtle control in experiment. On the other hand, three measures were employed in this research to evaluate players' immersion. We expected to offer more objective and convincing results with those methods, and intended to make a correlation among them to find out a relatively more reliable measurement.

The role of background music in video games

Although we usually call computer games as "video" games, the audio also plays an important part in video games [4,8,9]. Zehnder and Lipscomb [6] made a conclusion about the functions of music in video games. It can serve to "enhance a sense of immersion, cue narrative or plot changes, act as an emotional signifier, enhance the sense of aesthetic continuity, and cultivate the thematic unity of a video game". Games are becoming more reliant on music since they have an important role to play in supporting the user interaction with the game environment [4]. In short, music has not been a peripheral part of games, but is, rather, an integral part of the overall experience [5].

In fact, a crowd of researches have demonstrated the functions of music in video games. Nacke, Grimshaw and Lindley [3] asked participants to play a fast-paced, immersive first-person shooter (FPS) game modification, in which sound (on/off) and music (on/off) were manipulated. Result showed that more positive or neutral dimensions of the experience were experienced more positively when the sound of the game was playing. The opposite was the case when sound was turned off. It had also been shown that music's tempo can influence the speed with which roulette players place bets in a casino [10], as well as increase intensity of exercise (Karageorghis, Jones & Low, 2006). By varying the songs or altering the order of the songs, players not only experienced different immersive and emotional states, but also considerably changed how they play the game [5]. An interesting research done by Tan, Baxa and Spackman (2010) showed that playing with music that was unrelated to players' actions or events unfolding on screen got the highest scores than non-music and concurrent group.

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This was a challenge of processing multisensory cues during the initial stages of an elaborate role-playing game. It also indicated that a great deal of efforts needed to been done to dig out the secret of the role of background music in video games.

Although the importance of music has moved into the focus of game developers and players, it still does not receive the same level of attention than high-end computer graphics (Rober, Deutschmann, & Masuch, 2006). Further understanding of these aspects is vital for reaching a deeper understanding of how music affects us all, and also for finding new and better ways to employ music as an active and effective means of expression in various forms of computer entertainment [11].

What is immersion

Immersion as understood here is the sense of being "in a game" where a person's thoughts, attention and goals are all focused in and around the game [12]. The notion of absorbing and engaging experiences is not a new concept and there are several other concepts that have a relation to immersion that have already been considered.

Immersion is often viewed as critical to game enjoyment and regarded as the outcome of a good gaming experience. However, although there seems to be a broad understanding of immersion, it is still not clear what exactly is meant by immersion and what is causing it [1].

Pine and Gilmore [13] insisted that "immersion means becoming physically or virtually a part of the experience itself". It is a psychological state characterized by perceiving oneself to be enveloped by, included in, and interacting with an environment that provides a continuous stream of stimuli and experiences [14]. Haywood and Cairns [15] considered immersion has the following features: Loss of awareness of the real world involvement, lack of awareness of time and a sense of being in the task environment. Some researchers [7,16] believed that the immersion was consisted with two parts: perceptual immersion and psychological immersion. Perceptual immersion refers to as sense of having one's perceptual system submerged in a virtual environment, while psychological immersion refers to the degree to which the user feels involved in or engaged with stimuli from the virtual environment.

In summary, immersion clearly had links to the notion of flow and presence and both of them used things like temporal dissociation and awareness of surroundings as indicators of high involvement. However, immersion was focused on the specific, psychological experience of engaging with a video game [1].

The effect of background music in video games on immersion

The background music plays a significant role in the immersive quality of a video game [9]. Video game audio aims to combine usability with presence and immersion in the fictional game world. The overall soundscape contributes to a sense of presence or even immersion in a game by creating an illusion of the game world as an actual space. Sound may thus give the impression of a realistic space by presenting virtual offscreen sources [17]. Morris [18] claimed that sound video games in the market are used to provide an audio complement to action on the screen and to create a sense of a real physical space. All sounds in the video game contribute in some way to player immersion [19]. Game music has the potential to be much more than a passive element of the background. By tightly linking the content of game play and background music, the player becomes much more immersed in the gaming experience [20].

