ENHANCING MOTIVATION TO EXERCISE FOR OBESE PARTICIPANTS IN EXERGAMES: TESTING PARTNER CHARACTERISTICS AS A MODERATOR OF THE KÖHLER EFFECT

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ABSTRACT

ENHANCING MOTIVATION TO EXERCISE FOR OBESE PARTICIPANTS IN EXERGAMES: TESTING PARTNER CHARACTERISTICS AS A MODERATOR OF THE KÖHLER EFFECT

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This thesis examined the effects of playing an exergame that involved abdominal strength exercises (with a virtually-presented partner) on exercise motivational effort. Specifically, this research explored whether exercise duration could be increased using the Köhler motivation gain principles (based on the group dynamics principles of upward social comparison and indispensability) with a lighter versus same weight virtually-presented partner in an obese community sample (BMI > 30). Participants were community adults ($N = 35$; $M_{age} = 46$; $SD = 17.34$ years) who completed the first block of three isometric abdominal exercises alone. After resting, participants completed the second block either alone (Control), with a lighter weight, or with a same weight partner. Partners were actually confederates recorded earlier and presented virtually as live, from another lab. Exercise persistence, self-efficacy beliefs, enjoyment, and perceived exertion were recorded. Results showed that mean persistence was greater for participants in the lighter weight condition (24.45 sec) than for those in the control condition (-9.92 sec), but not for participants in the similar weight condition (15.64 sec). There were no differences across conditions in self-efficacy, enjoyment, or perceived exertion.

This thesis is dedicated to Melody and James Beckles.
Thank you for your constant prayers and encouragement.

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CHAPTER 1

INTRODUCTION

Nature of the Problem

Obesity has become one of the top major health threats in the United States. In 2010, more than 35% of US men and women were obese (Ogden et. al, 2012). Obesity is a multifaceted health issue that involves biological, behavioral, and environmental sources. Energy imbalance sits at the core of the obesity problem because weight gain is a result of consuming more calories than one burns. For many people, the imbalance accrues from eating too many calories and not getting enough physical activity. Obesity plus physical inactivity put added stress on every part of the body and are associated many health risks, such as Type 2 diabetes, coronary heart disease (CVD), and stroke (USDHHS: US Department of Health and Human Services, 2008; Weinstein et al., 2004).

Even though the health benefits of participating in physical activity have been well documented, the majority of American adults are inactive or insufficiently active (CDC, 2001). The high prevalence of inactivity may be related, in part, to the public perception that a high frequency of vigorous exercise is required to achieve significant health benefits (Pate et al., 1995; Sallis & Owen, 1999). As a result, people frequently do not engage in physical activity at a vigorous enough intensity and long enough duration in order to maintain health benefits (Trojano et al., 2008). However, higher levels of intensity in exercise are important for several aspects of fitness. For instance, the American Diabetes Association recommends 150 min/week of moderate-to-vigorous exercise to improve glycemic control, assist with weight maintenance, and reduce risk of CVD (Sigal et al., 2006). Additionally, higher levels of exercise intensity, duration, and frequency have been shown to result in greater loss of total and abdominal fat and better metabolic profiles (Church, Earnest, Skinner, & Blair, 2007).

However, being obese is negatively associated with exercise adherence, and especially as exercise intensity and duration increase (Dishman & Buckworth, 1996; Dishman & Ickes, 1981; Trost et al., 2002). Thus, individuals may need specific motivational strategies to help keep them exercising longer or more intensely. Obese individuals have named numerous barriers to adhering to exercise. Recent studies have shown that obese participants mentioned barriers to exercising that were similar to the general sedentary population, such as reporting minor aches and pains, lacking of self-discipline, and living in neighborhood environments that have little or no access to gyms or community centers to allow them to exercise, but also included unique barriers, such as feelings of being too overweight, feeling self-conscious, and experiencing high levels of distress when exercising among others (i.e., social physique anxiety), (Lange, 2010; Napolitano et. al., 2011; Smits et. al., 2010;). Perhaps adherence to exercise might be increased if individuals utilize an approach that could address some of these barriers to keep them motivated.

Exergame technology is an alternative tool in promoting physical activity and exercise. Exergames is a term used for video games that are also a form of exercise. Exergames are physical activities that are technology driven and which require physical exertion in order to play the game (Witherspoon, 2013). Exergames also require limb and/or trunk movement (large muscles rather than simple hand and finger movements) as the primary interface with the technology (Straker et al., 2015). Due to their growing popularity and the increasing sophistication of their interfaces, exergames have been given great consideration as a potential avenue to get people engaged in physical activity (Staiano & Calvert, 2011). Additionally, exergames may be a solution for those with social physique anxiety to be able to exercise in the privacy and safety of their home (Bain, Wilson, & Chaikind, 1989). Unlike older video games, which promoted sedentary activity, exergames stimulate considerably more active gaming experience that involves the entire body. Participating in exergames has shown considerable increases in heart rate, coordination, and caloric expenditure. Although empirical research with exergames is still limited, the few existing studies report the high potential of exergames to promote physical activity and focus primarily on the physiological impact of exergame play (Graves, Stratton, Ridgers, & Cable, 2007; Maddison, Mhurchu, Jull, Jiang, Prapavessis, & Rodgers, 2007; Peng, Lin, & Crouse, 2011).

Staiano & Calvert (2011) have posited that exergames have not just a physical impact but may also have a potential psychosocial impact, by increasing self-esteem and motivation. However, Feltz, Kerr, and Irwin (2011) have argued that these exergames have not incorporated theoretical principles of group motivation gains that have been shown to improve task motivation. One group-motivation effect that has been studied recently in exergames by Feltz and colleagues (Feltz et al., 2011; Feltz, Irwin, & Kerr, 2012; Forlenza, Kerr, Irwin, & Feltz, 2012; Kerr, Feltz, & Irwin, 2013) is the *Köhler effect*, named after a German industrial psychologist, Otto Köhler (O Köhler, 1926; O. Köhler, 1927). Köhler found that the less capable member of a dyad group performed more "yoked" (i.e., performing a task jointly with a partner) bicep curls than when performing alone. This effect occurred in conjunctive task conditions. In conjunctive group tasks, a group can persist no longer than its weakest member. In this case, when the weaker member could no longer perform the bicep curls, it was functionally impossible for the stronger partner continue. In other words, Köhler demonstrated that weaker members of dyad groups will push themselves harder--beyond their usual performance limits—when paired with someone stronger in a conjunctive persistence task.

Explanations for the Köhler effect include an invidious social comparison with one's more capable partner and the indispensability of one's efforts for team success (Kerr et al., 2007). In invidious social comparison, when confronted with a more capable partner, the weaker partner may revise his/her personal performance goal upward or compete with the partner. In terms of indispensability, task motivation is enhanced when one sees one's efforts as being highly instrumental in achieving valued outcomes.

In applying the Köhler effect to exercise, Feltz et al. (2011) found that exercising with a virtually-present, moderately more capable partner led to a 24% improvement in persistence at a series of isometric plank exercises, relative to exercising alone. In a second study (Feltz et al., 2012), they replicated the basic effect in a conjunctive version of the isometric exercise task (overall, an increase in persistence of 48%, relative to individual exercise).

In a subsequent study (Forlenza et al., 2012), the researchers examined partner characteristics as potential moderators of the Köhler effect. Specifically, they explored dissimilarities in one's partner's appearance: a ~25-year older partner (compared to a same-age partner) and a heavier-weight (BMI: Body Mass Index > 30) partner (compared to a same-weight partner) because prior research has suggested that partner dissimilarity can attenuate the Köhler effect if one's partner was viewed as too dissimilar or incomparable (Messe, Hertel, Kerr, et al., 2002; Mussweiler, 2003). However, results showed that participants, who were average-weight college-aged students, persisted longer, relative to individual exercise, regardless of their virtually-presented partners' age and weight. The researchers concluded that differences in age and weight do not attenuate the Köhler effect in exergames. However, the studies on the Köhler effect in exercise have thus far employed only normal weight, college-aged participants. Whether or not these partner characteristics moderate the Köhler effect with adult obese participants has not been explored. It is not known whether or not an obese partner or an average-weight partner will remove the goal of comparing favorably or the goal of holding up one's responsibility to the partner for obese participants.

Purpose of the Study

The primary purpose this study was to examine the potential moderators of the Köhler effect by exploring partner similarities in an exergame task with participants whose BMI is 30 or greater. This study extends the research of Forlenza et al. (2012) to examine a potential moderator of the Köhler effect by exploring dissimilarity in one's partner's physical size, namely, having a similar-weight partner (compared to a lighter-weight partner) with participants who are defined as obese. As Forlenza et al. note, having an incomparable partner (e.g., someone far superior in ability) can undermine the Köhler effect. Because obese individuals may perceive lighter-weight people as being more physical fit, they may view them as an incomparable partner and not be as motivated to keep up with them on the task.

Hypotheses

Hypothesis 1: Compared to working alone, regardless of partner size, participants will exercise longer when working together with a moderately superior virtual same-sex partner under conjunctive task demands.

Hypothesis 2: Compared to working with a moderately superior virtual same-sex partner who is dissimilar (lighter) in weight, participants will exercise longer when working together with a similar-weight partner.

Delimitations

The findings are limited to obese participants from a weight management clinic, and thus may not generalize to other obese populations.

Definitions

Borg Scale: a self-selected subjective measurement of an exerciser's overall level of intensity- commonly referred to as Rate of Perceived Exertion (RPE)- described on a scale of 1 to 10 (very easy to extremely hard).

Coactive Task: individuals work simultaneously without any interdependence or common outcome.

Conjunctive Task: the group outcome is determined by the least capable member.

Indispensability: perceived instrumentality of individual effort for the group outcome.

Köhler Effect: when superior group members provide an available comparison standard, upward social comparison should motivate the subject to exert more effort in the group compared to working alone.

Obesity: Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared, rounded to one decimal place. Obesity in adults was defined as BMI greater than or equal to 30

Social Comparison: adjustment of performance to standards provided by their social environment.

CHAPTER 2

LITERATURE REVIEW

The purpose of this chapter is to provide a review of literature that is relevant to the variables and procedures in this study. This chapter begins with a review physical activity and obese populations. Next, a review of group motivation research and theory is presented. This is followed by, a review of the Köhler effect as a motivational gain phenomenon based on conceptual contributions and empirical research. The chapter concludes with a summary of social factors influencing exercise, including research on self efficacy.

Physical Activity and Obese Population

Positive Physiological Effects of Physical Activity

Obesity is considered a modifiable health risk factor (Annesi & Unruh, 2008). Maintenance of a healthy weight requires a balance between energy consumption and energy expenditure, and obesity occurs when energy consumption exceeds energy expenditure. Exercise has both acute and chronic positive physiological effects on obese individuals. The acute physiological effects of exercise are limited however; a single session of prolonged aerobic exercise (30–60 min at ∼60–70% of maximal oxygen consumption) can significantly lower plasma glucose levels (Henriksen, 2002). Chronic physiological effects of exercise include improvement in insulin sensitivity and glucose tolerance (Weinstock, Huilliag, & Wadden, 1998). Chronic exercise increases maximum oxygen uptake by increasing maximum cardiac output and the uptake of oxygen from the blood to use by muscles. It decreases myocardial oxygen demands for equivalent levels of external work by decreasing the product of heart rate and systolic arterial blood pressure (Fletcher, Balady, Amsterdam, Chaitman, 2001). Exercise is also effective in decreasing body mass, since increasing energy expenditure, and metabolic rate can decrease adipose mass. Exercise-induced weight loss is known to reduce total fat significantly more than diet-induced weight-loss (Ross, Dagnone, Jones, Smith, Paddags, Hudson, & Janssen, 2000).

