Better Together: Outcomes of Cooperation Versus Competition in Social Exergaming

Arwen M. Marker, BA, and Amanda E. Staiano, PhD

Abstract

Children and adolescents most often play active videogames, or exergames, in a social environment. Social play may enhance the potential benefits of an exergaming experience, much like group exercise and team sports are observed to improve physical activity–related outcomes above those of solitary exercise. Two ubiquitous elements of exergames are cooperation and competition. Previous literature suggests that cooperative and competitive aspects of exergames may affect physiological and psychosocial changes. Competitive play has been found to increase energy expenditure and aggression in short bouts of exergaming. Cooperative exergaming has been found to increase motivation, promote continued play, enhance self-efficacy, and increase pro-social behaviors. In one study, a cooperative exergaming condition also resulted in significant weight loss for overweight and obese adolescents. Individual player differences such as individual preferences, competitiveness, weight status, age, gender, and ethnicity may moderate effects. Although the current volume of literature on competition and cooperation in exergaming is small, social exergames hold promise as an engaging alternative to traditional physical activity interventions and may promote a broad range of positive outcomes for children and adolescents. Principles of cooperation and competition are applicable for developers of health-promoting games. Future research is needed to further understand the mechanisms of how competition and cooperation in social exergaming impact physiological and psychosocial outcomes.

Introduction

EXERGAME PLAY IS A SOCIAL experience: Over 70 percent of gamers today play socially with a physical partner,¹ and even those playing solo are playing with an on-screen avatar or virtual partner. In fact, social interaction was reported as the most important influence on players' interest and involvement in a 20-week exergaming intervention for adolescents.² The social support and communication inherent in exergame play are proposed as key mediators for subsequent behavior change, encouraging adherence to sustained play.³ Yet we know surprisingly little about the differential effects of cooperative versus competitive gameplay, particularly in the nascent field of exergaming research.

In the following review, we discuss the current literature on social exergaming, specifically how competitive and cooperative components of social play impact physical activity, motivation, and aggression. The review is based on a presentation from the senior author (A.E.S.) and subsequent group discussion among invited experts in the field of exergaming at “Games for Increasing Physical Activity: Mechanisms for Change,” a symposium held in May 2014 in

conjunction with the International Society of Behavioral Nutrition and Physical Activity Annual Conference.

Active videogames, or exergames, in which gross motor body movement is required to facilitate videogame play, provide a potential tool for children and adolescents to achieve social and emotional gains, as well as to engage in physical activity. Measurements of energy expenditure from exergaming range from 3 to 7 metabolic equivalents (or 4–6.7 kilocalories expended per minute), depending on the game, level, and intensity of play.⁴ In addition to providing an alternative form of physical activity, exergames have been shown to improve children's interest in physical activity and motor skill competence more than traditional physical education classes.⁴

As with any kind of physical activity, it is generally agreed that exercising in groups is more enjoyable than exercising alone.⁵ This conjecture has been supported by research showing that children who play exergames socially report greater increases in perceived social support, self-esteem, motivation, and self-efficacy than do children who play individually.^{5,6} Social or group videogame play has been found to encourage continued use of exergames, maximize physical activity, and increase energy expenditure.^{4–7} For example,

children in a 12-week exergaming intervention were physically active for longer durations when they played in a multiplayer group (a total of 901 minutes) than when they played at home alone (356 minutes).⁷ What is it about the social exergaming environment that facilitates prolonged physical activity?

Theoretical Underpinnings of Social Interaction in Exergame Play

Social psychology and communication theories postulate how social interaction influences motivation, goal setting, and ultimately behavior. Social Cognitive Theory posits that an individual is led to behave in certain ways depending on the salient features of the social environment.⁸ People self-monitor their own actions and the outcomes of their actions. This self-awareness leads to motivation and goal setting to achieve more desirable outcomes. In a social context, individuals also make referential comparisons between themselves and others, which can lead to increased or decreased motivation. For instance, in a competitive environment where individuals are forced to make comparisons between their performance and the performance of others, individuals may feel demoralized if their performance is comparatively poor and thus be less motivated to make behavioral changes.⁸

Conversely, the Kohler Motivation Effect proposes that unfavorable social comparisons can in fact lead to increases in motivation.⁹ Groups often contain members with diverse skills, including some stronger and some weaker members. The Kohler Motivation Effect purports that the least capable or weakest group members, when they feel their performance is indispensable to the group, are motivated to perform better in order to not disappoint their fellow group members. For example, in exergaming studies with college students, participants were asked to hold an exercise (a plank) or ride a stationary bicycle with a partner (human or virtual).^{9,10} Participants who were told their team's score would be decided by the partner who stopped exercising first and that their partner had previously performed better than they had "rose to the occasion" and performed significantly better than when they were alone or in a condition where there was no unfavorable social comparison. However, improvements in performance were actually diminished when the more capable partners provided verbal encouragement.¹¹ The authors suggest that feedback, albeit positive feedback, from more superior partners may be perceived as condescending or patronizing, which leads to negative self-evaluation.

