

Commentary

Exergaming: Hope for future physical activity? or blight on mankind?

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Higher levels of moderate-to-vigorous physical activity (MVPA), and maybe even light physical activity (LPA), have been related to better health,¹ motor skills,² and cognitive³ outcomes in virtually all age and ability groups. Problematically, however, most people in general are not prone to enjoy and participate in substantial amounts of physical activity (PA),⁴ and it has been challenging to find ways to increase the number of minutes of PA per day to a high enough level to achieve the aforementioned benefits.⁵ Low levels of PA may also in part be due to possible compensation with lower activity later in the day, or the next day, in response to bouts of PA.^{6,7}

Serious games, that is, games designed to achieve an outcome in addition to entertainment, have been developed to enhance health outcomes⁸ and have been demonstrated to yield broad positive effects.⁹ Serious games have influenced self-efficacy, or confidence, for doing a behavior (e.g., PA), which is a determinant of doing the behavior and thereby on the pathway to behavior change.⁹ Exergames are a genre of serious games and games for health, but the game mechanic, or method of game play, requires body movement to move the game forward, thereby increasing levels of PA. Exergames appeal to some age groups¹⁰ owing to their intrinsic motivation (or fun) enhancing aspects.¹¹ Some have argued that given the high appeal of gaming in general, exergames hold the promise of being even more effective than other PA-promoting programs in initiating and maintaining PA.¹² Some scholars, however, have concluded that exergames are a blight on humanity because they may not provide higher levels of PA intensity and may displace naturally occurring outside sports and PA,¹³ whereas others¹² emphasize the possible replacement of sedentary gaming with active gaming and the broad, even international, reach of some games (e.g., the recent Pokémon Go release).¹⁴ Alternatively, among children, simply providing a selection of exergames did not increase children's PA levels,¹⁵ suggesting that more than just the games needs to be provided.

Exergames were originally introduced using PA as an innovative gaming mechanic that was hoped and expected to

enhance the games' attractiveness to some groups and thereby enhance sales, not promote the public's health. As a result, some investigators have experimented with exergame mechanics to further enhance the healthfulness (it is hoped without impairing the enjoyment). Three groups have been identified for special interest in and benefit from exergames: children, who generally play extensive amounts of games and thereby may be prone to exergaming, and seniors¹⁰ and people with disabilities,¹⁶ who can perform and benefit from the somewhat lighter intensity activities associated with exergaming.

The interesting articles in this special issue of the *Journal of Sport and Health Science* address these important and diverse issues. Exergaming may be a "gateway" to PA (i.e., increasing diverse kinds of activity from earlier playing of exergames), but little research has addressed this hypothesized effect. Staiano and colleagues¹⁷ tested in an experimental design whether dance exergaming offered 3 times per week over 12 weeks under coaching supervision to 37 adolescent girls (randomly assigned to groups) affected psychosocial variables that influenced PA or had the gateway effect. The investigators introduced an interesting free-play period with diverse activities available to test the gateway effect. The intervention group girls, in comparison to the control group, increased self-reported intrinsic motivation, self-efficacy, and PA from before to after the 12 weeks of exergames, but this had no impact on objectively assessed PA or sedentary behavior. Because attendance at the exergaming sessions was high (80%), PA was increased during the intervention, but this was LPA, not MVPA. The increased LPA did not transfer to the free-play period or to after the intervention, thereby providing no evidence of a gateway to other PA. This does not terminate the gateway speculation because it might exist for younger children, adults, or boys, or in response to more intense activity, but the findings do not exactly stoke the fires of hope, either. Alternatively, the adolescent girls, who are famously inactive, did engage in mostly LPA during the intervention, suggesting that supervised dance exergaming could be offered to increase their usual PA.

Continuing the focus on children, Gao and colleagues¹⁸ tested whether a choice of exergames could be offered on a population basis to otherwise underserved children (second and third graders) to increase their amount and level of PA at school.

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The 2 participating schools' policies offered 125 min/week of physical education or PA and daily 20 min recess. The experiment revealed no school differences in change in any aspect of PA, energy expenditure, or sedentary behavior, indicating that while the exergaming did not increase PA, it was no worse than usual physical education. Unfortunately, we do not know the impact of these exergames on PA outside school (i.e., the possible compensation or gateway effects).