Positive Psychological Effects of Physical Activity

Exercise also has positive psychological effects for all individuals, including the obese. It improves mental health, self-efficacy, and mood, while decreasing depressive and anxiety symptoms (Nieman et al., 2000; Penedo & Dahn, 2005). The World Health Organization (WHO) defines mental health as “a state of well-being in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community” (WHO, 2007). Similarly, self-efficacy theory suggests that confidence in one’s ability to perform a given action is strongly associated with one’s actual ability to perform that action (Marcus, Selby, Niaura, & Rossi, 1992). An individual’s confidence is a determinant of the initial decision to perform an action, the effort completed, and persistence in the presence of difficulty (Sherer, Maddux, Mercandante, Prentice-Dunn, Jacobs, & Rogers, 1982). The positive psychological effects of improved mood and self-esteem associated with acute exercise may increase the propensity to follow a lifestyle in which daily exercise is performed (Perri et al. 1997; Annesi & Unruh, 2008; Wadden et al., 1997)

Negative Experiences with Exercise

A commonly cited deterrent to physical activity is physical pain (Clark 1999, Grubbs and Carter 2002). Sedentary individuals who begin to increase physical activity will often experience pain as a result of increased movements. Pain can be worse in people who are overweight or obese because extra body weight can induce joint pain due to the extra force exerted on the joints (Melissas et al., 2005; Nevitt & Lane 1999; Tukker et al., 2009). Overweight and obese individuals have also been found to experience increased symptoms of exertion as compared to sedentary individuals of normal weight. These symptoms include a higher heart rate and percentage of cardiovascular capacity used compared to a normal weight person when performing an equal amount of work. This may result in a higher rate of perceived exertion (RPE) and decreased enjoyment of activity (Ekkekakis and Lind 2006). Overall, overweight and obese individuals have a heightened, more extreme physical reaction to exercise than normal weight individuals (Wingo et al. 2006). This is in line with other previous studies that have shown a higher cardiovascular response to exercise among overweight adults (Mattson et al. 1997, Hulens et al. 2003, Hills et al. 2006). Thus, there exists a need to find ways to overcome these potential negative experiences with exercise.

Group Motivation Research and Theory

A substantial body of research conducted over the last 40 years has focused on the consequences for individual task motivation of performing a task collaboratively in a group. The initial wave of this body of research documented that group performance contexts are sometimes demotivating (Karau & Williams, 1993). Baron & Kerr (2003) provide possible causes for this. Compared to individual performers, group members may (a) feel less personally identifiable and hence, less subject to evaluation; (b) recognize that in some instances they may be able to free-ride on other group members' efforts, or (c) reduce their efforts rather than contribute what they perceive to be more than their fair share of the collective effort. Although extensive research on motivation losses in groups is available, empirical demonstrations for the opposite - motivation gains - has only recently been explored in depth. There is much support for the notion that motivational gains can occur in task groups. Hertel et al. (2000) note that the facilitation of performance of simple, well-learned tasks in the presence of audiences or coactors (Zajonc,

1965) might be counted as a type of group motivation gain if enhanced effort occurs. There are also a number of studies that suggest that implicit or explicit competition between members of cooperative task groups can enhance member motivation and performance (e.g., Erev, Bornstein, & Galili, 1993; Stroebe, Diehl, & Abakoumkin, 1996). Hertel et al. (2000) states the possibility that the "social facilitation" effect reported in Triplett's (1897) classic experimental study was due to implicit competition between children winding fishing reels. There are a few studies (e.g., Kerr & MacCoun, 1984; Kerr & Sullaway, 1983) that have suggested that group composition can underlie some group motivation gains. In these studies, researchers have found higher task motivation by both male and female participants in mixed-sex groups than in same-sex groups or individual performers. They attribute this effect to special evaluation concerns arising in mixed-sex interactions. There is also some evidence that when difficult performance goals have been set, people may work harder in a group than individually (Matsui, Kakuyama, & Onglatco, 1987).

Two motivation gain phenomena have been studied systematically. The first is the *social compensation* effect. When one has reason to doubt that one's fellow group members can or will contribute enough to achieve an important group goal, one may compensate for their low inputs by increasing one's own effort (Williams & Karau, 1991). Although this effect has been well replicated, it appears to have many necessary conditions (e.g., collective success must be extremely important, the act of compensating should not be viewed as too inequitable, individual levels of effort must be anonymous). This suggests that the social compensation effect would be of limited value for enhancing motivation in aerobic exercise. Therefore, the current study focuses on the second motivation gain phenomena, the *Köhler effect*. Köhler's work is examined in more detail below.

The Köhler Effect

The Köhler effect was first discovered in the 1920s by the German industrial psychologist, Otto Köhler. Studying male members of a Berlin rowing club, Köhler found that dyads could perform a taxing physical task (e.g., doing as many standing bicep curls as possible) longer than one would expect from knowledge of the dyad members' performances at a comparably difficult individual version of the task. The demands of Köhler's dyad task meant that the group could persist no longer than its weaker member and once that weaker member was exhausted and quit, it was impossible for the stronger member to continue. Such group tasks—where the group's potential productivity is equal to the productivity of its least capable member—are commonly referred to as conjunctive tasks. Köhler demonstrated that weaker members of dyads will push themselves harder when they are paired with someone stronger in a conjunctive persistence task. Köhler also found that this motivation gain was moderated by the discrepancy between partners' abilities where the motivation gain was largest when this discrepancy was moderate. When there was either very little discrepancy in the abilities of the dyad members or a very large discrepancy, the dyads did worse than the average member, whereas for moderate levels of discrepancy, the dyads did better than the average member. Köhler took the latter result as evidence for a group motivation gain.

Subsequent research suggests that the conjunctive nature of Köhler's (1926, 1927) task is a crucial feature of this work context, and, as such, it differentiates his effect from Triplett's (1898) *social facilitation* phenomena, another type of potential motivation gain. In social facilitation, the mere presence of others (as coactors or an audience) can motivate individuals to try harder. Research indicates, however, that the motivation gains that the weaker coworker on a conjunctive task displays are not due to the mere presence of others and, thus, are not a product of social facilitation. For example, Hertel et al. (2000) found that the less able worker tried significantly harder under conjunctive task demands (i.e., the group score was defined by that less capable member's performance) than under additive task demands (i.e., the group score was the sum of the dyad's performances), even though exactly the same number of people were present in both conditions. Task conjunctivity, in addition to the coworkers' differential abilities, also distinguishes the Köhler effect from social compensation (e.g., Williams & Karau, 1991).

Köhler's (1926, 1927) original study has been replicated several times in various domains. Stroebe et al. (1996) successfully replicated the effect using Köhler's original lifting task. Dyads did better than their average (average of the two individual dyad members - Köhler's original baseline) and their less capable member (the appropriate baseline for detecting motivation gains) when there was a relatively large discrepancy in abilities. As a version of Köhler's second task, in another series of experiments, Stroebe et al. (1996) had participants turn a crank (with a mechanical brake) as fast as possible for 10 min. On all trials, participants worked in separate rooms. To capture the conjunctive aspect of Köhler's task, participants were told that unless the turning speeds of the two dyad members were sufficiently close to one another, a penalty would be assessed. A computer screen continuously displayed the discrepancy in turning speeds between dyad members on dyadic trials. Dyads generally did better than isolated individuals, and in one study, motivation gains relative to the weaker-member baseline were positively related to the discrepancy between group member's individual performances.

More recent attempts to replicate and explain the Köhler effect (Hertel et al., 2000; Hertel, Kerr, Scheffler, et al., 2000; Lount et al., 2000) have yielded similar findings. In these studies a paradigm was used that incorporated most of the basic features of Köhler's original procedure but that was also more efficient and afforded less risk of pain or injury to participants than did Köhler's task. In this new procedure, participants held their arms extended above a trip-alarm device for as long as they felt they could without experiencing undue distress or risking injury. The researchers made this task more difficult either by having the workers hold a metal bar or by attaching a weighted band to their wrist. In the individual condition, the task ended whenever the participant lowered his or her arm far enough to trigger the alarm. In the group condition, conjunctive task demands were created where the task was over when either of two coworkers did so. Hertel et al. (2000) explains the most important advantage of this new task over Köhler's original task is that successful performance of the revised task requires minimal inter-individual coordination and therefore one can assume that effort and output increase and decrease in the same manner.

Using this paradigm in five studies (Hertel et al., 2000, Experiments 1 and 2; Hertel, Kerr, Scheffler, et al., 2000, Experiments 1 and 2; Lount et al., 2000; Messé et al., 2001) examined people's performance under both individual and conjunctive task demands (i.e., in which the less able participant's score determined how well the team did). Across all studies, the researchers consistently found significant motivation gains for the weaker coworker, with average performance increases in group trials compared with individual trials ranging between 10% and 50%. Similarly, Weber and Hertel's (2007) meta-analysis (17 studies, N = 2, 240) results indicated that the overall motivation gain effect of weaker group members is moderate and significant (g = .60) (Scorniaenchi, 2011).

Mechanisms Underlying the Köhler Effect

Social comparison processes. Recent research (e.g., Kerr et al., 2007) reveals that there are at least two mechanisms underlying the Köhler effect. The first stresses *social comparison* processes. When confronted with a more capable partner or coacter on an ambiguous but valued task, the weaker partner may revise his/her personal performance goal upward. An alternative explanation suggests that doing as well or better than the partner becomes a salient goal. Although there are interesting differences between the two explanations—goal-setting version and intragroup-competition version—both explanations hold that it is the opportunity for performance comparison that is critical for the phenomenon. Such opportunities can arise even when performers are not actually working together as a group (e.g., when they are coacting, i.e., two people exercising in one another's presence). In a recent study, Sambolec et al. (2009) observed significant motivation gains in both conjunctive and coactive work conditions but there was no significant difference in the magnitude of these gains. This pattern implied that social comparison (equally possible in both work conditions) might be sufficient to explain the Köhler motivation gain effect. However, there is evidence in support of instrumentality as a mechanism underlying the Köhler effect.

Instrumentality. The second mechanism stresses the *indispensability* of one's efforts for one's group. As instrumentality and value models of motivation suggest (e.g., Karau & Williams, 1993; Shepperd, 1993; Vroom, 1964), task motivation is likely to be enhanced when one sees one's efforts as being highly instrumental—i.e., indispensable—in achieving highly valued outcomes. This suggests that task conditions that increase instrumentality will increase motivation. Under conjunctive task conditions, the group's performance is highly contingent on the weaker member's effort—i.e., the weaker member's efforts are indispensable for group success. Note that such contingencies depend largely on the demands of the task—in particular, it is the conjunctive nature of the group task that makes the weaker member's efforts particularly indispensable. One way of competitively testing these two generic explanations is to vary how indispensable the weaker member's efforts are (Steiner, 1972). Hertel, Kerr, Scheffler, et al.

(2000, Experiment 2) utilized this approach when they compared the performance of the less capable member of a dyad when working side-by-side at an arm-lifting persistence task under conjunctive task demands (i.e., the group score was defined by that less capable member's performance) versus additive task demands (i.e., the group score was the sum of the dyad's performances). Results indicated that this motivation gain occurred under conjunctive but not under additive task demands, suggesting that the instrumentality of one's contribution to valued outcomes is a more likely explanation of the Köhler effect than social comparison processes.

