THE KÖHLER EFFECT – INTERGROUP COMPETITION USING SOFTWARE-GENERATED PARTNERS

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A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

Kinesiology – Master of Science

2015

ABSTRACT

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Past research has examined the Köhler motivation gain effect (i.e., when an inferior team member performs better when paired with a more capable partner, from knowledge of his/her individual performance) in an active video game (AVG) using a superior, software-generated partner (SGP). The present investigation examined how incorporating a superior SGP into an AVG would affect an individual's motivation when competing against one other human/virtual-partner team in an planking competition. Participants (N = 90 college-aged students) were randomly assigned to one of three conditions: individual control, conjunctive partner no competition (PNC), or conjunctive partner with opposing-team competition (PWT) in a 3 (conditions) x 2 (gender) factorial design.

Participants performed the first series of five exercises alone, and after a rest period those in the partner conditions were told that they would do the remaining trials with a same-sex SGP whom they could observe during their performance. Participants were also told that they would work with their SGP as a team, and that the team's score would be defined as the score of the person who stops holding the exercise first. Those in the opposing-team competition condition were also told that they and their virtual partner would be competing against one other human-virtual partner team. A significant motivation gain was observed in all partnered conditions compared to the control, $F(2,89) = 15.63$, $p < .001$, but the PNC and PWT groups were not significantly different from each other ($p = 0.35$). These findings suggest that competing against an opposing team does not ultimately boost the Köhler effect in AVGs.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

Within the United States, adults are currently not meeting the recommended physical activity standards. Researchers have estimated that only 20% of North American adults regularly exercise (CDC, 2014). Furthermore, Dishman (1988) speculated that roughly 50% of people who start an initial workout program abandon it and give up within the first 6 months. One suggested cause for this issue is lack of motivation (Dishman, 2001). Motivation is the process that initiates, guides, and maintains goal-oriented behaviors. This definition of motivation includes three major components: activation, persistence, and intensity (Nevid, 2013). For this experiment, the focus will be on the maintenance aspect of motivation, such as the persistence or intensity of an exercise behavior, within a single exercise session. Although this thesis examines the acute effects of motivation on exercise behavior, it sets the foundation for examination of these effects over multiple sessions.

Research has provided evidence describing the psychological and social factors that motivate individuals to exercise (Franzini et al., 2009; USDHHS, 2008). Specifically, these factors include social modeling of physical activity (Feltz & Riessinger, 1990; Fox, Rejeski, & Gauvin, 2000), co-exercisers (Carron, Hausenblas, & Mack, 1996), and social support from health professionals, family, and friends (Coleman, Cox, & Roker, 2008; Zakarian, Hovell, Hofstetter, Sallis, & Keating, 1994). Self-efficacy to overcome exercise barriers and to enjoy physical activities also have consistently been linked to exercise adherence (McArthur & Raedeke, 2009; McAuley, 1993; Sallis, Prochaska, Taylor, Hill, & Geraci, 1999). These variables also are likely to motivate exercisers to persist longer or to exercise more intensely, even within one exercise session.

Another psychosocial factor that has been shown to foster motivation to exercise is exercising in group settings (Burke, Carron, Eys, Ntoumanis, & Estabrooks, 2006; Dishman & Buckworth, 1996). Dishman and Buckworth's (1996) meta-analysis of 136 physical activity interventions found that interventions delivered to groups (and communities) had significantly higher effect sizes than those administered to individuals, families, or individuals within groups. Group exercise programs are also related to higher levels of enjoyment, increased intention to continue exercising, as well as higher levels of social support and opportunities socially to compare and compete with others. However, structured group exercise programs can be problematic for those who have scheduling conflicts, lack financial resources to join a group, have critical rather than supportive others, are dissimilar in ability, or have social physique anxiety (Bain, Wilson, & Chiakin, 1989). Furthermore, little is known about the psychological and group dynamics mechanisms through which such social influences work within group exercise programs (Carron, Hausenblas, & Mack, 1996).

Active video games (AVGs) played with partners (or other group members online) are one way to solve some of the practical problems of structured group exercise. AVGs can eliminate the problems of scheduling, membership fees, partner ability, critical others, and social physique anxiety. AVGs are electronic games that require limb and/or trunk movements in order to be played successfully (Peng, Lin, & Crouse, 2011). In recent years, AVGs have become progressively more popular. Individuals are becoming more motivated to exercise because of the AVGs' increased appeal and entertainment value (Yim, 2007). Research has shown that AVGs can promote healthier behavior (Hawn, 2009). Several studies have explained that AVGs that are more entertaining, appealing, and interactive have a greater chance to motivate individuals to exercise (Hawn, 2007; Warburton, 2013). However, researchers have also noted that AVGs can

eventually become dull and boring when one is participating in isolation (Lyons & Hatkevich, 2013).

Current research on motivation gains in partnered AVGs has examined the social psychological mechanisms through which such social influence works, including social comparison, competition, and indispensability. Feltz, Kerr, and Irwin (2012), for example, found that motivation to exercise in an AVG was increased by exercising with a moderately more capable partner, under conjunctive task demands. A conjunctive task is defined as one in which a team's performance is determined by the performance of its least capable member (i.e., the "weak link"). This motivational increase, or "motivation gain" phenomenon, is known as the *Köhler effect*. The Köhler effect is the result of upward social comparison (i.e., the tendency for a participant to be motivated to exceed the performance of one's more capable partner) and indispensability (i.e., the contingency between one's own performance and other valued outcomes—e.g., good group performance, positive social evaluations).

Köhler's (1926) initial research examined the effects of group ability composition on group performance among male rowing club members (Hertel, Kerr, & Messé, 2000). Köhler asked the rowers to perform a basic motor task as individuals or in dyads. Köhler found an overall motivation gain through the group tasks. In subsequent research, the Köhler effect has been well replicated, and a number of moderating factors have been identified (Kerr & Hertel, 2010).

A number of studies have expanded the original Feltz et al. (2011) Köhler motivation gain research in AVGs, in order to demonstrate enhanced motivation to exercise. The Feltz et al. (2011) and other recent studies have examined the Köhler effect with the EyeToy: Kinetic Plank Workout video game for the PlayStation 2. The results showed that performing plank exercises

with a moderately superior virtually-present partner led to a 24% improvement in the holding times for plank exercises (Feltz et al., 2011). Other studies have shown that exercising with a more capable partner who provided encouragement did not lead to higher motivation gains than a partner who did not communicate (Irwin, Feltz, & Kerr, 2013; Max, Feltz, Wittenbaum, & Kerr, 2014), and that motivation gains did not decrease because of age and weight discrepancies with the partner (Forlenza, Kerr, Irwin, & Feltz, 2012).

Most recently, Feltz and her colleagues (Feltz, Forlenza, Winn, & Kerr, 2014) tested whether a Köhler effect could be demonstrated in an AVG by exercising with a moderately superior, software-generated partner. Their research was based on the premise of the Media Equation concept (or Computers as Social Actors paradigm) (Reeves & Nass, 1996), that people often interact with computers, television, and media as though they were interpersonal interactions. For instance, people respond socially to computer/software agents and apply social rules, much as if they were human. Indeed, Feltz et al. (2014) showed a significant Köhler motivation gain with a nearly human-like software-generated partner (10.25%) and even a very cartoon-like software-generated partner (7%), compared to exercising alone, within the AVG, but the effect was not as strong as when participating with a perceived human partner, virtually-presented (29.09%). One advantage of having a SGP partner, however, is that it can be programmed to adjust its abilities as the participant's ability changes over time, to be maximally motivating to the exerciser (Feltz et al., 2014).

In general, these studies also have shown that participating in these AVGs with a more capable partner did not detract from participants' enjoyment, interest in continuing the game, self-efficacy, or intention to exercise in the future. These experiments, therefore, suggest that group exercise play with AVGs is an effective way for increasing exercise effort in participants.

The Köhler effect has been examined in many types of settings (e.g., work settings, exercise settings, athletic competitions); however, only one Köhler motivation gain study to date has examined how intergroup competition can influence an individual's motivation (Kerr & Seok, 2008). Intergroup competition is the involvement of two or more labeled groups, in which the teams compete for a certain outcome (Bornstein, Gneezy, & Nagel, 1999). Furthermore, researchers believe intergroup competition induces motivation to be competitive because of the strategic incentive when collaborating with a teammate for winning a competition (Bornstein et al., 1999). Kerr and Seok found that competition with an equal ability team could undermine and eliminate the Köhler effect. Furthermore, the authors found that competition with a stronger ability team may augment the Köhler effect (Kerr & Seok, 2008).

The incorporation of intergroup competition has been widely used in multiplayer video gameplay. Multiplayer gameplay allows players to interact with other gamers in competition or in an alliance. In popular multiplayer games such as *World of Warcraft* and *Call of Duty*, two or more human players work collectively to achieve a goal. However, researchers have not included intergroup competition by pairing a participant with an SGP. For my experiment, participants should be able to identify socially with the SGP to increase their intra-team motivation. Social identity is the part of an individual's self-concept that is derived by which groups one belongs to. According to social identity theory, in intergroup competition, an individual's strength in social identification will influence his/her effort exerted on behalf of the ingroup (Ouwerkerk, Gilder, & Vries, 2010). Furthermore, Gockel and researchers (2008) explained that social identity causes motivation in groups as a result of depersonalization. This means that in a group task, an individual will become assimilated with the group's aim of performance rather than focusing on his or her own individual thoughts and behaviors (Gockel, Kerr, Seok, & Harris, 2008).

There is some evidence that people will team up with a computer to compete against others (Nass, Fogg, & Moon, 1996). Nass et al. (1996) found that individuals view themselves as part of a team with a computer partner if the computer displays the same attitudes and behaviors of regular humans. With the results of their study, the authors concluded that convincing participants that they are teammates with a computer party is fairly simple. With the inclusion of an SGP, participants will hopefully have a greater sense of motivation maintenance on the experimental task. Furthermore, intergroup competition with an SGP could potentially promote social support without the assistance of family and friends, and without the practical complications of structured group exercise.

In conclusion, the purpose of this research was to determine how incorporating an SGP into an AVG would affect an individual's motivation when competing against one other human/virtual-partner team in an isometric planking competition. The conditions of the experiment included the individual control condition (IC), the conjunctive partner with no competition (PNT), and the conjunctive partner with opposing team competition (PWT).

Purposes and Hypotheses

Research Questions and Hypotheses

The first research question this thesis explored was:

RQ 1: What are the effects of working with an SGP?

Hypothesis 1: Participants in each of the two of the experimental conditions (e.g., conjunctive partner and opposing team competition; conjunctive partner and no opposing team competition) will significantly improve their exercise performance compared to participants in the individual control condition (IC).

The second and third research questions this thesis explored were:

RQ 2: What are the effects of intergroup team competition when one has an SGP?

Hypothesis 2: Participants in the experimental condition with a conjunctive partner and opposing team competition will significantly improve their exercise performance compared to participants in the experimental condition with a conjunctive partner and no opposing team competition

RQ 3: How will a participant's perception of the team be affected when cooperating with an SGP?

Hypothesis 3: Participants in the conjunctive partner with opposing team competition condition will show significantly greater team perception effects (i.e., greater sense of team identity), compared to participants in the conjunctive partner/no competition condition.

Definitions

- *Additive tasks:* a task where the scores are added together to obtain one team score
- *AVGs*: exercise video games (or active video games) that require physical movements in order to be played successfully
- *Coactive tasks:* a task in which individuals work in the real or imagined presence of others, but outcomes depend only on one's own personal efforts
- *Conjunctive tasks*: tasks where the group's outcome is determined by the least capable or weakest member
- *Indispensability*: how crucial one's contributions are for the group's success
- *Intergroup competition*: the involvement of two or more labeled groups in which the teams compete for a certain outcome

- *Köhler discrepancy effect*: a moderating factor of the Köhler effect; compared to a small or large discrepancy between partners, a medium discrepancy leads to the largest gains in motivation and performance
- *Köhler motivation gain effect*: the increase in motivation and performance exhibited by the least capable member of a group when performing a task with a superior partner (compared to performing the task individually); alternatively referred to as simply the Köhler effect
- *Media equation*: the mindless application of social rules from human-human interactions to human-computer interactions
- *Social comparison*: the process whereby people evaluate their own ability or performance by comparing it with the people around them (e.g., fellow group members)
- *Uncanny Valley*: the continuum of affective responses to humanoid robots; when robots look simultaneously human-like and non-human, they fall into the Uncanny Valley, reducing feelings of familiarity and increasing feelings of strangeness

CHAPTER 2

LITERATURE REVIEW

The purpose of this chapter is to review the literature on motivation and exercise. First, there is a brief overview of the psychosocial factors in exercise. Next, the benefits of AVGs are explored. This is followed by the explanation of group motivation theories, including the Köhler effect. Lastly, the chapter concludes with an assessment of the Köhler effect in AVGs, including the introduction of inter-team competition.

Psychosocial Factors Influencing Exercise Participation

Motivation is the primary reason that people do not engage in regular physical activity in exercise routines or programs to meet the U.S. Department of Health and Human Services (DHHS: 2008; Dishman, Sallis, & Orenstein, 1985) recommended guidelines. There are a number of psychosocial factors that motivate individuals to exercise (Franzini et al., 2009; USDHHS, 2008). Specifically, these factors include the social modeling of physical activity (Feltz & Riessinger, 1990; Fox, Rejeski, & Gauvin, 2000), co-exercisers (Carron, Hausenblas, & Mack, 1996), and social support from health professionals, family, and friends (Coleman, Cox, & Roker, 2008; Zakarian, Hovell, Hofstetter, Sallis, & Keating, 1994). Self-efficacy to overcome exercise barriers and to enjoy physical activities also has consistently been linked to exercise adherence (McArthur & Raedeke, 2009; McAuley, 1993; Sallis, Prochaska, Taylor, Hill, & Geraci, 1999).

Another psychosocial factor that has been shown to foster motivation to exercise is exercising in group settings (Burke et al., 2006; Dishman & Buckworth, 1996). Group and interpersonal level physical activity interventions have been found to be very successful at increasing physical activity, compared to exercising alone (Burke et al., 2006). Furthermore,

Burke et al. (2006) found that exercising outside of a structured class activity was the most preferred setting for exercising with others. To understand the benefits of exercising with others, Carron, Hausenblas, and Mack (1996) created a meta-analysis of 87 studies and 49,948 participants, in which the authors focused on adherence behavior in exercise. The results were that exercising with others had a small to moderate positive effect on adherence behavior (effect size = .32), compared to participants exercising alone. Furthermore, in cohesive groups the effect increased from moderate to large (effect size = .62; Carron et al., 1996). Dishman and Buckworth (1996) provided another meta-analysis of the results from 127 studies, including 131,156 participants, to inspect the efficacy of physical activity intervention. The results were that interventions delivered to groups had larger effects (r = .75), compared to interventions delivered to individuals (r = .16; Dishman & Buckworth, 1996). The results from these studies provide sufficient evidence on how exercising in the presence of others improves exercise adherence.

However, structured group exercise programs can be problematic for those who have scheduling conflicts, lack financial resources to join a group, have critical rather than supportive others, are dissimilar in ability, or have social physique anxiety (Bain, Wilson, & Chiakind, 1989). Furthermore, little is known about the psychological and group dynamic mechanisms through which such social influences work within group exercise programs (Carron et al., 1996). The next section involves AVGs, which are a certain type of exercise strategy that can be one way to solve the practical problems of structured group exercise.

