GAMES FOR HEALTH JOURNAL: Research, Development, and Clinical Applications
Volume 4, Number 3, 2015

DOI: 10.1089/g4h.2014.0092

"Just Dance": The Effects of Exergame Feedback and Controller Use on Physical Activity and Psychological Outcomes

Jih-Hsuan Lin, PhD

Abstract

Objective: In Asia, dance games are among the most popular types of exergames. Whereas traditional dance-based games emphasize step movements on a dance pad, more recent dance games emphasize intuitive dance movements using simple controllers or players' own bodies to ''just dance.'' However, because of limited space and access, young adults in Taiwan often do not use these games. Popular dance videos on YouTube are more readily available to students because these videos can be accessed on a computer. Therefore, the current study examines the effects of interactivity (the role of feedback) and controller use on participants' physiological and psychological outcomes during exergames.

Materials and Methods: The dance game ''Just Dance 3'' (Ubisoft, Montreuil, France) was chosen as the stimulus for this study. Participants danced through one song for rehearsal and warm-up, followed by three songs for the experiment, which lasted approximately 12 minutes. One hundred twenty-nine college students participated in a $2\times2\times2$ (interactivity, feedback versus no feedback; controller, with versus without; sex, male versus female) between-subject factorial design.

Results: A series of $2\times2\times2$ (interactivity, controller, and sex) analyses of variance showed no significant differences in interaction effects on participants' heart rates, blood pressures, body movements, step counts, or perceived psychological outcomes.

Conclusions: Dance game videos without feedback are also effective tools for achieving moderate-level exercise intensity. These videos can supplement the limited access to games in Asian countries, such as Taiwan.

Introduction

EXERGAMES HAVE BEEN POPULAR in the global market and have received growing attention from academic research in different fields, including applications for the elderly,[1] rehabilitation,[2] education,[3] and health.[4] Empirical research has shown the positive effects and potential gateway effects of exergames on players' physical activity levels[5,6] and their motivation to exercise.[7,8] A recent meta-analysis[9] of 18 empirical studies indicated that participating in exergames resulted in energy expenditures similar to those from traditional moderate-intensity activities. Recent studies also showed that exergames have been widely used as effective tools for rehabilitation,[2] physical activity education,[10] and motivation for higher exercise efficacy[11–13] via an enjoyable and entertaining approach.

Among the various types of exergames, dance games, especially ''Dance Dance Revolution'' (Konami, Tokyo, Japan), have been extensively studied throughout the past decade because they require high levels of energy and full-body movements. A recent meta-analysis[9] found that exergames that require both upper and lower body movements result in greater energy expenditures compared with games that require only upper (e.g., boxing) or lower (e.g., bicycling) body movements. A recent study[14] showed that dance games result in higher energy expenditures than other games, such as shooting or band games. In addition, studies also indicated that college students' energy expenditures during dance games meet the minimum guidelines of the American College of Sports Medicine[15] and are comparable with expenditures from moderate-level walking among children.[16] Furthermore, intervention studies that used dance games as treatments significantly reduced participants' body fat over 8 weeks[17] and improved their sleep over 6 weeks.[18] Dance games have been recommended as efficient tools for engaging people in exercise.

Dance games have positive effects not only on participants' physical activity, but also on their psychological outcomes. Although playing dance games may not be able to completely replace traditional aerobic exercise, one study found that players who engaged in dance games showed

Department of Communication and Technology, National Chiao Tung University, Zhubei City, Taiwan.

higher self-efficacy and enjoyment than players who engaged in aerobic dance.[5] In addition, interactive dance games have positive effects on players' social lives and aspects of physical health, such as endurance and muscle strength.[19] Players also have higher motivation for the future use of dance games.[8]

Whereas traditional dance-based games emphasize step movements on a dance pad, more recent games emphasize natural and intuitive dance movements that make use of simple controllers or even the players' own bodies as controllers; recent games include the ''Just Dance'' (Ubisoft, Montreuil, France) and ''Dance Central'' (Harmonix, Cambridge, MA) series. Instead of stepping on the arrows of a dance pad, players simply follow the real dance moves that are portrayed in the games, and players use their entire bodies to engage in real dancing. Current game consoles use motion-sensing technology to allow players to freely dance as they play.