Hertel, et al. (2008) also showed support for the importance of instrumentality. In a study involving computer-supported dyads without face-to-face contact, based on previous research on the Köhler effect (Hertel et al., 2000), the researchers expected high motivation of group members when their individual effort was highly instrumental for the group's success. Consistent with their expectations, motivation of the group members was high and even exceeded the baseline of individual work (thus revealing motivation gains) when the individual's contribution was highly instrumental for the dyad's success (i.e., weaker coworker under conjunctive task demand). When instrumentality was low (i.e., weaker coworker under additive task demand), inconclusive results were obtained. This lends support to the importance of instrumentality as an underlying mechanism of the Köhler effect and indicates that motivation gains can be produced in computer-supported dyads, even without face-to-face interaction. This indication is of particular relevance to the current study, as one of its conditions are computer-supported dyads.

Earlier work often contrasted upward comparison and social indispensability as alternative explanations for motivation gains of inferior group members (e.g., Hertel, Kerr, & Messé, 2000; Hertel, Kerr, Scheffler, et al., 2000). However, recent work has emphasized that these different motivational mechanisms are not necessarily mutually exclusive but can be complementary (Hertel et al., 2008; Kerr et al., 2005; Kerr et al., 2007; Lount et al., 2000). For instance, a person might both try to maximize the group outcome (pursuing collectivistic goals) and try to outperform the coworker (pursuing individualistic goals) at the same time. Therefore, upward comparison and social indispensability processes may be active simultaneously and the relative strength of the processes being determined both by situational factors (e.g., norms, task structure) and by the personality of the individual (e.g., need for achievement, need for affiliation). It is important to note that these two mechanisms may work differently when moderated by other variables.

Potential Moderators of Group Motivation Gains. There are many potential factors that moderate the effects of group motivation gains discovered in recent research. A meta-analysis (17 studies, N= 2,240) conducted by Weber and Hertel (2007) included a moderator analysis which revealed the following moderators: task structure, physical presence, gender, performance information, and task type. Results indicated that the overall motivation gain effect of inferior group members observed is moderate and significant (g = .60). Recently, social ostracism has also been explored as a potential moderator of group motivation gains (Kerr et al., 2008).

Task structure. Additive task conditions (i.e., the group score is the sum of the dyad's performances) support the social compensation theory and therefore promotes outcome interdependence between partners. Kerr et al. (2008) state that "previous failures to observe significant motivation gains with invidious social comparison under additive task conditions (e.g., Hertel et al., 2003; Hertel et al., 2000) may plausibly be attributed to other motivational processes (e.g., free riding on one's partner) obscuring this social comparison effect" (p.832).

The notion of “free riding on one’s partner” is often referred to as *social loafing*. Under additive task conditions, less capable members might anticipate that stronger members will compensate for their poorer performance and therefore will “free ride” on the stronger members’ efforts (Kerr, 1983; Williams & Karau, 1991). Kerr et al. (2007) speculates that this social loafing effect could counter and possibly eliminate any motivation gains due to social comparison. To avoid such ambiguities, the current study will use a conjunctive condition, where one’s more-capable peer will be a teammate and the group score will depend entirely on one’s own level of performance in addition to a coactive condition where social comparison is just as possible but without the outcome interdependence that occurs with additive task conditions.

Physical presence. Another potential moderator of motivation gains is the physical presence of group members. The growing number of computer-mediated forms of group work (e.g., Hertel et al., 2005) emphasizes the importance of investigating the effects of physical presence on motivation. Recent studies have demonstrated that working face to face leads to significantly higher effort increases in the weakest group member compared to working with physically absent partners (Hertel et al., 2008; Lount et al., 2007). Lount et al. (2007) examined whether increasing evaluation concerns would increase the magnitude of the Köhler effect. Evaluation concerns were manipulated by having participants work in the physical presence or virtual presence of their coworker. Results showed that motivation gains were significantly greater for participants who worked in the physical presence of their coworker, which suggests that evaluation concerns can potentially increase the magnitude of the Köhler effect.

Apart from the effects of the mere social presence of others (e.g., Zajonc, 1965), positive effects of physical presence can also be caused by impression management or self-presentation concerns (Goffman, 1959; Tedeschi & Rosenfeld, 1981; Tedeschi, Schlenker, & Bonoma, 1971).

When other individuals are physically present, the social consequences of being the weaker person should be more noticeable because evaluative feedback is more likely (Carron, Burke, & Prapavessis, 2004). These effects are relevant both for social comparison and for social indispensability processes. Being the weaker person in a social competition should be more harsh when an individual is visible to others and can see their reactions as compared to spatially distributed groups (Hertel et al., 2008; Kerr et al., 2005; Lount et al., 2000). Similarly, social sanctions (e.g., stigmatization, exclusion) for holding the group back when personal effort is indispensable should be more aversive with a physically present, compared to an absent, coworker (Hertel, Kerr, Scheffler, et al., 2000). Such findings have interesting implications for the use of computer-supported exercise and virtual exercise partners by those whose lack of exercise motivation or aversive feelings towards exercise stem from such things as social physique anxiety or low self-efficacy.

Moreover, significant motivation gains have been repeatedly demonstrated under conditions where participants did not meet or know their partner (e.g., Hertel et al., 2003). In line with these findings, research on social facilitation has reported effort increases when other people were not physically but electronically present in brainstorming groups (e.g., Aiello & Kolb, 1995; Aiello & Svec, 1993). Even under conditions in which participants worked together with individuals who were neither physically nor electronically present, such effort increases have been documented (e.g., Dashiell, 1930; Feinberg & Aiello, 2006), and as a result the current study aims to discover whether the use of a virtual partner during a strength task supports such findings.

Availability of partner-related performance information. Another potential moderator of motivational gains of weaker group members is the information that is available about the other group members' performance. This moderator can affect both social comparison and social indispensability processes. When information about a partner's current performance is available continuously during group work, this permanently updated comparison standard facilitates comparison processes (e.g., Seta, 1982; Stroebe et al., 1996). This in turn might lead to greater motivation gains compared to conditions in which such feedback is either not provided at all or only once during or after a group trial (Hertel et al., 2008; Kerr et al., 2005). Similarly, partner-related performance information can affect indispensability perceptions, particularly during conjunctive tasks. When partner-related performance information is available continuously, weaker group members can constantly verify whether they are holding the group back or not. This should highlight the indispensability of their efforts for the group and thus should increase the efforts of the weaker group members compared to conditions in which partner-related performance information is not continuously available. Of course, this is true only if the available information indicates that the weaker group member is indeed holding the group back. Taking this into consideration, the current study includes a manipulation of the time of the virtual partner (viz., the virtual partner will always be holding the plank slightly longer than the subject) in the conjunctive condition, thus providing the subject with constant partner-related performance feedback by enabling the subject to constantly see their partner holding the plank longer than them on the screen. However, in the current study, researchers will not provide the subject with any actual information regarding their partner's ability prior to each ride nor with a means of communicating directly with their partner.

The lack of continuous partner feedback does not necessarily debilitate continuous upward comparison or indispensability effects because the knowledge that one might currently be the weaker person or might be holding the group back could be sufficient to trigger additional effort. Using a short physical persistence task (about 2–3 min each trial), Kerr et al. (2005) found motivation gains when partner-related performance feedback was given after the group trial even though these gains were significantly lower than in conditions with continuous partner feedback. However, in a study using a cognitive maximizing task that lasted somewhat longer (20 min each trial), motivation gains occurred only when partner feedback was continuously available and not when partner feedback was promised to be given after the group trials (Hertel et al., 2008). Thus, motivation gains of weaker group members seem to be rather fragile when partner-related performance feedback is not continuously available.

While the potential effects of partner-related performance information have been discussed with respect to implications of information about another person in the group it is important to note that feedback can be bidirectional- participants not only receive feedback about other individuals' performance but also expect that the other individuals are continuously informed about the participants' performance level. This permanent identifiability of personal contributions might also increase efforts and work on social loafing has documented that the identifiability of individual contributions decreases the tendency to loaf (Karau & Williams, 1993). This could be because the individual has less opportunity to hide in the crowd (Davis, 1969), so that the risk of being identified for poor performance is increased, or because the individual feels less lost in the crowd (Latane´ et al., 1979), so that high individual efforts are more likely to be noticed and rewarded. Moreover, research on brainstorming groups documented that group members reduced their effort and performance if their contributions were not identifiable and could not be evaluated (Diehl & Stroebe, 1987), while explicit feedback during the task enhanced performance in electronic brainstorming groups (e.g., Jung, Schneider, & Valacich, 2005; Paulus, Larey, Putman, Leggett, & Roland, 1996; Roy, Gauvin, & Limayem, 1996; Shepherd et al., 1996). However, the current study will not explicitly state to participants in the conjunctive tasks that their partner can see them performing the plank exercises. Since participants will be able to see their partners on the screen and monitor their progress, it is likely that they will assume that their own progress is identifiable by their partners thus, motivational gains are expected.

Social ostracism. Kerr et al., (2008) examined the effect of being ostracized by one's work partner on the Köhler motivation gain. Such ostracism weakened but did not eliminate the Köhler motivation gain. Ostracism only had such an effect when subjects worked in a group and not under coactive work conditions. This finding indicates that social ostracism does not seem to affect the social comparison mechanism (viz., when the coactor had previously ostracized the subject, the subject was no more or less willing to use the ostracizers' performance as a basis for social comparison). But ostracism did attenuate the indispensability mechanism, which depends on working together in a group. Researchers speculate that being ostracized reduced the value that one attached to the group's success or to teammates' evaluation. Conclusively, Kerr and his colleagues also argue that social ostracism can undermine group members' concern for group success or for protecting their reputation in the group without affecting the social comparison processes that also contribute to the Köhler effect.

Köhler Effect in Exercise

Although performing a physical task conjunctively with a more capable partner in ad hoc laboratory groups has been shown to be motivating, Feltz et al. (2011) argued that implementing these principles in exercise settings may present some obstacles. For instance, finding an ideally matched exercise partner (i.e., moderately more capable) could be difficult and would not be particularly helpful for the stronger partner. Therefore, they proposed the use of a virtually-presented partner to test the effectiveness of the Köhler effect for enhancing motivation to exercise in a series of recent studies. Feltz et al. (2011) reported the first empirical attempt to demonstrate a Köhler motivation gain in exercise groups with virtually present partners. Participants were randomly assigned to one of four conditions (individual control, coaction, additive, and conjunctive) and performed a series of isometric plank exercises within an exercise game. They performed the first series of five exercises alone holding each position for as long as they could, and, after a rest period, those in the partner conditions were told they would do remaining trials with a same-sex virtual partner whom they could observe during their performance. The partner's performance was manipulated to be always moderately superior to the participant's. They found that exercising with a virtually-present, more capable partner led to a 24% improvement in persistence at a series of five isometric plank exercises compared to controls exercising individually. This remarkable motivation gain was achieved without any observable increase in subjective effort, intention to exercise in the future, or decrease in interest in the task. The results suggest that exercising with virtually present, superior partners can improve persistence motivation on exercise game tasks.

Feltz et al.'s (2011) study, however, involved a one-time only exercise experience, and the exercise was isometric in nature. Irwin et al. (2012) investigated whether a virtually present partner would influence participants' motivation (duration) during aerobic exercise over a 2-week time period. Fifty-eight females were randomly assigned to either a coactive condition (exercising alongside another person, independently), a conjunctive condition (performance determined by whichever partner stops exercising first) where they exercised with a moderately superior partner (whose time was reported to be 40% longer in duration), or to an individual condition. Participants exercised on a stationary bike on six separate days. They found that exercising with a virtually-present, more capable partner at a conjunctive team exercise task led to an impressive 125% improvement in persistence at an aerobic exercise task, compared to controls exercising individually. The results showed that exercising with a virtually present partner can improve performance on an aerobic exercise task across multiple sessions.