Active Video Games

AVGs are types of video games that incorporate exercise with actual game play; various studies have found that AVGs increase caloric expenditure, heart rate, and coordination (Staiano

& Calvert, 2011). In the 1980's, AVGs were first created as exercise bikes that were connected to video game consoles (Staiano & Calvert, 2011). In the first AVGs, participants played by pedaling and steering the bike on an attached game pad (Staiano & Calvert, 2011). The first generation AVGs were a failure because of high financial costs and inadequate designs of the game interface, which made the AVG convoluted, easily broken, and un-inviting for gamers (Staiano & Calvert, 2011). Dance Dance Revolution (DDR) and the second generation of AVGs have increased the prevalence of cost-effective AVGs and have provided an attractive way for individuals to exercise (Lanningham-Foster, Jensen, Foster, Redmond, Walker, & Heinz, 2006; Schiesel, 2007; Staiano & Calvert, 2011).

AVGs are now used as health tools, and various fitness facilities are currently incorporating AVGs into exercise equipment (e.g., including a virtual trainer AVG on a treadmill; Staiano & Calvert, 2011). With the advantages of technology, AVGs can now focus on body movement in three different dimensions: measured reaction time, acceleration, and obtained information on the speed and power of a player's movement. However, critics in the health industry have negatively critiqued AVGs, expressing concerns that AVGs do not actually produce any health benefits or motivation to sustain exercise for a greater time period (Staiano & Calvert, 2011). Nevertheless, using AVGs as a tool to decrease sedentary behavior may be a start to change the obesity epidemic in the United States.

Benefits of Playing Active Video Games

This section critically examines the positive benefits that AVGs have on the human body and mind. In addition, research is provided to understand how AVGs have affected the human population.

Physical benefits. Research has provided evidence for the physical benefits of AVGs, as well as the transfer of skills to sports or other types of physical activity outside of AVG contexts (Staiano & Calvert, 2011). This information on AVGs is very important for changing the epidemic of obesity in the United States. An increase in caloric expenditure, a developed sense of coordination, and improved athletic skills all can all be achieved with participation in AVGs (Staiano & Calvert, 2011). In a study by Maddison, Mhurchu, Jull, Jiang, Prapevessis, and Rodgers (2007), 21 adolescent youth played the Sony EyeToy AVG. The youth participants increased their energy expenditure from 129% to 400% while participating in active AVG play. AVGs can also be used to increase heart rate. For example, Hindery (2005) provided research on how the DDR AVG doubled 35 adolescents' rest level heart rates during a 45-min workout period. Furthermore, Tan, Aziz, Chua, and The (2002) sampled 40 young adults playing DDR, and they discovered that playing DDR at a medium level intensity met cardiorespiratory fitness standards. Constant AVG use over an extended period of time will lead to fitness and weight loss (Unnithan, Houser, & Fernhall, 2006). An individuals' coordination can also be enhanced with the use of active video games.

Many AVGs, such as DDR or *Wii* Sports, rely on a gamer's hand-eye or foot-eye coordination, which can lead to an improvement in general coordination skills (Staiano & Calvert, 2011). However, most of the research on coordination and video games has focused on elderly participants playing sedentary video games, not AVGs. Even though the research on AVGs is scarce, video games have been shown to increase perceptual-motor skills, dexterity, and fine motor ability (Drew & Waters, 1986). More research is needed to examine the true potential benefits of how AVGs can improve coordination.

Cognitive benefits. Research on AVGs has suggested that participation in AVG play can improve academic performance, spatial awareness, attention, and further comprehension of cause-effect relationships (Staiano & Calvert, 2011). Additionally, participating in active video games has been found to explain how to manipulate a tool (i.e., controller), respond to visual feedback, design specific actions, comprehend spatial constraints, and construct a cognitive configuration of body movements in unison with game play (Hoysniemi, 2006). Playing AVGs can also provide aerobic activity, and research has shown that aerobic physical activity (with or without and AVG) improves cognitive performance, such as perceptual skills, intelligence quotient, achievement scores, verbal tests, mathematical performance, and academic readiness (Etnier, Nowell, Landers, & Sibley, 2006). In addition, playing an AVG on a high level of intensity can enhance a participant's control of attention, which can also improve his/her cognitive functioning (Hillman, Pontifex, Raine, Hall, & Kramer, 2009).

Although AVGs have physical and cognitive benefits, and have become increasingly popular as a way to improve people's motivation to exercise, few are based on behavior-change principles (Straker et al., 2015). Further, few AVGs take advantage of the potential of group dynamics to motivate physically active play. This is important because AVGs have been shown to become boring within a short period of time when played in isolation (Madsen KA, Yen S, Wlasiuk L, Newman TB, Lustig R. Feasability of a dance videogame to promote weight loss among overweight children and adolescents. *Arch Pediatr Adolesc Med*. 2007; 161(1): 105-107.). Thus, one gap in the literature on AVGs is that there is little research based on group motivation theories to improve people's motivation to exercise. The next section provides background on group motivation theories, followed by one group dynamic approach (the Köhler effect) in AVGs.

Group Motivation Theories

The literature on group motivation gains and losses is critically examined in this section, in order to understand fully the main concepts of the research on these theories. Most of the past research has concentrated on motivation losses, or social loafing (Everett, Smith, & Williams, 1992; Karau & Williams, 1993; Williams & Karau, 1991; Williams, Nida, Baca, & Latané, 1989). There has been a recent shift in focus, and now current research has been concentrating on motivation gains instead.

Motivation Losses

When a certain group member's motivation decreases from maximal effort when in a group setting, it is considered a motivation loss (Kerr & Bruun, 1983). In the past couple of decades, there has been a lot of research on group motivation losses (e.g., Kerr & Brunn, 1981; Latané, Williams, & Harkins, 1979a). Furthermore, several studies have examined and indicated that motivation losses are increased by group size for specific tasks (Ingram, Levinger, Graves, Peckham, 1974; Latané et al., 1979a). This phenomenon has been identified as social loafing. Social loafing occurs when an individual exerts less effort while working collectively, compared to working individually on a particular task. Since 1974, approximately 80 studies have focused on social loafing and have studied individual coactive efforts, compared with individual collective efforts (Karau & Williams, 1993). Coactive efforts are when individuals work in the real or imagined presence of others but the outcomes depend only on one's own personal efforts.

In 1913, Max Ringelmann created the first experiment on social loafing, finding an inverse relationship between group productivity and group size on a rope-pulling task. Ringelmann arranged male participants in groups of various sizes, and asked them to pull on the rope, tug-of-war style, with all of their strength. The results indicated that as the group size

expanded, group performance was lower than estimated (cited in Kravitz & Martin, 1986). Steiner (1972) explained that a reduction in individual motivation, and coordination loss, were the two plausible explanations for the performance decline. Ingham et al. (1974) conducted a follow-up study to understand the differences between motivation and coordination losses. The researchers had their participants perform a rope-pulling task in actual groups and in "pseudogroups." The blindfolded students in the pseudogroups were told that they were pulling with a different group member; however they were actually pulling alone (Ingham et al., 1974). The results of the pseudogroups revealed that performance decreased as perceived group sized increased (Ingham et al., 1974).

To understand motivation losses conceptually, and more specifically, social loafing, Latané, Williams, and Harkins (1979) replicated the past findings on social loafing while holding the audience size constant. In their first experiment, the experimenters asked college male participants to shout in both pseudo and actual groups. Additionally, the researchers blindfolded and put headphones on each subject to barricade any noise. The study resulted in participants experiencing coordination losses. The outcomes of this experiment demonstrated that a decrease in group performance was caused, in part, by a reduction of individual effort (Latané, Williams, & Harkins, 1979). These findings directed the researchers to consider that coordination losses were not sufficient to explain the Ringleman effect (Latané et al., 1979).

The researchers attributed the demotivating effects to social loafing, and they introduced a new phenomenon called social impact theory. Latané (1981) defined social impact as any stimuli that can have a social influence on an individual's emotions, thoughts, or behavior. Furthermore, the likelihood of an individual to respond in a situation relies on the strength (i.e., reputation of the group influencing the target), immediacy (i.e., distance between the group and

target), and number of sources and targets present (i.e., number of individuals in the group; Latané, 1981). Researchers concluded with evidence showing that social influence decreases in impact on a target as group size increases (Karau & Williams, 1993). Social impact theory is now very prominent in the field of social psychology, and it provides a sufficient framework for understanding how individuals react in social environments (Nowak, Szamrej, & Latané, 1990). However, other researchers (e.g., Williams et al., 1981; Kerr et al., 1981) argue that Latané's theory of social impact does not provide an adequate explanation of how individuals react in social environments. Rather, Kerr et al.'s (1981) study explained that social loafing could result from the "hide-in-the-crowd" mechanism. This effect is a result of participants not giving as much effort because they take advantage of the anonymity in larger groups. However, the researchers also found that the hide-in-the-crowd mechanism could also produce the opposite of social loafing, the social striving effect (Kerr et al., 1981). For example, working anonymously in large groups may generate an increase in motivation. In relation to how individuals will react in a social environment, Kerr and researchers stated that as the potential for embarrassment increases in a large crowd, the less likely individuals will work hard at a particular task (Kerr et al., 1981).

Karau and Williams (1993) conducted a meta-analysis of 78 studies on social loafing and found a significant effect across several task domains and effort modalities. There was also a handful of elements that frequently affected motivation in group situations and contexts: evaluation potential, dispensability of effort, matching of effort, and self-attention (Karau & Williams, 1993). Their overall findings explained that social loafing is generalizable across gender, culture, and tasks. Additionally, researchers have found that individuals are more likely to partake in social loafing when collectively working with another person (Karau & Williams,

1993). However, more research on social loafing in real world settings, as opposed to social loafing within a controlled laboratory setting, is crucial for the future advancement and understanding of this phenomenon.

Other research suggests that an individual's identifiability can also have an important role in modifying social loafing. Identifiability is when each group member's performance in relation to the total team output is made public to the group. Increasing identifiability on a task can significantly reduce the social loafing effect because one's contribution to the group becomes evident.

Identifiability. According to Høigaarda, Tofteland, and Ommundsen (2006) identifiability is when each group member's performance in relation to the total team output is made public to the group. Identifiability, as explained earlier, reduces social loafing. Additionally, several researchers have stated that reduced identifiability in a group can contribute to social loafing (e.g., Hardy, 1990; Harkins, 1987; Kerr & Bruun, 1983; Latané et al., 1979). Williams, Nida, Baca, and Latané (1989) examined the phenomenon of identifiability on the relay and individual performances of swimmers at the intercollegiate level. When the swimmers' lap times were identifiable to the group, the results were significantly higher in the relay condition compared to the individual performances (Williams et al., 1989). Additionally, the researchers found that swimmers exerted more effort under conditions of high identifiability, compared to conditions of low identifiability. Besides identifiability, social comparison within a group could also emanate from indispensability. There are also plausible measures to counteract social loafing and stimulate motivation, leading to more effort exerted and better performances.

Motivation Gains

Although many researchers have found support for social loafing, it is also possible to improve individual motivation in group settings. Group motivation gains occur when an individual has greater motivation as a result of working collectively with a group on a certain task. Additionally, Köhler (1926, 1927) found that people performed a demanding physical persistence task better when working together in dyads or triads than would be expected from their efforts as individuals (Hertel, et al., 2000).

For the analysis of motivation gains, Hertel et al. (2000) found that the absolute difference (ADS) between the weaker and stronger group members is established through individual trials. The ADS score was the predictor variable in an analysis where the signed difference (CDS), the change between the performance of the dyad and the individual performance of the weaker person in the dyad, was the criterion variable (Hertel et al., 2000). Comparable to Kohler's (1926, 1927) analysis, Hertel et al. (2000) treated each dyad as an independent data point, even though each individual was part of two different dyads. Moreover, the authors found that the CDS measure indicated a significant overall motivation gain. For example, Hertel et al.'s (2000) overall analysis suggested the following conclusions: there is a motivation gain in dyads for their task; this gain effect is moderated by the discrepancy in abilities between dyad members performing as individuals; and the function of the discrepancy and the motivation gain observed linear effect was not significant. Using Köhler's initial analysis structure seems to produce motivation gains in most experimental replications, which is when weaker participants experience a motivation gain when working in a conjunctive persistence task. The next two sections examine the two best-documented motivation gain phenomena: the social compensation and the Köhler motivation gain effects.

Social compensation. Social compensation is one of the earliest examples of the group motivation gain phenomena. Social compensation occurs when group members increase their efforts on collective tasks to compensate for other group members (Todd, Seok, Kerr, & Messe`, 2006). Additionally, in common social compensation studies, subjects work at simple effort tasks, either in a coacting pair (i.e., who are not interdependent or able to monitor one another's performance but work in one another's presence) or in a cooperative dyad (i.e., collective condition). For example, in the collective condition, positive group performance can only happen when one provides a greater effort to compensate for the poor performance of one's teammate (Todd et al., 2006). Under certain collective conditions social loafing is reduced, and the social compensation effect is recognized. Furthermore, using a coaction control section provides the possibility of a comparison of scores with another performer (Todd et al., 2006). This coaction condition produces a different explanation, which the authors term the *social-comparison* effect (Todd et al., 2006).

Todd et al. (2006) found evidence of the social compensation effect using 167 female undergraduate students from a psychology course. The task for this experiment was the same idea generation exercise that most social compensation research has used in the past (Todd et al., 2006). Participants were asked by the experimenters to create as many uses for a common object (i.e., viz. knife) as they possibly could in a 12-minute period (Todd et al., 2006). Moreover, in the collective condition, there was a common box inside, which caught the slips of paper that both dyad members pushed through a slit in the walls. Furthermore, participants in the collective condition were told that they were part of a two-person group, and the point of the experiment was to see the total number of uses produced by the group. Having only female participants could have changed the outcome of the experiment dramatically. The researchers only used

females for participants because previous studies reported no moderation of the social compensation effect by the sex of the participant (Todd et al., 2006).

Todd et al. (2006) suggested that the research findings of social compensation could be due to the importance of compensating for an incompetent partner in the collective condition (the usual interpretation), or to the demotivating effects of public comparison in the coaction condition (Todd et al., 2006). Their results provided no support for the latter explanation. The next section explains the Köhler motivation gain effect in detail. The importance of the Köhler effect is crucial because many studies have based their replication and explanation of the Köhler effect on Köhler's initial work.

The Köhler effect. Other than social compensation, the Köhler effect is another example of a type of motivation gain. Otto Köhler's research involved the tradition of human engineering, and it focused on the approach of applied social psychology, which emphasized finding optimal working conditions (Witte, 1989). The Köhler effect can potentially be explained as a result of two processes: social comparison and indispensability (Hertel et al., 2000). Köhler's (1926) initial research examined the effects of group ability composition on the group performance of male rowing club members (Hertel et al., 2000). Group composition is the particular combination of partners with certain abilities.

To examine group composition and performance, Köhler asked the rowers to perform a basic motor task as individuals or in dyads. For example, the individual condition consisted of a participant holding a bar connected to a 41-kg weight through various pulleys, and in the dyad condition, the weight was 82 kg, and one member of the dyad held each side of the bar (Hertel et al., 2000). Köhler found an overall motivation gain through the group tasks. Witte (1989) explained the importance of Köhler's initial lifting experiment, because it is one of the few early

studies to use a group conjunctive task to encourage motivation. Conjunctive tasks produce the strongest motivation gains in settings where the performance of the least capable group member is pivotal for group success (Hertel et al., 2000). Furthermore, Forlenza et al. (2012) and other recent studies examined the Köhler effect with AVGs (i.e., EyeToy: Kinetic Plank Workout video game for the PlayStation 2). For example, doing exercises with a superior virtual partner led to a 24 percent improvement on holding times for plank exercises (Forlenza et al., 2012). These experiments suggest that group exercise play may be an appropriate way for increasing persistence in participants.