SCI model can well explain the role of background music in players' immersion. SCI (sensory immersion, challenge-based immersion and imaginative immersion) is a comprehensive model about gameplay experience put forward by Ermi and Mäyrä (2007). They suggest the gameplay experience and immersion into a game are multidimensional phenomena. Immersion is a many-faceted phenomenon with different aspects that can appear and be emphasised differently in the individual cases of different games and players.

In this model, there are three fundamental factors that can exert influences to palyers' overall experience: sensory immersion, challenge-based immersion and imaginative immersion. The best video game experience is the optimal combination of the three dimensions. Among them, sensory immersion relates to the audiovisual execution of games. They claim that this is something that even those with less experience with games can recognize: digital games have evolved into three-dimensional, audio-visually impressive and stereophonic worlds that surround their players in a very comprehensive manner. They thought powerful sounds easily overpower the sensory information coming from the real world, and the player becomes entirely focused on the game world and its stimuli [2].

The measurements of immersion

There are many ways to measure players' immersion during gameplay. One of the main challenges facing the game research is a lack of a coherent and sounded set of method and tools that enable the measurement of subjective experiences in a sensitive, valid and reliable manner [21]. Different researchers employed different methods according to their experiment requirements. Most of them used immersion questionnaire [1,2,22-24]. Some others employed psychological instrument [23,25,26], behavior during gameplay [27,28] and functional Magnetic Resonance Imaging (fMRI) [29] to detect players' immersion level.

Overall previous findings suggest that immersion can be measured subjectively (for example, questionnaires) as well as objectively (for example, psychological index and behavior during gameplay). In present study, three methods (Questionnaire, Stroop task after game and Time distortion) were exerted to measure players' immersion level in order to get a more accurate result as well as pick out a relatively more reliable measurement.

Immersion questionnaire Immersion questionnaires used in our research was from a work done by Jennett et al. [1], which was a revision of Brown and Cairns' [30]. It has been successfully applied into several researches [3,31,32]. The questionnaire consisted of 31 items overall: basic attention (4 questions), temporal dissociation (6 questions), transportation (6 questions), challenge (6 questions), emotional involvement (5 questions) and enjoyment (4 questions). Participants are asked to rate from a scale of 1 to 5 how they felt at the end of the game (where 1 = not at all and 5 = very much so). Immersion scores are computed by summing participants' answers to all 31 questions. The overall KMO value of the questionnaire is 0.845 and individual values ranged from 0.926 to 0.590, which is a more sophisticated tool to measure players' immersion in video games than the original.

Stroop task Players' immersion state also can be evaluated through the performance of irrelevant task after video game. That is because when the player is immersed, his or her attention is focused upon the action or content that is related to the video game. So if a person is highly immersed in a game, one might predict that it would be more difficult for them to switch from the game environment to the task at hand. As a result, their performance in the task will be impaired [1]. For example, Jennett et al. [1] asked participants which were randomly

assigned to video games group and control group to finish a Tangram task. Result show that participants in video games performed significant poorer in subsequent Tangram task than control group because of their relative higher immersion in task than control group. The results also demonstrated that the degree of immersion in task significantly negatively correlated with the performance in the Tangram task.

In present experiment, a classical color Stroop task was employed because it was more convenient to operate in laboratory and get more precisely qualified results. In this paradigm, words stimuli consisted of a random presentation of three color names (red, green, or yellow) presented in one of these three colors. In the congruent condition, the color in which the word was presented matched the color name (e.g. the word red displayed in red color). In the incongruent condition, the color of the word presented did not match the color name (e.g. the word red displayed in green color). We assumed that the players in high immersion would behave much worse than in low immersion and vice versa.