Finally, Social Identity Theory purports that all individuals identify with and self-categorize into certain social groups. Individuals acquire a positive social identity by making comparisons between their group (in-group) and other groups (out-groups). Inequalities between groups lead to competition and normally in-group favoritism.^{12,13} Competition, in turn, leads to motivation to improve performance. In all three of these theories, an overarching theme emerges: Differential responses to the social environment, including whether the environment is cooperative or competitive, will likely impact motivation and behavior change.

Competition Versus Cooperation in Exergaming

Two nearly ubiquitous aspects of the social environment in videogame play are the elements of competition and co-

operation. In competitive videogame play, players succeed when their individual performance is better than the performance of other players. In other words, personal success in competitive play is inversely related to the success of others. In cooperative play, players can succeed through their team's achievement of team goals, as well as through their own individual performance. Individual success in cooperative play is directly and positively associated with the success of others.¹⁴ In this way, cooperative play is thought to facilitate stronger benefits and feelings of achievement because it allows more opportunities for success than are available individually.^{7,15}

Videogame structure elicits both competitive and cooperative play. For example, traditional first-person shooter games like "Halo" (Bungie, Bellevue, WA) allow players to choose whether they wish to play individually against other players (competition) or on a team (cooperation) to defeat opponents. The game provides feedback, scores, and visual representations to track individual and team successes. Exergames, such as "Just Dance" (Ubisoft, Montreuil, France) and "Wii™ Sports" (Nintendo, Kyoto, Japan), promote competition by allowing multiple players to "battle" each other, providing running scores for each player, and identifying winners at the end of each battle. Exergames can also facilitate cooperative play by allowing players to select team modes in which individual scores are summed as a group.

The capability of exergames to be played cooperatively and competitively makes them valuable across several dimensions. Cooperative videogame play, in particular, may promote feelings of cohesion and peer support in order to promote success much like traditional physical activities and team sports.^{16,17} In previous research with traditional soccer and basketball teams, greater team cohesion was significantly and positively associated with team success (i.e., winning percentage), implying that cooperation between team members fosters success.¹⁶ Children with greater perceived interpersonal support during physical activities (e.g., friends/siblings/parents came to watch more games; more perceived friend support) were also more physically active.¹⁸ However, nationally representative data from the 2011 Youth Risk Behavior Surveillance System indicate that 41.6 percent of adolescents do not play on sports teams and that 48.2 percent do not attend physical education class.¹⁹ Thus, it is necessary to find alternative ways to sustain social support and physical activity in this age group. Exergaming provides a unique and exciting opportunity to examine the effects of social interaction, cooperation and competition, and physical activity on positive outcomes for children and adolescents.

Outcomes of Cooperation Versus Competition in Exergaming

Physical activity and weight loss

Cooperative and competitive aspects of exergaming may impact a broad range of physiological outcomes associated with videogame play, including short-term changes, which may promote physiological arousal in acute states, and long-term changes, which may induce cardiometabolic changes and potentially weight loss, in physical activity.

Competition appears particularly useful for short-term physiological arousal: A within-subjects design of 23 female college students observed that exercise intensity increased

for competitive participants when exercising against a live versus virtual competitor, indicating that competition (particularly against a live partner) elicits higher energy expenditure.²⁰ Similarly, a between-subjects study found that young adults in a competitive exergaming condition (with the opponent in a separate physical space) expended more physical effort than those in a cooperative condition (with the partner in the same physical space).⁵ However, this study found no differences between the competitive condition (competing against a live partner) and a single-player condition, which is contrary to the hypothesis that social game play may be more beneficial than solitary play.^{4,6,7} This may be explained by a study limitation: The cooperative group had a smaller playing area due to sharing the gaming space with their cooperator, which may have reduced activity in the cooperative group and confounded study findings.

In another study, adolescents who played “Wii Sports Tennis” competitively against another participant increased caloric expenditure significantly more than adolescents who played alone.¹⁵ Adolescents in this study exhibited similar levels of caloric expenditure during competitive exergame play as they did participating in a beginner tennis lesson on a tennis court. However, cooperative play was not assessed in this study.

In addition, no studies to date have tracked changes in physical activity due to social exergaming in competitive versus cooperative contexts long term.