Similar to earlier studies that mentioned motivation gains and social compensation, Forlenza et al. (2012) included undergraduate students as their population. Additionally, in previous experiments all participants were paired with their own ingroup. In the experimental task, both male and female participants were randomly assigned to one of three conditions (i.e., same weight partner, partner heavier, no partner) and were instructed to hold the certain plank exercises for as long as possible (Forlenza et al., 2012). For the first block of exercises, all three conditions completed each plank exercise individually. After the first block, the control group was told their average time held for each plank exercise and that they would do the same set of exercises after 10-min of rest (Forlenza et al., 2012). For the experimental condition, participants were told the same fact; however, they would be working with a same-sex partner connected to the lab through the Internet (Forlenza et al., 2012). Before the second block, the researcher told the participants that their partner held the exercises 40 percent longer (Forlenza et al., 2012), because having participants believe they are inferior to their partner promotes a stronger Köhler effect. Lastly, in the partner conditions the participants were told that during block two their performance would be measured using a team score equal to the score of the first team member

to quit (Forlenza et al., 2012). This made the experiment a conjunctive task, in which the team's outcome was dependent on the inferior group member.

Overall, the tasks of most Köhler experiments were very similar to those of the social compensation and other motivation gain studies. Most motivation gain experiments have a common goal: to try and facilitate performance, by using a well-learned task in the presence of others (Hertel et al., 2000).

Social comparison. According to Kerr and researchers (2008), the social comparison mechanism is an invidious performance comparison that could cause an individual to increase their motivation via goal setting, or maybe even via interpersonal competition. A consequence of social comparison is the tendency for a participant to strive to match or exceed the performance of one's more capable partner (Irwin, Schorniaenchi, Kerr, Eisenmann, & Feltz, 2012). Hertel et al. (2000) suggested that group members engage in social comparison based on one another's performance level to decide on performance goals or outcomes. Additionally, Feltz, Kerr, and Irwin (2011) found that motivation gain was mostly due to social comparison, and that the conjunctive group task did not improve motivation above the level obtained with coacting but otherwise independent exercisers. This is important because most previous studies explained that conjunctive group tasks improved motivation gains for participants. The authors speculated that their one-time aerobic exercise session was seen as a competitive task instead of a collaborative task setting (Feltz et al., 2011). Conjunctive tasks are settings when the least capable or weakest member determines the group's outcome. Instead of a single session, repeated exercise sessions with a partner might increase the importance of being indispensible, by strengthening one's concern for and identification with one's group (Feltz et al., 2011).

To test the social comparison explanation, Hertel et al. (2000) focused on the level of effort in the individual control condition (where no direct social comparison is possible), compared to the coaction control condition (where such comparison is possible). Hertel et al.'s (2000) results suggested that the social compensation effect would have been stronger if individual controls were used rather than coactive controls. For future research, using the correct test for comparing conditions (i.e., individual, coactive) will significantly increase the social comparison explanation. Social comparison within a group could also emanate from indispensability.

Indispensability. Indispensability is the tendency for someone to work harder when the group's outcome or one's evaluation by the group is solely put on one's own level of effort (Irwin et al., 2012). The conjunctive nature of Köhler's experiments makes the performance of the less capable group member crucial for the group's success (Hertel et at., 2000). For example, in Köhler's original experiment paradigms, when one member quits, the other participant must quit in a timely manner as well. This means that the less skilled group member is going to see his or her efforts as indispensable for the group's success (Hertel et al., 2000). Additionally, in the Köhler task, when one person in the dyad quits, he or she induces their partner to quit before their partner wants to quit, and additionally is likely to be responsible for both the partner's and the group's unproductivity (Hertel et al., 2000).

To test the significance of perceived indispensability, Hertel et al. (2000) and other researchers used different variations of Köhler's (1926, 1927) Instrumentality X Value (I X V) model. "These models hold that one's choice of effort level is governed by how instrumental that level of effort is for achieving an outcome, weighted by the value placed on that outcome" (Hertel et al., 2000, p. 592). For example, a participant would be more likely to pick a higher

level of effort if one perceived their contribution to be highly important for group success (Hertel et al., 2000). Lastly, according to the I X V/dispensability explanation, the conjunctive condition is the only place where the Köhler motivation gain can be maximized, but this effect can also happen elsewhere. This is because it is the only condition for which the weaker member is indispensible for the dyadic performance (Hertel et al., 2000).

Evaluation concerns. Lount, Park, Kerr, Messe`, and Seok (2008) speculated that the motivation gains in Köhler effect experiments are the result of evaluation concerns of participants, and there are at least two evaluation concern types that could potentially boost effort in the Köhler paradigm: evaluation concerns about being responsible for a subpar group outcome, and/or evaluation concerns about being seen as a weaker, or less capable group member than other members of the group (Lount et al., 2008). Lount, Messe`, and Kerr (2000) found evidence on evaluation concerns when experimenting with men working on a conjunctive task (e.g., holding a weight above a trip wire). They found that the men worked twice as hard when working with the opposite sex (Lount, Messe`, & Kerr, 2000). According to Lount and colleagues (2008), the effect could be due to men's increase in evaluation concerns in mixed-sex dyads. To examine further the evaluation concerns in the Köhler paradigm, Lount et al. (2008) created an experiment to test how working in the physical presence (i.e., side by side) compared to virtual presence (i.e., over a computer network), of a coworker impacts effort. For the experimental task, participants in the virtual presence condition were in a private room, and they suspended weight over a small level to press down on the space bar of the computer terminal keyboard. In the physical presence condition, two computer terminals were placed in a room side by side, and participants could oversee each other's performance. The results of the study demonstrated that in environments of mutual observation and social comparison, increasing

evaluation concerns of participants enhanced motivation gains (Lount et al., 2008). Additionally, researchers found participants to have higher motivation gains when working in the presence of a coworker, compared to participants working with a virtual partner or working alone. In conclusion, the findings of this experiment help show that individuals experience more motivation when working in the physical presence of another person than when working in a virtual group.

Group identity. According to Chen and Xin Li (2009), group identification is when individuals belong to a particular group, and their sense of identity is likely to be derived from that group. Past research (e.g., Haslam, 2004) has indicated that ostracism should undermine an individual's identification with their group, and even decrease the Köhler effect. In an experiment by Geller, Goodstein, Silver, and Sternberg (1974), the researchers found participants not to exert as much effort at a motor task when ignored. However, William and Sommer's (1997) study had the opposite results. Being ostracized had a miniscule effect for exerting effort by male participants, and women actually had an increase of motivation (William & Sommer, 1997). Ostracism has led to hostile and antisocial reactions in some studies, while in other experiments it has promoted prosocial behavior and less effort placed on group tasks (Kerr, Seok, Poulsen, Harris, & Messe`, 2007).

Kerr and colleagues (2007) extended the Köhler effect research by looking at the effects of exclusion or ostracism on group behavior. Furthermore, the researchers examined if prior ostracism by one's fellow group member's could alter or moderate the Köhler effect (Kerr et al., 2007). The researchers hypothesized that under conjunctive demands, ostracism undermines the relationship between group members and their group. To test how exclusion or ostracism could moderate the Köhler effect, Kerr et al. (2007) divided 381 participants into three different

conditions to perform a persistence lifting task: conjunctive, coactive, and control. Participants who were selected for the group conditions either completed the first block of exercises then subsequently completed the second block of exercises without any manipulations, or the participants completed a task to manipulate social ostracism or inclusion before the second block. The results of the study holistically showed that the prior ostracism of a teammate significantly reduced the Köhler motivation gain effect (Kerr et al., 2007). Furthermore, the indispensability mechanism was entirely depleted in the particular conditions of this study (Kerr et al., 2007). Finally, the authors speculated that being ostracized causes the reduction in one's attachment to group success and teammate evaluation (Kerr et al., 2007).

The Köhler Effect and Active Video Games

Köhler's initial work focused on demonstrating motivation gain effects by using athletes and an exercise task. As discussed earlier, Feltz, Kerr, and Irwin (2011) applied Köhler's preliminary research to document motivation gains using health video games with a virtually present partner. Male and female college students ($N = 181$) were divided into four conditions (individual control, coactive, additive, and conjunctive). Additive tasks are where the scores are added together to obtain one team score. Participants in each condition performed two sets of exercises. In the control condition, the participants completed both rounds of exercises individually. However, for the second block in the partnered conditions (e.g., conjunctive, coactive), a virtually present partner was produced from the PlayStation 2 gaming console. In the individual conditions, the exercise task used for the two exercise blocks consisted of five different abdominal plank tasks, and webcam projected a live feed of the participant side-by-side with a software-generated trainer, who demonstrated the exercises. In the second block of exercises in the partnered conditions, the participant could also see their partner's image before

and during the exercise, in addition to their own (Feltz, Kerr, & Irwin, 2011). The results gained from the coactive, additive, and conjunctive conditions were significant. A participant's comparison with a more capable virtual partner produced a motivation gain (Feltz, Kerr, & Irwin, 2011). Furthermore, participants in the partner conditions held the plank exercises an average of 54 s longer (a 24% increase), compared to individual controls. The researchers credited the results of the experiment to the competitiveness nature of the AVG, or to the extrinsic incentive (i.e., money) rewarded to successful teams with the best performance (Feltz, Kerr, & Irwin, 2011).

Extrinsic Incentives

Kerr, Feltz, and Irwin (2012) conducted an experiment to examine how extrinsic incentives for good performance would alter the Köhler effect. The experiment's design was similar to past research (e.g., Feltz, Kerr, & Irwin, 2011), with two blocks of plank exercises. However, in this study, there were only two task conditions (individual control and conjunctive), with the presence or absence of an extrinsic reward as an added variable. For data on the two incentive-present conditions, experimenters acquired the data from Feltz et al.'s (2011) initial study and compared it with the new data collected where an extrinsic reward was not given. Participants in the conjunctive teams condition exerted more effort and persisted longer than participants in individual control conditions (Kerr, Feltz, & Irwin, 2012). Furthermore, when no incentives were offered to the participants, the Köhler effect was stronger. This resulted in the conjunctive team members with no extrinsic incentive persisting longer (improvement of 43%) than individuals who were offered the incentive. The researchers in this experiment explained that extrinsic incentives could have undermined the Köhler effect for a couple reasons: extrinsic incentives might have provoked the participant to view their performance as a reflection of their

partner's desire for the reward instead of a reflection of their own ability, or participants' feelings of obligation could have been undermined by extrinsic rewards if participants did not value the extrinsic reward. The results of this experiment assist in explaining how upward social comparison and an individual's indispensability to the group are the most plausible and efficient ways to increase motivation and personal involvement on an exercise task.

Perpetual Inferiority

The Köhler motivation gain effect relies heavily on an upward social comparison and perceived indispensability; however, perpetual inferiority, or always being a group's "weak link," has been shown to lessen the Köhler phenomenon. In a recent study, Kerr, Forlenza, Irwin, and Feltz (2013) wanted to know the optimal ability discrepancy of the less-fit member, for producing the Köhler motivation gain. One hundred seven male and female participants were randomly assigned to one of eight conditions (e.g., conditions varied in partner superiority and order of exercises; Kerr et al., 2013). The experiment resulted in participants exerting more effort when working out with a moderately more capable team member, compared to working out in isolation (Kerr et al., 2013). Furthermore, the longer a participant worked with a more capable partner, the smaller the motivation gain. The cause of the decrease could be attributed to a participant's discouragement when partnered with a more capable partner over time (Kerr et al., 2013). Nevertheless, the Köhler effect occurs as long as certain conditions are sufficient for the particular task (e.g., moderately inferior to one's teammate at a conjunctive group task; Kerr et al., 2013). Irwin, Scorniaenchi, Kerr, Eisenmann, and Feltz (2012) additionally provided support for the insignificance of perpetual partner superiority over time with an aerobic task (e.g., having a participant cycle with a superior virtually present partner for six separate days). In the conjunctive condition, the participants' performance improved over the six trials

Partner Characteristics

For AVG studies of the Köhler effect, most partner characteristics are very similar to those of the participants. Most research has only spotlighted young adults of the same age, gender, and race as their partners (Forlenza et al., 2012).

Age, weight, and ability. Forlenza and colleagues (2012) examined the effect of pairing participants with a more-capable and older partner in comparison to a partner of a similar age. Additionally, the researchers wanted to inspect the perception of obesity, and they paired participants with either similar-weight (non-obese) or heavier-weight (obese) partners (Forlenza et al., 2012). The results showed dissimilarities between males and females. The differences of age and weight for female participants did not alter the Köhler effect. For males, however, variances in partners' weight marginally ($P = 0.08$) moderated participants to exert more effort (Forlenza et al., 2012). Being partnered with a similar-weight partner resulted in males working 52.7 s longer on Block 2 (compared to Block 1, 21.1 percent gain); however when partnered with an obese individual, males continued 87.9 s longer (35.1 percent gain; Forlenza et al., 2012). The Köhler effect did not change for differences in the partners' age. Past research that has examined partner dissimilarities hypothesized that if participants view their partner as too dissimilar or incomparable, this could cause the Köhler effect to lessen (Forlenza et al., 2012). The researchers were not able to determine which different aspects of dissimilarity (e.g., age or weight) decreased the Köhler effect.

Researchers have also speculated that dissimilarities could improve the Köhler effect in either engendered competition or situations in which the participants feel more capable than their partner (Forlenza et al., 2012). In Forlenza et al.'s (2012) study, the researchers found a trend for males to experience a weight dissimilarity effect; however, for females there were no

dissimilarities effect for weight or age found. Furthermore, it is very pertinent to note that in a previous study, the dissimilarity in age completely reduced the Köhler effect. The researchers speculated that the difference in experimental tasks (e.g., novel computer vigilance task, AVGs) could have produced the different results.

Researchers have also analyzed discrepancies or differences in the ability of the Köhler effect experiment paradigm. Research has provided evidence that having a slightly more or extremely more capable partner produced a smaller Köhler motivation gain effect (Messe`, Hertel, Kerr, Lount, & Park, 2002; Kerr, Messe`, Seok, Sambolec, & Lount, 2007). However, ability discrepancy with AVGs had never been researched. Feltz, Kerr, and Irwin (2011) initiated partner discrepancy research with AVGs and assigned participants to a moderately superior virtual partner, which improved a participant's persistence in AVGs. Feltz, Irwin, and Kerr (2012) expanded on these findings and conducted an experiment that focused on the different ability levels of a virtually present partner. Furthermore, the researchers specifically wanted to know the ideal level of ability discrepancy between a virtual partner and an AVG player, in order to increase plank persistence in a conjunctive task (Feltz, Irwin, & Kerr, 2012). Participants were randomly assigned to one of four conditions (e.g., individual control, low-, moderate-, or high-partner discrepancy) and performed five isometric abdominal exercises while completing two trial blocks. The results of the study found that participants who worked with a moderately more capable partner under a conjunctive task increased plank persistence by 58% (Feltz, Kerr, & Irwin, 2012). The studies concluded that it is plausible that moderate partnership in AVGs under a conjunctive task can be highly motivating in AVGs.

Human verses humanoid. In initial research on the Köhler effect in AVGs, only a prerecorded virtually present partner (i.e., recorded video of actual human) has been used.

However, because of limitations such as costs, inflexibility, and the sometimes-costly use of deception, other researchers have examined the Köhler effect using a software-generated partner (Feltz, Forlenza, Winn, & Kerr, 2014). This software-generated partner had human characteristics, but was artificial and synthetic. Furthermore, having a software-generated partner had many potential benefits, such as completely eliminating scheduling problems, manipulating the partner's behavior and ability easily, and potentially reducing social physique anxiety for participants (Feltz, Irwin, & Kerr, 2012; Feltz et al., 2014). To test the motivating benefits of a software-generated partner, compared to a real human partner, Feltz and colleagues (2014) incorporated a software-generated partner into an AVG to see if the interaction would result in a Köhler motivation gain effect. The researchers randomly divided participants into four exercise conditions (i.e., individual control, human partner, nearly human partner, and hardly human partner). The experimental task was very consistent with other Köhler plank experiments (e.g., Feltz, Kerr, & Irwin, 2011; Kerr, Feltz, & Irwin, 2012), with two blocks of plank exercises. Participants increased effort when working with a SGP, compared with participants who exercised alone. More specifically, when using difference scores the two versions of the humanoid partner (Nearly Human Partner, Hardly Human Partner) produced considerably higher effort compared with the individual control condition. To describe further how humans interact with computers, the Media Equation is discussed next to explain how individuals respond to computer/software agents.

