Defining Exergames & Exergaming

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Abstract

With growing interest in exergames research, various terms and definition have introduced to describe exergames. The authors reviewed current literature to understand the inconsistencies and gaps between fields. We found patterns between health-related researchers and non-health related researcher's terms and definitions. Exergame was the most frequently used term, but the combination of exercise and videogames could cause confusion since the term exercise is limited to a particular condition. The authors propose to redefine exergames as a combination of exertion and video games including strength training, balance, and flexibility activities. Exergaming is playing exergames or any other video games to promote physical activity.

Introduction

Many researchers have recommended reducing sedentary activities, such as watching television and playing videogames, to prevent obesity among children and adolescents (Epstein et al., 1995; Robinson, 1999; Rosenberg, Bull, Marshall, Sallis, & Bauman, 2008). For example, Robinson's (1999) physical activity intervention research showed that children who were asked to reduce sedentary behaviors lowered the percent of members overweight and their percent body fat more than another group with children who were asked to do more exercise and a final group who were asked to both reduce sedentary behaviors and increase exercise. Although the authors did not include behaviors like doing homework, reading for school or pleasure, and listening to music for target sedentary activities in their analysis, they considered playing video games a sedentary activity. This ignores the many video games that require players to be physically active, such as the 1988 title *World Class Track Meet (WCTM)* for the Nintendo Entertainment System (Bogost, 2007). Playing *WCTM* requires players to move their feet similar to walking, running,

or jumping on a power pad, a foot pad that has circles each with a sensor that recognizes the player's movement, in order to play it (Bogost, 2007). Even though *WCTM* was released in 1988 (Bogost, 2007) and numerous similar games have been released since then, some recent researchers still consider playing video games a sedentary behavior (e.g. Rosenberg et al., 2008).

The inconsistent use of terminology and definitions

There are some researchers in the health-related fields that acknowledge that playing video games is not always sedentary and may indeed be a way to accumulate more physical activity. In simple terms, exergames are any number of types of video games / multimedia interactions that require the game player to physically move in order to play.

> *Exergaming or exer-gaming (a portmanteau of "exercise" and "gaming") is a term used for video games that are also a form of exercise. (Wikipedia, 2010)*

Because this area of study is still in "its infancy" (Yang, Smith, & Graham, 2008), researchers have used various terms to describe these kinds of video game play (see Table 1) and as components of these descriptions (see Table 2). Out of 23 articles, 10 first authors chose "exergame", which is the most frequent term in the literature (see Table 1). The other authors used the terms exertainment, dance simulation video game, interactive video game, activity promoting video game, active video game, physical gaming, (kin)aesthetic video game, and physical activity-change game. There is a pattern apparent after dividing the first authors by whether they are in health-related areas like kinesiology, nutrition science and medical science or not. We reviewed the articles based on where they were published and the authors' affiliation to decide whether authors were health-related researchers or not.

As you can see from Table 1, health-related researchers showed an inconsistent use in terminology compared to those who are not in health-related fields. Only two health-related researchers used the term exergame (Maddison, 2007; Yang, 2008). First-authors who are not in health-related areas all used the term exergame (Adams et al., 2009; Behrenshausen, 2007; Bogost, 2005; Bogost, 2007; Klein & Simmers, 2009; Sall & Grinter, 2007; Sinclair, Hingston, & Masek, 2007 ; Sinclair, Hingston, Masek, & Nosaka, 2009; Suhonen, Väätäjä, Virtanen, & Raisamo, 2008; Wylie & Coulton, 2008).

After we looked at the elements of these various terms used (see Table 2), eleven out of fifteen health-related researchers described the elements as combining videogames and physical activity (Adams et al., 2009; Maddison et al., 2007; Suhonen et al., 2008; Yang et al., 2008). Six out of eight non-health related researchers used Bogost's (2007) definition combining exercise and videogames (Klein & Simmers, 2009; Sall & Grinter, 2007; Sinclair et al., 2007; Suhonen et al., 2008; Wylie & Coulton, 2008).

This reflects a possible disagreement over the term among researchers. While the term exergame is frequently used the most, why do health-related researchers disagree about using the term exergames? This inconsistency in terminology causes confusion and makes communication among researchers more difficult.