Time distortion

Time distortion is a facet of immersion that involved losing track of time or being unconscious of the passage of time [33,34]. Douglas and Hargadon [35] claimed that when people were intensively immersed at something, the perceptions of time would become distorted, and one often loses sense of time. When an individual is doing a particularly absorbing activity, such as playing a video game, they may find time suddenly alters its perceived speed [7].

The perception of elapsed time can be measured under two paradigms: prospective and retrospective. In the case of a prospective paradigm, a person is aware that they needed to make a time estimate before experiencing gameplay. In the case of a retrospective paradigm, a person is unaware of the need for a time estimate until after they have finished the game. Prospective time estimation attention is needed to monitor time passing. The more a person's attention is required elsewhere, the more ticks they miss and resulting in an under-estimate time. For retrospective time estimates, a person looks back over their memory for a period of time and essentially counts the memories. The fewer contextual changes requiring distinct memories, the lower the time estimates [36].

Present research

As stated at the outset of this passage, there has been a serious paucity of empirical research into the role of video game music on players' immersion. Both players and, judging from all outward appearances, those involved in creating the games share the belief that the presence of music enhances the video game experience. However related literature revealed seldom experimental studies into this relationship [6].

On the basis of previous researches, present study aimed to making an investigation about the influence of video game music on the players' immersion. The video game used in this study was a classic fighting game with stirring background music. In order to control the irrelevant variables strictly at the most extent, all the participants in this experiment were randomly assigned in pairs to play the same kind of video game, one with earphone to enjoy the background of video game while the other not. The two players sat in separate room and their computers were connected with local area network, thus they can fight with each other in game. That is to say, every group of participants experienced same experimental procedure and stimuli except that the background music was turned on or off.

Furthermore, a massive amount of evidences from researches have demonstrated that the gaming experience was also an important factor that can not be neglected in the influence of numerous psychological states and behaviors [37]. For example, Green and Bavelier [38] claimed that excessive playing video games can alter fundamental characteristics of the visual system, such as the spatial resolution of visual processing across the visual field. Swing [39] reported a positive correlation between video game experience and a composite index of symptoms related to attention deficits and hyperactivity. Researches also showed that high gamer performed much better in terms of the ability to inhibit attention from returning to previously attended locations [40]. Together with the desensitization phenomenon being heated discussed in video game filed [41,42], the gaming experience was also used as an important independent variable in present research.

According to the evidences illustrated on the above, therefore our preliminary hypotheses are:

1. The participants with background music will enjoy a significantly higher level of immersion to video games than those participants without background music.
2. The background music would just exert significant influences on low gamers' immersion but not high gamers'.
3. The three measures of immersion (immersion questionnaire, Stroop task and time distortion) significantly related with each other.

Method

Participants

Participants were selected from a pool of about 100 undergraduates who completed a video game usage questionnaire completed at least 2 weeks earlier as part of a large department-wide screening session. Because the sex is an important variable that can influence the results [43], only males were chosen to finish the questionnaire. According to the results from questionnaires, the participants ranking at the highest 40 participants (M=32.3 hours per week, SD=11.7) and lowest 40 participants (M= 7.6 hours per week, SD=2.1) were chosen as the high gamers and low games to join present experiment, $t(78)=21.47$, $p<0.001$. The high gamers (M=21.63, SD=2.35) and low gamers (M=20.97, SD=1.27) were similar in years of age and all are right handed.

Materials

Video games KOF (The King of Fighters) 1997 was the only video game selected in present experiment. It is a classical fighting game and has enjoyed a great popularity since its appearance at market. In this game, two fighters stand on two sides separately and begin to fight with each other after a start command. Besides, this game can be connected through local area network so that each group of participants can fight with each other on line. Therefore, participants in same group saw a same screen and proceeded in a completely same pace. What's more, the background music of this game was regarded as extremely provocative and passionate.