Cooperative exergaming, in contrast, may promote more enduring, sustained exergame play for health improvements like weight loss. Overweight and obese adolescents in a cooperative exergaming condition lost an average of 1.7 kg, whereas participants in a competitive condition maintained their prestudy weight, and a no-gaming control condition actually gained an average of 0.9 kg over a 20-week intervention.⁶ This evidence lends support to the idea that cooperative exergaming, specifically, may produce significant weight loss in overweight and obese adolescents and implicitly suggests that cooperative exergaming may encourage adolescents to sustain physical activity. However, weight loss in the cooperative condition did not differ significantly from that of the competitive condition. Larger sample sizes and longer interventions may be needed to detect significant differences in weight loss or other health outcomes between sustained cooperative versus competitive play.

Aggression

Videogame research has long focused on the perception that violent videogames may increase aggression and anti-social behaviors,²¹ and more recent research has examined how aspects of cooperation and competition impact these variables. Violent videogames, when coupled with competition, do appear to promote aggressive behaviors and thoughts.^{22,23} When players of a violent videogame were primed with competitive instructions, they exhibited aggression by unnecessarily killing more videogame avatars.²² In a different study, violent videogame players were divided into competitive, cooperative, and solo conditions. The competitive condition listed significantly more violent words in a word-completion task, exhibited more cognitive violence, and were more motivated to engage in violent strategizing than participants in the cooperative or solo conditions.²³ In contrast, playing videogames cooperatively

with a parent has been shown to increase pro-social and helping behaviors, decrease aggression, and reduce internalizing problems in children.^{1,24} One study found increased pro-social behaviors due to cooperative videogame play only for adolescent girls,²⁴ whereas another found these results regardless of gender.¹ One may expect that aggression and pro-social behaviors in exergames may be similarly impacted by cooperation and competition, but most research on these behaviors has focused on traditional (i.e., sedentary), and usually violent, videogames.

Motivation and self-efficacy

Intrinsic motivation and self-efficacy are mediators of physical activity, promoting game enjoyment and positive attitude.²⁵ In a 20-week exergaming intervention, players assigned to cooperative play were found to increase their self-efficacy toward exercise more than a no-play control group, whereas competitive players did not differ significantly from either the control or the cooperative group.⁶ Cooperative and competitive exergaming conditions also reported greater enjoyment and more motivation to continue playing than single-player conditions.⁵ In addition, cooperative exergamers were more motivated, put forth more effort, and showed more commitment than those who played competitively.¹⁴ This increased motivation due to social and cooperative play is crucial to physical activity interventions because motivation promotes adherence and attendance, two factors that are necessary to create lasting behavior and physiological changes. In a study comparing a social-play group versus individual play, 64 percent of individual players dropped out of the study, whereas only 15 percent of social players dropped out.⁷ Previous research provides evidence that cooperative exergaming increases intrinsic motivation, self-efficacy, enjoyment, and continued participation over solitary play, and limited evidence indicates these psychosocial variables may be enhanced in cooperative play more so than competitive play.

Effects of Individual Player Differences

Many of the effects of social exergaming may be moderated by individual differences, including gender, age, ethnicity, weight status, and intrinsic preferences for aspects of gameplay like competition and cooperation. Exergamers in one study completed measures of intrinsic competitiveness prior to gaming.²⁶ Participants who ranked themselves as highly competitive reported more positive mood and greater enjoyment when placed in a competitive exergaming condition, whereas noncompetitive participants reported higher levels of enjoyment, mood, self-efficacy, motivation, and played for longer durations when placed in a noncompetitive exergaming condition. In this study, placing individuals in groups that did not match their intrinsic level of competitiveness had detrimental effects on their mood, enjoyment, and willingness to play, illustrating that it is important to tailor participation based on individual differences.

Another potential moderating factor is players' initial weight status. Overweight and obese children (body mass index ≥ 85 th percentile) in one study reported greater enjoyment and greater energy expenditure than normal-weight children while playing exergames like “Wii Boxing” (Nintendo, Kyoto, Japan), “Dance Dance Revolution” (DDR) (Konami, Tokyo, Japan), and “Jackie Chan Alley Run” (Xavix, San Diego,

CA).²⁷ However, in another study normal-weight young adults had greater energy expenditure while playing “Wii Fitness” and DDR than overweight participants,²⁸ and in a review of 18 exergaming studies, weight status was not a significant moderator for energy expenditure.²⁹ At least one study with overweight and obese adolescents has suggested that cooperative play is more beneficial than competitive play, with cooperative players achieving greater weight loss and greater increases in self-efficacy than a no-play control group, whereas the competitive players did not differ from the control group.⁶ These findings suggest that exergames are an enjoyable physical activity alternative for overweight and obese youth, but it is not known whether cooperative exergame play would result in similar benefits for normal-weight individuals.