In this paper, we will introduce the different terms that have been used in the literature and how researchers define them. We will combine these views and propose a new definition for this new way to play these kinds of video games.

Terms used by health-related researchers

Researchers, especially those who study health-related areas, showed inconsistent term use to describe these video games, and many of them were reluctant to use the term "exergaming" (see Table 1). Although health-related researcher terms varied, their definitions shared a common purpose in increasing the level of physical activity (see Table 2). Researchers who used the term *activity promoting* and *active video game* defined them by using same word. For example, *activity promoting video games* were defined as video games that "have the potential to promote physical activity during screen time" (Lanningham-Foster et al., 2006, p. e1832), and *active video games* "might provide a novel opportunity to turn a traditionally sedentary behavior into a physically active one" (Maddison, 2007, p. 335). The main idea of using these terms is to distinguish playing video games that promote active behavior from those that result in a sedentary one.

Four studies used the term *interactive video game* (DiRico et al., 2009; Epstein, Beecher, Graf, & Roemmich, 2007; Schuler et al., 2009; Warburton et al., 2007). Epstein et al. (2007) is the only one who defined this term, saying that *interactive video games* "use physical activity as

the game playing controller, combining exercise and video game entertainment" (p. 124). However, all video games are interactive because one distinguishing element for video games is "immediate and interactive feedback" (Salen & Zimmerman, 2004, p.87). Since this term potentially includes most of video games whether they are sedentary or not, the term "interactive video game" may fail to specify this particular kind of video game.

Tan, Aziz, Chua, & The (2002) and Unnithan, Houser, & Fernhall (2006) used the term *dance simulation* for describing *Dance Dance Revolution* (*DDR*). Although Chin, Jacobs, Vaessen, Titze, & van Mechelen (2008) also used the same term, it is hard to guess what dance simulation meant for them since they did not state which video games they used in the study. Without knowing the definition for the term and inferring it from the one example of *DDR*, it is difficult to apply the term to other games. Dance simulation might include games like *Britney's Dance Beat*. *Britney's Dance Beat* is similar to *DDR* except it does not use a dance pad and instead only uses a hand-held game controller, which makes the game play sedentary. The term "dance simulation" may therefore not be able to distinguish between playing videogames that are sedentary from more active play.

Exergame

Exergame was the most commonly used term primarily by researchers who do not have a heath-related background. Since the term "exergame" is the most frequently used in the literature, media, and is a catchy word, we propose to continue using this term; however, we will take a deeper look at its definition. In fact there are several commercial companies that use the term exergame or a derivative in their company name and there is even a non-profit advocacy group called the Exergame Network who's mission it is to "promoting an active and healthy lifestyle by combining video games technologies and exercise, known as exergaming" (2010). Bogost (2007) stated that "exergaming is the combination of exercise and video games" (p. 294) and the term was referenced in a WebMD article by a medical journalist (see Lawrence, 2005). As such, it may help us to understand the term better after knowing what each of these words mean.

There are competing complex definitions of what games are (see Salen & Zimmerman, 2004). For the purpose of defining exergames, a simpler definition will work. A video game is

"any game played on a digital device and encompasses a wide range of games played at arcades, …on personal computers, or on dedicated game consoles (e.g., Nintendo GameCube, Sony PlayStation, or Microsoft Xbox) or handheld units (e.g., Nintendo Game Boy, Sony PSP)" (Baranowski, Buday, Thompson, & Baranowski, 2007, p. 74). For example, Go played on a physical Go board is not a videogame, but Go played on a digital device like a computer or any other gaming console is considered a videogame.

Lawrence's (2005) article title is "Exercise, lose weight with 'exergaming' – new 'active' video games combine body movement with gaming skill." She lists both exercise and body movement which can interpreted as physical activity to describe exergming. Since people often conflate the term exercise with physical activity (Caspersen, Powell, & Christenson, 1985), it is unclear weather she considered them different or not. In health studies, physical activity and exercise have different meanings. Physical activity is "any bodily movement produced by skeletal muscles that results in energy expenditure" (Caspersen et al., 1985, p. 126). For example, physical activities include doing dishes, driving a car, sitting down and drawing pictures. Even sleeping is a physical activity, albeit one that is very sedentary. Because physical activity includes wide range of body movements, exergame should be combination of videogames and physical activity that is more than sedentary one.