Feltz, Irwin, & Kerr (2012) investigated whether there was an optimal level of ability discrepancy between a participants and their virtually-presented partners in order to increase the participants' task persistence in conjunctive tasks. Thus, they replicated the basic Köhler effect in a conjunctive version of the isometric exercise task using participants randomly assigned to one of four conditions (individual control or low-, moderate-, or high- partner discrepancy).. They performed the first series of five exercises alone (trial block 1), and after a rest period, those in the partner conditions performed remaining trials (trial block 2) with a same-sex virtually presented partner whom they could observe during their performance, while those in the individual control condition performed the remaining trials alone. In the partner conditions, the partner's performance was manipulated to be always better than the participant's, the exact difference depending on the discrepancy condition. Persistence, the outcome measure for the study, consisted of the total number of seconds the participants held the exercise position. The participants demonstrated more persistence in the moderate-discrepancy condition than in the low-discrepancy condition or the high-discrepancy condition. Feltz et al. showed that virtually presented partners who are moderately more capable than participants are the most effective at improving persistence in exergame tasks. Overall, there was an increase in persistence of 48%, relative to individual exercise. It seems clear that the Köhler effect can be effective in boosting motivation to exercise of the less fit member of an exercise group.

In the first few studies that Feltz and her colleagues conducted, college students of the same gender were paired with a similar-aged virtually-presented partners. However, dissimilar partners might moderate the effect. In a subsequent study (Forlenza et al., 2012), the researchers examined partner characteristics as potential moderators of the Köhler effect. Specifically, they explored dissimilarities in one's partner's appearance: a ~25-year older partner (compared to a same-age partner) and a heavier-weight (BMI: Body Mass Index > 30) partner (compared to a same-weight partner) because prior research has suggested that partner dissimilarity can attenuate the Köhler effect if one's partner was viewed as too dissimilar or incomparable (Messe, Hertel, Kerr, et al., 2002; Mussweiler, 2003). However, results showed that participants, who were average-weight college-aged students, persisted longer, relative to individual exercise, regardless of their virtually-presented partners' age and weight. One exception was with males who tended to persist longer when paired with an obese partner ($p = .08$). The researchers concluded that differences in age and weight do not attenuate the Köhler effect in exergames. However, the studies on the Köhler effect in exercise have thus far employed only normal weight, college-aged participants. Whether or not these partner characteristics moderate the Köhler effect with adult obese participants has not been explored. It is not known whether or not an obese partner or an average-weight partner will remove the goal of comparing favorably or the goal of holding up one's responsibility to the partner for obese participants.

Self-Efficacy and Exercise

Motivating people to do regular physical exercise depends on several factors; the belief in one's capability to perform is an important factor. Perceived self-efficacy has been found to be a driving force in forming intentions to exercise and in maintaining the practice for an extended time (Dzewaltowski, Noble, & Shaw, 1990; Feltz & Riessinger, 1990; McAuley, 1992, 1993;

Shaw, Dzewaltowski, & McElroy, 1992; Weinberg, Grove, & Jackson, 1992; Weiss, Wiese, & Klint, 1989). A series of experiments on the role of self-efficacy on muscular tasks have shown that endurance in physical performance depended on efficacy beliefs that were created. (e.g., Weinberg, Gould & Jackson, 1979; Weinberg, Gould, Yukelson & Jackson, 1981; Weinberg, Yukelson, & Jackson, 1980). The relative importance of self-efficacy to exercise motivation is the reason the current study will include self-efficacy as a dependent variable.

Self-efficacy is the “belief in one’s capabilities to organize and execute the courses of action required to produce given attainments” (Bandura, 1997, p. 3). Given sufficient motivation to engage in a behavior, it is a person’s self-efficacy beliefs that determine whether that behavior will be initiated, how much effort will be expended, and how long effort will be sustained in the face of obstacles and aversive experiences (Bandura, 1997). Moreover, individuals who perceive themselves as highly efficacious activate sufficient effort that, if well-executed, produces successful outcomes, whereas those who perceive low self-efficacy are likely to cease their efforts prematurely and fail on the task (Bandura, 1986, 1997).

A better understanding of the efficacy-effort relationship can be gained through experimental manipulation of self-efficacy. Weinberg and his associates (Weinberg, Gould, & Jackson, 1979; Weinberg et al., 1981; Weinberg et al., 1980) conducted a series of studies designed to test the predictions of self-efficacy theory in a competitive, motor-performance situation. Self-efficacy was manipulated by having participants compete against a confederate on a muscular leg-endurance task where the confederate was said to be either a varsity track athlete who exhibited higher performance on a related task (low self-efficacy group) or an individual who had a knee injury and exhibited poorer performance on a related task (high self-efficacy group). To create aversive consequences, the experiment was rigged so that participants lost in competition on the two muscular leg endurance task trials they performed (Weinberg et al., 1981). The results of these studies supported self-efficacy predictions with the high self-efficacy participants tolerating the task significantly longer than low self-efficacy participants.

Differences in self-efficacy and perceptions of aches and exertion were explored in a study by Hutchinson, Sherman, Martinovic, & Tenenbaum (2008). The results of their study demonstrated that increased self-efficacy leads to improved tolerance of an exerting task (viz. hang grip task). Participants in the high efficacy group were able to tolerate the handgrip task an average of 40s (23%) longer than participants in either the low efficacy or control group following the manipulation. Researchers concluded that self-efficacy manipulation lead to differential perceptions of aches, exertion, and affect during acute exercise bouts. Specifically, increased self-efficacy leads to lower perceptions of aches and exertion, and an enhanced affective response to exercise. This latter finding is consistent with McAuley et al.'s (1999) findings where participants assigned to a high-efficacy manipulation condition reported more positive affect and less negative affect than those assigned to a low-efficacy manipulation condition. Perceptions of pain and discomfort can act as barriers to exercise initiation and maintenance. In addition, positive affect plays an important role in the motivation for exercise (Scanlan & Simons, 1992). Thus, self-efficacy interventions that improve the affective experience of the exerciser are likely to also have the potential to enhance exercise adherence. Although the current study will not manipulate self-efficacy, in order to test such assertions, the variables of task self-efficacy will be included in addition to an exercise intention measure at the end of the study.

Although previous research has shown that participants with high self-efficacy tolerate certain tasks for longer, have more positive affect, and have lower perceptions of aches and exertion than participants with low self-efficacy, there is also a possibility that high self-efficacy participants could show a poorer performance than low self-efficacy participants. High self-efficacy participants might feel complacency or overconfidence for their task performance (Stone, 1994; Vancouver, Thompson, Tischner, & Putka, 2002) and, as a result, they might not increase their effort substantially. Additionally, low self-efficacy participants might show greater motivation gains than their high self-efficacy counterparts to prove their capability. For example, high self-efficacy participants may not feel the need to prove themselves because of the favorable performance feedback given to them through the self-efficacy manipulation while low self-efficacy participants may feel that they have something to prove being the weaker link or because they did not receive favorable performance feedback.

In an unpublished thesis by Seok (2004), subjects performed a task twice on their own and then worked in a dyad with conjunctive task demands in subsequent trials and were given feedback on partner's performance during the preceding two trials (suggesting partner slightly, moderately, or much superior to subject). Self-efficacy was manipulated via feedback about the subjects first two solo performances where high self-efficacy feedback indicated that it was very likely that the subject could perform well on the upcoming trials and low self-efficacy feedback indicated that it was not likely that the subject could perform well on the upcoming trials.

Results suggested that participants showed greater motivation gains when they had low self-efficacy than when they had high self-efficacy and this effect was strongest under a moderate level of perceived discrepancy. However, even though there were significant motivation gains in all the high self-efficacy conditions and all the low self-efficacy conditions, researchers concluded that low self-efficacy participants exerted extra effort when they had a moderate discrepancy (and, to a lesser degree, when they had a large discrepancy). The researchers note that these results do not indicate that high self-efficacy is a detrimental factor of task performance but rather, low self-efficacy could have motivating effects on task performance.

In summary, the purpose of this study will be to extend the research of Forlenza et al. (2012) to examine a potential moderator of the Köhler effect by exploring dissimilarity in one's partner's physical size, namely, having a similar-weight partner (compared to a lighter-weight partner) with participants who are defined as obese (BMI is 30 or greater). Based on previous research (Forlenza et al., 2012; Messe, Hertel, Kerr, et al., 2002; Mussweiler, 2003) stating that having an incomparable partner (e.g., someone far superior in ability) can undermine the Köhler effect, two hypotheses will be proposed. Hypothesis 1: Compared to working alone, participants will exercise longer when working together with a moderately superior virtual partner under conjunctive task demands. Hypothesis 2: Compared to working with a moderately superior virtual partner who is dissimilar (lighter) in weight, participants will exercise longer when working together with a similar-weight partner.

CHAPTER 3

METHODS

Participants

Although the population of people who might benefit from this motivation-gain approach to health games is potentially quite large, the focus of this study was on obese individuals. Obese individuals were defined as individuals having a body mass index (BMI) of 30 or greater (M_{BMI} = 38.25, *SD* = 5.83). The author's intent was to recruit 66 adult participants (males and females) through Michigan State University's Human Participation in Research system, a weight management program by Sparrow's Weight Management Clinic, and various places within the community. However, although only 35 participants (31 females, 4 males; M_{AGE} = 46; SD = 17.34 years) ended up participating, a power calculation determined that there was enough power to find a Köhler effect with probability > 0.80 with the smaller sample size.

By participating in the experiment, each participant received a free assessment of their body composition, including BMI, percent body fat, fat free mass, and an estimate of total body water (ordinarily, a monthly fee is required to purchase this assessment at the Sparrow's Weight Management clinic) and a chance to win one of the three $50 gift cards. Both male and female experimenters will conduct sessions throughout the experiment.

Research Design

The experiment used a 3 (Treatment Conditions: Individual control, Partner Similar Weight, Partner Lighter Weight) x 2 (Participant Gender: Male, Female) design. Participants completed two blocks of three isometric abdominal exercises: front plank, side plank (left), and side plank (right) (see below for details). Participants were randomly assigned to one of the two work conditions or the control condition. The primary dependent variable was persistence in the exercises, defined by the total time the exercises were held across the trial.

Health Games and Task

The health game used for this study was an exergame designed for the PlayStation 2 (PS2) gaming module. The software used was EyeToy: Kinetic, a game that offers a variety of fitness activities (e.g. yoga, strengthening exercises, combat exercises). This particular software operates in conjunction with an additional accessory called the EyeToy, designed specifically for the PS2. The EyeToy is a small camera that connects to the PS2 via a USB cable and projects images of the user on the TV monitor. This allows the user to interact with virtual environments in the exergame.

The abdominal plank exercises within the strength training module of the EyeToy: Kinetic software were used for this experiment. These are a type of body-weight exercise where participants are required to suspend their own body weight primarily using their abdominal muscles. These exercises are also isometric in nature and require very little coordination, and thus are highly effort-based, which is important because the primary dependent measure is effort. Each exercise targets the abdominal muscles, but there are slight differences between each. On the first exercise, participants were positioned face down on a cushioned mat, with legs extended straight, and lifting their body upward by resting their elbows and toes on the mat and using their abdominals to lift their body. In this way, the body is in a straight line, the spine is directly in line with their head and legs and nothing is touching the ground except for the forearms and toes. In a similar fashion, the second exercise requires an elevated position, but without facing the ground, the participants are on their left side with only the left forearm and left foot on the ground, emphasizing the use of the outer abdominal muscles. The third exercise is the same as the second, except the participants perform this on the right side. Participants perform each exercise once within each of two blocks.