Video game immersion questionnaire Immersion questionnaires used in our research was from a work done by Jennett et al. [1], which was a revision of Brown and Cairns' [30]. The questionnaire is a measuring a mixture of person factors (cognitive involvement, real world dissociation, emotional involvement) and game factors (challenge, control). The overall KMO value of the questionnaire is 0.845 and individual values ranged from 0.926 to 0.590.

Computers connected with Local Area Network In order to meet the requirement of this research, all the computers in laboratory should be divided in pairs and connected with Local Area Network. Participants were divided into pairs to fight each other on the screen at the same time.

Procedure

After provided with informed consent, participants with same level of video game experience were randomly divided in pairs to finish the experiment (i.e., high gamers played with high gamers, low gamers played with low gamers). They two were invited to sit in two separate rooms but the computer in each room was connected with local network, thus they could manipulate the video game at the same time and faced a completely same game picture. Before formal gameplay, they had several minutes to be familiar with the game. Once participants expressed they had prepared well, experimenter needed to tell they need to make an evaluation of the duration of the following gameplay. Then the formal gameplay began and continued for 20 minutes. During the game time, one player put on the earphone to enjoy the game music but the other did not hear any sound. All players were fixed with one same character (Kyo Kusanagi) to represent them but with different colors of clothes, insuring they were in a same level and with same power all the time.

After 20 minutes, the video game was stopped. The participants were asked to make an evaluation of the game time immediately and then finish the color Stroop task. The task consisted of 2 blocks (120 trials at each block). Participants were instructed to distinguish the color of words as quickly as possible while maintaining a high level of accuracy. Next to the task, the immersion questionnaire [1] was prepared for every participant to fill in. After finishing all these procedures, they were debriefed, thanked for their participation, and dismissed.

Results

Immersion from questionnaire : Immersion scores were computed by summing participants' answers to all 31 questions of the immersion questionnaire revised by Jennett et al. [1]. The majority of questions are marked positively; only 6 are subjected to negated marking (Q6, Q8, Q9, Q10, Q18, Q20).

A two-way ANOVA of 2 (with music & without music)×2 (high gamer & low gamer) was conducted with the immersion score as the dependent variable, and a significant interaction existed between them, $F(3,76)=4.55$, $P<0.05$. A simple effects analysis was used to probe this significant interaction, and the results showed that low gamers got significant higher scores when background music was turned on than turned off, $F(1,76)=8.87$, $P<0.01$. Besides this, no other significant differences were detected.

Stroop task : A two-way ANOVA was conducted with the reaction time of Stroop task as the dependent variable, video game experience and background as the independent variable. Results demonstrated a significant main effect for background music, $F(3,76)=8.67$, $P<0.01$. It meant all participants performed much better when the background music was turned off than turned on, which indicated that the group with background music enjoyed significant higher level of immersion than those without background music.

As illustrated before, if a person is highly immersed in a game, one might predict that it would be more difficult for them to switch from the game space to the task space. As a result, their performance in the task will be impaired [1]. At the basis of this theory, we assumed that the players' immersion level in video game was significantly in inverse proportion to their performance afterward. So a correlation was made between the participants' scores in immersion questionnaire and the reaction time in Stroop task. But the result did not confirm our hypothesis, $r(18)=0.03$, $p>0.05$, which indicated that the task performance after video game was not significantly correlated with the players' immersion stats in gameplay.

Time distortion: At first, the descriptive results suggested that the participants perceived the game time from a minimum of 8 minutes to maximum of 27 minutes ($M=16.99$, $SD=4.86$).

Then, a t test was employed to indicate that all participants significantly underestimated the length of the game time, $t(79)=-5.54$, $P<0.001$.

