INCREASING PHYSICAL ACTIVITY IN FREE-LIVING CONDITIONS: AN EXAMINATION OF THE KÖHLER MOTIVATION GAIN EFFECT

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ABSTRACT

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The purpose of this study was to examine the efficacy of Köhler motivation gain principles (i.e. indispensability, social comparison) for increasing physical activity under free-living conditions. This field experiment employed a 2 (gender) x 3 (condition: individual, coactive, conjunctive) x 8 (weeks) factorial design with repeated measures on the last factor. After a 1-week assessment of baseline habitual physical activity (using Sensewear Armband monitors, expressed as energy expenditure), participants had a brief orientation in the lab where they learned safe strategies for increasing their physical activity, appropriate for stage of participant readiness for change (Marcus, Banspach et al., 1992). After the orientation, participants were randomly assigned to one of the three conditions and their task was to increase their physical activity over a 7-week period. All subjects received performance feedback on their energy expenditure each week. Participants in the partner conditions also received performance feedback on their partner’s energy expenditure, which was manipulated to be always greater than the subject’s. Planned contrasts showed that partner conditions initially decreased, $F (1,17) = 7.92, p = .01$, but maintained a steady level of physical activity (and approached a significant positive linear trend) over the last 3 weeks of the study, $F (1, 16) = 4.12, p = .06$. Physical activity for subjects in the individual condition did not change, $F (6, 18) = 1.40, p = .27$. Limitations, implications, and directions for future research are discussed.
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CHAPTER 1

Introduction

Nature of the Problem

Physical inactivity is a primary risk factor of poor health (USDHHS, 2008). Over the past 50 years, health professionals and researchers have developed an empirically based set of physical activity (PA) recommendations that include at least 30 min of moderate-intensity PA at least 5 days per week for adults (Haskell et al., 2007). While previous estimates of self-reported physical activity were 45% of adults meeting these recommended levels (Macera et al., 2005), more recent reports of objectively measured (e.g., accelerometer) activity indicate that the adherence to the recommendation is less than 5% (Troiano et al., 2008). Furthermore, only 1.4% of all days achieved 10 min or more of vigorous PA (VPA), and in 91.1% of all days, participants accumulated less than 1 min of VPA (Metzger et al., 2008).

One barrier to achieving and adhering to recommended levels of PA is motivation (Dishman, 1993). Motivation has been defined as “the hypothetical construct used to describe the internal and/or external forces that produce the initiation, direction, intensity, and persistence of behavior” (Vallerand & Thill, 1993; p. 18). For those who initiate an exercise regimen, research has typically reported about a 50% drop out rate within the first 6 months (Dishman, 1994). Researchers have also shown that adherence to exercise decreases as intensity and duration of activity increases (Dishman & Buckworth, 1996). However, experts point out that one does not necessarily need to engage in high intensity exercise to receive the benefits of PA (Haskell et al., 2007), and indeed there are many health benefits associated with even low and moderate intensity PA. Thus, many interventions have focused on lifestyle physical activities of normal daily living (e.g. walking to work instead of driving, taking the stairs instead of the escalator)
and have shown similar changes in PA as structured exercise programs (Dunn et al., 1999), while also being more cost-effective (Sevick et al., 2000).

As ecological (McLeroy, Bibeau, Steckler, & Glanz, 1988) and psychosocial (Bandura, 1986) models of behavior suggest, there are a variety of forces that influence health behaviors. One specific genre is social influence. There are a variety of social and psychological factors that influence PA behavior (Franzini et al., 2009; USDHHS, 2008). For example, significant effects on PA have been found for social support from health professionals, family, and friends (Coleman, Cox, & Roker, 2008; Zakarian, Hovell, Hofstetter, Sallis, & Keating, 1994), social modeling of PA (Feltz & Riessinger, 1990; Fox, Rejeski, & Gauvin, 2000), other exercise participants (Carron, Hausenblas, & Mack, 1996), as well as the influence group exercise settings (Dishman & Buckworth, 1996). Group exercise, in particular, is a fertile area for research given that researchers have consistently found that group exercise leads to higher exercise adherence than individual exercise programs (Dishman & Buckworth, 1996).

