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Clinical Briefs

Is Enhanced Physical Activity Possible Using Active Videogames?

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Abstract

Our research indicated that 10–12-year-old children receiving two active Wii™ (Nintendo®; Nintendo of America, Inc., Redmond, WA) console videogames were no more physically active than children receiving two inactive videogames. Research is needed on how active videogames may increase physical activity.

Introduction

As we are facing an epidemic of obesity,[1] especially among children,[2] there is substantial interest in how to increase physical activity (PA), even though lack of PA was not necessarily a primary contributor to the epidemic.[3] Active videogames (AVGs) offer a possible method of increasing PA. Laboratory research has demonstrated that when instructed to be active, AVG players attained moderate,[4–6] and even intense,[7] workouts. AVGs (especially the Wii™ [Nintendo®; Nintendo of America, Inc., Redmond, WA]) increased energy expenditure among lean and obese children, but somewhat less so among the obese.[8] In more naturalistic circumstances, some AVGs led to increased PA,[9,10] some did not,[11,12] and some attained initial enthusiasm, but AVG play waned after perhaps a week[9] or more (six).[13]

A recent randomized clinical trial tested the effect of two Wii console AVGs (treatment group) versus two inactive videogames (control group). No differences were detected in objectively assessed PA between groups at any time across 13 weeks of participation.[14] This study resulted in over 700 media releases (as monitored by an international media tracking service). Here we will briefly restate the methods and findings, provide a proper interpretation of the results, and identify additional research needed on AVGs eliciting PA.

Methods and Findings from the Original Study

We designed, and obtained National Cancer Institute funding to conduct a pilot or feasibility study.[14] We wanted to simulate the effect on PA of obtaining a new Wii AVG under naturalistic circumstances. We expected our results to reflect initial increased PA from an AVG that trailed off over a relatively short time.[9] We wanted to test this twice (with two AVGs) to reliably assess the pattern of response. Because indoor PA should be particularly appealing to parents with children who live in unsafe neighborhoods,[15] we stratified on the parent's perceived neighborhood safety. Reflecting the expertise of several co-investigators,[16,17] we incorporated several measures of PA parenting practices,[18] expecting to predict which children would become more active.

To provide the strongest test, we used a randomized clinical trial (initial $n=84$, final $n=78$; 10–12-year-old children). To provide all participants with a game playing experience and an effective incentive to provide data, they received a Wii console, which they could keep contingent on providing complete data for the entire project. To obtain the most objective, currently available measure of PA, we used accelerometers for 5 weeks across the 13-week study. To conduct a clinical trial run-in, we asked all children to provide a week (7 days) of baseline PA data and allowed only those children providing complete data to proceed into the trial. To systematically vary only the PA component of game play, children randomly assigned (after baseline assessment) to the treatment group selected two from five AVGs, whereas the control group selected two from five inactive videogames. Choice was offered to ensure children wanted to play the games selected.[19] Project staff reviewed and tested all Wii games touted to promote PA to be sure their game play involved PA and identified five AVGs. Staff reviewed the reported sales data and entertainment industry ratings for Wii games to identify the five most commonly sold (i.e., popular) inactive games that were appropriate for 10–12-year-old children.

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Participating children were offered the selection of the first videogame (and all the peripherals necessary to play that game) right after the completion of baseline PA monitoring, followed by a week of accelerometer monitoring at the first and sixth weeks after receiving the game (Weeks 2 and 7 of study), and then offered the choice of a second game, followed by a week of accelerometer monitoring for Weeks 8 and 13. Interviews were conducted with children after Week 13. The Wii console recorded what game was inserted in the console for how long, and the parent was asked to keep a diary of when their child played the games.

To our surprise, the primary finding was no difference in levels of moderate-vigorous or light PA from baseline to Week 13 and no treatment–control group differences at any of the five weeks of accelerometer recording. In the initial screening, almost all parents believed they lived in a safe neighborhood (responses to a single-item question), so we were unable to stratify on perceived neighborhood safety. Using a separate 12-item neighborhood safety questionnaire,[20] no relationship was detected between perceived neighborhood safety and outcomes of the study. We tried to assess the possible increase in PA during the minutes of AVG playing but found that we had not calibrated the date on the Wii consoles prior to distributing them (leading to mismatches in date between the parent diaries and the console records); the game consoles did not record the times of cartridge insertion; and game cartridges were often left in the consoles for long periods, which meant we could not estimate actual AVG play time. Thus, we could not ascertain if AVG play resulted in increased PA during game play. Interviews at the end revealed that children, siblings, friends, and parents played the games and bought crossover games (e.g., inactive games purchased by those receiving an active game, and vice versa).