If we go back to Bogost's (2007) definition of exergames, a "combination of exercise and video games", exergaming may refer to playing a video game for exercise.
The problem of using the "exer-" part of "exergaming" from exercise is that researchers who have used it did not use "exercise" with a precise definition. Researchers instead used exercise in terms of being active.

Of 23 first-authors, 14 indicated that exergames are video games that can increase physical activity level. Only 8 out of 23 first authors indicated it is combination of video game and exercise; however, none of them stated what exercise meant or incorporated a definition of exercise. They considered an exergame to be a video game that requires more than sedentary levels of physical activity.

Wylie & Coulton (2008) defined exergaming as "video games that also provide exercise" (p. 338) and this is similar to Bogost's (2007) perspective. Klein & Simmers (2009, p. 35) de-

fined exergaming as "the ability to tie video games and exercise into a single medium for the benefit of making exercise fun" by referencing Sall & Grinter's (2007) study, although Sall & Grinter (2007) defined exergaming more simply as "tying play to physical activity" (p. 200).

Problems for the definition of exergame

Using the term "exergame" to define video games that promote physical activity has some problems because of the "exercise" part. Exercise is a subset of physical activity, but specific conditions distinguish it. Exercise is doing physical activity "intentionally to improve or maintain physical fitness with a planned, repetitive, and structured format" (Caspersen et al., 1985, p. 126); thus, applying the definition of exercise to exergames has some potential problems. To be an exercise, the activity needs intentionally to maintain and improve physical fitness and the actions are done repetitively in a structured and predetermined format. In this case, intention matters as when two people play *DDR* at a similar level. One wants to use this play to lose weight and the other one has no such similar intention. Although they are physically active and spending more energy than if they were sitting and talking, only the one who thought of the play in terms of fitness can call it *exergaming.*

From this viewpoint, using the definition of "exercise" for exergames may be problematic for promoting physical activity because it will not include some healthy behaviors without the intention to maintain or improve fitness. From a health benefit standpoint, some physical activity is better than nothing (U.S. Department of Health & Human Services, 2008). For an adult, participating in a minimum of 30 minutes of moderate intensity physical activity (e.g., walking) is recommended to achieve minimum health benefits.

Keeping in mind both the definitions of video game and exercise, exergaming may look like this. Someone can call playing the video game *Wii Fit yoga* as an exergame only if he/she plays it with the intention to maintain fitness (including balance and flexibility activities) and does so regularly in a structured format with planning. This means that playing *Wii Fit yoga* without having any intention to improve or maintain physical fitness (e.g., because it's fun) may not be an instance of exergaming, even though the activity itself may look same. Because the na-

ture of exercise definition relies heavily on the player's intentions and behaviors, it is extremely difficult to call a video game an exergame.

Another problem of using this definition of "exercise" for exergames is that may include sedentary activity as well. Physical fitness comprised of two groups: One is health-related, and the other one is skill-related. The health-related physical fitness components are cardiorespiratory endurance, muscular endurance, strength, body composition, and flexibility (Caspersen et al., 1985). The skill-related physical fitness components are agility, balance, coordination, speed, power, and reaction time (Caspersen et al., 1985). Since physical fitness components also include flexibility, balance, coordination, and reaction time, physical activity working on these components may include playing video game that result in sedentary activity.

The coordination and reaction time components are prevalent in many video games but the activity may not contribute to one's health. If we continue to use the definition of exercise in exergaming, someone can also claim playing a first person shooter game, such as *Team Fortress 2* (*TF2*), by sitting on a chair and using a mouse is exergaming. He/she may want to improve hand-eye coordination and reaction time and does so repetitively in a planned and structured format. Although coordination and reaction time are included as components of physical fitness, playing *TF2* this way is a sedentary physical activity. This definition may thus be unhelpful in distinguishing sedentary and non-sedentary video games.

This suggests that the media (e.g., Lawrence, 2005) may have started using exercise to create exergame without considering its traditional definition (Casperson et al., 1985), instead using it rather loosely to mean being physically active. Doing so implies some video games allow players to be active. Researchers from non-health backgrounds may have adopted this use since none appear to examine the definition of exercise critically when referring to exergaming. When we looked at the definition of exercise, it is problematic to call video games as exegames unless knowing players' intention and playing behaviors.