Media equation. Reeves and Nass (1996) speculated that computers are social actors because of the human-like interactions we have with them, which encourages social responses. Additionally, the researchers speculated that any human-like medium can cause people to treat this entity like a human, even if people believe the entity to be foolish (Reeves & Nass, 1996).

To test these predictions, the researchers had participants work with computers on a particular task, and afterwards they asked them to assess the computer. The evaluation process included asking how they felt about their computer and how they thought the computer performed during the past session (Reeves & Nass, 1996). The results of their experiments provided evidence that human beings apply social norms to computer media (Reeves & Nass, 1996)

Uncanny Valley. According to Mori (2005), robots that are created to be extremely comparable to human beings are assigned to the "Uncanny Valley" (see Figure 1) category. The area of negative emotional responses towards robots that seem "almost human" is the Uncanny Valley. The Uncanny Valley is also used when the quality of the particular robot is too human-like, which can cause the viewer to have an unpleasant impression (Flach, Moura, Musse, Dill, Pinho, & Lykawka, 2012). The graph below illustrates the emotional response of human beings when participating with a particular robot. Furthermore, the introduction of movement can also amplify the human's emotional response (Flach et al., 2012).

Flach et al. (2012) decided to expand past research on the uncanny valley, to see how people perceive various computer graphic-made characters. To test this theory, the researchers

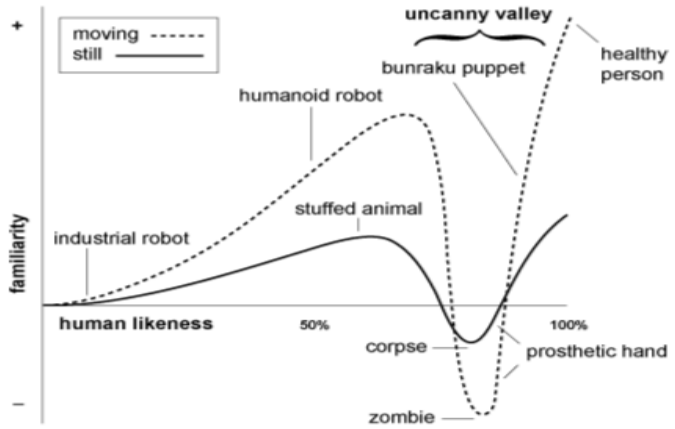


Figure 1: A Simplified Version of Mori's Uncanny Valley (1970/2005)

provided a survey for participants to answer questions about their feelings toward particular computer-generated characters (e.g., can you perceive the Uncanny Valley effect in CG characters; do static images and video lead to different perceptions; Flach et al., 2012). The results were that the computer graphics generated characters that the participants had the most familiarity with (e.g., Obama's cartoon, The Incredibles, Beowulf) tended to have the highest human-likeness correlation (Flach et al., 2012). Additionally, the researchers found that natural human models with strange movements created the most discomfort for participants. Choosing the correct SGPs to boost motivation for participants is pertinent in an inter-team competition.

Inter-team Competition

Intergroup competition is the involvement of two or more labeled groups in which the teams compete for a certain outcome (Bornstein, Gneezy, & Nagel, 1999). Previous research has examined this subject matter and has found that intergroup competition increases group productivity by decreasing the social loafing effect (Bornstein, Erev, & Rosen, 1990; Erev, Bornstein, & Galili, 1993; Bornstein & Erev, 1994). Furthermore, researchers believe intergroup competition induces opposition because of the strategic incentive when collaborating with a teammate for winning a competition (Bornstein et al., 1999). In other words, working collectively with a teammate against another team, with winning a competition on the line, invokes a higher sense of effort. However, there is scarce research on how intergroup competition can be affected by pairing participants with a SGP.

In my experiment, participants partook in a planking competition against one other hypothetical human-virtual partner team. Understanding how participants were motivated with a SGP was crucial for further understanding of our research on motivation maintenance. Participants must be able to identify socially with the SGP in order to increase their intra-team

motivation. Socially identifying with a teammate will increase collaboration within the group, which will ultimately lead to an increase in performance. Social identity is the part of an individual's self concept that dictates which groups one belongs too. According to social identity theory, in intergroup competition an individual's strength in social identifications influences their effort exerted on behalf of their ingroup (Ouwerkerk, Gilder, & Vries, 2000). Additionally, research has also specified that in ongoing intergroup competition (e.g., ranked planking competition), individuals do not abandon themselves from an unsuccessful group (e.g., a group in last place); instead, they will attempt to improve the ranking of their team to be comparable to other teams in the competition (Ouwerkerk et al., 2000). For a participant to identify himself/herself with a software-generated partner, researchers must create conditions that increase the salience of the group and their social identity (Ouwerkerk et al., 2000). For example, Worchel, Rothgerber, Day, Hart, and Butemeyer (1998) explained that social loafing was enhanced when group members were working more collectively and in unison when wearing matching uniforms. In our research, participants wore matching uniforms, as did their SGP. Additionally, researchers had participants create a team name (e.g., giants, cobras) before the beginning of the plank competition. It was hoped that this would cause the participant to have a better sense of social identification with their virtual partner.

Ouwerkerk et al. (2000) expressed how one's social identity is threatened by one's standing or ranking in relation to the group. The researchers assigned 63 psychology undergraduate students into either a low-status or high-status condition. Low-status indicated being the eighth ranked position in the departmental competition. Additionally, the high-status condition ranked participants second in the departmental competition. The participants first completed the pretest to practice a spatial choice reaction task (Ouwerkerk, Gilder, & Vries,

2000). The participants then completed a questionnaire asking about their identification with other psychology students, and lastly they completed a posttest on the same space choice reaction task. However, in the posttest, each participant's performance was influenced by a ranking system established to compare his or her time with other psychology students who had completed the study. The results of the study found that participants exerted more effort when their current standing or ranking was unfavorable (i.e., threatening of their social identity); however, female participants tended to exert more effort in a high-status condition. Ranking participants might also make participants view their competitors as outgroups.

James and Greenburg (1989) studied how intergroup competition can cause one team to perceive other opposing teams as outgroups. Creating team names hopefully caused participants to heighten their social identity with their partner, and in so doing create a perception of outgroups for their competition. To understand the tendencies of why people favor the ingroup over the outgroup in evaluations and behavior, Tajfel (1970) created the minimal-group paradigm. In this paradigm, subjects were randomly classified as members into two groups on the basis of some trivial performance criterion, for example, a preference for paintings by one or two artists (Taylor & Moriarty, 1987). The results found that outgroup members were evaluated less favorably and received fewer rewards than ingroup members (Taylor & Moriarty, 1987). Additionally, using Worchel's paradigm, the authors predicted that the tendency to favor the ingroup over the outgroup was enhanced with the competitive group. Intergroup competition with SGPs hopefully allows researchers to see if participants exert more effort in plank exercises compared to conditions without group competition.

Kerr and Seok (2008) was the first Köhler effect experiment on intergroup competition. The experiment was a variant of Köhler's (1926) task and participants had to hold a set of

pulleys above a trip wire for as long possible as individuals or in dyads. The researchers placed participants into three different conditions: individual control, no competition dyads, or the competition dyads conditions. In the control condition, participants did two trials alone, and after veridical feedback of performance they would perform two more trials. The no competition dyad had two participants do the trials alone, after receiving veridical feedback from own performance the experimenter would give each participant a false score of their partner's first two trials. Then they would perform two more trials as a dyad. Lastly, in the competition dyads condition, the partner was manipulated to be less capable, equally capable, or more capable.

The results found that a participant's motivation was higher when they were the weak link in a group performing a conjunctive task. Furthermore, the possibility of intergroup comparison and competition was not sufficient to alter the magnitude of the usual Köhler motivation gain effect. Overall, Kerr and Seok found that competition with an equal ability team could undermine and eliminate the Köhler effect. Furthermore, the authors found that competition with a stronger ability team may augment the Köhler effect (Kerr & Seok, 2008).

Summary

Research supports that being physically inactive can contribute to a variety of major heath issues, such as diabetes and cardiovascular disease. This is why it is important to discover different strategies that can assist with developing a solution for battling the sedentary lifestyle. Furthermore, in recent years a new generation of active video games has contributed to the cause of living a healthy lifestyle and has been promoting physical activity. Recent research on the Köhler effect has incorporated group dynamics into these active video games and found that participants tend to exercise longer when partnered with an ostensibly real person. Extending these findings with the inclusion of intergroup competition would be advantageous for

researchers, practitioners, and AVG designers who are trying to keep individuals engaged and motivated in exercise settings. This thesis explored how individual's motivation can be affected when competing against one other human/virtual-partner team in an isometric planking competition.

CHAPTER 3

METHOD

Design and Participants

The study employed a 3 (condition: individual control/IC, conjunctive partner no competition/PNC, conjunctive partner with opposing team competition/PWT) x 2 (gender) x 2 (performance block) factorial design, with repeated measures on the second factor. Participants were 90 (41 males, 49 females) undergraduate students at Michigan State University, who completed the study for either course credit (HPR) or 10-dollars cash (College of Communication Arts and Sciences SONA recruitment system). Students were unable to participate in the study if they were under the age of 18, or if they had any injuries that would prevent them from reaching their potential on the exercises (i.e., injuries to their arms, legs, or shoulders).

Experimental Task

Following previous research on the Köhler effect and exercise, the experimental task was holding a series of five abdominal planks for as long as possible (Feltz et al., 2014; Feltz et al., 2011; Forlenza et al., 2012). These types of exercises are ideal for promoting motivation gains and losses, because the planks are mostly effort-based, and little coordination is needed. There was a 30 s break between each exercise. In addition, each series of plank exercises was performed twice, with a 10-min. break period between Block 1 and 2.

Participants completed a front plank, two side planks (left and right), and two one-legged planks (left and right) on an exercise mat. For the first exercise, participants were face down on the mat, with legs straight, and they raised their body by placing elbows and toes on the mat. This allowed participants to use their abdominals to elevate and lift their body. The legs, back,

and neck should all have been in line for this exercise. Comparable to the front plank, side planks also require the body to be elevated from the mat. Participants arranged their body and propped themselves up with their right or left forearm so that their body formed a diagonal line. Lastly, the one-legged planks were similar to the front plank, except either the right or left leg was raised in the air; thus the participant performed with only the left or right foot firmly on the ground.

The game that was used for the experimental task was based on The CyBuddy Exercise (CyBud-X: Feltz et al., 2014 game, which was adapted from the PlayStation 2 EyeToy: Kinetic AVG (Sony Computer Entertainment America LLC, San Mateo, CA). CyBud-X was developed for the Feltz et al. (2014) study, and it used a Web camera to show the participants' image on a projector screen. CyBud-X had four different play versions for research purposes: individual play and three partner play versions (Human Partner, Nearly Human Partner, and a Hardly Human Partner; see Appendix A). The Nearly Human Partner is a transformed video of the live Human Partner to provide an animated resemblance to a partner. The Hardly Human Partner is software generated and modeled as a 3D graphical character.

In this thesis, an advanced graphical version of the Nearly Human Partner and Individual versions of the game were used. In the Individual version (IC), participants only saw their own image on the projector screen as they performed the exercises. However, in the Nearly Human Partner versions (PNC and PWT), participants viewed and played the game with a same-sex virtual partner.

Measures

Sport Orientation Questionnaire

The Sport Orientation Questionnaire (SOQ) is a multidimensional, sport-focused instrument (see Appendix B) used to measure the individual differences in sport achievement

orientation. The three subscales of this instrument are Competitiveness, Win orientation, and Goal orientation. The SOQ was employed to explore whether or not individual differences in sport achievement orientation would influence participants' persistence on the task in each of the conditions. The measure is on a 5-point Likert scale (i.e., 1 – Strongly Disagree, 5 – Strongly Agree). Gill and Deeter (1988) provided evidence that the SOQ is a reliable and valid measure of sport achievement orientation. All participants in each condition completed the 25-item survey at the beginning of each session.

Persistence

The primary outcome variable was exercise persistence, which was characterized as the length of time the plank exercises were held (measured in seconds), from when participants moved into position until the moment they quit. A stopwatch was used for each of the exercises. To calculate the block scores, the experimenter summed the length of time each individual plank exercise was held.

Rating of Perceived Exertion (RPE)

The Borg Ratings of Perceived Exertion (RPE) was used to measure perceived exertion (see Appendix C). Immediately following the end of each exercise, the experimenter asked the participants to rate their total feeling of exertion. This scale ranges from 6 to 20, where 6 is "no exertion at all" and 20 is "maximal amount of exertion." Previous research has shown that the Borg RPE scale is an adequate measure of exercise intensity. Specifically, Borg (2009) provided evidence that the psychometric properties of this scale are acceptable and exhibit sufficient retest reliability (> .70) and intratest reliability (.93). Using the Borg Scale for RPE has also been strongly correlated with heart rate (> .90), predicting performance (with coefficients ranging from .56 to .82), and signifying sufficient concurrent and predictive validity (Borg, 1998).

Self-efficacy Beliefs (SE)

Self-efficacy (see Appendix D) is an individual's belief in her or her ability to perform well in a variety of social situations. Throughout the experiment, SE was measured at three different points, before Block 1, before Block 2, and after all plank exercises are concluded. The SE measure is the same as has been used in previous plank AVG studies on tests of the Köhler effect (e.g., Feltz et al., 2014; Feltz et al., 2011; Forlenza et al., 2012). Each SE measure consisted of five items, one for each plank exercise (i.e., front plank, two side planks, and two one-legged plank), using the question: "What is the number of seconds which you are completely confident that you can hold the first exercise?" The sum of the five estimates constitutes an overall SE score (see Appendix D). Lastly, the second SE measurement occurred after the partner manipulations and after participants were told the average length of time they held the plank exercises during Block 1.

Enjoyment and Intention to Exercise

Enjoyment was measured with an 8-item version of the Physical Activity Enjoyment Scale (see Appendix E), following the completion of the experiment (PACES; Raedeke, 2007). This instrument asked participants to rate their enjoyment of the particular exercise on a 1 to 7 scale (e.g., 1 = *loved it*, 7 = *hated it*). The prior psychometric support for the 18-item version of the PACES emanated from two developmental studies, which found the scale's internal consistency to be robust (Cronbach's $\alpha = .93$; Kendzierski & Decarlo, 1991). Due to worries that items on the 18-item scale assessed consequences of enjoyment supplemental to enjoyment itself, the 8-item version of PACES was created (Raedeke, 2007). A strong correlation ($r = .94$) was found between the shortened version and the complete scale (Raedeke, 2007). Furthermore, participants were requested to rate their likelihood of exercising the following day on a -3 (*not at*

all true for me) to +3 (*completely true for me*) scale (see Appendix E; Mohiyeddini, Pauli, & Bauer, 2009).

Uncanny Valley

In my experiment, the participants in the two partnered conditions completed a questionnaire using the Alternative Godspeed Indices (Ho & MacDorman, 2010), which was intended to assess the emotional responses and reactions to an artificial, computerized character. The questionnaire asked the participants to rate a series of 19 bipolar items from 1 to 5 (e.g., 1 = *artificial*, 5 = *natural*; 1 = *unfriendly*, 5 = *friendly*). The items include three sub-scales: humanness, eeriness, and attractiveness (see Appendix F). Average scores for each participant for each scale were used in the analysis.