Similarly, a two-way ANOVA was conducted with the estimated duration of the gameplay as the dependent variable, video game experience and background music as the independent variable. The results showed a significant interaction between the experience and music, $F(3,76)=4.91$, $P<0.05$. Follow-up contrasts showed that low gamers estimated significantly low gamers when background music was turned on than turned off, $F(1,76)=12.33$, $P<0.001$. Besides this, no other significant differences were found. According to the hypothesis that have been made above, a correlation was made between the participants' scores from immersion questionnaire and their estimated duration of gameplay. The results supported the hypothesis, $r(18)=-0.49$, $p<0.01$, which indicated that the estimated duration was significantly inverse correlated with the players' immersion in gameplay. This demonstrated that the higher level of immersion player felt in gameplay, the shorter game duration they estimated.

Disscussion

Immersion in video games in this sense is the psychological experience of being involved in a game thanks to the opportunities it offers [44]. It is one aspect of the experience of playing video games and is widely held to be important to the overall success of a game [44]. Many video game are sold describing the more "realistic" experience the gamer will have upon playing the game [9]. Immersion, being the outcome of a good gaming experience, is often viewed as critical to game enjoyment [1].

As an integral part of video games, background music has a major impact on players' immersion during gameplay. It can not only provide an audio complement to action on the screen but also help create a sense of a real physical space [18]. Research also demonstrated that using sound feedback in games can make them indeed more playable [3]. Collins [9] found that audio helps to overcome the two-dimensionality of the image, and helps the player feel immersed in a three-dimensional space.

This may well be the case but the assumption lacks thorough evidence to support the influence of video game background music on players' subjective immersion. Present research aimed to fill this relative blank filed with an empirical study. A type of classic fighting game (KOF 1997) was elaborately chosen and 80 participants (half were high gamers, the others were low gamers) were recruited to finish the video game for 20 minutes in pairs connected with Local Area Network. During the gameplay, one was with earphone to enjoy the background music, the other not.

The results basically supported the hypothesis at the beginning. The background music did increase players' immersion. Just as the SCI model illustrated, sensory immersion, as the one of three fundamental

factors, indeed can exert vital influences to players' overall experience [2]. Background music improves the narrative experience and can be used to guide the player through the game [45]. Whalen [46] claimed that music may be encouraging the immersion which must compliment engaging with the game's scripts. Some other researches also got similar results [7,23,36]. All of these results showed that the background music had some kind of effect on players' immersion.

On the other hand, one aspect that should be noticed is the improvement of immersion caused by background music seemed to just exist during low gamers rather than high gamers. Previous research seldom considered the role of players' gaming experience. Since the high gamers usually contacted with various video games, they became desensitized to most video games [41], which meant the high gamers were already adaptive to video games, and their emotional reactions to video games tended to be attenuated or blunted. So in present research, high gamers might feel the video game more boring and became less immersive than those low gamers no matter with music or not. On the contrary, the low gamers would feel very novel and curious about every details of video game because of their relative less game experience. So compared to video game without background music, they would become significantly more immersive when playing a video game with background music.

Besides these, another purpose of present research is to find out a more reliable way to measure immersion. Because the immersion questionnaire has been proved to be a valid way to measure subjective immersion [1,3,7,23,36] so the other two measures were separately used to make a correlation with the result of immersion questionnaire. Results showed a significant negative correlation between time distortion and the scores in questionnaire. But this effect did not exsited between the performance of Stroop task and immersion questionnaire.

The significant negative correlation between time distortion and the scores in questionnaire demonstrated that the higher level of immersion in video game, the shorter time they had estimated. That is to say, time distortion is a reliable way to measure players' immersion states. One component of immersion is that players report losing their sense of time passing and indeed this can be viewed as both a good and bad aspect of the overall experience of playing videogames [12]. People who play video games often report the sense of immersion in the game with a particular feature of immersion being a loss of the sense of time passing [36]. It appears that there are features of these activities that have the potential to absorb some player's attention to the extent that their perception of time is altered [12].