In Asia, along with motion-sensing exercise games, dance games are among the top types of exergames. Dance games were influenced by famous dance arcade games from Japan, such as ''Dance Dance Revolution'' and ''Para Para Paradise'' (a dance game focusing on hand movements) (also from Konami), which are popular in Taiwanese arcades. However, in the Asian context, the living room is often reserved for watching TV and hosting guests and is generally not used for gameplay. In addition, the average household space in Taiwan is much smaller than the average space in the United States, and the average household may not have sufficient space for console game machines. Furthermore, the emphasis on education in Asian cultures means that most parents focus on their young children's and teenagers' academic performance, and parents tightly control their children's finances and leisure activities. Children who live with their parents are typically unable to freely play console games or exergames in their homes. For college students, the shared and limited space in dormitory rooms is unsuitable for playing console games. Therefore, mobile games and computer games are common in

Table 1. Characteristics of a Videogame for Health (''Just Dance 3'')

Characteristic	
Health topic(s)	Dance game
Targeted age group(s)	All ages
Short description of the game idea	The dance game ''Just Dance 3'' was chosen as the study's experimental stimulus. The game provides the latest pop and classic songs with various dance styles and different levels of difficulty.
Target player(s)	☑ Individual ☑ Dyad ☑ Small group ☐ MMOG ☐ Other: _____
Guiding knowledge or behavior change theory(ies), models, or conceptual framework(s)	NA
Intended health behavior changes	NA
Knowledge element(s) to be learned	NA
Behavior change procedure(s) (taken from the Michie inventory) or therapeutic procedure(s) used	NA
Clinical or parental support needed	☐ Yes ☑ No
Data shared with parent or clinician	☐ Yes ☑ No
Type of game (check all that apply)	☐ Active ☐ Action ☐ Adventure ☐ Role-playing ☐ Simulation ☐ Strategy ☐ Sports ☐ Casual ☐ Educational ☑ Other: Dance game
Game components	
Player's game goal/objective(s)	To imitate the dance moves that appear on the screen
Rules	Precisely follow the beat and dance moves
Game mechanics	Dance to receive a higher score to unlock more songs
Procedures to generalize or transfer what is learned in the game to outside the game	Dance moves learned in the game can also be considered actual dance moves in the real world.
Virtual environment	
Setting (describe)	A console game connected to a TV screen and motion-detecting sensor
Avatar	
Characteristics	Female and male avatars are programmed to dance on the screen, and players do not choose these dancers.
Abilities	NA
Game platform(s) needed to play the game (check all that apply)	☐ Smartphone ☑ Tablet ☑ Xbox Kinect ☑ Wii ☑ PlayStation ☐ Computer ☐ Handheld device ☐ Other: _____
Sensors used	Controllers in Wii and PSMove and a motion-detecting sensor in Xbox Kinect
Estimated play time	12 minutes for three songs

MMOG, massively multiplayer online game; NA, not applicable.

Taiwan because young people have better access to these types of games.

Thus, even though college students enjoy exergames, they have limited access to these games. However, because of the popular shared videos on YouTube and other online sites, students can easily ''just dance'' by following the game on a computer screen. The content is the same, and the only difference is the absence of personalized feedback from the game system. For example, in interactive games, feedback (e.g., ''perfect,'' ''great,'' ''ok,'' or ''miss'') appears on the screen, whereas dancing to a YouTube video does not allow dancers to have feedback on their performance. Does this difference influence dancers' physical activity or their perceived effort spent on the dance?