Attitudes towards Partner

Participants in the two partner conditions completed one questionnaire measuring how they perceived their working relationship with their partner. This questionnaire asked participants to rate a series of statements from *Strongly Disagree* to *Strongly Agree* (e.g., I felt like I was part of a team). The questionnaire is a five-item Team Perception index formerly used in human-computer interaction research (Nass & Reeves, 1996). The questionnaire was scored by averaging together the items, and had displayed adequate internal consistency (Cronbach's $\alpha > 0.70$) in previous research (Brown et al. 1986; Nass & Reeves, 1996) (see Appendix G).

Manipulation Checks

Participants were given an open-ended question for both partner and control conditions asking, "Was anything confusing or off about this particular experiment?" Participants in the partner conditions also answered a question about the experimental protocol, to confirm they recognized the conjunctive nature of the task. They were asked, "How was your Total Score

determined during the last series of exercises?" (1 = My score is the number of seconds I held each exercise; 2 = My score is an average of how long I held each exercise and how long the other person held each exercise; 3 = My score is the sum of my team's score on each exercise, where the team's score is the number of seconds each exercise was held by the first team member to quit; 4 = My score is the sum of my team's score on each exercise, where the team's score is the number of seconds each exercise was held by the last team member to quit) (see Appendix H).

Demographics

All participants were asked to self-report basic demographic information at the end of the experiment. This included their gender, age, class year, height, weight, and race/ethnicity (see Appendix I).

Procedures

Laboratory Set-up

The procedure for this experiment stemmed from previous research (Feltz et al., 2014). The study took place in a lab, which had a location for participants to sit (small desk and chair) with a laptop, on which participants watched an instructional video and completed the multiple questionnaires. In addition, a desk, chair, and two computers for the experimenter were also in the lab. A projector screen was hung on a wall, and the projector was placed on a small cart. Lastly, an exercise mat was positioned on the floor in front of the desk, which is where participants performed the plank exercises. There was also a poster of the Borg Scale hung on the wall, along with the order of the five plank exercises.

Approval was obtained from the institutional review board before conducting this study (see Appendix J). Subjects in all three conditions received a reminder email about the experiment, and what room the participant should go to. In the IC and PNC conditions, the email

only specified that one participant was involved in the study. For the PWT condition, the email explained that two individuals were coming to partake in the study. Before each session, an experimenter confirmed that none of the participants had any hindering injuries to their arms, shoulders, back, or legs. After the participants arrived at the lab and gave their informed consent, they were asked to remove any wrist jewelry/watches. Participants watched a 9-minute video that explained the experimental procedures by demonstrating each of the five plank exercises. Furthermore, a virtual trainer instructed them on how to rate their exertion using the Borg Scale. Following the video, participants were able to ask questions regarding the experimental protocol, and they then provided a baseline rating of SE. All participants then performed the first block of exercises, individually, holding each of the five exercises for as long as they could, with 30 s rest between each plank exercise. Immediately after each exercise, the participant reported his/her perceived exertion on the Borg Scale. After Block 1 finished, there was a 10-min. break before Block 2. The manipulation took place during this rest period.

Manipulations

The following sections explain the procedures for each of the three conditions. For more explicit details, please refer to Appendix K.

Individual-control (IC). During the 10-min. break period, participants in the IC were instructed to wait patiently for further instructions. After a few minutes, participants were told they would complete the same set of exercises again after the end of the break. Each participant was then given veridical feedback on his/her performance (i.e., the average of the number of seconds they held each exercise), and then completed the second SE measure. (For all conditions, participants did not know that they would complete a second set of exercises until after they completed Block 1).

Following the break period and the manipulations, participants were given a brief synopsis of the protocol immediately before performing Block 2, which was in the same sequence as Block 1, but with small changes to the format. In the IC condition, participants completed the Block 2 exercises without a partner. In the partner conditions (PWT, PNC), participants worked with an SGP as either a team or against another human/virtual team in intergroup competition. Following Block 2, participants completed the third SE measure and post-experimental questionnaires; they were thanked and given a debriefing sheet.

Conjunctive partner/no competition (PNC). In this condition, during the 10-min. break participants were told that they would complete the exercises again with a same-sex partner. Participants were also told that their partner was computer-generated. Additionally, the participants had an opportunity to meet their SGP. In this virtual introduction, the partner presented a personal introduction (i.e., name, hometown, what he/she likes to do for fun) on the game monitor through a Web camera-like connection, followed by the participant reciprocating with the same information. This personal interaction was included because prior research has shown that people treat a computer agent more like a human when there is an initial verbal interaction between them (Fischer, 2007; Lee, Kiesler, & Forlizzi, 2010).

After this brief interaction, participants were informed that in Block 2 of the exercises, they would work with their partner as a team, and that the team's score would be defined as the score of the person who stopped holding the exercise first. This made the task conjunctive. As with the IC, participants were then given veridical feedback on their own performance from the first block of exercises, and they were also told that their virtual partner performed better on his/her first series of exercises. In line with previous studies, the partner's plank average was always was 40% better than the participant's, creating an unfavorable social comparison that was

still engaging and set a goal that seemed achievable (Feltz et al., 2014; Feltz et al., 2012). Participants were also told that although their partner was computer-generated and performed better on the first set of exercises, it was programmed to become fatigued over time, just like an actual human being. During Block 2, the partner always held each exercise longer than the participant. This was achieved in the CyBud-X game through pre-recorded looped videos of a human partner that was animated. The experimenter then asked participants to choose a team name out of 20 various names (i.e., Dragons, Bears, Vipers; please refer to Appendix L for the list of team names and the amount of times chosen) to represent their virtual team for Block 2. Additionally, the experimenter gave participants a team shirt of the same color as their SGP, further to represent the team's identity. The SGP chose the color of the shirt for the participant to wear. To ensure the understanding of the experiment, the nature of the task was explained again after the introduction. Following this, participants finished the second SE measure and were told to sit quietly on the exercise mat until the experimenter signaled the beginning of the second block.

Conjunctive partner with opposing team competition (PWT). The procedure of this condition was slightly different from the Conjunctive partner/no competition condition. A day before the session, all participants received an email advising them where to meet for this experiment. This email explained that two individuals were coming to partake in the study. The participant received the email as a blind carbon copy; the opening greeting provided two names (e.g., the participant's actual name, and a fake confederate name, see Appendix M), and provided further direction for them to meet at different rooms on campus. Participants in this condition were also told between Blocks 1 and 2 that they would work with their SGP as a team, and that the team's score would be defined as the score of the person who stopped holding the exercise

first. However, they were also told that they and their virtual partner would be competing against one other human-virtual partner team in a virtual competition. Each team had its own randomly assigned virtual partner. After receiving veridical feedback on their own performance from Trial Block 1 and their virtual partner's performance (always 40% higher), they were asked to choose a team name, and they were given a team shirt selected by his/her SGP for his/her computer-generated to wear. Afterwards, the experimenter pretended to text the other lab to disclose the chosen team name, and to receive the opposing team's chosen name. The other team name was chosen by the hypothetical participant in the across campus lab, and was received via a text message to write on the competition board. The experimenter then wrote the corresponding team members by each team name on the whiteboard. It is important to note that the experimenter did not disclose any additional information about the other team before the end of the experiment. The participants were told that after the second block of exercises, the winner and loser of this competition would be identified. The feedback given at the end of the experiment was the participant's Block 2 score compared to the previous participant's score in the opposing team competition condition (e.g., Participant #39 just completed Block 2. At the end of the experiment, the researcher would compare their Block 2 score with participant #38's Block 2 time). The first participant's Block 2 team score in the PWT condition was compared to another condition that already had data collected.

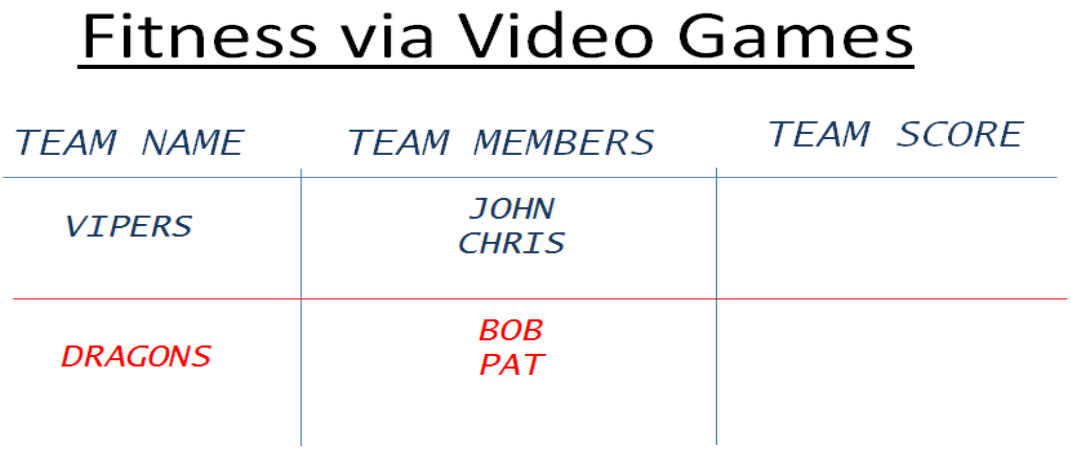


Figure 2: An Example of the Competition Whiteboard in the lab

Analyses

Persistence

To analyze persistence scores, the times for each exercise were summed within each Trial Block. The primary dependent variable was the difference score between both blocks (Block 2 – Block 1). Furthermore, Block 1 scores were included as a primary variable in the analyses of persistence scores. This approach is preferable to using ANCOVA, because the difference score means are more directly interpretable than the adjusted means that are produced by ANCOVA, and they show any changes in persistence while controlling for individual differences in fitness. Further, this approach generally produced the same pattern of results as using the Block 1 scores as a covariate in the analysis of Block 2 scores in previous research (Forlenza et al., 2012; Kerr et al., 2013). The difference scores were analyzed in a 3 (Condition) x 2 (Participant Gender) between-subjects analysis of variance (ANOVA), supplemented with Newman-Keuls post-hoc follow-up tests, if applicable, to determine any significant differences between the conditions.

Ancillary Analyses

Analyses were conducted to determine if any significant motivation gains in the treatment conditions are accompanied by changes in subjective effort (RPE), SE, task enjoyment, or intention to exercise in the future. Additionally, in the partnered conditions, assessment was made of participants' perceptions of their partner. For RPE a separate 3 (Condition) x 2 (Gender) x 2 (Block) ANOVA with repeated measures on Block was conducted with Newman-Keuls post-hoc follow-up tests. For SE, separate 3 (Condition) x 2 (Gender) x 3 (Block) ANCOVAs with repeated measures on Block and SE Block 1 as the covariate was conducted with Newman-Keuls post-hoc follow-up tests. For task enjoyment and intention, separate 3 (Condition) x 2 (Gender) ANOVAs were conducted with Newman-Keuls post-hoc follow-up tests. For the uncanny valley measures, using averages for each of the three subscales, a 2 (Condition) x 2 (Gender) MANOVA were conducted with Newman-Keuls post-hoc follow-up tests if appropriate. For the team perception measures, two separate 3 (Condition) x 2 (Gender) ANOVAs (on the team perception index and group identification scale) were conducted with Newman-Keuls post-hoc follow-up tests if appropriate.

An exploratory analysis was conducted using SOQ scores, dichotomized into high and low groups with the median-split method to compare the three conditions on persistence. For the dichotomized SOQ scores, a 3 (Condition) x 2 (SOQ levels) x 2 (Persistence Blocks) ANCOVA was conducted with Block 1 persistence as covariate.

CHAPTER 4

RESULTS

The purpose of this research was to determine how incorporating an SGP into an AVG would affect an individual's motivation when competing against another human/virtual-partner team in an isometric planking competition. The first section provides the results of the preliminary analyses, including the various manipulation checks that were used to ensure the necessary protocol for the experiment. The second section presents the major analyses, including descriptive statistics and testing of the three hypotheses. The third section presents ancillary analyses, including descriptive statistics, and correlations. Summary Tables for all analyses are contained in Appendix K.

Preliminary Analyses

Missing Data

Missing data can occur frequently in research. In the present study**,** few data were missing, and missing data were random (i.e., the value of the variable that is missing was not related to the reason it was missing). There were two counts of missing data for the second set of exertion scores. There were 10 counts of missing data for the third measurement point of self-efficacy beliefs. There was one count of missing data for the attitudes toward partner and team perception questionnaires. Lastly, for the Alternative Godspeed Indices, there was only one count of missing data. These cases were not included in their corresponding analyses. Missing data points were not replaced because they were not included in the corresponding analyses.

Manipulation Check – Partner Conditions

Results from the partner manipulation check signified that participants in the PNC (76%, n = 23) and PWT (67%, n = 20) conditions understood the conjunctive nature of the task by

stating that the team score was the time of whoever quit holding the plank exercise first. One participant reported suspicion on an open-ended question that asked if there was anything confusing or odd about the experiment. This participant sensed that his partner would not fatigue and could hold the plank exercises indeterminately. The main analysis was executed with and without the suspicious participant, but the pattern in the results did not alter.

Main Analysis

The main analysis consisted of three hypotheses. The first hypothesis stated that participants in each of the two of the experimental conditions (e.g., conjunctive partner and opposing team competition; conjunctive partner and no opposing team competition) will significantly improve their exercise performance compared to participants in the individual control condition (IC). Moreover, the second hypothesis stated that participants in the experimental condition with a conjunctive partner and opposing team competition (PWT) will significantly improve their exercise performance compared to participants in the experimental condition with a conjunctive partner and no opposing team competition (PNC). Descriptive statistics for performance scores are presented in Table 1 and 2 between performance and all other dependent variables.

Due to individual differences in fitness, intrinsic interest, and strength that should be controlled, the primary dependent variable to test the hypotheses was the difference score in persistence between both blocks (Block 2 – Block 1). Block difference scores were created by averaging persistence scores across each block and by subtracting the first Block score from the second, creating an average block difference score. Therefore, to test Hypothesis 1 and 2, a 3 (Condition: PNC, PWT, IC) x 2 (Gender: Male, Female) ANOVA was conducted on the block difference scores. The results were significant for Condition only, $F(2,89) = 15.63$, $p < .001$.

Results for Gender were nonsignificant, $F(1,89) = 0.69$, $p = 0.44$, as well as the interaction, $F(2,89) = 0.95$, $p = 40$. Post-hoc follow-up tests were conducted by means of the SNK procedure. Results indicated that participants in PNC and PWT groups persisted significantly longer than the IC group ($p < .001$), but the PNC and PWT groups were not significantly different from each other ($p = 0.35$). Thus, the first hypothesis was supported. However, the second hypothesis was not supported. A (Condition: PNC, PWT, IC) x 2 (Gender: Male, Female) ANOVA was conducted on Block 1 scores. The results found a significance for Condition, $F(2,89) = 4.89$, $p < .05$, and Gender (1,89) = 9.95, $p < .05$, but the interaction was not significant, $F(2,89) = 0.34$, $p = 0.70$. See Table 1 for means and standard deviations.