Clarifying the Findings

Some of the media stories on our study reported that (1) AVGs cannot lead to increased PA, (2) companies creating AVGs misled consumers, and (3) children "cheated" when playing AVGs. Addressing these issues in order, first, our findings indicate that AVGs did not lead to increased PA. Limitations of our study were that we provided no instructions/prescriptions to be physically active, had too small a sample to be definitive, used only one AVG console (and thereby only one way of monitoring active game play), and involved only 10–12 year olds (results may have differed with other age groups) and that we recruited participants late in the diffusion curve of Wii purchases.[21] Children early in the diffusion curve might have used the games more actively. Thus, our results provided only a limited picture of what is possible with AVGs.

Second, companies created these games to make a profit. They believed that some children would enjoy the screen actions associated with the games and that the game activities were a means to enhance game enjoyment. Nintendo ads emphasize families and fun. It is the public health community that expected PA health-related benefits from AVGs. There appears to be little that was misleading from the companies. Other AVG consoles with other ways of monitoring game-related PA may result in increased PA.

Third, while we know that many of our participants, families, siblings, and friends played the AVGs,[14] we do not know if they found inactive ways (e.g., active wrist movement) to gain the enjoyment of games (and thereby minimized their activity), or they compensated later in the day for increased activity from the games (as suggested from physical education in SPARK[22]). This is a critical point for understanding our results that we could not address.

Needed Research

Anyone interested in addressing the same issues, but minimizing the problems, will need to:

- identify a fool-proof method of synchronizing times of AVG play with accelerometer data
- conduct power calculations to detect what will likely be small effect sizes
- study one of the many new AVG consoles or games for which children will be earlier in the diffusion curve and which may more thoroughly require PA to advance game play (e.g., the Kinect for Xbox 360 [Microsoft, Redmond, WA])

AVGs have led to increased PA when incorporated into therapeutic programs[23] or when the participants were instructed, or prescribed, to use AVGs actively.[24] Thus, future research should systematically vary the nature of the instructions/prescriptions and monitor the maintenance of PA over time. There is some evidence that AVGs played socially/competitively lead to more and longer maintained activity.[9] Because people differ in their sociability or desire for social contacts,[25] it would be important to understand what types of people would be more physically active under what social, collaborative, or competitive circumstances.

AVGs appear to induce PA by movement to obtain the fun (a reward) of playing the game. Sometimes, fun is in the form of competition. Figure 1 presents a graphical representation of how gamification principles[26] in an AVG may induce PA. A player would need to be motivated (want to) play an AVG. There have been two generic types of motivation: Intrinsic (wanting to do something because it is enjoyable) and extrinsic (wanting to so something to get an external reward).[27] Games may involve both types of motivation. Playing the AVG would constitute exposure, which might lead to immersion in game play, which maintains PA. PA moves the screen activity (for example, boxing games provide an opportunity to "knock out" an opponent, and bowling games can knock down bowling pins), which is often experienced as enjoyable or fun (i.e., intrinsically motivating). Points are also accumulated, which is a reward and a form of feedback about performance[28]; comparing one's point total with others' point totals on a leader board may also be a form of reward, at least for competitive individuals.[29] Increasing levels of a game leads to increased perceived challenge, which would mean increased perceived competence, which would increase intrinsic motivation to play. Interactivity in videogames activated the reward regions of the brain more than exposure to a game's vivid and dynamic sensory stimulation.[30] This model is speculative and requires extensive research to verify or expand pathways and does not explain why AVG play might decline after a week or two (e.g., negative feedback loops will be needed for that), nor what constitutes "fun" in an AVG.[31]