Table 2. Descriptive and *t* Test Data

Group	n	*Mean*	*SD*	t *test* (P *value)*
Height (cm)				
Female	95	160.20	5.81	−11.81 (0.00)
Male	34	173.74	5.51	
Total	129	163.77	8.28	
Weight (kg)				
Female	95	52.20	5.73	−9.42 (0.00)
Male	34	67.44	8.79	
Total	129	56.22	9.46	
BMI (kg/m^2)				
Female	95	20.33	1.82	−3.76 (0.00)
Male	34	22.37	2.97	
Total	129	20.86	2.35	
Weekday gameplay by self (minutes)				
Female	95	36.22	72.08	−1.49 (0.14)
Male	34	56.38	54.42	
Total	129	41.53	68.25	
Weekday gameplay with others (minutes)				
Female	95	11.96	42.81	−2.75 (0.001)
Male	34	36.12	44.48	
Total	129	18.33	44.38	
Weekend gameplay by self (minutes)				
Female	95	47.18	101.30	−2.09 (0.04)
Male	34	93.50	135.19	
Total	129	59.39	112.55	
Weekend gameplay with others (minutes)				
Female	95	14.57	56.80	−2.71 (0.01)
Male	34	48.82	65.44	
Total	129	23.60	60.85	
Dance game experiences				
Female	90	3.09	1.30	4.11 (0.00)
Male	34	2.06	1.07	
Total	124	2.81	1.32	
Game music evaluation				
Female	95	4.61	1.14	−0.15 (0.88)
Male	34	4.65	1.39	
Total	129	4.62	1.21	
Dance experience				
Female	95	3.12	1.77	1.12 (0.27)
Male	34	2.74	1.50	
Total	129	3.02	1.71	
Heart rate monitor chest strap (1 = not at all bothering)				
Female	95	2.58	1.51	−0.60 (0.55)
Male	34	2.76	1.67	
Total	129	2.63	1.55	
Accelerometer (1 = not at all bothering)				
Female	95	2.64	1.72	1.06 (0.29)
Male	34	2.29	1.38	
Total	129	2.55	1.64	
Overall perceived game skill				
Female	95	2.68	1.44	−3.74 (0.00)
Male	34	3.77	1.50	
Total	129	2.97	1.53	

BMI, body mass index; SD, standard deviation.

Feedback from games can be theorized as a dimension of game interactivity. Existing research has focused mostly on the empirical evidence of exergames' effects on players' motivation to exercise and their energy expenditures.[20,21] Research seldom examines how various characteristics of interactive digital games influence players' motivation and physical activity levels, which suggests the need for further research.[22] As research has recently indicated,[23,24] interactivity (i.e., playing versus watching) in digital games is an essential element that can enhance the effects of the traits that are conveyed to players through the game's characters (via character identification). Another study has shown that higher levels of interface embodiment, including more feedback and sensory immersion, increase players' heart rates and motivation for future game use through a sense of presence.[25] In this study, feedback refers to audio and visual cues, such as projections of the players' body movements on the screen, in order to increase players' involvement in and relevance to the game. The current research focuses on whether interactivity (i.e., performance evaluation feedback) from exergames exerts similar effects on players' perceived effort and physical activity levels compared with YouTube dance videos from the game. Additionally, because of the popularity of using players' bodies as controllers in exergames, this study tests whether controller use influences players' physical activity levels and motivation in exergame play.

The purpose of this study was to examine two main effects—the presence of feedback and the use of a digital

Table 3. Descriptive Data for Dependent Variables

Dependent variable	*Mean*	*Standard deviation*
Systolic blood pressure change	6.70	9.39
Diastolic blood pressure change	−1.52	8.83
Heart rate change (beats/minute)	22.23	13.54
Averaged heart rate (beats/minute)	109.23	45.03
Maximum heart rate (beats/minute)	130.66	50.49
Vertical axis body movement (counts/minute)	27,605.52	16,470.24
Horizontal axis body movement (counts/minute)	27,900.40	9493.76
Perpendicular axis body movement (counts/minute)	23,300.38	8753.13
Step counts (counts/minute)	768.33	310.25
Vector magnitude body movement (counts/minute)	51,643.02	19,979.44
Vitality change (1–7 scale)	0.93	1.02
Perceived effort (1–7 scale)	4.80	1.09
Motivation for future use (1–7 scale)	5.09	1.48
Using game for physical activity (1–7 scale)	4.07	1.07

game controller, on players' physiological and psychological outcomes. In addition, this study explored the potential interaction effects between feedback and controller use on subsequent outcomes. The study results will implicate players who lack access to interactive digital games that promote physical activity. The results will also shed light on whether dancing to a video has effects on physical activity levels similar to those of dancing with an interactive game.