Table 1:

Means and Standard Deviations of Difference Scores by Condition

Variable	PNC *M* (SD)	PWT *M* (SD)	IC *M* (SD)
Block 1 performance	243.90 (79.12)	303.32 (124.63)	249.66 (86.29)
Block 2 performance	252.89 (65.50)	328.19 (134.90)	201.35 (79.86)
Block 2 – Block 1	8.98 (38.61)	24.87 (56.57)	-39.31 (34.61)

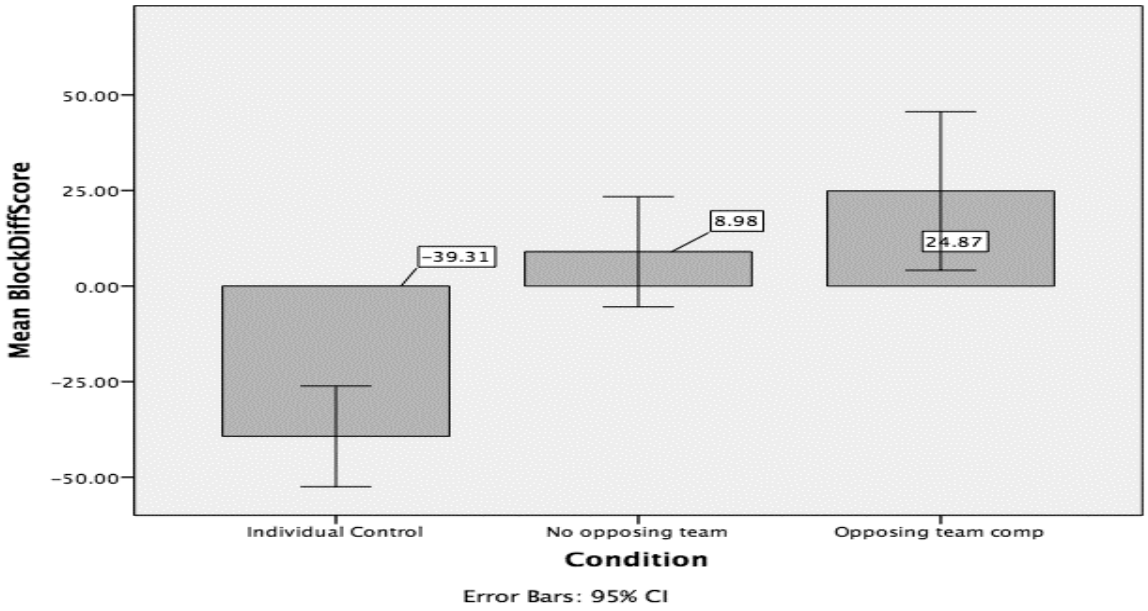
Table 2:

Bivariate Correlations between Motivation Gains and Identification Scores N = 60

	Motivation Gains	Identification Scores
Motivation Gains	1	0.22
Identification Scores	0.22	1

* = p < .05; * = p < .001

Figure 3: Mean Block 2 – Block 1 Difference Scores (in Seconds) with 95% Confidence Intervals. Negative difference scores indicate reduced performance compared to baseline, while positive difference scores indicate greater performance compared to baseline



The third hypothesis was concerned with team identity in the two-partnered conditions. This hypothesis stated that participants in the PWT condition would show significantly greater team perception effects (i.e., greater sense of team identity), compared to participants in the PNC condition. A reliability analysis was conducted on the five items of the team perception index. An adequate Cronbach's α was obtained (α = 0.88). Thus, averages were calculated for the five items and used in a 2 (Condition) x 2 (Gender) ANOVA on the team identity index. Results

showed a significant main effect for Condition only, $F(1,59) = 4.3$, $p < .05$. The results revealed that participants in PWT condition ($M = 5.70$, $SD = 1.6$) were significantly higher in team identity than participants in the PNC condition ($M = 4.75$, $SD = 1.54$), indicating that participants in the PWT condition had stronger perceptions of being part of a team with their partners. Thus, the third hypothesis was supported. Refer to Table 1 for means and standard deviations for each condition for the partner and group measures and Table 2 presents the correlations between motivation gains and identification scores for those in the partnered conditions. Table 3 refers to correlations between these measures and difference scores.

Table 3:
Bivariate Correlations between All Primary Dependent Variables

Measure	1	2	3	4	5	6	7	8	9	10	11	12	
1. Block 1 persistence	-												
2. Block 2 persistence	0.89**	-											
3. Differences Scores	-0.08	0.40**	-										
4. RPE Block 1	-0.06	-0.18	-0.28**	-									
5. RPE Block 2	.022	-0.53	-0.16	0.87**	-								
6. SE Time 1	0.52**	0.42**	-0.12	-0.06	-0.04	-							
7. SE Time 2	0.67**	0.66**	0.07	-0.19	-0.06	0.60**	-						
8. SE Time 3	0.66**	0.70**	0.18	-0.16	-0.06	0.48**	0.82**	-					
9. Enjoyment	0.25*	0.27*	0.08	-0.07	-0.02	0.05	0.31**	0.32**	-				
10. Intention	0.25*	0.25*	0.05	0.03	0.12	0.12	0.20	0.17	0.18	-			
11. Comp. Orient	0.35**	0.34**	0.04	-0.02	-0.02	0.34**	0.35**	0.28**	0.17	-0.01	-		
12. Win Orientation	0.09	0.11	0.07	0.09	0.02	0.15	0.13	0.90	0.11	0.17	0.71**	-	
13 Goal Orientation	0.16	0.13	-0.04	0.09	-0.08	0.20	0.17	0.80	0.27*	0.15	0.41**	0.26*	-

Note. ** $p < .001$, * $p < .05$

Ancillary Analyses

In previous research on the Köhler effect in AVGs, significant motivation gains were generally not accompanied by differences in perceived exertion, self-efficacy, perceived enjoyment, or intention to exercise (e.g., Feltz et al., 2011, 2014; Kerr et al., 2013). Similarly, analyses were conducted to check for any possible differences in these variables. In addition, analyses were conducted on orientation toward being competitive and how participants emotionally responded to one's partner in terms of the uncanny valley.

Ratings of Perceived Exertion (RPE)

RPE scores were averaged across each Block, creating an average RPE score for Block 1 and an average RPE score for Block 2. To analyze RPE scores across conditions, a 3 (Condition) x 2 (Gender) x 2 (Time: Block 1, Block 2) ANOVA was used with repeated measures on Time. The results indicated no significant difference for Condition, $F(2,82) = 2.50$, $p = .09$, as well as the interaction, $F(2,82) = .53$, $p = .59$.

Self-efficacy Beliefs (SE)

SE was measured three times throughout the experiment. According to Bandura (1997), SE scores should be strongly correlated with performance on the specific task. A preliminary one-way ANOVA suggested no significant differences between conditions on the first measurement point ($p = .29$). However, there was a significant difference on the second SE measurement point, $F(2,87) = 4.60$, $p < .05$. Post-hoc follow-up tests, conducted by means of Tukey WSD procedure, indicated that the PNC ($M = 170.90$; $SD = 68.24$) and PWT ($M = 225.94$; $SD = 116.91$) conditions had greater SE than IC ($M = 160.76$; $SD = 76.20$), but there were no significant differences between PNC and PWT.

A 3 (Condition) x 2 (Gender) x 3 (Time) ANCOVA with repeated measures on Time was also conducted on SE scores, using the first SE sum as the covariate to control for individual differences in initial SE. The results indicated a significant main effect for Time, *Wilks' Λ* = 0.61, $F(2,82) = 25.60$, $p < .01$ However, the Condition main effect was not significant, $F(2,82) = 2.90$, $p = 0.06$., as well as the interaction, $F(2,81) = 1.13$, $p = 0.33$. Although the Condition main effect was not significant, it was close, and therefore, the means were compared. The condition mean for participants in the PWT was 222.72 compared participants in the PNC ($M = 173.42$) and IC ($M = 172.21$) Lastly, even though gender effects were not a priority in the analysis, the results found a significant effect for Gender, $F(1,82) = 6.23$, $p = .015$, such that males scored higher on the self-efficacy measure than the females at all three time points.

Enjoyment and Intention to Play AVG

Overall task enjoyment was measured by means of the 8-item PACES scale. The responses from the PACES survey were averaged to attain an exercise enjoyment score. An adequate Cronbach's α was obtained (α = 0.90). A 3 (Condition) x 2 (Gender) ANOVA of the measure was not significant for Condition, $F(2,89) = 2.97$, $p = .057$. Even though this measure was not significant, there still was a trend toward significance, therefore means were compared. Participants in the PWT ($M = 5.12$, $SD = 0.77$) tended to enjoy the significantly more compared to the PNC ($M = 4.69$, $SD = 0.62$) and IC ($M = 4.71$, $SD = 0.81$) conditions. Additionally, there was not a significant effect for Gender, $F(1,89) = .72$, $p = .398$, as well as the interaction, $F(2,89) = .35$, $p = .71$.

Intention to play the active video game again was assessed with a single item in the post-experimental questionnaire. A 3 (Condition) x 2 (Gender) ANOVA on the intention item yielded

no significant effect for Condition, $F(2,89) = .74$, $p = .48$. Moreover, the results were not significant by Gender, $F(1,89) = .58$, $p = .45$, as well as the interaction, $F(2,89) = .03$, $p = .97$

Table 4:

Means and Standard Deviations for RPE, SE, Enjoyment, and Intention by Condition

Measure	PNC	PWT	IC
RPE Block 1	14.83 (1.59)	13.75 (2.25)	14.45 (1.32)
RPE Block 2	15.47 (1.66)	14.42 (2.27)	14.58 (1.55)
SE Time 1 (sec)	205.34 (121.91)	267.77 (220.39)	219.93 (142.37)
SE Time 2 (sec)	170.90 (68.24)	225.94 (116.91)	160.76 (76.20)
SE Time 3 (sec)	139.69 (55.96)	147.38 (67.26)	132.66 (61.69)
Enjoyment	4.69 (.617)	5.12 (.772)	4.71 (.808)
Intention to exercise	5.27 (.944)	5.52 (1.12)	5.17 (1.10)

Note. Rating of perceived exertion was measured with a 6-20 scale, with higher mean scores representing greater exertion. Enjoyment was measured on a 1-7 scale, with higher mean scores indicating greater task enjoyment. Intention to exercise was measured on a -3 to +3 scale, with higher mean scores indicating greater intention to exercise the following day.

Sport Orientation Questionnaire

The Sport Orientation Questionnaire (SOQ) was used to investigate the role of one's orientation toward competitiveness, winning, and performance goals on one's persistence at the planking task. The SOQ was a 25-item survey with three subscales: Competitiveness (Items 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25), Win orientation (Items 2, 6, 10, 14, 18, 22), and Goal orientation (Items 4, 8, 12, 16, 20, 24). An adequate Cronbach's α was obtained for

Competitiveness (α = 0.92), Win orientation (α = 0.83), and Goal orientation (α = 0.73) subscales.

To obtain the score for the three subscales, all participants' scores were summed and averaged. Subsequently, I dichotomized the three subscales into high and low SOQ subscale score using a median split. To identify interactions between condition and SOQ score, A 3 (Condition) x 2 (Persistence) ANCOVA was conducted with dichotomized SOQ subscale scores as fixed factors. The interaction between condition, and the Competitiveness dichotomized subscale was not significant, $F(2,68) = 2.50$, $p = .091$, $\eta p^2 = .068$. The interaction between condition, and dichotomized Goal Orientation subscale was not significant, $F(1,68) = .163$, $p = .850$, $\eta p^2 = .005$. Lastly, the interaction between condition, and Win Orientation dichotomized subscale was not significant, $F(2,68) = 1.28$, $p = .285$, $\eta p^2 = .036$. Overall, the ANCOVA revealed no interaction effects for all three dichotomized SOQ subscales.

Table 5:

Means and Descriptive Data for Competitiveness Dichotomized Variable

					95% Confidence Interval	
Condition	**Competitive Level**	**Persistence**	Mean	Std. Error	Lower Bound	Upper Bound
IC	1.00	1	230.70	32.42	165.99	295.39
		2	204.40	32.91	138.73	270.07
	2.00	1	265.80	32.21	201.70	330.24
		2	217.95	32.70	152.71	283.20
PNC	1.00	1	209.44	38.93	131.77	287.12
		2	205.10	39.52	126.24	283.95
	2.00	1	285.53	25.62	234.42	336.65
		2	285.73	26.00	233.85	337.62
PWT	1.00	1	241.85	32.42	177.16	306.55
		2	252.10	32.91	186.43	317.78
	2.00	1	331.82	26.81	278.31	385.32
		2	370.10	27.22	315.78	424.41

Table 6:

Means and Descriptive Data for Goal Orientation Dichotomized Variable

Condition	Goal Orientation Level	Persistence	Mean	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
IC	1.00	1	206.80	32.42	142.07	271.46
		2	176.94	32.91	111.27	242.61
	2.00	1	289.90	32.21	225.63	354.18
		2	245.41	32.70	180.17	310.66
PNC	1.00	1	255.82	27.75	200.45	311.18
		2	266.12	28.17	209.91	322.33
	2.00	1	239.16	37.44	164.46	313.87
		2	224.71	38.00	148.88	300.54
PWT	1.00	1	286.51	25.13	236.37	336.65
		2	315.41	25.51	264.51	366.31
	2.00	1	332.47[a]	37.44	257.77	407.18
		2	361.43[a]	38.00	285.65	437.32

Table 7:

Means and Descriptive Data for Win Orientation Dichotomized Variable

Condition	Win Orientation Level	Persistence	Mean	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
IC	1.00	1	212.04	33.86	144.47	279.61
		2	173.03	34.38	104.44	241.63
	2.00	1	284.63	30.69	223.39	345.87
		2	249.32	31.15	187.15	311.49
PNC	1.00	1	255.32	33.66	188.15	322.49
		2	254.13	34.17	185.94	322.31
	2.00	1	239.66	32.22	175.35	303.96
		2	236.70	32.71	171.43	301.98
PWT	1.00	1	326.70	33.86	259.11	394.25
		2	369.60	34.38	301.00	438.19
	2.00	1	276.98	24.47	228.15	325.80
		2	291.93	24.83	242.37	341.50

Uncanny Valley

One questionnaire (Alternative Godspeed Indices) was used to understand how participants emotionally responded to one's partner. An adequate Cronbach's α was obtained for the Humanness (α = 0.81), and Attractiveness (α = 0.82) subscales, but not for Eeriness (α = 0.51). Thus, Eeriness was not included in the analyses. The following analysis only took place in the two experimental conditions (PWT, PNC), in which a partner was involved. For this

questionnaire, the averages were calculated for each individual subscale. Refer to Table 6 for means and standard deviations for each Alternative Godspeed measure.

Table 8:

Means and Standard Deviations for the Partner Conditions for Emotional Responses to Their Partners and Attitudes Toward their Partners by Partner Condition

Questionnaire	Subscale	PNC	PWT
Alternative Godspeed Indices	Humanness	2.57 (0.79)	2.79 (0.73)
	Attractiveness	3.47 (0.49)	3.55 (0.69)
Team Perception		4.75 (1.54)	5.70 (1.56)
Group Identification		3.41 (0.56)	3.62 (0.68)

Note. The Alternative Godspeed Indices were rated on a 1-5 scale, with higher mean scores indicating stronger feelings on that subscale. Team Perception was rated on a 1-9 scale, with higher mean scores indicating a greater sense of teamwork. Group Identification was rated on a 1-5 scale, with higher mean scores indicating a stronger degree of identification with the exercise group

Table 9:

Correlations between Difference Scores and Emotional Responses and Attitudes Toward Their Partners and Attitudes Toward Their Partners by Partner Condition

Questionnaire	Subscale	PNC	PWT	Overall
Alternative Godspeed Indices	Humanness	.042*	-.209	-.069
	Attractiveness	.135	-.083	.001
Team Perception		.105	.124	.162

* = $p < .05$; ** = $p < .01$

For the uncanny valley measure, using averages for each of the two subscales, a 2 (Condition) x 2 (Gender) MANOVA was conducted. The results found no significant effects for Condition, *Wilks' Λ* = 0.99, $F(2,55) = .351$, $p = .71$. Furthermore, the results found no significant effects for Gender, *Wilks' Λ* = 0.97, $F(2,55) = 0.80$, $p = 0.45$, and for interaction effects, *Wilks' Λ* = 0.95, $F(2,55) = 1.48$, $p = 0.24$.

