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The effects of playing cooperative and competitive video games on teamwork and team performance

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Abstract
Playing video games is a pervasive activity among middle school students. Researchers are now investigating whether such play carries any educational benefits. One aspect of many video games is teamwork. The goal of the present research was to investigate whether playing video games cooperatively with or competitively against others affects later teamwork behavior and team performance. 60 middle school students, all without previous video game playing experience, participated in the present study. They were randomly assigned to one of three experimental conditions: no video game playing, cooperative video game playing, and competitive video game playing. Those in the video game conditions then were taught how to play Modern Warfare 3 and played for two hours. They were randomly paired with another subject from the same condition and either played with or against that person. Two weeks later, all participants were randomly paired with new partners from the same experimental condition and played a Prisoner's Dilemma game where points are awarded to players based on whether they play cooperatively or competitively with each other. Total team scores were tallied after 20 trials. Results showed that those who played Modern Warfare 3 cooperatively scored the highest, while those who played it competitively scored the lowest. Results suggest that video game playing can bolster teamwork and team performance when played cooperatively and impair teamwork and team performance when played competitively.

Keywords: video games, cooperative, competitive, team work, team performance

1. Introduction
Statistics show that ninety-seven percent of the American adolescent population plays video games (Lenhart, Kahne, *et al.*, 2008) [19], and the playing time averages about thirteen hours per week (Gentile, 2009) [15]. While video games come in all sorts of varieties, the genre of violent and first person shooter (FPS) games have clouded the worldwide view of video games. Rumored to be the instigator of school shootings and public massacres, violent video games have held a negative stereotype for decades. Blamed for physical aggression and psychological distress, they make parents think twice before letting their kids engage with them. After the Sandy Hook Elementary School shooting, President Obama demanded that Congress spend $10 million for the research of violent media, particularly video games (Obama & Biden, 2013) [21]. This has caused researchers to look at and analyze the impact of the negative along with the positive aspects of this media.

1.1 Video Game's Cognitive Impacts
While the common belief is that video games, in the long run, cause depression and other mental disorders, they actually have some cognitive benefits. Previous research also suggests that these cognitive advantages increases neural processing and efficiency. Bavelier *et al.* (2012) [4] conducted an fMRI study and found that gamers use their control attention network less than non-gamers. The researchers then concluded that the FPS gamers designate their attentional energy less than non-gamers, meaning that they sift out insignificant information from significant information efficiently. Spatial skills can be easily strengthened by playing FPS games (Uttal *et al.* 2013) [29]. The spatial awareness acquired from these games can be correlated with the same skills that can be attained at college level courses aimed sharpening these very skills. Uttal *et al.* (2013) [29] also shows that the skills can be acquired from the games more quickly than they can be acquired from the classes. In addition, the spatial skills from the games last longer than the skills from the courses.
Problem solving skills are the basis of all video games, and they can also be refined via video games (Prensky, 2012) [22]. Problem can range from "find the item" to "figure out how to kill the monster." In short, they come in all shapes and sizes. It is up to the player to evaluate the current situation, pull strategies from past experiences, and then develop a solution to the problem and put it into execution. Prensky states that introduction to these types of unrestricted situations will give rise to a generation called the "digital natives", who will have a mindset capable of solving real life situation with "outside of the box" thinking. While classrooms teach students "by the book", the digital natives learn by trial and error.
Cooper's study shows how these digital natives can help in real life situations. University of Washington created a game called Foldit, which allowed gamers to model the makeup of proteins genetically. After the playing period had ended, the players were able to help researchers pinpoint the structure that they had been trying to get for the past ten years. In this way, the revolutionary thinking process developed by the digital natives was implemented into a real life situation and produced stellar results (Cooper *et al.* 2010) [7].
Even though video gameplay consists of a remote controller, video games can improve hand eye coordination. These skills can not only be helpful in sports, but also careers that require this skill (McKinley *et al.* 2011) [20]. McKinley found that video game players were successfully able to fly and operate

drones, and were able to complete this task with similar competency as trained pilots. Another example of such career related benefits via video games is an experiment that investigated surgical skills (Rosser *et al.*, 2007; Schlickum *et al.*, 2009) [23, 25]. Inexperienced surgeons who were also ardent gamers outclassed the most accomplished surgeons. The gaming surgeons demonstrated stellar hand-eye coordination, attention, and quick decision-making skills, which they refined through the participation of video games. In essence, video games should not be viewed negatively as they provide an assortment of cognitive benefits.