Materials and Methods

Participants

An *a priori* power analysis showed that in order to obtain a power of 0.8 and an α level of 0.05 and to detect an effect size of $f = 0.29$ (the medium size of partial $\eta^2 = 0.08$), a sample size of 114 is required. In total, 129 undergraduate and graduate students between 18 and 26 years of age participated in this experiment; the participants were recruited via a university announcement and promotions in several introductory courses. All participants were in good health. The group had a range of body mass indexes (BMIs) from 15.76 to 29.70 kg/m^2; eight participants had BMIs over 25 kg/m^2 (overweight), and 15 had BMIs less than 18.5 kg/m^2 (underweight).

Design

This study used a 2 × 2 × 2 (interactivity, feedback versus no feedback; controller, with versus without; sex, male versus female) factorial design. To operationalize the interactivity conditions, the author used an interactive game and a recorded game that provided no feedback. In the feedback condition, participants played the game with timely feedback for their dance moves and performances. In the no feedback condition, the game was replaced with a prerecorded video that featured the exact song and dance moves but no feedback. The names that were shown on the screen were the same in all conditions.

Regarding controller use, the game was played on either a PlayStation® 3 (Sony, Tokyo) with a controller or an Xbox™ 360 (Microsoft, Redmond, WA) without a controller. Both consoles used a motion-sensing system to detect dance moves; the PlayStation detected motion with a moving controller, and the Xbox detected full-body movement without a hand-held controller.

Material

The dance game ''Just Dance 3'' was chosen to be the experimental stimulus for the study (Table 1). To ensure that the songs provided an equal challenge and required equal effort for both sexes, the research team used the official online difficulty ratings and effort charts to match the difficulty and effort levels of the songs. The research team chose an easy-level song for warm-up and practice. The songs for the males and females were ''Think'' and ''Gonna Make You Sweat,'' respectively. The research team also chose three songs at difficulty levels 1, 2, and 3. For the male participants, the three songs were ''Are You Gonna Go My Way'' (level 1), ''Forget You'' (level 2), and ''Pump It'' (level 3). For the female participants, the three songs were ''I'm So Excited'' (level 1), ''Price Tag'' (level 2), and ''Barbra Streisand'' (level 3). Different songs were provided for male and female participants to match participants with the sex of the character on the screen and to match preprogrammed dancing styles based on sex.

Table 4. Model Statistics for 2 × 2 × 2 Analysis of Variance

Factor/DV	HR change	AveHR	MaxHR	BP change		Vitality change	Perceived effort	Future use	Use for PA
				Systolic	Diastolic				
Interactivity	0.24 (0.62)	1.07 (0.30)	0.58 (0.45)	0.01 (0.93)	0.002 (0.96)	0.64 (0.43)	0.79 (0.38)	1.55 (0.22)	0.09 (0.76)
Controller	2.41 (0.12)	0.65 (0.42)	0.40 (0.53)	0.58 (0.45)	2.73 (0.1)	0.86 (0.35)	0.20 (0.66)	2.33 (0.13)	2.32 (0.13)
Sex	0.14 (0.71)	0.03 (0.87)	0.04 (0.85)	10.04 (0.002)[a]	0.22 (0.64)	0.31 (0.58)	0.60 (0.44)	2.78 (0.10)	1.84 (0.18)
Interactivity × Controller	1.03 (0.31)	0.30 (0.59)	0.16 (0.69)	2.62 (0.11)	0.69 (0.41)	3.75 (0.055)	0.59 (0.44)	0.15 (0.70)	0.02 (0.89)
Interactivity × Sex	1.92 (.17)	1.51 (0.22)	0.89 (0.35)	2.35 (0.13)	0.19 (0.67)	3.18 (0.08)	0.90 (0.35)	2.27 (0.14)	0.04 (0.85)
Controller × Sex	2.87 (0.09)	1.02 (0.32)	0.16 (0.70)	2.14 (0.15)	0.002 (0.97)	0.09 (0.76)	0.60 (0.44)	0.38 (0.54)	1.12 (0.29)
Interactivity × Controller × Sex	1.91 (0.17)	2.67 (0.11)	3.93 (0.05)[a]	0.45 (0.51)	0.001 (0.98)	2.62 (0.11)	2.80 (0.10)	0.31 (0.58)	0.01 (0.91)

Data are *F* values (*P* values).
[a]Indicates significant difference.
AveHR, averaged heart rate; BP, blood pressure; BP change indicates the difference between before and after the game play. Future use refers to the motivation to play the game in the future. HR, heart rate; MaxHR, maximum heart rate; PA, physical activity; Use of PA refers to the intention of participants to use the game for physical activities.