Measures

Physical Activity Readiness Questionnaire (PAR-Q). The PAR-Q is a self-administered form that contains seven yes or no questions focused on symptoms of heart disease and bone or joint problems (see Appendix A). The purpose of this form was to determine if participants could be reasonably safe starting an exercise program or increasing their current level of activity. If they answered yes to any questions, it was recommended that they consult their physician prior to starting exercise.

Persistence. Persistence was the total number of seconds a plank is held from when participants move into position to the moment they quit (i.e., stop holding the plank), measured using a stopwatch. Block scores were calculated by taking the sum of how long participants held each of the three exercises within each trial.

Self-efficacy (SE). Task SE was measured with a scale based on previous research (Feltz et al., 2011). The measures contained three items, each corresponding to one of the three exercises within each Block. All items were preceded by the stem, "What is the number of seconds that you are completely confident you can hold:" followed by "the first exercise", "the second exercise", and "the third exercise" (see Appendix B). Respondents wrote in the number of seconds in a blank box following each item. The questionnaire was administered at three time points: once before Block 1 (after the participants have watched a brief instructional video demonstrating the exercises), a second time after performing the exercises for Block 1 (which is when the participants were told an average of how long they held the plank exercises the first time through), and again before the second Block of exercises (after meeting their partner if they were in the experimental conditions). A total SE score for each trial was calculated by taking the sum of the three items within each trial.

Ratings of Perceived Exertion (RPE). Perceived exertion was measured using the 6-20 version of the Borg (1998) RPE scale. The Borg Scale (1998) is a self-selected subjective measurement of an exerciser's overall level of intensity, described on a scale of 6 (no exertion) to 20 (maximal exertion). An explanation of the scale was given prior to each plank exercise to ensure participants understand the numerical meaning. This scale appeared on a large poster on the wall in direct sight of the participant while doing the plank exercises. When asked to report their level of perceived exertion immediately after performing each plank exercise, the participants told the experimenter which number corresponded with how hard they were working, and that number was recorded (see Appendix C).

Enjoyment. Enjoyment was measured using a short 8-item version of the Physical Activity Enjoyment Scale (PACES; Raedeke, 2007). Each item was rated on a 7-point bipolar scale beginning with the stem "Please rate how you feel at the moment about the physical activity you have been doing according to the following scales" (e.g., 1= "I loved it"; 7 = "I hated it"). See Appendix D.

Intention to exercise in the future. Intention, adapted from the scale used by Mohiyeddini, Pauli and Bauer (2009), was measured with two items: "My goal is to exercise tomorrow for at least 20 minutes" and "I intend to exercise tomorrow for at least 20 minutes." Ratings were made on a 6-point scale, from -3 (not at all true for me) to +3 (completely true for me). The two items were added together for an intention score. See Appendix E.

Post-experimental questionnaire. Additional questions included demographic information, a manipulation check to ensure participants understood the instructions and procedures, assessment of interest in participating in a future exercise study like the present one, a rating of task difficulty, and a rating of effort expended on the task, each on 8-point scales. For participants in the partnered conditions, a series of questions assessed feelings toward the partner (e.g., likeability, comfort), partner's ability and effort, and perceptions of partner's feelings toward the participants (see Appendix F for post-experimental questionnaire).

Procedure

The procedure was similar to the procedure from previous research (Forlenza et al., 2012). Permission to conduct this study was obtained from the Institutional Review Board for Human Subjects Research (see Appendix G for approval letter). Following approval, researchers contacted Sparrow Weight Management Clinic to start recruiting participants. Members of the research team attended several Sparrow Weight Management Center exercise sessions to explain the purpose of the study and ask for volunteers. These were individuals who had already signed a release to participate in an exercise program, which is required for their participation in the Sparrow exercise classes. Interested persons signed up for a time to participate in the experiment. Participants arrived at the lab individually where they signed a consent form (see Appendix H). After signing the consent form, researchers weighed the participants on a Tanita scale (model BC-418) in order to calculate their BMI and give them their free body composition measurements. The Tanita BC-418 was used to conform to Sparrow's Weight Management Clinic's protocol for measurement of body composition. After calculating their BMI, participants completed the PAR-Q and a demographic survey. Afterward, participants watched a video demonstration of the three plank exercises that they would be asked to perform. All exercises were completed as part of the EyeToy: Kinetic exergame, which showed a virtual trainer demonstrating the exercises. Participants were instructed to hold each plank for as long as possible and were given short breaks between each exercise.

After watching the videos, participants completed a short SE questionnaire. Participants then completed Block 1 (each plank exercise once) individually. After each plank exercise, participants provided the researcher with a number that represented their perceived exertion using the Borg Scale. Next, participants in the control condition were told the average time they held the planks and that they would asked to complete the same set of exercises again (Block 2) after a 10 min. rest. Before completing Block 2, participants completed a second set of SE questions. Upon completion of each plank exercise, participants again stated the number that represented their perceived exertion using the Borg Scale.

Participants in the experimental conditions, however, were told they would complete the exercises again, only with a same-sex partner connected to the lab through the internet. Participants were introduced to their partner over a simulated Skype connection. Participants were led to believe they were interacting live with another person; however, their partner was a confederate whose video content had been pre-recorded.

During the introductions, the partner provided personal background information (e.g., age, favorite television shows), followed by participants providing similar background information. Which partner participants meet depended on their experimental condition. The dissimilar-weight conditions participants were introduced to partners who were lighter-weight than participants ($19 < BMI < 25$), while participants in the similar-weight conditions were introduced to obese partners ($BMI \geq 30$).

Following the introductions, participants were provided accurate feedback on their own Block 1 performance and false feedback regarding how long their partner held the plank exercises. Participants were given a time of their partner's that was 40% longer than their own because previous research has demonstrated that this moderate discrepancy results in greatest effort (Feltz, Irwin, & Kerr, 2012). Thus, participants were led to believe they were the inferior group member.

Participants in the partner conditions were also told that during Block 2 their performance would be measured using a team score. The team score was defined by the time of the person who quits first. Therefore, when one person stops exercising, the other person must stop, and the team's score was the length of time the first person lasted. This made the task a conjunctive task, where the team's performance depends on the inferior member.

During Block 2, a superficially live video of the partner doing the same exercises was displayed for the participant to see. This view was actually a series of pre-recorded videos that were looped, which means the confederate always held the exercises longer than the participant. Thus, participants were continually outperformed by their partner. Upon completing Block 2, participants completed the post-experimental questionnaires and were then debriefed. See Appendix I for debriefing script.

CHAPTER 4

RESULTS

The purpose of this study was to examine the potential moderators of the Köhler effect by exploring partner similarities in an exergame task with participants whose BMI is 30 or greater. This chapter is organized into three main sections. The first section provides results on manipulation checks and descriptive statistics. The second section provides results for the main hypotheses. The final section presents results on ancillary analyses used to help interpret the main hypotheses.

Manipulation Checks and Descriptive Statistics

Confound Checks

Experimenters were asked to record signs of suspicion, discomfort, boredom, the presence of equipment failures, whether they thought a participant's fitness level or previous activity affected participants' performance, and whether the experimenter knew the participant. Upon completion of data collection, participant responses to the open-response item in the post-experimental questionnaire "was there anything odd or unusual about the experiment" were also coded for suspicion.

A 3 (Condition) x 2 (Experimenter Gender) ANOVA on performance scores was performed, excluding all participants who showed signs of suspicion, discomfort, boredom, etc ($n = 1$). Results did not differ from the same analysis performed with these participants. Consequently, the participant was included in all subsequent analyses.

Both male and female experimenters were used, but a 2 (Experimenter Gender) x 3 (Condition) analysis found no performance differences by experimenter gender, $F(1,33) = 1.07$, $p=.309$). Consequently, experimenter gender was excluded from all subsequent analyses.

Manipulation Checks

In order to make sure participants understood their assigned condition and how the score will be determined, two questions were asked in the post questionnaire to conduct a manipulation check. There were no issues among any of the groups in their understanding of the condition they were in. However, there was a bit of confusion for those assigned to the partnered conditions on how the last series of exercised would be scored. Those assigned to the partnered conditions understood the condition they were in (i.e., they worked with a partner over an internet connection), but responses to the item "how was your score determined in the last series of exercises" indicated that some (*n*=9) misunderstood how the last series of exercises was scored (e.g., they inaccurately reported that the score for the last series of exercises was determined by a team average score rather than the sum of the first person who quit).

Correlations

Descriptive statistics were calculated for all major study variables. Refer to Appendix J for a complete table.

Hypothesis Testing

Because the three exercises were small variations of one another, the total persistence across all three exercises was computed. The primary dependent variable was the difference score between both blocks (Block 2 - Block 1), which would show changes in persistence while controlling for individual differences in strength and fitness. This approach was used because the difference score means are more directly interpretable than adjusted means produced by ANCOVA, and this approach has generally produced the same results as using the Block 1 scores as a covariate in the analysis (Forlenza et al., 2012; Kerr, Forlenza, Irwin & Feltz, 2013). There were too few male participants ($n = 4$) to include Participant Gender as an independent variable, therefore, the data were analyzed in a one-way ANOVA on the difference scores to test the hypotheses. Participants were placed into three conditions: participants who perform planks alone (control group) (n=13), participants who perform the plank exercises with a similar weight partner (n=11) and participants who perform the plank exercises with a lighter weight partner (n=11). Results showed a significant effect among conditions, , $F(2,32) = 4.74$, $p < 0.05$. Both the Tukey and Scheffe post-hoc tests showed significant differences in the mean of persistence difference scores between the control condition (M= -9.92, SD=29.69) and the lighter weight condition (M=24.45, SD=32.14). There was no difference between the control group and the same weight partner group (M=15.64, SD=23.09), nor between the two partnered groups. Thus, Hypothesis 1, which stated that compared to working alone, participants will exercise longer when working together with a moderately superior virtual partner under conjunctive task demands, was supported for the lighter-weight partner condition. However, Hypothesis 2, which stated that compared to working with a moderately superior virtual partner who is dissimilar (lighter) in weight, participants will exercise longer when working together with a similar-weight partner, was not supported. The relevant work condition means (e.g. individual, similar weight partner, lighter weight partner) and standard deviations are provided in Table 2 and are plotted in Figure 1.

Ancillary Analyses

Exercise Self-Efficacy

Due to few male participants (n=4), only females were used in the following analysis. The three self efficacy judgments (the number of seconds participants estimated they could persist at each of the three exercises) were examined in a 3 (Condition) x 2 (Block) ANCOVA, which used pre-block 1 self-efficacy scores as a covariate (i.e., each participant's estimate prior to performing any exercise) to control for chronic differences among participants of their self-efficacy belief pertaining to the task. Unlike in previous studies, there was no Block main effect, $F(2,27) = .12$, $p > .05$, partial $\eta^2 = .009$. Participants were not significantly less optimistic about their potential for performance after Block 2 (*M* = 66.42s, *SD* = 43.73) than after Block 1 (*M* = 69.32s, *SD* = 44.17). Participants in the individual conditions on average reported lower self-efficacy estimates than participants in the lighter weight condition but gave higher reports than those in the similar weight condition, an effect which appeared for all self-efficacy reports.