1.2 Video Game's Impacts on Aggressive Behavior

Scientists have questioned the connections between video games and aggressive behavior (Anderson & Dill, 2000; Sherry 2001) [3, 28]. Research suggests that violent games trigger the aggression scripts in the mind (Anderson & Bushman, 2002) [2]. Also, ingrained pathways arouse related networks when prepped with aggression (Eastin, 2006) [10]. FPS and violent games can be held accountable for invoking these actions. An analysis conducted in 2001 states that 89% of video games on the market contain some violence (Children Now, 2001) [6]. That number is slowly rising as violent games gain increased popularity. The effects of these games can spill onto the behaviors of the players in real life. Playing violent games leads to more "harming" behavior in real life (Bavelier *et al.*, 2011) [5]. Anderson and Bushman (2001) [1] conducted 54 independent tests to discover the relationship between violent behavior and video games. They used over 4000 participants and discovered robust results. The violent effects discovered were aggressive behaviors, aggressive cognitions, physiological arousal. The effects were found in all sorts of participants, including children, adults, males, and females.

Zhang *et al.* (2010) [31] found that competition along with violent content, increased aggressive cognition and aggressive behavior. This leads to the conclusion that it is not just the violence of the video game that is causing aggression but also the competitive aspect of the game. Fleming and Rickwood (2001) [13] studied the result of violent gaming by children. They discovered that arousal was definitely greater after gameplay, but saw no correlation between gameplay and aggressive characteristics. Anderson and Dill (2000) [3] conducted a similar experiment, but instead of children, he used college students as test participants. They detected that college students who played violent games tended to act more violently towards their opponents than those that played non-violent games. In addition, they found that the women participants were more hostile afterwards than the men that participated. One can assume that the context of gameplay can play a factor in the violence behavior, since the results of Anderson and Fleming varied while they put their participants in similar situations.

Since the scope of this study is related to both the pro-social benefits and the anti-social drawbacks of cooperative and competitive video games, we must look at the other side of the spectrum as well. In a cooperative circumstance, one only achieves one's objective when others also achieve their objective (Johnson & Johnson, 1983) [18]. In contrast, one only achieves one's objective in a competitive situation when others do not achieve their objective. The general conclusion of current research suggests that competitive environments nurture more aggression since the player tends to have to block or obstruct his or her opponents from reaching their goal (Sheese & Graziano, 2005) [27]. While in cooperative situations the payer has to work together with their team. This will nurture feelings of teamwork and cohesion, thus eliminating most aggressive sensations (Deutsch, 1973) [8].

1.3 Video Game's Prosocial Impacts

Research has shown that video games, when played cooperatively instead of competitively, can lead to prosocial behavior (Greitemeyer *et al.*, 2012) [17]. In addition, the playing of video games in a prosocial environment can beneficially impact cognition and "helping" behaviors (Bavelier *et al.*, 2011; Gentile *et al.*, 2009; Greitemeyer & Osswald, 2011; Saleem *et al.*, 2012) [5, 14, 16, 24].

Gentile *et al.* (2009) [14] discovered that prosocial games can have both short and long term influences. Immediately after video game play, the participants exhibited behaviors that demonstrated assistance towards others. Also, children exhibited prosocial traits at the end of the school year, if they played the game at the beginning of the school year (Gentile *et al.*, 2009) [14]. We can conclude from this research that simply playing cooperative video games can lead to prosocial behaviors. While, the term "prosocial" is quite general, it encompasses a wide range of social behaviors that are beneficial for the self and the other.

The real issue is that most cooperative and competitive games are violent and FPS games, and these are the games that are known to promote aggression. However, there is research that suggests that violent games do not in and of themselves promote aggression. Ferguson *et al.* (2011) [12] found that participants who played violent games cooperatively tended to display "helpful" behaviors inside and outside of the game world. In addition, they discovered that these gamers exhibited this quality more than gamers who played nonviolent games cooperatively. Consistent with this finding, Eastin reported that violent games, when played in social groups, can reduce the tendency for hostile feelings (Eastin, 2007) [9] compared to when played individually. Additional research confirms Eastin's findings (Schmierbach, 2010; Velez *et al.*, 2012) [26, 30].