Procedure

All members of the research team trained and rehearsed for the experiment, and all members followed the study protocol for interacting with participants. Before the experiment, participants were instructed to wear comfortable exercise clothing. Upon arriving at the lab, participants were welcomed to look over the consent form while they rested. Each participant read and signed the written consent form to voluntarily participate in this experiment. The consent procedure also informed participants that they could withdraw from the experiment at anytime if they did not want to continue, and they would still be compensated. The baseline heart rate and blood pressure were measured after the consent procedure was complete. Participants were then instructed to complete a preexperiment questionnaire that consisted of physical information and perceived vitality. The moderator placed a Polar® FT1 heart rate monitor (Polar Electro, Kempele, Finland) around the participants' chests and an ActiLife GT3X accelerometer (ActiGraph, Pensacola, FL) around their waists. For the experiment, participants were instructed to follow the dance moves illustrated in the practice video, which was approximately 3½ minutes long, followed by the dance moves in three songs that totaled approximately 12 minutes. Immediately after the third song, the monitoring ceased, and the moderator measured participants' poststimulus heart rates and blood pressures. The participants then completed the remainder of the questionnaire regarding their perceived vitality and effort. All participants were then debriefed and compensated with $100 Taiwanese dollars ($3.3 USD).

Measurement

Prestimulus and poststimulus heart rate and blood pressure were measured using wrist blood pressure monitors. Average and maximum heart rates during the experiment were measured with Polar FS1 monitors. Body movements consisted of horizontal, vertical, perpendicular, and vector dimensions, and step counts were measured with the ActiLife GT3X accelerometer.

Perceived effort was measured using the effort subscale of the Intrinsic Motivation Inventory.[26] Participants rated their perceived effort during gameplay by answering five questions, such as ''I put considerable effort into the game'' and ''I put considerable energy into the game'' ($\alpha = 0.83$), using a scale that ranged from 1 (not at all true) to 7 (very true).

Subjective vitality was measured with the Subjective Vitality Scale,[27] which consisted of seven statements, such as ''At this moment, I feel alive and vital'' and ''Currently, I feel so alive I want to burst.'' Participants rated their perceived vitality using a scale that ranged from 1 (not at all true) to 7 (very true). Vitality changes were calculated by subtracting the poststimulus score ($\alpha = 0.85$) from the prestimulus score ($\alpha = 0.86$).

The motivation for future use scale was adapted from a previous study[28] and consisted of three statements, including ''I would like to continue playing this game'' and ''Given the chance, I would play the game in my free time'' ($\alpha = 0.96$). Participants rated the statements on a scale that ranged from 1 (strongly disagree) to 7 (strongly agree).

Finally, intentions of using the game for physical activity were measured using a published scale[11] ($\alpha = 0.79$). Participants rated seven statements, including ''I would play this game when I feel tired'' and ''I would play this game during bad weather.'' The statements were rated with a scale that ranged from 1 (not true) to 7 (certainly true).

Potential covariates included experience playing dance games and experience with real-life dancing. Participants were asked to rate their experiences on a scale from 1 (not at all experienced) to 7 (very experienced). In addition, they reported the time(s) at which they typically played games (i.e., during the week, on weekends) and how long they spent playing during the week and on the weekends.

Results

This study used a 2×2×2 (interactivity, feedback versus no feedback; controller, with versus without; sex, female versus male) analysis of variance to investigate the effects of interactivity and controller use on physical and psychological outcomes. No potential covariates were significant in the analyses, so all covariates were removed from the model. The descriptive data are shown in Table 2. The results showed that female and male participants differed significantly in height, weight, BMI, gameplaying time, dance game experience, and overall perceived game skills. Game-related confounding variables were not significantly different between sexes.

Table 3 shows the descriptive data for the outcome variables in the study. The results indicate that there were positive changes in heart rate, blood pressure, and perceived vitality. The average heart rate during gameplay (mean = 109.23) reached the 55 percent target zone in adults 20–29 years of age,[29] indicating that the participants engaged in moderate levels of exercise intensity. In addition, on the 7-point scales, the participants rated their perceived effort as 4.80, their motivation for future use as 5.09, and their willingness to use the game for physical activity as 4.07.