Subjective Effort

Due to few male participants (*n*=4), only females were used in the following analysis. To determine the participants' subjective effort, the ratings of perceived exertion were reported after each exercise and later averaged across exercises within blocks. Consistent with the previous studies, a 3 (Condition) x 2 (Block) ANOVA of RPE data did not exhibit significant differences among conditions; $F(2,26) = .33$, $p > 0.05$ (Block 1) and $F(2,26) = .24$, $p > 0.05$ (Block 2). Participants, on average, reported similar ratings of perceived exertion at Block 1 (*M* = 14.21, *SD* = 1.89) and Block 2 (*M* = 14.25, *SD* = 1.87).

Task Evaluation

Due to few male participants (*n*=4), only females were used in the following analysis. Overall task enjoyment was measured by the means of the 8-item PACES scale. The overall mean (*M* = 4.36, *SD* =.92) was higher than the scale midpoint. A one-way ANOVA on the three Conditions found a significant difference among conditions, $F(2,26) = 3.29$, $p = 0.05$. A post-hoc Tukey test showed that the mean scores of the lighter-weight group (*M* = 4.82; SD = .94) was significantly higher than the similar weight (*M* = 3.89, *SD* = .59) group in terms of enjoyment.

Participants' post-experimental rating of the difficulty of the task was higher than the scale midpoint (M = 6.03, SD = 1.27) suggesting that participants found the task moderately challenging. A one-way ANOVA revealed no significant differences among groups on this measure.

Intention to Exercise

Intention to exercise was assessed with a single item in the post-experimental questionnaire. The mean (M = 6.17, SD = 1.32) was greater than the scale midpoint, suggesting that in general, participants intended to exercise the following day. However, a one-way ANOVA revealed no significant differences among groups on this measure, $F(2,26) = .16$, $p > 0.05$.

CHAPTER 5

DISCUSSION

The primary aim of this study was to examine a potential moderator of the Köhler effect by exploring dissimilarity in one's partner's physical size, namely, having a similar-weight partner (compared to a lighter-weight partner) with participants who are defined as obese (BMI is 30 or greater). My results showed that those who exercised with a lighter-weight partner (one in the normal BMI range) persisted significantly longer than the individual control. Unlike Forlenza et al.'s (2012) findings with normal weight participants, where, the partner's larger physical size did not matter, it mattered in this study with obese participants.

The biggest Köhler effect was among obese participants who were paired with a slimmer (normal weight) partner. Although participants who exercised with a similar-weight partner persisted longer than controls, the difference was not significant. The motivation gains achieved in both partnered conditions did not come at the expense of aversion to the task. Although all partnered participants viewed the task as more difficult than individual controls, there was no evidence that they perceived they were working any harder (i.e., no significant differences in RPE), enjoyed the exercise less, or had lower SE at the task than controls (i.e., no significant differences in SE). The lack of differences in RPE does not support previous research showing that overweight and obese individuals may report a higher rate of perceived exertion (RPE) and decreased enjoyment of activity (Ekkekakis & Lind, 2006). In fact, participants in the normal weight partnered condition reported a slightly higher average of overall enjoyment (*M* = 4.83, *SD* = .94) than those in the individual condition (*M* = 4.38, *SD* = .98). In particular, there was a significant difference between the partnered conditions, where participants who had a lighter weight partner reported higher overall enjoyment than those who were paired with someone of similar weight (*M* = 3.89, *SD* = .59). Further, there were no significant differences in intention to exercise in the future. SE was not significantly correlated with persistence at the task and there was no effect of experimental condition on SE ratings.

So why are obese participants persisting longer and reporting higher levels of enjoyment when paired with a normal weight partner? Perhaps, the obese participants have adopted the normal weight partner as an ideal social comparison partner. They may not want to identify with the similar partner who looks like them. They could have also perceived the normal weight partner as more attractive. They also may have been more motivated to want to make a good impression (not be the weak link) on their lighter-weight partner. In order to gain further knowledge, a qualitative study should be conducted in order to try to understand why there is a bigger Köhler effect with the normal weight partner.

No study is without its limitations, and this study is no exception. I employed only a single type of exercise—an isometric plank exercise. I cannot say that my findings will generalize to other exergames that are more dynamic in nature. In addition, the game and interaction with a virtually presented partner was a relatively brief one-time experience (approximately 10 min). Future studies should examine more dynamic exergames that involve longer interactions and over multiple sessions. Moreover, majority of the participants were females. Future studies should recruit more male participants to investigate whether there are any significant difference between gender among obese individuals. Additionally, researchers could study whether a computer-generated partner, rather than a real but absent human partner, can produce substantial motivation gains.

Another limitation to the present study is the majority of volunteers came from the Sparrow Weight Management clinic. Those individuals are members of the Sparrow Weight

Management program because they want to lose weight and become healthier. It is possible that they are already motivated to exercise whereas obese individuals who are not in a program may be less motivated and less active. Perhaps the results may be different if I was able to compare participants who were members of the program and those who were not.

Other potential limitations include the setting and task. The research took place in a lab, which could limit its generalizability to real-world conditions. However, because the experimental set-up led participants to believe they were interacting with another student over the Internet, it is plausible this set-up could be incorporated into future exergames. Because modern gaming systems allow people to play games with each other from all over the world via the Internet, expanding this to exercising with a partner seems very plausible.

The results of the present study suggest that obese individuals are concerned with their partner's physical size. Specifically, obese participants working out with virtually present, superior normal weight partners can improve persistence motivation on exercise game tasks. These findings provide a starting point to test additional features that have the potential to improve exercise persistence among obese individuals.

APPENDICES

APPENDIX A

PAR-Q

PAR-Q

1. Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?

YES or NO

2. Do you feel pain in your chest when doing physical activity?

YES or NO

3. In the past month, have you had chest pain when you were not doing physical activity?

YES or NO

4. Do you lose your balance because of dizziness or do you ever lose consciousness?

YES or NO

5. Do you have bone or joint problems that could be made worse by a change in your physical activity?

YES or NO

6. Is your doctor currently prescribing medication for your blood pressure or heart condition?

YES or NO

7. Do you know of any other reason why you should not do physical activity?

YES or NO

APPENDIX B

Self-Efficacy Questionnaire

Self-Efficacy Questionnaire

Figure 1.
Self-Efficacy Questionnaire

1. What is the number of seconds which you are completely confident that you can hold:
(You can use Tab key to move on to next text box)

The FIRST exercise?

The SECOND exercise?

The THIRD exercise?

First Exercise

APPENDIX C

Ratings of Perceived Exertion

Ratings 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

Physical Activity Enjoyment Scale (PACES)

Physical Activity Enjoyment Scale (PACES)

Please rate how you feel at the moment about the physical activity you have been doing according to the following scales (find the scales above and to the left of each row of checkboxes- ex. 1 = _______, 7 = _______)

1. 1= I loved it, 7= I hated it
2. 1 = I felt bored, 7 = I felt interested
3. 1 = I disliked it, 7 = I liked it
4. 1 = I found it pleasurable, 7 = I found it unpleasurable
5. 1 = I was very absorbed in this activity, 7 = I was not at all absorbed in this activity
6. 1 = It was no fun at all, 7 = It was a lot of fun
7. 1 = It was very pleasant, 7 = It was very unpleasant
8. 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

APPENDIX E

Intention to Exercise

Intention to Exercise

Please respond to the following statement:

"My goal is to exercise tomorrow for at least 30 minutes"

-3 -2 -1 0 1 2 3

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

Please respond to the following statement:

"I intend to exercise tomorrow for at least 30 minutes"

-3 -2 -1 0 1 2 3

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

APPENDIX F

Post-experimental Questionnaire

Post-experimental Questionnaire

1. How much interest would you have in participating in another exercise study like this one? (1= None at all, 8 = Very much)

	1	2	3	4	5	6	7	8
Rate	◯	◯	◯	◯	◯	◯	◯	◯

2. How difficult did you find the exercises that you did today? (1= not at all difficult, 8 = extremely difficult)

	1	2	3	4	5	6	7	8
Rate	◯	◯	◯	◯	◯	◯	◯	◯

3. How much effort did you exert when performing these exercises? (1= my absolute minimum, 8 = my absolute maximum)

	1	2	3	4	5	6	7	8
Rate	◯	◯	◯	◯	◯	◯	◯	◯

4. How capable to perform these exercises do you feel? (1 = extremely incapable, 8 = extremely capable)

	1	2	3	4	5	6	7	8
Rate	◯	◯	◯	◯	◯	◯	◯	◯

5. If you performed the last series of exercises with anyone (beside the Experimenter), what is your best estimate of how that person compared to you in ability?

- ◯ 0 Not applicable, I didn't perform the last series of exercises with anyone (beside the Experimenter)
- ◯ 1 (The other person was much less capable than me)
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5
- ◯ 6
- ◯ 7
- ◯ 8
- ◯ 9 (The other person was much more capable than me)

6. In which of the following conditions did you perform the last series of exercises? (check one)

- 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
- 4. I performed these exercises as part of a two-person team
- 5. I performed these exercises as part of a three-person team

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

- 1. My score is the sum of the number of seconds I held each exercise
- 2. My score is the 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

***8. In relation to your current weight, your partner's weight is __________ .**

	n/a - I did not have a partner	much lighter	slightly lighter	the same	slightly heavier	much heavier
Rate						

***9. Was there anything confusing or odd about the experiment?**

***10. What, in your own words, do you think the purpose of this experiment was?**

APPENDIX G

Consent Form

Consent Form

Research Consent Form

Group Performance Study

1. The purpose of this study is to examine the effect of exercise video games on exercise behavior.

2. This study is being conducted by Professor Deborah Feltz of the MSU Department of Kinesiology. An IRB trained member of her study team will be present during the session.

3. In this study, you will be asked to perform a number of abdominal exercises (i.e., plank exercises) for as long as you feel comfortable alongside a PlayStation 2 exergame, the EyeToy: Kinetic. You will also complete questionnaires throughout the study, including a short pre-screening (see #7). You may also be asked to report your reactions to the task verbally. As part of your participation, you will receive a free body composition assessment using the Tanita BC-418 scale. This involves the use of 8 polar electrodes, which will be placed on your arms, legs, and trunk in order to obtain an accurate measure.

4. There are two foreseeable risks to participating in this study. It is possible that you will become fatigued or experience some muscle soreness as a result of performing the experimental tasks. And, if you already have some arm, shoulder, leg, or back injury,

performing the tasks could aggravate that injury. For that reason, if you have any such injuries, you may **not** participate in this study.

5. Although there may not be a direct benefit to you for participating, in the future, we hope others may benefit from the information we obtain from your participation.

6. Your responses will be kept strictly confidential (to the maximum extent allowable by law). All your responses will be used for research purposes only. Your name will not be associated with any report of research findings. Within these restrictions, results of the study will be made available to you at your request. Results will be kept in a locked cabinet in the office of the primary investigator for a minimum of 5 years following the study, accessible only by the primary investigator or the Institutional Review Board. While we will collect your name and email address, this is so we are able to contact you about the study if needed. Your name and email address will be kept separate from your data and deleted when the data analysis is complete.

7. Participation in this research project is completely voluntary. You may choose not to answer specific questions or to stop participating at any time without penalty or loss of benefits. Participation in this study will require about 50 minutes.

8. You can participate in the study only if you feel healthy, are in normal or good bodily constitution, and have no arm, shoulder, leg, or back injuries. You must also complete the

Physical Activity Readiness Questionnaire (PAR-Q) which assesses your readiness to perform physical activity.

9. As compensation for participating in the study, you will receive: a free Tanita scale measurement, a chance to win one of three $50 gift cards, and a short workout.

10. If you have concerns or questions about this study, such as scientific issues, how to do any part of it, or to report an injury, please contact Dr. Deborah Feltz (130 IM Circle, Dept. of Kinesiology, MSU, East Lansing, MI 48823; phone: 355-4732, e-mail: dfeltz@msu.edu) at the MSU Kinesiology Dept.