1.4 Video Game's Impacts on Teamwork

While countless projects have been conducted on the impact of video games on prosocial behaviors, aggressive sensations, and cognitive benefits, minimal research had been done on the effects of participation in competitive and cooperative videogame play on participants' teamwork performance afterwards. As this is the main focus of the present` study, it is important to delve deeper into this area.

Ewoldsen *et al.* (2012) [11] conducted an experiment that is very similar to the present study. They told participants to play Halo 2, which is a videogame that can be played competitively or cooperatively. Afterwards they measured the participants' behavior in a Prisoner's Dilemma task. Ewoldsen *et al.* [11] found that participants who played Halo 2 cooperatively were more likely to engage in "tit-for-tat" behavior in the Prisoner's Dilemma task than those who had played cooperatively. However, while the researchers pointed out that "tit-for-tat" behavior can be a precursor to cooperation, "tit-for-tat" can also be employed in competition as well. The researchers did not clarify this as they did not report whether the participants in the cooperative condition did indeed cooperate more and

achieve a higher group score than those in the competitive condition. Moreover, they did not investigate whether the effects of game play persisted beyond the day of the study.

The present study builds on the work of Ewoldsen *et al.* [11]. Our methodology is similar in that participants first play a video game, either cooperatively or competitively, and then participate in a Prisoner's Dilemma game. Unlike the participants in the Ewoldsen *et al.* [11] study, all of our participants have no previous video gaming experience (to eliminate any prior effectives of playing video games), we added a control condition where no video games are played and we look at Prisoner's Dilemma performance two weeks after the game playing to determine if there are any lingering effects from game playing.

2. Materials and Methods

2.1 Participants

Participants were 60 middle school students who were recruited from middle schools in Fairfax and Loudoun counties in Virginia. None of them had prior experience playing videogames. Each participated in the study without compensation. Each of the participants was a boy. This was not by design; it just turned out that when recruiting 60 volunteers from local middle schools, those responding were all boys.

2.2 Videogame

The videogame used in the experiment was Call of Duty: Modern Warfare III. It is a first-person shooter game in which players engage in combat against an opposing force, which can either be the computer itself or another human. The game was chosen because it can be played in either a cooperative or competitive mode, making it suitable as a testbed for the experimental hypothesis. In competitive mode, players oppose each other in combat and the goal is to kill the opposing player. In cooperative mode, two players work together to defeat a computer-controlled force. They make joint decisions on the strategies they will use to defeat the enemy, including how to spend the money they are given in the game on weapons. Of particular interest to the present study is the fact that if one player is injured, the other can save him if he is close enough to arrive before the injured player dies. If the injured player dies, then the game is over. Therefore, a key teamwork element taught by the game is that the fates of both players are linked; in order for one to succeed, both must succeed and if one fails, then both fails. Therefore, the best path to success is for each player to think of both himself and his partner.

2.3 Procedure

The 60 participants were randomly assigned to pairs and to one of the three experimental conditions: control, competitive, and cooperative. The latter two conditions involved playing the videogame. Those in the control condition only played the Prisoner's Dilemma game. Those in the other two conditions received training on how to play the videogame and then played the videogame for two hours. Participants in the videogame conditions were brought back two weeks later to play the Prisoner's Dilemma game. The rationale behind the delay was twofold. First, by delaying the Prisoner's Dilemma game, it could be determined whether experience playing the game had a more lasting effect on participants' behavior than could be measured if the Prisoner's Dilemma game were played immediately after the videogame. Second, delaying the Prisoner's Dilemma game was designed to negate a potential immediacy effect whereby participants who just competed in a videogame might be inclined to compete in the Prisoner's Dilemma game while those who had just cooperated might be inclined to cooperate.

However, before playing the Prisoner's Dilemma game, each subject was randomly reassigned to a new partner. The new partner was from the same videogame condition (cooperative/competitive) as the subject. This was done in case the previous competitive or cooperative relationship the subject had with his partner in the videogame might spill over the Prisoner's Dilemma game. Moreover, the participants were blind to the experimental conditions their new Prisoner's Dilemma partners had been in so as to not induce a bias in the participants as to how their new partners might act in the Prisoner's Dilemma game.