Table 4 shows the analysis of variance results for each independent variable, and Table 5 shows the analysis of

Table 5. Model Statistics for 2×2×2 Analysis of Variance

Factors/DV	*Vertical axis*	*Horizontal axis*	*Perpendicular axis*	*Vector magnitude*	*Step count*
Interactivity	1.60 (0.21)	1.21 (0.27)	0.22 (0.64)	1.20 (0.28)	2.39 (0.13)
Controller	2.47 (0.12)	1.87 (0.17)	0.00 (0.98)	1.59 (0.21)	1.68 (0.20)
Sex	1.14 (0.29)	2.93 (0.09)	0.10 (0.76)	0.00 (0.99)	0.32 (0.57)
Interactivity × Controller	0.57 (0.45)	1.04 (0.31)	0.64 (0.43)	0.88 (0.35)	1.07 (0.30)
Interactivity × Sex	0.72 (0.40)	0.45 (0.50)	0.52 (0.47)	0.70 (0.40)	1.55 (0.22)
Controller × Sex	0.40 (0.53)	2.06 (0.15)	0.45 (0.50)	0.82 (0.37)	0.51 (0.48)
Interactivity × Controller × Sex	0.69 (0.41)	0.39 (0.54)	1.57 (0.21)	0.97 (0.33)	0.04 (0.84)

Data are *F* values (*P* values).

variance results for body movements. The results show that there were no significant three-way or two-way interaction effects on physical or psychological outcomes. A main effect of sex was only found for systolic blood pressure, as females (mean = 8.12, standard deviation = 9.24) showed a greater change than males (mean = 2.74, standard deviation = 8.77).

In the present experiment, participants were not notified of the manipulation. However, the research team added an additional condition with 30 participants who were explicitly told that they were dancing to a recorded video (no feedback) without a controller. A comparison of the results between the aware and unaware groups found no significant differences between these two groups, except for diastolic blood pressure (Table 6), and the results for the interaction effects remained nonsignificant.

Table 6. Comparison by *t* Test Between Groups that Were Informed About the Dancing Video and Those that Were Not Informed

Factor, informed or not	n	*Mean*	*SD*	t *test* (P *value*)
Heart rate change				
No	34	−21.94	13.02	−0.20 (0.84)
Yes	30	−21.27	14.28	
Systolic BP change				
No	34	−7.29	8.24	0.82 (0.42)
Yes	30	−9.53	13.39	
Diastolic BP change				
No	34	−0.47	11.09	−2.10 (0.04)[a]
Yes	30	4.97	9.45	
Average heart rate				
No	34	109.35	45.57	−0.68 (0.50)
Yes	30	116.17	32.22	
Maximum heart rate				
No	34	128.09	54.96	−1.92 (0.06)
Yes	30	148.73	28.41	
Vitality change				
No	34	−0.99	1.18	0.56 (0.58)
Yes	30	−1.14	0.89	
Enjoyment				
No	34	5.08	1.00	−1.16 (0.25)
Yes	30	5.37	1.01	
Effort				
No	34	4.68	1.18	−1.04 (0.30)
Yes	30	4.99	1.21	
Motivation for future use				
No	34	5.01	1.42	−1.76 (0.08)
Yes	30	5.58	1.11	
Use the game for PA				
No	34	4.19	1.22	−0.19 (0.85)
Yes	30	4.25	1.23	
Vertical axis				
No	34	24,799.74	15,183.07	−1.35 (0.18)
Yes	30	30,646.83	19,414.82	
Horizontal axis				
No	34	26,840.00	7625.78	0.27 (0.79)
Yes	30	26,196.80	11,066.69	
Perpendicular axis				
No	34	22,555.24	7289.77	−0.25 (0.80)
Yes	30	23,146.40	11,001.29	
Step count				
No	34	728.18	282.86	−1.09 (0.28)
Yes	30	816.23	361.02	
Vector magnitude				
No	34	48,523.24	17,061.74	−0.73 (0.47)
Yes	30	52,342.37	24,532.84	

[a]Indicates significant difference.
BP, blood pressure; PA, physical activity.