11. If you are a minor (under the age of 18), you cannot participate in this study.

12. If you have questions or concerns about your role and rights as a research participant, would like to obtain information or offer input, or would like to register a complaint about this study, you may contact, anonymously if you wish, the Michigan State University's Human Research Protection Program at 517-355-2180, Fax 517-432-4503, or e-mail irb@msu.edu or regular mail at 408 W. Circle Dr., 207 Olds Hall, Michigan State University, East Lansing, MI 48824.

Your signature below indicates your voluntary agreement to participate in this study.

Signature: ____

Print Name: ____

Today's Date: ____

APPENDIX H

Debriefing Script

Debriefing Script

Group Performance Study

Participant Information Sheet

First of all thank you very much for participating in this study. You have made an important contribution to a developing literature in exercise psychology research. At this point, at the end of the study, we would like to tell you a little more about the background of this research.

As you probably have noticed, one of our main interests in this study is the differences in performance when persons work alone or together with other people. Although working in a group usually is more fun than working alone, a lot of research in the past has shown that the productivity of groups is somewhat lower than the added performance of persons working alone. Two general reasons might be responsible for this difference: (a) problems due to coordinating actions of group members, so-called ‘coordination losses’ and (b) a decrease of motivation in groups because each member expects that others are doing the work, so-called ‘motivation losses’.

However, we are convinced that sometimes working in a group can increase productivity beyond the added single productivity of persons. In particular, we expect that working with a person slightly higher in capability can increase performance more than working with a person equal in strength. In combining persons of different strengths in the exercise task we wanted to test this hypothesis. Overall, the results of this study should further our knowledge about group productivity and how to increase the performance of working teams.

Additionally, although your partner (if you were in the experimental conditions) was a real person, this person was not connected to us "live." Instead, their interactions and behaviors were pre-recorded and we automated our programs to make their interactions and behaviors as real as possible. As such, you did not exercise with a real, live partner, but instead a real, pre-recorded partner. Therefore, while the information we gave you about your performance was true, the information we have about your performance relative to your partner was not true, as your partner was a pre-recorded person and programmed to last longer than you no matter how long you held the exercises.

Because we are still running this study, we ask you to avoid discussing this study with other students who have not already participated in our experiment. Thank you for your cooperation. As you now know the full purpose of the study, you have the option of removing yourself from the study if you desire at no penalty to you.

If you have any questions or want more information, please contact Dr. Deborah Feltz (dfeltz@msu.edu). You may also refer to the following source:

Kerr, N. L., Messé, L. M., Seok, D., Sambolec, E., Lount, R. M., & Park, E. S. (2007). Psychological mechanisms underlying the Köhler motivation gain. *Personality and Social Psychology Bulletin, 33*, 828-841.

APPENDIX I

Tables and Figures

Tables and Figures

Descriptive Statistics

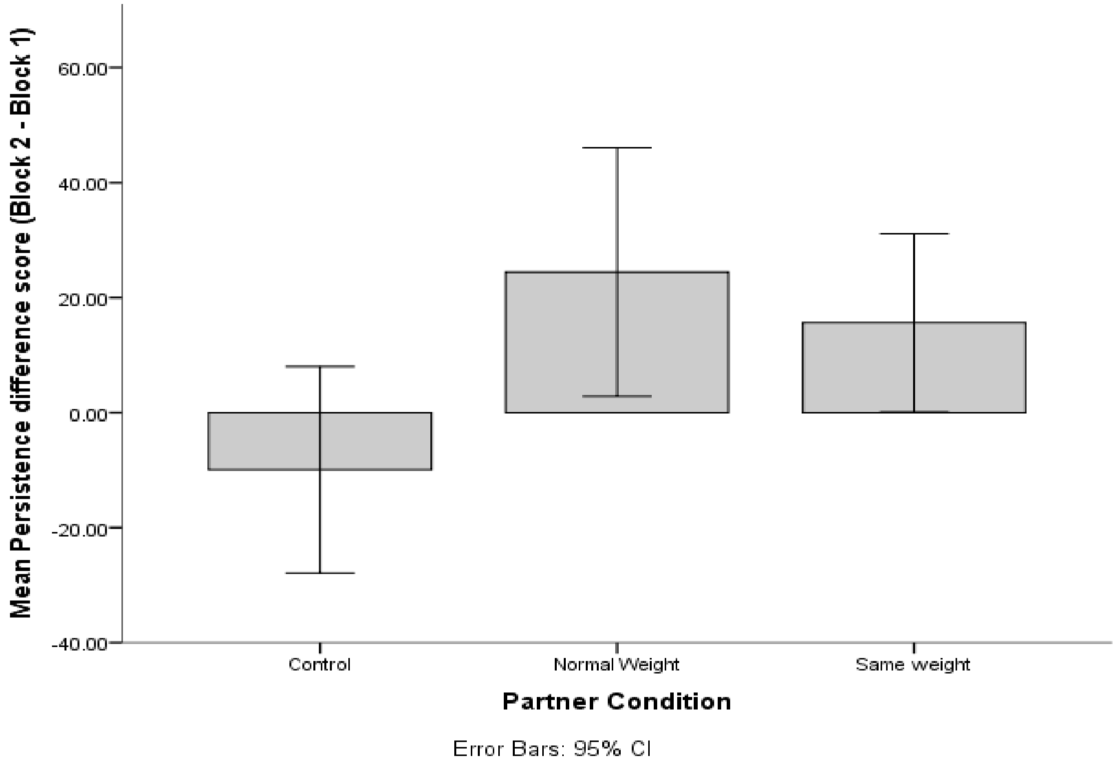
Table 1.
Primary dependent variables

Variable	Mean	Std. Deviation	N
Persistence Block 1 Sum	88.17	57.88	35
Persistence Block 2 Sum	97.09	52.04	35
Difference score (Block 1 - Block 2)	8.91	31.63	35
Pre-Block 1 Self Efficacy	70.17	49.98	35
Post-Block 1 Self Efficacy	69.97	43.09	35
Post-Block 2 Self Efficacy	69.20	45.07	35
Block 1 RPE	42.42	5.76	33
Block 2 RPE	42.97	5.45	33
Enjoyment	4.36	0.92	35
Intention to Exercise	6.17	1.32	35

Table 2.
Persistence Difference Score by Condition

Partner Condition	Mean	N	Std. Deviation
Control	-9.92	13	29.69
Lighter Weight	24.45	11	32.14
Same weight	15.64	11	23.09

Figure 2.
Block 2 – Block 1 mean persistence scores.



BIBLIOGRAPHY

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Aiello, J. R., & Kolb, K. J. (1995). Electronic performance monitoring and social context: Impact on productivity and stress. *Journal of Applied Psychology, 80, 339-353*.

Aiello, J. R., & Svec, C. M. (1993). Computer monitoring of work performance: Social facilitation and electronic presence. *Journal of Applied Social Psychology, 23, 537- 548.*

American College of Sports Medicine (2000). *ACSM's Guidelines for Exercise Testing and Prescription, 6; 145.*

Annesi, J. J., & Unruh, J. L. (2008). Relations of Exercise, Self-Appraisal, Mood Changes and Weight Loss in Obese Women: Testing Propositions Based on Baker and Brownell's (2000) Model. *The American Journal of the Medical Sciences, 335*(3), 198-204. doi:10.1097/maj.0b013e318152010c

Bain, L. L., Wilson, T., & Chaikind, E. (1989). Participant perceptions of exercise programs for overweight women. *Research Quarterly for Exercise and Sport, 60, 134-143.*

Bandura, A. (1986). Social foundations of thought and action: A social cognitive theory. Englewood Cliffs, NJ: Prentice-Hall.

Bandura, A. (1997). Self-efficacy: The exercise of control. New York: Freeman.

Baron, R.S., & Kerr, N. (2003). Group Process, Group Decision, Group Action. 2nd ed. Buckingham: Open University Press. Bain, L. L., Wilson, T., & Chaikind, E. (1989). Participant perceptions of exercise programs for overweight women. *Research Quarterly for Exercise and Sport, 60, 134-143.*

Borg, G. (1998). Borg's Perceived Exertion and Pain Scales. Champaign, IL: Human Kinetics.

Carron, A.V., Burke, S. & Prapavessis, H. (2004). *Journal of Applied Sport Psychology, 16, 41-58.*

Davis, J. H. (1969). Group performance. Reading, MA: Addison-Wesley.

Diehl, M. & Stroebe, W. (1987). Productivity loss in brainstorming groups: Toward the solution of a riddle. *Journal of Personality and Social Psychology, 53, 497-509.*

Dishman, R.K, & Buckworth, J. (1996). Increasing physical activity: a quantitative synthesis. *Medicine and Science in Sports and Exercise, 28, 706-19.*

Dishman, R.K, Sallis. J.F, & Orenstein, D.R. (1985). The determinants of physical activity and exercise. *Public health reports, 100, 158-71.*

Dzewaltowski, D.A., Noble, J.M., & Shaw, J.M. (1990). Physical activity participation: Social cognitive theory versus the theories of reasoned action and planned behavior. *Journal of Sport and Exercise Psychology,12, 388–405.*

Erev, I., Bornstein, G., & Galili, R. (1993). Constructive intergroup competition as a solution to the free rider problem in the workplace. *Journal of Experimental Social Psychology, 29, 463-478.*

Feinberg, J. M., & Aiello, J. R. (2006). Social facilitation: A test of competing theories. *Journal of Applied Social Psychology, 36, 1087-1109.*

Feltz, D.L., Irwin, B.C., Kerr, N.L. (2012) Two-player partnered exergame for obesity prevention: Using discrepancy in players' ability as a strategy to motivate physical activity. *Journal of Diabetes Science and Technology, 6, 1-8.*

Feltz, D.L., Kerr, N.L., Irwin B.C. (2011). Buddy up: The Köhler effect applied to health games. *Journal of Sport and Exercise Psychology, 33, 506-526.*

Feltz, D.L., & Riessinger, C.A. (1990). Effects of in vivo emotive imagery and performance feedback on self-efficacy and muscular endurance. *Journal of Sport and Exercise Psychology 12, 132-143.*

Feltz, D.L., Short, S.E., & Sullivan, P.J. (2008). Self-Efficacy in Sport. Champaign, IL: Human Kinetics. Fletcher GF, Balady G, Blair SN, Blumenthal J, Caspersen C, Chaitman B, et al. (1996). Statement on exercise: benefits and recommendations for physical activity programs for all Americans. A statement for health professionals by the Committee on Exercise and Cardiac Rehabilitation of the Council on Clinical Cardiology, *American Heart Association. Circulation, 94, 857-62.*

Fletcher G.F., Balady G.J., Amsterdam E.A., Chaitman B., Eckel R., Fleg J., et al. (2001). Exercise standards for testing and training: a statement for healthcare professionals from the *American Heart Association. Circulation, 104, 1694-1740*.