Each player was given a sheet (shown in Figure 1) that described the rules of the Prisoner's Dilemma game and allowed the player to keep score. There were 20 trials in the game for which participants were asked to select either X or Y. If both participants chose X, they each received five points. If they both chose Y, each lost five points. If one chose X and the other chose Y, then the one choosing Y received ten points and the one choosing X lost ten points. After each player made his choice, he was told his partner's choice as well. The player then recorded both choices on the sheet provided and kept track of his and his partner's total points.

3. Results and Discussion

The primary purpose of the Prisoner's Dilemma game was to test whether experience playing a videogame can influence subsequence teamwork behavior. The Prisoner's Dilemma game was chosen because it provides an overall score of team performance that is dependent upon how well players look out for their partner's success and not just their own, something representative of real life team performance. Therefore, the measure of importance in the present study is the total score achieved by each pair of players. Accordingly, the team score for each pair of players was determined by adding the individual scores for each player in the pair. As a result, there were ten scores per condition, reflecting the ten pairs per condition. These were then averaged across players in each condition. The averages are shown in Table 1.

As can be seen from Table 1, the average team score was highest in the cooperation condition and lowest in the competition condition. A one-way analysis of variance revealed that a statistically significant difference between conditions, $F(2.27) = 87.00$, $P < .0001$. A Tukey test was used to determine which means were significantly different from each other. Because multiple comparisons were being made, a .01 level of significance was used instead of a .05 level. The critical value required for the means to be significantly different from each other at the .01 level is 35.53. Accordingly, each mean was statistically significantly different from each other mean at the .01 level.

The primary purpose of the research was to investigate whether playing videogames can affect subsequent teamwork behavior. While many skills comprise effective teamwork, an important one is thinking in terms of overall group, not individual, performance, which entails maximizing the success

of one's partners as well as one's own success as the two are often linked. The present results indicate that playing videogames can affect team performance, both positively and negatively. Those with no prior videogame experience showed differences in their team performance after only two hours of videogame play.

A Prisoner's Dilemma game was chosen to test whether the cooperation/competition skills learned during the videogame would extend to contexts beyond the videogame. The results suggest that there was such as transfer of behavior. The Prisoner's Dilemma game was purposely conducted with different partners in order to demonstrate that any effect produced from the videogame was not linked to the specific videogame partner/opponent as this could be construed as implying that the videogame merely induced a competition or cooperation mindset that was unique to the individual Prisoner's Dilemma game partner. The fact that the effects occurred two weeks after playing the videogame suggests that the effects were not an immediate by-product of having just competed or cooperated in a videogame, but rather may reflect a genuine change in how the participants approach situations where they have the choice to compete or cooperate with others.

4. Tables and Figures

Table 1: Mean Prisoner's Dilemma Game Scores based on Condition

Cooperation	Competition	Control
127	-20	60

Instructions for Prisoner's Dilemma Game

You will be playing a game with another student. There will be 20 rounds for this game. In each round, you will be asked to choose either the letter X or the letter Y. The other student will also be asked to choose either the letter X or the letter Y.

When you have made your choice after each round, let the leader of the game know your choice. He will tell the other student what you chose and tell you what the other student chose.

If you each choose X, you each get 5 points.

If you each choose Y, you each lose 5 points.

If one of you chooses X and the other chooses Y, the person choosing Y gets 10 points and the person choosing X loses 10 points.

You can keep score after each round so you know your total score. Use the table below.

Round	Your choice	Other's choice	Your points this round	Other's points this round	Your total points	Other's total points
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						

Fig 1: Prisoner's Dilemma Instructions

5. Conclusion

As noted in the Introduction, video game play is prevalent in adolescents with the predominant type of video game being violent first person shooter games. Research suggests that there are both positive and negative potential effects from playing video games. Given that video games are likely to remain prevalent in the marketplace and that adolescents show a preference for violent games, the issue becomes how to manage video game playing to maximize benefits from game playing and minimize harmful effects. Games that require cognitive abilities and eye-hand coordination can be beneficial. To the extent that adolescents prefer violent games,

these should be played cooperatively to maximize teamwork and prosocial skills.

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