Table 10:

Correlations Between Subscales of the Alternative Godspeed Indices

	Humanness	Eeriness	Attractiveness
Humanness	1	0.28*	0.58**
Eeriness	0.28*	1	0.08
Attractiveness	0.58**	0.08	1

* = $p < .05$; * = $p < .001$

CHAPTER 5

DISCUSSION

The purpose of this thesis was to determine how incorporating an SGP into an AVG would affect an individual's motivation to persist at the game when competing against one other human/virtual-partner team in an isometric planking competition. In this chapter, manipulation checks are discussed first, followed by discussions of the results of the main and auxiliary analyses with practical implications. The chapter concludes with a discussion of the thesis's limitations and future research directions.

Manipulation Checks

In the partnered conditions, participants were asked one question to measure their understanding of the group structure. Overall, most participants in these conditions (i.e., PWT, PNC) understood the structures of the task, indicating that the team's score was determined by the score of the person who stopped holding the exercise first. Given that participants were told that their partner held the exercises for a longer time during the first set, it is likely participants realized the team's score would depend on their own performance, and thus they would feel indispensible for their team's performance. However, only two-thirds of participants in the PWT condition reported understanding the conjunctive nature of the task, which was lower than the PNC. The reason for this is unclear; it may be that participants were not able fully to understand how their SGP would stop holding the plank exercises after they did. However, the persistence results did not appear to be affected by some participants' lack of understanding. Participants in partnered conditions still persisted significantly longer than controls. To make sure that the participants who did not understand the conjunctive nature of the task did not affect the results, I filtered for cases where the manipulation check identified whether participants understood the

conjunctive nature of the task. The results of this analysis did not change or alter any differences between conditions.

Main Analysis

Consistent with previous research on the Köhler effect, participants who exercised with an SGP persisted for significantly longer than participants who exercised alone (Feltz et al., 2014). As in the Feltz et al. study, even though participants knew their partner was computer-generated and not real, they still significantly increased their persistence compared to those performing the exercise alone. This lends further support to Media Equation arguments that people respond socially to computer-generated agents as if they were human (Reeves & Nass, 1996). Furthermore, the results support that an SGP can elicit the Kőhler motivation gain in exergames.

However, if this effect can be achieved with SGPs and intergroup competition, it could develop other opportunities in which the Köhler effect can be produced. Investigating this question was the primary purpose of this thesis. The purpose of this study was to determine how incorporating an SGP into an AVG would affect an individual's motivation when competing against one other human/virtual-partner team in an isometric planking competition. Although I did not find exactly what I intended through the analyses of the data, this study used a one-session active video game. More sessions might begin to show differences between the treatment groups, because over time, participants in the PWT may have socially identified more in multiple bouts of intergroup competition compared to participants in the PNC condition.

The email with the confederate opponent's name sent to participants in the PWT condition could have been a confound and caused participants to persist longer on the plank exercises in Block 1. Furthermore, the confederate's name could have triggered participants to

exert more effort during Block 1. For Block 1 performance, participants in the PWT (M = 303.32) persisted longer compared to participants in the PNC (M = 243.90, SD = 79.12) and IC (M = 240.66, SD = 86.29). A follow up study should be created to examine how participants in the PWT condition would perform on Block 1 without this email induced confound. This study also elicited some ceiling effects, which means that participants were asked do their best on both persistence blocks and only so much improvement is possible on the duration of plank exercises. It is possible for future studies to explore the raising of the ceiling or telling participants to quit at the first sign of fatigue. This method may reduce the risk of ceiling effects.

Even though participants in the PWT condition did not persist significantly longer than those in the PNC, they identified more with their partner as belonging to a team. This makes sense because participants were working with an SGP against another team thus, creating a stronger positive response to their partners. These findings agree with James and Greenburg's (1989) research on how individuals will favor their ingroup more highly when in an intergroup competition.

To heighten the participants' social identity with their partner in both groups, I had participants choose a team name for their group, and their SGP chose a team shirt for the team to wear. However, these findings suggest that it is easier to identify with a partner in an intergroup competition, which could be another advantage for using SGPs for improving performance. However, perceptions of belonging to a team could be improved, by showing pictures of the opposing team and incorporating other gamifying strategies to enhance the team identity feeling – such as adding multiple teams or pairing participants with partners from different types of outgroups (i.e., race).

The main analysis also discovered that female participants had significantly larger difference scores compared to male participants. This finding is consistent with previous research (Feltz et al., 2012; Kerr et al., 2013; Weber & Hertel, 2007). It could be that female participants believed in the manipulations more than male participants, because they performed better during the second block, compared to their first block performance, than did the male participants. Furthermore, male participants could have given more effort during Block 1. This could have caused them to be fatigued or tired during Block 2.

The results in my study showed stronger persistence effects with SGPs than Feltz et al. (2014) showed with their SGP. In my study, the combined partner conditions verses control resulted in a large Cohen's effect size value of $d = 1.33$ compared to the Feltz et al. study ($d = 0.33$). The SGP in the Feltz et al. study was not very human-like, showed no expression, his/her mouth did not move, and cartoon-type word bubbles appeared along with the voice. As stated earlier, Feltz and researchers (2014) either incorporated a "live" human partner (HP) presented visually, a nearly human-like partner, and a hardly humanlike software-generated partner (HHP). In my study, the SGP was improved compared to the Feltz et al. (2014) study (see Appendix M). The appearance of the SGP was graphically updated and displayed accurate characteristics for body and fitness components for males and females. Furthermore, the participant and their SGP were introduced through a dialogue tree. Throughout the short introduction, the SGP would speak, and the participant was able to respond by clicking on one of four different response choices. The incorporation of the dialogue tree may have led participants to identify more with their SGP.

Ancillary Analyses

In addition to performance results (i.e., length of time holding plank exercises), secondary measures were included, such as ratings of perceived exertion, self-efficacy beliefs, enjoyment, and intention to play the AVG again. Despite significant differences in performance, no differences between groups were observed in perceived exertion, enjoyment, and intention to exercise the following day. This supports previous research (Feltz et al., 2011, 2014; Forlenza et al., 2012) using the exergame planking task. So, even though participants in the partnered conditions were working harder (i.e., holding the planks longer), they did not perceive themselves as working harder, enjoying the task any less, or lowering their intention to play the game again compared to controls.

Contrary to the Feltz et al. (2014) study, participants in the SGP conditions reported higher SE than participants working individually prior to the second set of exercises. Feltz et al. reported the opposite. As this measurement was assessed after participants were introduced to their partners, Feltz and her colleagues surmised that working with an SGP partner led participants initially to believe that they could not compare in ability to a non-human partner (versus working individually), even though their subsequent performance showed otherwise. This perception was not the case in the current study where findings suggest that anticipating doing the task with a partner, even a superior SGP, had a mild efficacy-boosting effect. Perhaps knowing that they would be performing as part of a team, rather than doing another set alone, gave participants greater confidence in performing the task. By the third measurement point (following Block 2), however, the efficacy boost from having a partner was eliminated, but SE beliefs were no less than for those who performed alone. This finding is consistent with previous literature (Feltz et al., 2011; Forlenza et al., 2012).

The results of the SOQ suggest that those who were competitively oriented and in the PWT increased their exercise persistence more than those who were not competitively oriented (effect size = 1.43); however, those in the IC condition who were competitively oriented decreased their exercise persistence more than those in other conditions who were not competitively oriented (effect size = -1.49). In speculating, competitive-oriented individuals may need some type of competition to motivate them to do their best, and when they do not have this competitive element, they do far worse than their potential. This result could have implications for the designing of games. Allowing participants a choice to exercise with another team if they have a competitive orientation might be a plausible avenue for future research. Participants in both of the experimental conditions (PWT, PNC) completed the Alternative Godspeed Indices to understand their emotional reactions to their partners (Ho & MacDorman, 2010). Results showed no significant differences between the two conditions. This makes sense because the SGPs looked exactly alike. The means were slightly above the midpoint of the scale indicating that participants did not view the SGPs as too nonhuman-like or artificial.

Limitations and Future Research Directions

As with any research project, this thesis had limitations. The first is that participants might have felt that they could never surpass their partner's performance. The participants were told that their partner would become fatigued over time and stop holding the plank exercise. However, participants might not have believed this because the SGP never displayed any signs of being fatigued (i.e., tensing muscles, facial expressions). As a result of this limitation, the social mechanism may not have been as strong as it could have been with a visually-fatiguing SGP, which may have led participants to quit earlier on the plank exercises. More research should be done to understand how to strengthen the Köhler effect.

Another limitation is how the task of this experiment cannot be applied to all types of individuals. My study's participants were young and healthy college students. This group of people has experienced electronic and internet-based devices on a common basis throughout most of their lifetime. Research has documented that teenagers and young adults spend the most time playing video games, compared to other age groups (Lenhart, Sousan, Smith, & Macgill, 2008; Rainie, 2010). Moreover, this means that teenagers and young adults have had more experience relating to computer technology. Thus, the results from this thesis may not generalize to people who are not as familiar with novel technologies and computer-generated agents. More research is needed to understand how different populations respond to their SGPs.

There are further research avenues that can be explored from this thesis. One potential research direction is exploring how adding multiple human/virtual teams or sessions could strengthen or attenuate the Köhler effect. Only one other hypothetical team was used in my experiment. The addition of multiple teams could increase or decrease a participants' social identification within their own teams. According to social identity theory, in intergroup competition, an individual's strength in social identification will influence his/her effort exerted on behalf of the ingroup (Ouwerkerk, Gilder, & Vries, 2010). Future research should attempt to understand this research avenue, and how identity boosting with their SGP can be manipulated to improve exercise performance.

Another research avenue might investigate how being paired with an outgroup member or competing against other types of outgroups could alter how participants are motivated. Using the literature on cross-categorization may assist in researching the idea of pairing participants with partners from a different race outgroup in an intergroup competition. Cross-categorization is an experimental paradigm used to reduce ingroup bias from individuals from different social

categories (Ensari & Miller, 1998). Furthermore, cross categorization techniques have been an effective tool for deceasing intergroup bias. Taylor and Moriarty (1987) explained that a competitive relationship with a dissimilar race results in the greatest ingroup bias. For example, participants without biases towards their outgroup might hold their plank exercises longer compared to those participants who have a bias. This future research avenue may assist in understanding how individuals collectively work with others from different outgroups (i.e., race).

Conclusions

The results from this thesis suggest that individuals will socially compare themselves to another team in an intergroup competition, as well as with another SGP, in exercise contexts. As a result, a Köhler motivation gain effect will cause an increase in motivation and, ultimately, in performance. Additionally, this thesis suggests that intergroup competition does not attenuate the Köhler motivation gain effect and may be an effective model for improving performance on exercise duration tasks such as plank exercises. Intergroup competition may also be an enjoyable way to enhance motivation and performance, for those who like competition while exercising. Future research should examine the effect of intergroup competition with an SGP using different types of outgroups and understanding how the effects of multiple teams can increase or decrease exercise duration in active video games.

APPENDICES

Appendix A:

Pictures of the different Feltz et al's (2014) SGPs

Figure 4: Pictures of the three male partners (from left to right): human partner, nearly human partner, and hardly human partner

Appendix B:

Sport Orientation Questionnaire (SOQ)

1 = Strongly Disagree, 5 = Strongly Agree

1) I am a determined competitor.

1	**2**	**3**	**4**	**5**

2) Winning is important.

1	**2**	**3**	**4**	**5**

3) I am a competitive person.

1	**2**	**3**	**4**	**5**

4) I set goals for myself when I compete.

1	**2**	**3**	**4**	**5**

5) I try my hardest to win.

1	**2**	**3**	**4**	**5**

6) Scoring more points than my opponent is very important to me.

1	**2**	**3**	**4**	**5**

7) I look forward to competing.

1	**2**	**3**	**4**	**5**

8) I am most competitive when I try to achieve personal goals.

1	**2**	**3**	**4**	**5**

9) I enjoy competing against others.

1	**2**	**3**	**4**	**5**

10) I hate to lose.

1	**2**	**3**	**4**	**5**

11) I thrive on competition.

1	**2**	**3**	**4**	**5**

12) I try hardest when I have a specific goal.

1	**2**	**3**	**4**	**5**

13) My goal is to be the best athlete possible.

1	**2**	**3**	**4**	**5**

14) The only time I am satisfied is when I win.

1	2	3	4	5

15) I want to be successful in sports.

1	2	3	4	5

16) Performing to the best of my ability is very important to me.

1	2	3	4	5

17) I work hard to be successful in sports.

1	2	3	4	5

18) Losing upsets me.

1	2	3	4	5

19) The best test of my ability is competing against others.

1	2	3	4	5

20) Reaching personal performance goals is very important to me.

1	2	3	4	5

21) I look forward to the opportunity to test my skills in competition.

1	2	3	4	5

22) I have the most fun when I win.

1	2	3	4	5

23) I perform my best when I am competing against an opponent.

1	2	3	4	5

24) The best way to determine my ability is to set a goal and try to reach it.

1	2	3	4	5

25) I want to be the best every time I compete.

1	2	3	4	5

Appendix C:

The Borg Scale of Perceived Exertion

The Borg Scale

6	**No exertion at all**
7	**Extremely light**
8	
9	**Very light**
10	
11	**Light**
12	
13	**Somewhat hard**
14	
15	**Hard (heavy)**
16	
17	**Very hard**
18	
19	**Extremely hard**
20	**Maximal exertion**

Appendix D:

Self-efficacy Beliefs

For Time 1 (prior to Block 1) and Time 2 (prior to Block 2):

What is the number of seconds which you are completely confident that you can hold:

The FIRST exercise (front plank)? _____

The SECOND exercise (right side plank)? _____

The THIRD exercise (right one-legged plank)? _____

The FOURTH exercise (left side plank)? _____

The FIFTH exercise (left one-legged plank)? _____

For Time 3 (following Block 2):

If you were to hold these exercises one more time (after a similar break as before), what is the number of seconds which you are completely confident that you can hold:

The FIRST exercise (front plank)? _____

The SECOND exercise (right side plank)? _____

The THIRD exercise (right one-legged plank)? _____

The FOURTH exercise (left side plank)? _____

The FIFTH exercise (left one-legged plank)? _____

Appendix E:

Physical Activity Enjoyment Scale (PACES) and Intention to Play AVG Again

Please rate how you currently feel about the physical activity you have been doing according to the following scales:

1 = I loved it, 7 = I hated it

1	**2**	**3**	**4**	**5**	**6**	**7**

1 = I felt bored, 7 = I felt interested

1	**2**	**3**	**4**	**5**	**6**	**7**

1 = I disliked it, 7 = I liked it

1	**2**	**3**	**4**	**5**	**6**	**7**

1 = I found it pleasurable, 7 = I found it unpleasurable

1	**2**	**3**	**4**	**5**	**6**	**7**

1 = I was very absorbed in this activity, 7 = I was not at all absorbed in this activity

1	**2**	**3**	**4**	**5**	**6**	**7**

1 = It was no fun at all, 7 = It was a lot of fun

1	**2**	**3**	**4**	**5**	**6**	**7**

1 = It was very pleasant, 7 = It was very unpleasant

1	**2**	**3**	**4**	**5**	**6**	**7**

1 = I felt as though I would rather be doing something else, 7 = I felt as though there was nothing else I would rather be doing

1	**2**	**3**	**4**	**5**	**6**	**7**

I would play this exercise game again if I had the opportunity.