Moving a bit up the age gradient to college students, Pasco and colleagues¹⁹ changed the exergame mechanic from free play or movement in front of a screen to exercise bicycling while viewing a mobile application-based exergame and introduced an underutilized, and it is hoped explanatory, construct: situational interest (i.e., a highly interesting activity that attracts attention and provides positive feelings). Intervention group participants were randomly assigned to play the game for one 15 min session in conjunction with a bicycle ergometer connected to game play, whereas the control group was provided with a bicycle ergometer with feedback on amount of time left (often 15 min), cycling cadence, and power output. Although intervention group participants spent 90% of their time engaged in MVPA while on the exerbike, control group participants spent 95% of their time in such activity, with the authors potentially explaining away the unexpected disparity by the nature of the students involved: sport science students. Situational interest explained the level of activity among experimental group students but not control group students, perhaps owing to a ceiling effect (i.e., there was little variability in PA in the control group to correlate with situational interest). Nevertheless, the new game did show promise of promoting high levels of PA among college students, but this needs to be verified with samples with other characteristics.

Shifting to children with autism spectrum disorder (ASD), a group with low levels of PA and underdeveloped fundamental movement skills, Edwards and colleagues²⁰ tested whether 6 exergame sessions of 45 min apiece played at home over 2 weeks could increase the fundamental movement skill of object control (OC) (i.e., a skill necessary to being physically active) among elementary school children with ASD in comparison to a group of children without ASD. Unfortunately, neither group demonstrated an enhancement of OC after playing the exergames. It wasn't clear from the results whether exergames could not impact OC skills, there wasn't enough game play, or the game play sessions needed the supervision of a professional. Alternatively, the children willingly played the games, suggesting that this was a viable mode for promoting PA among children with ASD.

Last but not least, Zeng and colleagues²¹ conducted a systematic review of exergames' effects on rehabilitative outcomes among seniors. Only 1 of 19 studies had no effect on any rehabilitative outcome; 9 affected all outcomes; and 9 others affected some but not all the outcomes. Ten of 11 studies demonstrated an impact of exergames on balance. Alternatively, the poor quality and reporting of many of the included studies limited what could be concluded. No studies indicated that exergames were preferred over more usual rehabilitation therapy.

So what can we surmise from these interesting studies? First, it appears that using commercially available exergames had measured evidence of success. When incorporated into supervised programs, exergame players got levels of PA comparable to, but not better than, physical education or after-school programs. Exergame play also affected measures of intrinsic motivation and self-efficacy, which are on the pathway to behavior change and thereby support exergames' potential for promoting PA. Unfortunately, there was no evidence to support a gateway effect, and there was no effect on fundamental movement skills among children with ASD. Although there is evidence that exergames enhance rehabilitative outcomes among seniors, higher quality research is required to more confidently come to this conclusion. One study changed the usual game mechanic (free play in front of a screen) to a bicycle ergometer with a mobile application and showed somewhat less, but still very high, MVPA.

Each of these studies raises questions requiring additional research. An assumption in all these studies is that exergame play is more "fun" than other forms of PA. Unfortunately for the field, it is not clear what about the exergames could be considered fun;¹¹ if we knew, this could be used to further enhance the fun and by inference the PA. What constitutes fun may vary across age, gender, and ability groups. Unfortunately, fun has never been considered a respectable academic topic. We need to change that.

A characteristic of most entertainment games has been an associated story, or narrative, that captures the players' attention and immerses them in an alternative world in which they are more likely to attend to inserted health-promoting messages.^{8,22} Adding story or narrative to exergames could substantially enhance their appeal and effectiveness.^{22,23} What kinds of stories are the most appealing across age, gender, and ability groups^{24,25} and whether a story should be inserted into the game or be offered in parallel (so as not to interrupt the interactivity of game play)²⁶ are critical topics that deserve substantially more research.

The recent enormous international response to the release of Pokémon Go, an augmented reality geocaching exergame wherein players walked extensively to find and capture Pokémon characters in their neighborhoods, suggests that the game industry has other potentially impactful ways to increase PA yet to be released.¹⁴ The relatively short duration of this impact, however, indicates that research is needed to better understand its appeal and to use that information to design more appealing and longer-lasting programs.

We need to be grateful to the authors of the papers in this special issue for clarifying some issues and raising others. Although in their current form, exergames may not be the salvation for promoting PA that some may have hoped, they are not a blight on humanity either. More research is needed, soon.

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Competing interests

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