Forlenza, S. T., Kerr, N. L., Irwin, B., & Feltz, D. L. (2012). Is my Exercise Partner Similar Enough?: Partner Characteristics as a Moderator of the Köhler Effect in Exergames. *Games for Health Journal, 1(6), 436-441.*

Henriksen, E. J. (2002). Invited Review: Effects of acute exercise and exercise training on insulin resistance. *Journal of Applied Physiology J Appl Physiol*, *93*(2), 788-796. doi:10.1152/japplphysiol.01219.2001

Hertel, G., Deter, C., & Konradt, U. (2003). Motivation gains in computer-mediated work groups. *Journal of Applied Social Psychology, 33, 2080–2105.*

Hertel, G., Kerr, N. L., & Messé, L. A. (2000). Motivation gains in groups: Paradigmatic and theoretical advances on the Köhler effect. *Journal of Personality and Social Psychology, 79, 580-601.*

Hertel, G., Kerr, N. L., Scheffler, M., Geister, S., & Messé, L. A. (2000). Instrumentality effects on motivation gains in groups: The role of impression management and spontaneous goal setting in promoting the Köhler effect. *Journal of Social Psychology, 31, 204-220.*

Hertel, G., Niemeyer, G., & Clauss, A. (2008). Social indispensability or social comparison: The why and when of motivation gains of inferior group members. *Journal of Applied Social Psychology, 38, 1329-1363.*

Hutchinson, J.C., Sherman, T., Martinovic, N., & Tenenbaum, G. (2008). The effect of manipulated self-efficacy on perceived and sustained effort. *Journal of Applied Sport Psychology.*

Jung, J.H., Schneider, C., & Valacich, J.S. (2005). The Effects of Real-Time Individual Performance Feedback and Goal Setting on Computer-Mediated Group Idea Generation. Proceedings of the *International Conference on Information Systems, Las Vegas, Nevada, USA.*

Karau S. J., & Williams, K. D. (1993). Social loafing: A meta-analytic review and theoretical integration. *Journal of Personality and Social Psychology, 45, 681-706.*

Kerr, N. L. (1983). Motivation losses in task-performing groups: A social dilemma analysis. *Journal of Personality and Social Psychology, 45, 819-828.*

Kerr, N. L., & Bruun, S. (1983). The dispensability of member effort and group motivation losses: Free rider effects. *Journal of Personality and Social Psychology, 44, 78-94.*

Kerr, N.L., Feltz, D. L., & Irwin, B. (2013). To Pay or Not to Pay?: Do extrinsic Incentives Alter the Köhler Group Motivation Gain? *Group Processes and Intergroup Relations, 16(2), 257-268.*

Kerr, N. L., Forlenza, S. T., Irwin, B., & Feltz, D. L. (2012). "... been down so long...": Perpetual vs. Intermittent Inferiority and the Köhler Group Motivation Gain and in Exercise Groups. *Group Dynamics: Theory, Research, and Practice, 17(2), 67-80.*

Kerr, N. L., & MacCoun, R. J. (1984). Sex composition of groups and member motivation: Effects of relative member ability. *Journal of Basic and Applied Social Psychology, 5, 255-271.*

Kerr, N. L., Messé, L. M., Park, E. S., & Sambolec, E. (2005). Identifiably, performance feedback and the Köhler effect. *Group Processes and Intergroup Relations, 8, 375- 390.*

Kerr, N, L., Messé, L. A., Seok, D. H., Sambolec, E. J., Lount, R. B., Jr., & Park, E. S. (2007). Psychological mechanisms underlying the Köhler motivation gain effect. *Personality and Social Psychology Bulletin, 33, 828-841.*

Kerr, N. L. & Sullaway, M. E. (1983). Group sex composition and member motivation. *Sex Roles, 9, 403-417.*

Kerr, N. L., Seok, D., Poulsen, J., Harris, D., & Messé, L. M. (2008). Social ostracism and group motivation gain. *European Journal of Social Psychology, 38, 736-746.*

Köhler, O. (1926). Physical performance in individual and group situations. *Industrial Psychology, 3, 274-282.*

Köhler, O. (1927). On group efficiency of physical labor and the conditions of optimal collective performance. *Industrial Psychology, 4, 209-226.*

Latane, B., K. Williams, & Harkins, S. (1979). Many Hands Make Light The Work: The Causes and Consequences of Social Loafing. *Journal of Personality and Social Psychology, 37, 822-832.*

Lount, R. B., Jr., Messé, L. A., & Kerr, N. L. (2000). Trying harder for different reasons: Conjunctivity and sex differences as bases for motivation gains in performing groups. *Journal of Social Psychology, 31, 221-230.*

Lount, R. B., Jr., & Phillips, K. W. (2007). Working harder with the out-group: The impact of social category diversity on motivation gains. *Organizational Behavior and Human Decision Processes, 103, 214-224.*

Matsui, T., Kakuyama, T., & Onglatco, M.L.U. (1987). Effects of Goals and Feedback on Performance in Groups. *Journal of Applied Psychology, 72, 407-415*

McAuley, E.(1992). The role of exercise cognitions in the prediction of exercise behavior of middle-aged adults. *Journal of Behavioral Medicine, 15, 65-88.*

McAuley, E.(1993). Self-efficacy and the maintenance of exercise participation in older adults. *Journal of Behavioral Medicine, 16, 103-113.*

McAuley, E., Talbot, H.M., Martinez, S. (1999). Manipulating self-efficacy in the exercise environment in women: influences on affective responses. *Health Psychology 18, 288–294.*

Messé, L. A., Hertel, G., Kerr, N. L., Lount, R. B., & Park, E. S. (2002). Knowledge of partner's ability as a moderator of group motivation gains: An exploration of the Köhler discrepancy effect. *Journal of Personality and Social Psychology, 86, 935- 946.*

Mohiyeddini, C., Pauli, G. & Bauer, S. (2009). The role of emotion in bridging the intention-behaviour gap: The case of sports participation. *Psychology of Sport & Exercise, 10, 226-234.*

Paulus, P. B., Larey, T. S., Putman, V. L., Leggett, K. L., & Roland, E. J. (1996). Social influence process in computer brainstorming. *Basic and Applied Social Psychology, 18, 3–14.*

Raedeke TD. The relationship between enjoyment and affective responses to exercise. *J Appl Sport Psychology 2007; 19: 105-115.*

Roy, M.C., Gauvin, S. & Limayem, M. (1996). Electronic Group Brainstorming: The Role of Feedback on Productivity. *Small Group Research, 27, 215-247.*

Ross, R., Dagnone, D., Jones, P., Smith, H., Paddags, A., Hudson, R., & Janssen, I. (2000). Reduction in Obesity and Related Comorbid Conditions after Diet-Induced Weight Loss or Exercise-Induced Weight Loss in Men. *Annals of Internal Medicine Ann Intern Med, 133*(2), 92. doi:10.7326/0003-4819-133-2-200007180-00008

Sambolec, E., Messé, L. A., & Kerr, N. L. (2007). The role of competitiveness at social tasks: Can subtle cues enhance performance? *Journal of Applied Sport Psychology, 19, 160-172.*

Scanlan, T.K., & Simons, J.P. (1992). *The construct of sport enjoyment*. In G.C. Roberts (Ed.), Motivation in sport and exercise (pp. 199-215). Champaign, IL: Human Kinetics.

Scorniaenchi, J. A. (2011). *Picking Up The Pace: Testing the Effects of The Köhler Motivational Gain on an Aerobic Task* (Master's Thesis).

Shaw, J. M., Dzewaltowski, D. A., & McElroy, M. (1992). Self-efficacy and causal attributions as mediators of perceptions of psychological momentum. *Journal of Sport & Exercise Psychology, 14, 134-147.*

Shepherd, M. M., Briggs, R. O., Reinig, B. A., Yen, J., & Nunamaker, J. F. (1996). Invoking social comparison to improve electronic brainstorming: Beyond anonymity. *Journal of Management Information Systems, 12, 155–170.*

Shepperd, J. A. (1993). Productivity loss in performance groups: A motivation analysis. *Psychological Bulletin, 113, 67–81.*

Seok, D.H. (2004). Exploring self-efficacy as a possible moderator of the Köhler discrepancy effect. Unpublished Thesis.

Seta, J. J. (1982). The impact of comparison processes on coactors' task performance. *Journal of Personality and Social Psychology, 42, 281-291.*

Steiner, I. D. (1972). Group processes and productivity. New York: Academic Press.

Stone, D. N. (1994). Overconfidence in initial self-efficacy judgments: Effects on decision processes and performance. *Organizational Behavior and Human Decision Processes, 59, 452-474.*

Straker, L. M., Fenner, A. A., Howie, E. K., Feltz, D. L., Gray, C. M., Lu, A. S., … Barnett, L. M. (2015). Efficient and Effective Change Principles in Active Videogames. *Games for Health Journal*, *4*(1), 43–52. http://doi.org/10.1089/g4h.2014.0077

Stroebe, W., Diehl, M., & Abakoumkin, G. (1996). Social compensation and the Köhler Effect: Toward a theoretical explanation of motivation gains in group productivity.

Tedeschi, J. T., Schlenker, B. R., Bonoma, T. V. (1971). Cognitive dissonance: Private ratiocination or public spectacle? *American Psychologist, 26, 685-695.*

Tedeschi, J. T., & Rosenfeld, P. (1981). Impression management theory and the forced compliance situation. In J. T. Tedeschi (Ed.), Impression management theory and social psychological research (pp. 147–177). New York: Academic Press

Triplett, N. (1897). The dyanmogenic factors in pacemaking and competition. *American Journal of Psychology, 9, 507—533.*

U.S Department of Health and Human Services (2000). Healthy People 2010 (2nd ed.) Washington, D.C.

U.S Department of Health and Human Services (2008). Physical Activity and Health: A Report of the Surgeon General. Washington, D.C.

Weber, B., & Hertel, G. (2006). Effect sizes and moderators of the Köhler motivation gain effect: A meta-analytical review. *Paper presented at the annual convention of the Midwestern Psychological Association, Chicago*.

Weinberg, R. S., Gould, D., & Jackson, A. (1979). Expectations and performance: An empirical test of Bandura's self-efficacy theory. *Journal of Sport Psychology, 1, 320-331.*

Weinberg, R. S., Gould, D., Yukelson, D., & Jackson, A. (1981). The effect of preexisting and manipulated self-efficacy on competitive muscular endurance task. *Journal of Sport Psychology, 4, 345-354.*

Weinberg, R., Grove, R., & Jackson, A. (1992). Strategies for building self-efficacy in tennis players: A comparative analysis of Australian and American coaches. *Sport Psychologist, 6, 3-13.*

Weinberg, R. S., Yukelson, D., & Jackson, A. (1980). Effects of public and private efficacy expectations on competitive performance. *Journal of Sport Psychology, 2, 340-349.*

Weinstein, A., Sesso, H., & Lee, I. (2004). Relationship of physical activity vs. body mass index with type 2 diabetes in women. *ACC Current Journal Review, 13*(12), 11. doi:10.1016/j.accreview.2004.11.012

Weinstock, R. S., Huilliang, D., & Wadden, T. A. (1998). Diet and Exercise in the Treatment of Obesity: Effects of 3 Interventions on Insulin Resistance. *Archives of Internal Medicine, 158*(22), 2477-2483.

Weiss, M. R., Wiese, D. M., & Klint, K. A. (1989). Head over heels with success: the relationship between self-efficacy and performance in competitive youth gymnastics. *Journal of Sport and Exercise Psychology, 11, 444-451. 108*

Williams, K. D., & Karau, S. J. (1991). Social loafing and social compensation: The effects of expectations of co-worker performance. *Journal of Personality and Social Psychology, 61, 570-581*.

Witherspoon, L. (2013). Exergaming. *American College of Sports*. Retrieved from https://www.acsm.org/public-information/brochures-fact-sheets/brochures

Vancouver, J. B., Thompson, C. M. Tischner, E. C., & Putka, D. J. (2002). Two studies examining the negative effect of self-efficacy on performance. *Journal of Applied Psychology, 87, 506-516.*

Vroom, V. H. (1964). Work and motivation. New York: Wiley.

Zajonc, R. B., (1965). Social Facilitation. Science, 149, 269-274.