In present study, compared to without background music, the video game with music would be much more attractive and appealing to gamers. So the gamers with music were more easily absorbed into the gameplay and forgot the time passing, which leaded to a more serious time distortion. Sanders and Cairns [36] have conducted a similar research and got a same result. This meant that the time distortion paradigm is indeed a stable and effective measurement of immersion.

However, the result also demonstrated that the correlation between the immersion questionnaire scores and performance in Stroop task was not significant. According to the hypothesis, the degree of immersion in video game should negatively correlate with the performance in the after-game task [1]. One possible reason that is the Stroop task may not be suitable in this research. In this task, stimuli consisted of a random presentation of three color names (red, green, or yellow) presented in one of these three colors. The participants were asked to just name the color of words but ignoring their meaning. Because there were just three color words written by three colors, the participants would be easily familiar with the rule and resulting in ceiling effect. But one fact we can not ignore is that the task after the video game is not a reliable measurement of immersion at least in present research (Tables1-3).

Game experience	With background music		Without background music	
	M	*SD*	*M*	*SD*
High gamers	96.00	11.85	96.15	13.39
Low gamers	103.25	12.33	91.00	14.31

Table 1: Means and standard deviations of immersion score from questionnaire.

Game experience	With background music		Without background music	
	M	SD	M	SD
High gamers	793.60	122.08	711.18	107.62
Low gamers	804.11	120.37	723.39	142.80

Table 2: Means and standard deviations of reaction time in Stroop test.

Game experience	With background music		Without background music	
	M	*SD*	*M*	*SD*
High gamers	16.65	4.82	17.20	6.12
Low gamers	14.50	3.31	19.60	3.56

Table 3: Means and standard deviations of time perception in video games.

Compared to previous researches, present study had some advantages in details. At first, the video game was elaborately chosen according to the purpose of research. The KOF 2007 is a popular fighting game, and as a necessary constituent, the fierce background music is tightly linked with the content and action of the game. So it would be easily to recognize the influence of background music on players. Other researches which failed to discover this effect may be due to improper game type. For example, Sanders and Cairns [36] chose a maze game to investigate the relation between music in video game and immersion. Secondly, the participants were divided into two groups based on their game experience. Seldom researchers in this filed considered the role of participants' game experience [1,3,36]. Considering the important impact of game experience found in this research, it is necessary to conduct a further work to confirm its functions in the future. Another advantage is the careful control on the irrelevant variables. All the participants were paired according to their game experience and each group played the game synchronously with the help of Local Area Network. One of them wore earphone to enjoy the background music while the other not. So it is reasonable to make deduction that it is the background music that led to the differences between the two groups. Last but not the least, three measures were employed to detect the players' immersion, which made the results more convincing.

Limitations and Future Works

Like all studies, there are still weaknesses of this study that need to be addressed. First of all, in order to let the gameplay more challengeable and attractive, the video game was played within group (i. e., high gamer paired with high gamer or low gamer paired with low gamer). So we still have no idea what will happen if they are mixed-matched. This is an interesting topic which needed further discussions. Then the Stroop paradigm may not be a proper task in present research. We did not find a correlation between it and other two measures may be because the task is too simple and its effect was overlooked. Another place that needs improvement is the order of measurements. The three measurements were offered to participants in a fixed order in this study, therefore the order effect may have an influence on the results. So the

different measurements should consider to be balanced in the future research.

At the same time, numerous important practical questions remain for future research. For example, this study made a research on the on/off effect of background music in video games; future works could conduct further investigations on different types (consistent or inconsistent with game content), the volume and the components (diegetic or non-diegetic sound) of background music on players' immersion.

Additionally, in the light of previous research, music added to a game is able to cause duration to be under-estimated in the prospective paradigm but not the retrospective paradigm. So only the prospective paradigm was used in present research. It is necessary to make a further investigation about whether a same effect is existed with retrospective paradigm. Furthermore, more reliable measurements should be discovered to make the results more accurate and stable. Those measurements should better be objective and real-time, such as physiological I.

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