Discussion

Although dance games are popular with young adults in Asian countries (e.g., Taiwan), young people have limited access to the game consoles at home or in their school dorms as a result of the limited living space and family culture. Previous studies[9,15,19,20] have shown that full-body dance games provide light- to moderate-intensity exercise levels and may serve as supplements to traditional physical activity. The results from this study suggest that dancing with a video that provides no feedback also achieves these effects on college students' heart rates and body movements.

Focusing on two important elements in games, this study examined the effects of feedback and controller use on participants' physical and psychological outcomes. Study participants displayed no significant differences in physical effort or perceived motivation to continue playing the game. Even when they knew that they were dancing to a video, the participants continued to demonstrate efforts that were equal to moderate levels of exercise intensity. This finding may be attributable to the intuitive dance movements that are portrayed in the games, as participants simply follow the full-body dance moves that appear on the screens. Therefore, the effects of feedback and controller use were diminished. Both the video and the game conditions showed similar physical activity intensity levels. Because dance games demand a high amount of aerobic energy,[15] this study's results indicate that dance videos are an alternative for individuals who have limited access to dance games or for those who have financial issues.

One limitation of this study is that the dance setting was a laboratory. In the open-ended comments, several participants expressed feeling awkward dancing in a lab (note that all participants danced alone in a block where the moderator could not observe). Despite this environmental limitation, most participants expressed their excitement about the dance experiment and concluded that it was ''really fun.'' On a 7-point scale, the average enjoyment rating among 129 participants was 5.17 (standard deviation = 1.06), which indicates high levels of enjoyment. Nevertheless, future studies should examine this line of research in a lounge or with the addition of a multiplayer condition to further examine the implications of having dance games in schools or dorms.

This study contributes to literature that focuses on the latest dance exergames that require no buttons to play and allow players ''just dance'' to the movements on the screen. Existing studies have primarily focused on dance simulation games, such as ''Dance Dance Revolution,'' whereas the current study focused on dance exergames that are intuitive and popular in Asian countries. The results suggest that the actual game and video both demanded moderate levels of aerobic energy from college students. In addition, the results indicate that the unique dance-style videos produced similar effects on physiological outcomes compared with interactive dance games.

These results suggest that young adults in Asian countries can take advantage of game videos that are posted on YouTube to increase their motivation to engage in additional physical activity and to reduce sedentary time. In addition to purchasing game consoles for use in dorms or lounge rooms for students, schools can take advantage of YouTube videos to provide materials for physical education courses. Future research should design interventions or field experiments that observe how students and other young adults use both dance games and videos to supplement their physical activity and how the games serve as a potential gateway to exercise.

Acknowledgments

This work was supported by the Ministry of Science and Technology (grant 103-2628-H-009-002-SS4). The work also received support from the Aiming for the Top University Plan of National Chiao Tung University, Taiwan Ministry of Education (grant 102W963).

The author gratefully acknowledges the director of T-lab, Dr. Chia-Jung Chang, for managing this experiment, and students who helped in data collection: Wan-Hsin Peng, Yi-Jia Chung, and Jia-Huei Kao. The author also thanks Tzu-Chieh Chiang who assisted in data analysis.

Author Disclosure Statement

No competing financial interests exist.