Other definitions of exergames

Some researchers added promoting "physical activity" or "exercise equipment" in addition to "exercise" in their definitions. Yang, Treece, Miklas, & Graham (2009) stated exergam-

ing is "a new form of video game interaction that requires the game player to physically move in order to play." Similar to Yang et al. (2009), Adams et al. (2009) defined it more specifically as "videogames that use exertion-based interfaces to promote physical activity, fitness, and gross motor skill development."

Some researchers mentioned exergaming but did not prefer to use that term. Maddison et al. (2007) referenced the term exergame in their study, but they used the term only once, instead preferring the term active video game. Similar to Maddison et al. (2007), Sall & Grinter (2007) used the term exergame, but used the term "physical gaming" more than exergaming, and defined it as "a genre of games that uses individual player's physical movement as input for gameplay" (p. 200). These researchers defined exergaming as video games that promote active physical activity.

Sinclair et al. (2007) defined exergaming as "the use of video games in exercise activity" (p. 289). This definition seems to be similar to Bogost's (2007) definition, but Sinclaire et al. (2007) also defined this by additionally defining exergaming as "the merger of video game and exercise equipment" (p. 289). The authors explained their examples of exergaming systems as an exercise bike connected to computer games, foot operated pads for the video games like *WCTM* and *DDR*, and motion sensors for the Sony *EyeToy* and Nintendo Wii.

For example, Warburton et al. (2007) used a racing video game that does not require players to be active, but by adding a stationary bike as the primary controller the game becomes more active rather than just sitting. If a player chooses to play the same racing video game without having a stationary bike, he/she will be participating in sedentary activity. It is also difficult to call the racing video game that was not built for stationary biking as an exergame, but the activity itself can be exergaming when playing video games on an exercise machines.

Exergaming for healthy life styles

We mentioned earlier in this paper that we consider exergaming as providing more than sedentary physical activity during play. How do people know which video games provide moderate physical activity during play? There are two ways to assess aerobic intensity: absolute intensity and relative intensity. In absolute terms, moderate to vigorous intensity is at least 3.0

metabolic equivalents (MET), where "a MET is the ratio of the rate of energy expended during an activity to the rate of energy expended at rest." (U.S. Department of Health & Human Services, 2008, p. 54). An example of an absolute moderate intensity activity is walking at 3.0 miles per hour, which is 3.3 METs (U.S. Department of Health & Human Services, 2008, p. 55).

Walking at 3.0 miles per hour may feel differently based on one's figure and fitness level. For example, an overweight person may feel tired and exhausted at this level while normal weight person may not. Since everyone has a different figure and fitness level, relative intensity is also important to consider for intensity. The 2008 physical activity guidelines used the simpler definition that a "relatively moderate-intensity activity is a level of effort of 5 or 6 on a scale of 0 to 10, where 0 is the level of sitting, and 10 is maximal effort. Relatively vigorous-intensity activity is a 7 or 8 on this scale" (U.S. Department of Health & Human Services, 2008, p. 55) Using this recommendation of moderate to vigorous physical activity focused on cardiorespiratory endurance will provide health benefits.

If one tried to improve one's balance by playing *Wii Fit* balance games, the player will probably not expend enough energy to meet this recommendation. Since people need to improve all around health-related fitness components, considering only energy expenditure is problematic.

As exergaming researchers, especially those who have health-related backgrounds, many want to see if exergaming has the potential to improve one's health; therefore, we would also like to consider other components of health-related and skill-related fitness. Health-related fitness components such as cardiorespiratory endurance, muscular endurance, strength, body composition, and flexibility while including balance from the skill-related fitness components since it is critical in maintaining one's health especially for older adults (U.S. Department of Health & Human Services, 2008). By including this one skill-related component, we avoid having the majority of sedentary skill-based games, like *TF2*, considered exergames.

We propose the new definitions of exergame and exergaming: An exergame is a video game that promotes (either via using or requiring) players' physical movements (exertion) that is generally more than sedentary and includes strength, balance, and flexibility activities. Exergaming is an experiental activity where playing exergames, videogames, or computer-based is used

to promote physical activity that is more than sedentary activites and also includes strength, balance, and flexibility activities (See figure 1). Figure 1 shows that exergaming is part of playing video games for a healthy lifestyle. This will allow the inclusion of playing any video games while using a stationary bike or similar equipment that is not necessarily contextually connected to the particular video games.