Differences in age, ethnicity, and gender may also influence the effects of social exergaming. For instance, boys reported greater enjoyment while playing competition-oriented sport and action-based exergames like “Wii Boxing” and “Jackie Chan Alley Run,” whereas girls preferentially enjoyed cooperative dance exergames like “Just Dance” and DDR.^{27,30} Although few studies have compared exergaming outcomes between different ages, a meta-analysis found that children expended more energy than adults while playing active videogames.²⁹ However, it is not clear if cooperation or competition is preferred differentially across the lifespan. Finally, ethnic differences and cultural norms may make individuals more or less likely to prefer cooperative or competitive exergame play. African American and Hispanic youths play videogames more than white youths,³¹ but racial differences in videogame usage have not translated into research on racial differences in exergaming outcomes. One study that examined cooperation versus competition on weight change and self-efficacy only included African American participants,⁶ preventing a comparison between race/ethnic groups.

Future Research Directions

Current research supports the idea that social exergame play, much like traditional social activities and organized sports, can promote enhanced benefits above those of individual play. However, the mechanisms of how social play in cooperative versus competitive contexts may affect physiological and psychosocial outcomes are still under investigation. Specifically, studies should examine acute bouts of exergame play to investigate the differential mechanisms of competition versus cooperation on energy expenditure, enjoyment, and attitude during or immediately after exergame play, as well as how these mechanisms vary by individual player differences like competitiveness, weight status, age, race, and gender. To examine longer-term changes in physical activity, cardiometabolic health, and weight, future studies should use designs that compare distinctive cooperative, competitive, and individual exergame play conditions over longer durations.

Multimonth interventions with sample sizes that are adequately powered to detect significant differences are necessary to establish whether or not exergames can produce long-term changes in health behaviors and outcomes, and how social interaction contributes to these changes. Given the success of one 20-week group-based intervention in

producing weight loss in overweight adolescents who played in a cooperative context,⁶ investigating group-based play over several months remains an important direction for future research. However, aside from this one trial there is little evidence that exergaming will be played volitionally for sufficient intensity, duration, and frequency to produce long-term health improvements. Two randomized clinical trials of children playing exergames between 4 and 6 months observed reduction in body fat and body mass index³² and increased moderate-to-vigorous physical activity³³ compared with the control groups. However, in both studies, exergames were played in the home and not in a group-based setting, and children were not given explicit goals or advice related to social play. In another study, children who were given an exergame to play in their home without instructions on when or how to play the games did not change physical activity levels.³⁴ Clearly more research is needed to elucidate how the social context may or may not encourage sustained interest in exergame play to produce long-term health outcomes for players.

Implications for Game Designers

Game developers should be mindful that most game play occurs in a social context. There is ample opportunity to design games that engage friends, parents, and even unknown virtual partners in a positive social environment. Game designers should consider competition and cooperation crucial elements to sustain interest and motivation among gamers. Gameplay should be tailored to appeal to individual player differences, using elements of cooperative or competitive play based on player preferences. Including a simple pre-game survey or allowing players to select the level of competition or cooperation within the game may accommodate each player.

Game developers should also focus on ways to include competitive and cooperative aspects of play simultaneously because both competitive play and cooperative play appear to positively affect varying outcomes. For instance, a gameplay session may utilize the Kohler Motivation Effect by making a team's performance dependent on the weaker player, thereby motivating the weaker player to perform better. Providing both real-time and instant replay feedback of multiple players' movements may promote self-monitoring of performance and positive social group comparisons, aligned with Social Cognitive Theory. Feedback may also be transmitted from a virtual partner, such that the player can see the virtual partner's actions and scores alongside his or her own. Camera interfaces commonly integrated in newer-generation exergames can facilitate this visual comparison. Performance can also be communicated among larger teams, allowing individuals to play with a larger virtual network of players who cooperate together as a team and also compete virtually against other teams. Finally, game designers should consider additional information that can be shared among players in a competitive or cooperative fashion, beyond performance-based game scores. For instance, players may wish to monitor their own and their partner's heart rate, weight, or activity intensity level, all of which can be combined into joint scores for a cooperative team or individual scores in a competitive context.

Conclusions

Previous research suggests that cooperative exergaming promotes increases in self-efficacy, intrinsic motivation, pro-social behaviors, and continued gameplay. By promoting the adherence to sustained play, cooperative play may lead to weight loss specifically in overweight/obese adolescents.⁶ In contrast, competitive exergaming may promote short-term physiological arousal leading to increases in energy expenditure and effort, but also aggression, in acute bouts. Social exergaming has the potential to help children and adolescents achieve a range of positive physiological and psychosocial outcomes. Aspects of cooperation and competition need to be examined in future gaming interventions to help players achieve the greatest possible benefits.

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Address correspondence to:
Amanda E. Staiano, PhD
Pennington Biomedical Research Center
6400 Perkins Road
Baton Rouge, LA 70808

E-mail: amanda.staiano@pbrc.edu