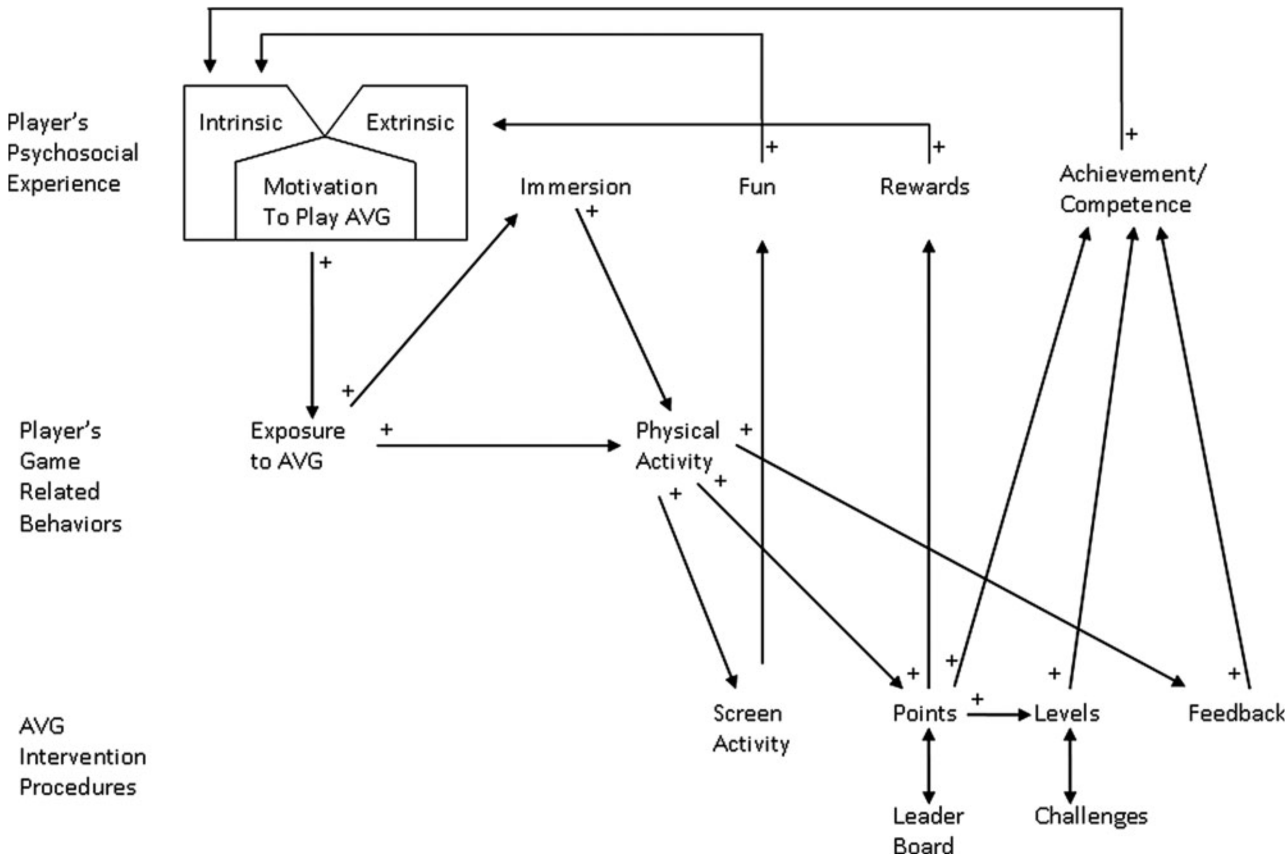

FIG. 1. Gamification principles for understanding activity in single-player active videogames (AVGs).

Understanding how videogames induce behavior change can lead to more effective games. Other models have been proposed of how story-based videogames may engage players, induce health-related behavior changes, and identify corresponding intervention procedures.[32] Research on media or game transportation (also called immersion) indicates that a story or narrative can capture, immerse, and focus a player's attention.[33,34] Most AVGs have little or no story. Marrying a story with AVG play (e.g., requiring activity to move the story[35] or offering surprises during usual activity) offers promise of encouraging more and maintaining higher levels of activity. Alternatively, story/narrative did not enhance science learning,[36] so the role of narrative is an important issue for research. Twenty-six different behavior change techniques or procedures have been identified for encouraging PA behavior change.[37] Research is needed on which of these procedures are appropriate for incorporating into videogames, and whether they result in behavior change.

While games that effectively increase PA may be designed, methods for delivering these games to broad groups of children who might benefit from them (a program's reach[38]) must also be developed. A business model that allows entrepreneurs to financially benefit from their distribution (and preferably also from their development) has been the hope of some. Neither children nor parents, however, have purchased enough healthy videogames to make it profitable. Other distribution channels, along with incentives for developing more such games, are urgently needed.

The primary focus in this article has been to increase PA for health promotion/obesity prevention, primarily among children. AVGs have also been used to enhance cognitive function among children,[39–41] encourage activity among seniors,[42] enhance range of motion,[43] or minimize cognitive deficits associated with aging.[44] AVG effects on these and other health outcomes in other populations must also be aggressively researched.

Conclusions

Our recent finding that children receiving new AVGs did not lead to increased all-day PA under naturalistic circumstances does not mean that AVG cannot be used to increase PA, nor that certain AVG designs could not lead to more PA. We are in the earliest stages of understanding optimal activity promoting AVG design for different health and mental outcomes, and how this interacts with different circumstances or conditions of AVG use, by different types of users. Exciting research opportunities beckon.

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Author Disclosure Statement

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