Conclusion

We explored the various terms used for exergames (e.g., active video game, interactive video game, activity promoting video games, etc) in current literature. We found that the term exergames may have started without consideration of traditional definition of exercise. Health-related researchers may be aware of the link to the definition of exercise and therefore may purposely try to avoid using it.

After reviewing how exergames are defined in the research literature (Table 2), most of them define exergames as videogames that require physical activity in order to play. We think that although the term "exergames" is often refers to exercise and video games (Bogost, 2007), many exergaming researchers have used exercise interchangeably with physical activity. We discussed how the definition of "exergame" is different from the one of "physical activity" (Casperson et al, 1985).

Based on the reviewed literature, we propose the new definition of exergaming as an experiental activity in which playing exergames or any videogames that requires physical exertion or movements that are more than sedentary activities and also include strength, balance, and flexibility activities. This new definition of exergame will hopefully clear the confusion on how to define exergames and reduce the inconsistency of its use in future studies.

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Table 1

Various terms for exergames

		Exergame (10)	Exertainment (2)	Dance simulation video game (3)	Interactive video game (4)	Activity promoting video game (3)	Active video game (5)	Physical gaming (1)	(Kin)aesthetic of video gaming (1)	Physical activity-change games (1)
Health-related researchers	Tan et al. (2002)			√						
	Unnithan et al.(2006)			√						
	Chin A Paw et al. (2008)			√		√				
	DiRico et al. (2009)				√					
	Schuler et al. (2009)				√					
	Epstein et al. (2007)		√		√					
	Warburton et al. (2007)				√					
	Lannigham-Foster et al. (2006; 2009)					√				
	Graves et al. (2007)					√				
	de Vries et al. (2009)						√			
	Brown et al. (2009)						√			
	Mellecker et al. (2008)		√				√			
	Baranowski et al. (2008)					√				√
	Maddison et al. (2007)	√					√			
	Yang et al. (2008; 2009)	√								
Non-Health related re-searchers	Bogost (2005; 2007)	√								
	Sinclair et al. (2007; 2009)	√								
	Sall et al. (2007)	√						√		
	Behrenshausen (2007)	√							√	
	Klein at al. (2008)	√								
	Wylie (2008)	√								
	Suhonen (2008)	√								
	Adams (2009)	√								

Table 2

Elements of definitions of exergame

		Videogame(23)	Physical Activity(14)	Exercise (8)	Physical input device(2)	Exercise equipment(1)
Health-related researchers	Tan et al. (2002)	√				
	Unnithan et al.(2006)	√				
	Chin A Paw et al. (2008)	√	√			
	DiRico et al. (2009)	√	√			
	Schuler et al. (2009)	√				
	Epstein et al. (2007)	√	√	√		
	Warburton et al. (2007)	√		√		
	Lannigham-Foster et al. (2006; 2009)	√	√			
	Graves et al. (2007)	√	√			
	de Vries et al. (2009)	√	√			
	Brown et al. (2009)	√	√			
	Mellecker et al. (2008)	√	√			
	Baranowski et al. (2008)	√	√			
	Maddison et al. (2007)	√	√			
	Yang et al. (2008; 2009)	√	√			
Non-Health related researchers	Bogost (2005; 2007)	√		√	√	
	Sinclair et al. (2007; 2009)	√		√		√
	Sall et al. (2007)	√	√	√	√	
	Behrenshausen (2007)	√		√		
	Klein at al. (2008)	√		√		
	Wylie (2008)	√		√		
	Suhonen (2008)	√	√			
	Adams (2009)	√	√			

Figure 1

Relationship of Physical activity, exercise, exergaming, and playing video games

Physical Activity

"Any bodily movement produced by skeletal muscles that
results in energy expenditure" (Caspersen et al., 1985, p. 126)

Sedentary

Light

Moderate

Vigorous

Exercise

to improve
phyiscal fitness
with intention,
plan, & repetition

Exertion

Exergaming

including
strength training
balance,
& flexibility

Playing
Video games