-3 = Not at all true for me, 3 = Completely true for me

-3	**-2**	**-1**	**0**	**1**	**2**	**3**

Appendix F:

Alternative Godspeed Indices

Rate your partner according to the following scales:

Humanness

1 = Artificial, 5 = Natural

1	2	3	4	5

1 = Human-made, 5 = Human-like

1	2	3	4	5

1 = Without definite lifespan, 5 = With definite lifespan

1	2	3	4	5

1 = Inanimate, 5 = Animate

1	2	3	4	5

1 = Mechanical movement, 5 = Biological movement

1	2	3	4	5

1 = Synthetic, 5 = Real

1	2	3	4	5

Eeriness

1 = Reassuring, 5 = Eerie

1	2	3	4	5

1 = Numbing, 5 = Freaky

1	2	3	4	5

1 = Ordinary, 5 = Superordinary

1	2	3	4	5

1 = Bland, 5 = Uncanny

1	2	3	4	5

1 = Unemotional, 5 = Hair-raising

1	2	3	4	5

1 = Uninspiring, 5 = Spine-tingling

1	2	3	4	5

1 = Predictable, 5 = Thrilling

1	2	3	4	5

1 = Boring, 5 = Shocking

1	2	3	4	5

Attractiveness

1 = Unattractive, 5 = Attractive

1	2	3	4	5

1 = Repulsive, 5 = Agreeable

1	2	3	4	5

1 = Ugly, 5 = Beautiful

1	2	3	4	5

1 = Messy, 5 = Sleek

1	2	3	4	5

1 = Crude, 5 = Stylish

1	2	3	4	5

Appendix G:

Team Perception Index

For each of the following statements, rate how much you agree or disagree with them.

1 = Strongly Disagree, 9 = Strongly Agree

I felt I was part of a team.

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

I thought of my partner as a teammate.

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

I felt I worked collaboratively with my partner.

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

I felt my partner and I worked together.

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

I felt I was working separately from my partner.

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

Appendix H:

Partner Manipulation Check

In which of the following conditions did you perform the last series of exercises?

1. Except for the experimenter, I performed these exercises alone.
2. I performed these exercises with another person through an internet connection.
3. I performed these exercises with two other persons through an internet connection.

How was your Total Score determined during the last series of exercises?

1. My score is the number of seconds I held each exercise.
2. My score is an average of how long I held each exercise and how long the other person held each exercise.
3. My score is the sum of my team's score on each exercise, where the team's score is the number of seconds each exercise was held by the first team member to quit.
4. My score is the sum of my team's score on each exercise, where the team's score is the number of seconds each exercise was held by the last team member to quit.

Appendix I:

Demographic Questions

Gender
- Male
- Female

Age

_____

Class
- 1st year
- 2nd year
- 3rd year
- 4th year
- 5th year
- > 5 years

Height (in feet and inches)

_____

Weight (in pounds)

_____

Race/Ethnicity
- Caucasian
- African American
- Hispanic
- Asian
- Native American
- Other

Appendix J:

IRB Approval Form

MICHIGAN STATE UNIVERSITY

Initial IRB Application Approval

August 18, 2014

To: Deborah L. Feltz
130 IM Sports Circle
Dept. of Kinesiology
MSU

Re: **IRB#** 14-810 Category: EXPEDITED 5,7
Approval Date: August 18, 2014
Expiration Date: August 17, 2015

Title: The Köhler effect - Testing Intergroup Competition with Computer Generated Partners

The Institutional Review Board has completed their review of your project. I am pleased to advise you that **your project has been approved**.

The committee has found that your research project is appropriate in design, protects the rights and welfare of human subjects, and meets the requirements of MSU's Federal Wide Assurance and the Federal Guidelines (45 CFR 46 and 21 CFR Part 50). The protection of human subjects in research is a partnership between the IRB and the investigators. We look forward to working with you as we both fulfill our responsibilities.

Renewals: IRB approval is valid until the expiration date listed above. If you are continuing your project, you must submit an ***Application for Renewal*** application at least one month before expiration. If the project is completed, please submit an ***Application for Permanent Closure***.

Revisions: The IRB must review any changes in the project, prior to initiation of the change. Please submit an ***Application for Revision*** to have your changes reviewed. If changes are made at the time of renewal, please include an ***Application for Revision*** with the renewal application.

Problems: If issues should arise during the conduct of the research, such as unanticipated problems, adverse events, or any problem that may increase the risk to the human subjects, notify the IRB office promptly. Forms are available to report these issues.

Please use the IRB number listed above on any forms submitted which relate to this project, or on any correspondence with the IRB office.

Good luck in your research. If we can be of further assistance, please contact us at 517-355-2180 or via email at IRB@msu.edu. Thank you for your cooperation.

Sincerely,

Ashir Kumar, M.D.
BIRB Chair

c: Tayo Moss

Office of Regulatory Affairs
Human Research Protection Programs

Biomedical & Health Institutional Review Board (BIRB)

Community Research Institutional Review Board (CRIRB)

Social Science Behavioral/Education Institutional Review Board (SIRB)

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Figure 5: IRB Approval Form

Appendix K:

Manipulation Scripts

Conjunctive partner with opposing team competition.

Spoken to participants at the start of the 10 min break:

> Okay. So, after a break, you will perform the same set of exercises again. However, during the next set of exercises, you will be paired with a software-generated partner as a team and you will be competing against another team in another lab on campus. You and your partner will be working together towards a team score, which will be defined by the score of the person who quits first. So while you are both holding the planks, when one person stops, the other person has to stop too, and the team's score will be the time of the person who stopped first. The team with the highest team score will win the competition. Before you two exercise together against the other team, we'd like you to meet your teammate. Give me one more moment to set up everything, and then I'll have you come up here to take a seat.

Spoken to participants and before their partner introduction:

> For your introduction, you and your partner will have a short conversation. After your partner introduces him/herself, you will be able to select response options using the mouse. Please press the spacebar to start the conversation.

Spoken to participants and in the middle of their partner introduction:

> Now to make you and your partner more of a team, your teammate will chose a team shirt for you to wear. (The participants will press the space bar and the computer-generated partner chose a red shirt for both of them to wear.) Okay, now that we have a team shirt for both of you, I would like you to choose a team name from the list of these names on this sheet. (The experimenter than wrote the information (i.e., team members/opponent team members and team names) of the competition white board for the participant to see before the second block began.)
>
> *After the participant chooses a team name for their group, the researcher will act via text message to receive other teams information from other researcher in the across campus lab.

Spoken to participants early in the 10 min break:

> So, on the coming set of exercises, you will both begin at the same time; you will be able to see his/her display, just as he/she will be able to see yours. You will both hold each exercise for as long as you can, saying STOP when you have to quit and dropping back down to your mat. After one of you stops, the other person has to stop. The team score is

the number of seconds the first team member lasts, and both teammates receive that score. The team with the highest total team score will win the competition.

Like before, tell me your perceived exertion after each exercise. After you have both stopped the exercise and after a brief rest period, we'll move on to the next exercise, just as before. Again, the score on the next series is equal to the team score, which is how long the first group member to quit lasts at each exercise. Any questions so far? Okay, so, during the set of five exercises you just completed, you held each exercise an average of (S's average from the spreadsheet) seconds. As I mentioned earlier, your partner, Chris, has been programmed to be somewhat better than you at holding the plank exercises. So, had s/he done the same exercises you just completed, s/he would have held each exercise for an average of (Partner's average from the spreadsheet) seconds. Although Chris is programmed to be better than you, s/he is unable to hold these exercises forever. At some point, Chris will become tired and stop holding the exercise, just like a real person

Spoken to participants in the final min of the break, before starting Block 2:

Okay. We're now ready to do the next set of exercises. When the countdown begins, focus your attention on getting into the proper position. As before, try to hold each exercise as long as you can consistent with your own physical well-being and comfort. Again, please say STOP when you can no longer continue. Then, report your exertion that best represents how you felt during the last exercise, and wait for the next exercise to begin. Again, when one of you stops, the other has to stop. I will let you know if Chris stops before you, in which case you should drop down to the mat and say your exertion number. I will let you know when you have completed the last exercise, and once you do, just sit on the mat until I give further instructions. Please watch the screen.

Conjunctive partner/no competition script.

Spoken to participants at the start of the 10 min break:

Okay. So, after a break, you will perform the same set of exercises again. However, during the next set of exercises, you will be paired with a software-generated partner as a team and you will be able to see how well you do at each exercise compared to him/her. The two of you will be working together towards a team score, which will be defined by the score of the person who quits first. So while you are both holding the planks, when one person stops, the other person has to stop too, and the team's score will be the time of the person who stopped first. Your new partner has been specially tailored to be just a bit more in shape than you. Before you two exercise together, we'd like you to meet your teammate. Give me one more moment to set up everything, and then I'll have you come up here to take a seat.

Spoken to participants and before their partner introduction:

For your introduction, you and your partner will have a short conversation. After your partner introduces him/herself, you will be able to select response options using the mouse. Please press the spacebar to start the conversation.

Spoken to participants and in the middle of their partner introduction:

Now to make you and your partner more of a team, your teammate will chose a team shirt for you to wear. (The participants will press the space bar and the computer-generated partner chose a red shirt for both of them to wear.) Okay, now that we have a team shirt for both of you, I would like you to choose a team name from the list of these names on this sheet. (The experimenter than wrote the information (i.e., team members names and team name) of the competition white board for the participant to see before the second block began.)

Spoken to participants early in the 10 min break:

So, on the coming set of exercises, you will both begin at the same time; you will be able to see his/her display, just as he/she will be able to see yours. You will both hold each exercise for as long as you can, saying STOP when you have to quit and dropping back down to your mat. After one of you stops, the other person has to stop. The team score is the number of seconds the first team member lasts, and both teammates receive that score. Like before, tell me your perceived exertion after each exercise. After you have both stopped the exercise and after a brief rest period, we'll move on to the next exercise, just as before. Again, the score on the next series is equal to the team score, which is how long the first group member to quit lasts at each exercise. Any questions so far? Okay, so, during the set of five exercises you just completed, you held each exercise an average of (S's average from the spreadsheet) seconds. As I mentioned earlier, your partner, Chris, has been programmed to be somewhat better than you at holding the plank exercises. So, had s/he done the same exercises you just completed, s/he would have held each exercise for an average of (Partner's average from the spreadsheet) seconds. Although Chris is programmed to be better than you, s/he is unable to hold these exercises forever. At some point, Chris will become tired and stop holding the exercise, just like a real person

Spoken to participants in the final min of the break, before starting Block 2:

Okay. We're now ready to do the next set of exercises. When the countdown begins, focus your attention on getting into the proper position. As before, try to hold each exercise as long as you can consistent with your own physical well-being and comfort. Again, please say STOP when you can no longer continue. Then, report your exertion that best represents how you felt during the last exercise, and wait for the next exercise to begin. Again, when one of you stops, the other has to stop. I will let you know if Chris stops before you, in which case you should drop down to the mat and say your exertion number. I will let you know when you have completed the last exercise, and once you do, just sit on the mat until I give further instructions. Please watch the screen.

Individual control (IC) script.

Spoken to participants early in the 10 min break:

> OK. During the five exercises you just completed, you held each exercise an average of _____ seconds. In a few minutes, you will be performing a series of the same exercises again. As before, you are going to hold each exercise as long as you can, consistent with your own physical well-being and comfort. Now, please have a seat over here in front of the computer. Before we move on to the rest period, answer the questions on the screen.

Spoken to participants in the final min of the break, before starting Block 2:

> OK. We're now ready to do the next series of exercises. When you hear the countdown, focus your attention on getting into the proper position. As before, try to hold each exercise as long as you can, consistent with your own physical well-being and comfort. Again, please say STOP when you can no longer continue. Then, report your exertion by saying the number from the scale on the wall that best represents how you felt during the last exercise, and wait for the next exercise to begin. I will let you know when you have completed the last exercise.

Appendix L:

Supplemental Analyses

Table 11:

Summary of the Main Analysis and Auxiliary Analyses

Main Analyses

3 (Condition) x 2 (Gender) ANOVA on Differences Scores

	df	***SS***	***MS***	***F***	***p***
Condition	2	62404.02	31202.01	15.63	0
Gender	1	1206.43	1206.425	0.6	0.44
Interaction	2	3774.03	1887.02	0.94	0.39

2 (Condition) x 2 (Gender) ANOVA on Team Perception Index

	df	***SS***	***MS***	***F***	***p***
Condition	1	9.97	9.97	4.3	0.04
Gender	1	6.2	6.2	2.66	0.11
Interaction	1	2.2	2.2	0.95	0.33

Auxiliary Analyses

3 (Condition) x 2 (Gender) x (Time: Block 1, Block 2) ANOVA on RPE Scores

	df	***SS***	***MS***	***F***	***p***
Condition	2	31.87	15.93	2.501	0.09
Gender	1	1.48	1.48	0.23	0.63
Interaction	2	6.73	3.37	0.53	0.6

3 (Condition) x 2 (Gender) x 2 (Time) ANCOVA with Repeated Measures on Time

	df	***SS***	***MS***	***F***	***p***
Condition	2	145995.56	72997.78	2.901	0.061
Gender	1	156379.04	156379.04	6.216	0.015
Time	1	327388.76	327388.76	29.932	0
Interaction	2	11755.91	5805.7	1.808	0.17

3 (Condition) x 2 (Gender) ANOVA of Enjoyment

	df	***SS***	***MS***	***F***	***p***
Condition	2	3.3	1.64	2.97	0.057
Gender	1	0.4	0.4	0.72	0.4
Interaction	2	0.38	0.19	0.35	0.71

Table 11 (cont'd)

A 3 (Condition) x 2 (Gender) ANOVA on the Intention Item

	df	*SS*	*MS*	*F*	*p*
Condition	2	1.71	0.85	0.74	0.48
Gender	1	0.67	0.67	0.58	0.45
Interaction	2	0.07	0.03	0.03	0.97

A 2 (Condition) x 2 (Gender) MANOVA on the Alternative Godspeed Indices

	df	*F*	*p*	*Wilks' Λ*
Condition	2	0.35	0.71	0.99
Gender	2	0.8	0.45	0.97
Interaction	2	1.48	0.28	0.95

A 3 (Condition) x 2 (Persistence) ANCOVA was conducted with dichotomized Win Orientation Subscale

	df	*F*	*p*	*ηp2*
Interaction	2	1.28	0.285	0.036

A 3 (Condition) x 2 (Persistence) ANCOVA was conducted with dichotomized Competitiveness Subscale

	df	*F*	*p*	*ηp2*
Interaction	2	2.5	0.091	0.068

A 3 (Condition) x 2 (Persistence) ANCOVA was conducted with dichotomized Goal Orientation Subscale

	df	*F*	*p*	*ηp2*
Interaction	1	0.163	0.85	0.005

Appendix M:

List of Team Names and Number of Times Chosen

1. Dragons (8)
2. Griffins (3)
3. Warriors (3)
4. Falcons (1)
5. Mustangs (3)
6. Cobras (2)
7. Vikings (1)
8. Pirates (2)
9. Rams (0)
10. Reds (7)
11. Penguins (8)
12. Werewolves (1)
13. Giants (2)
14. Vipers (2)
15. Bears (3)
16. Bulldogs (3)
17. Stripes (0)
18. Dolphins (4)
19. Leopards (3)
20. Huskies (5)

Appendix N:

Example Emails Sent to Participants in the Partner Conditions

Conjunctive Partner, no team competition (PNC)

Dear Mary,

Thank you for signing up to participate in this study. Just wanted to send an email as a reminder of your session - which is today at 5:00 PM. Please come to room 1 in Intramural Circle, which is downstairs in the basement. Remember to be in workout attire!

Tayo

Conjunctive Partner, opposing team competition (PWT)

John & Bob,

Thank you guys for participating in this study. Just wanted to send an email to both of you as a reminder of the session - which is today at 1 PM. John – please come to Room 1 in Intramural Circle, which is downstairs in the basement. Bob – please wait by Sparty's at the COMM Arts building. Remember to bring workout clothes! Please feel free to email me if you have any questions. Talk to you soon!

Tayo

Appendix O:

Appearance of Updated SGP

Figure 6: Updated version of the SGP used for thesis

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