References

1. Boot WR, Kramer AF, Simons DJ, et al. The effects of video game playing on attention, memory, and executive control. Acta Psychol 2008; 129:387–398.
2. Peng W, Crouse J, Lin JH. Using active video games for physical activity promotion a systematic review of the current state of research. Health Educ Behav 2013; 40:171–192.
3. Kiili K, Perttula PTA. Exerbraining for schools: Combining body and brain training. Procedia Comput Sci 2012; 15:163–173.
4. Baranowski T, Bower K, Krebs P, et al. Effective feedback procedures in games for health: A roundtable discussion. Games Health J 2013; 2:320–326.
5. Gao Z, Zhang T, Stodden D. Children's physical activity levels and psychological correlates in interactive dance versus aerobic dance. J Sport Health Sci 2013; 2:146–151.
6. LeBlanc AG, Chaput JP, McFarlane A, et al. Active video games and health indicators in children and youth: A systematic review. PLoS One 2013; 8:e65351.
7. Roemmich JN, Lambiase MJ, McCarthy TF, et al. Autonomy supportive environments and mastery as basic factors to motivate physical activity in children: A controlled laboratory study. Int J Behav Nutr Phys Act 2012; 9:16.
8. Epstein LH, Beecher MD, Graf JL, Roemmich JN. Choice of interactive dance and bicycle games in overweight and nonoverweight youth. Ann Behav Med 2007; 33:124–131.
9. Peng, W, Lin JH, Crouse J. Is playing exergames really exercising? A meta-analysis of energy expenditure in active video games. Cyberpsychol Behav Soc Netw 2011; 14:681–688.
10. Vernadakis N, Gioftsidou A, Antoniou P, et al. The impact of Nintendo Wii to physical education students' balance compared to the traditional approaches. Comput Educ 2012; 59:196–205.
11. Song H, Peng W, Lee KM. Promoting exercise self-efficacy with an exergame. J Health Commun 2011; 16:148–162.
12. Peng W, Lin JH, Pfeiffer K, Winn B. Need satisfaction supportive game features as motivational determinants: An experimental study of a self-determination theory guided exergame. Media Psychol 2012; 15:175–196.
13. Finkelstein S, Nickel A, Lipps Z, et al. Astrojumper: Motivating exercise with an immersive virtual reality exergame. Presence 2011; 20:78–92.
14. Lyons EJ, Tate DF, Ward DS, et al. Energy expenditure and enjoyment during video game play: Differences by game type. Med Sci Sports Exerc 2011; 43:1987–1993.
15. Tan B, Aziz AR, Chua K, Teh KC. Aerobic demands of the dance simulation game. Int J Sports Med 2002; 23: 125–129.
16. Graf DL, Pratt LV, Hester CN, Short KR. Playing active video games increases energy expenditure in children. Pediatrics 2009; 124:534–540.
17. Trout JM, Zamora KJ. Dance Dance Revolution: A physiological look at an interactive arcade game. J Res 2006; 3:67–72.
18. Mejia-Downs A, Fruth SJ, Clifford A, et al. A preliminary exploration of the effects of a 6-week interactive video dance exercise program in an adult population. Cardiopulm Phys Ther Jo 2011; 22:5–11.
19. Hoysniemi J. International survey on the Dance Dance Revolution game. Comput Entertain 2006; 4:8.
20. Biddiss E, Irwin J. Active video games to promote physical activity in children and youth: A systematic review. Arch Pediatr Adolesc Med 2010; 164:664–672.
21. Daley AJ. Can exergaming contribute to improving physical activity levels and health outcomes in children? Pediatrics 2009; 124:763–771.
22. Baranowski T, Buday R, Thompson DI, Baranowski J. Playing for real—Video games and stories for health-related behavior change. Am J Prev Med 2008; 34:74–82.
23. Lin JH. Identification matters: A moderated mediation model of media interactivity, character identification, and video game violence on aggression. J Commun 2013; 63:682–702.
24. Peng W. The mediational role of identification in the relationship between experience mode and self-efficacy: Enactive role-playing versus passive observation. Cyberpsychol Behav 2008; 11:649–652.
25. Kim SY, Prestopnik N, Biocca FA. Body in the interactive game: How interface embodiment affects physical activity and health behavior change. Comput Hum Behav 2014; 36:376–384.
26. McAuley E, Duncan T, Tammen VV. Psychometric properties of the Intrinsic Motivation Inventory in a competitive sport setting: A confirmatory factor analysis. Res Q Exercise Sport 1987; 60:48–58.
27. Ryan RM, Frederick CM. On energy, personality, and health: Subjective vitality as a dynamic reflection of well-being. J Pers 1997; 65:529–565.
28. Ryan RM, Rigby CS, Przybylski AK. The motivational pull of video games: A self-determination theory approach. Motiv Emotion 2006; 30:347–363.
29. American Heart Association. Target Heart Rates. www.heart.org/HEARTORG/GettingHealthy/PhysicalActivity/Target-Heart-Rates_UCM_434341_Article.jsp (accessed July 1, 2014).

Address correspondence to:
Jih-Hsuan Lin, PhD
Department of Communication and Technology
National Chiao Tung University
219B Hakka College
Zhubei City, 302, Taiwan

E-mail: tammylin@nctu.edu.tw