In their quantitative synthesis of 136 interventions, Dishman and Buckworth (1996) found that interventions delivered to groups (and communities) had significantly higher effect sizes than those administered to individuals, families or individuals within groups (weighted for sample size). Group exercise programs are also related to higher enjoyment, intention to continue exercising, as well as higher levels of social support and opportunities for comparison with others. However, despite the many positive associations between group contexts and PA behavior, little is known about the psychological mechanisms through which such influence works. Furthermore, while little or no relationship has been found for affiliation motives/incentives and adherence behavior (Carron et al., 1996), exercise programs do not
typically make participants interdependent with one another, which, according to basic research in group dynamics, may fail to capitalize on several potent motivating psychological processes.

A growing body of research suggests that motivation in task groups (e.g. exercise partners) can be enhanced via social psychological processes including social comparison, competition and indispensability. For example, Feltz, Kerr and Irwin (2011) found that motivation to exercise can be increased by exercising with a moderately more capable partner, especially under conjunctive task demands. Conjunctive tasks are those in which a team’s performance is defined by the performance of its least capable member (i.e. the “weak link”). This “motivation gain” phenomenon is known as the Köhler effect.

The Köhler effect occurs when individuals within groups (e.g. dyads) who are partnered with a more capable partner exert more effort than would otherwise be expected given his/her performance on a comparable individual task. Researchers suggest that the Köhler effect can be explained by two mechanisms; social comparison and indispensability (Weber & Hertel, 2007). The first mechanism stresses the importance of having the opportunity to compare one’s performance with a superior partner. When such opportunities exist, (a) performance goals are revised upwards and/or (b) a new performance goal of successful competition (i.e. beating one’s partner) becomes salient. Either way, it is the opportunity for comparison that partially underlies motivation gains. The second mechanism stresses the importance of feelings of indispensability. As value-expectancy and indispensability models suggest (Vroom, 1964), when one perceives his/her efforts as highly indispensable for a valued outcome (e.g., favorable peer evaluation, avoiding negative evaluation, successful team performance), one is more inclined to put forth higher effort. Indeed, there is strong evidence that suggests both of these mechanisms likely account for the motivation gains observed in laboratory settings (see Kerr et al., 2007).
The Köhler effect phenomenon has typically been studied in laboratory settings. The most common paradigm has involved a simple motor persistence task where subjects are asked to hold a small hand-held weight out in front of them, parallel to the floor, for as long as they can (Hertel, Kerr, & Messé, 2000). Others have extended this to other types of tasks, including cognitive and both isometric (Feltz et al., 2011) and aerobic (Irwin, Scorniaenchi, Feltz, Kerr, & Eisenmann, in press) exercise tasks. In general, these studies have supported previous research that used the hand-weight paradigm; motivation gains were observed for those exercising coactively with a partner, and even higher gains were observed for those exercising under conjunctive task conditions. Further, when tasks were performed over repeated sessions, the strength of the indispensability mechanism (i.e., for those in the conjunctive conditions) increased over time, as evidenced by increasingly longer bouts of aerobic exercise, rather than remaining constant (as was the case with the social comparison mechanism under coactive task conditions) or even attenuating over time (in individual control condition) (Irwin et al., in press).

Other researchers have observed the Köhler effect phenomenon in the field. For example, Hüffmeier & Hertel (2011) found, using archival data from the 2008 Olympics, that lower-ranked (within-team) relay swimmers performed better in relay events than would be expected given their performance in individual events. Higher ranked members performed about the same in the relay events as they did in their individual events. The authors attribute this phenomenon to the likelihood that these inferior athletes felt an increased sense of indispensability. This same pattern of results has been observed in other archival swimming data from NCAA championship swim meets (Osborn, Irwin, Skogsberg, & Feltz, in press).

Research examining the Köhler motivation gain effect has found evidence for the phenomena in a variety of settings and task conditions, including laboratory (see Weber &
Hertel, 2008, for review) and field settings (Huffmeier & Hertel, 2011; Osborn et al., Under review), temporally and spatially separated performances (Wittchen, Schlereth, & Hertel, 2007), and without continuous feedback regarding one’s partner’s performance (Kerr, Messé, Park, & Sambolec, 2005). For example, in a study of computer-supported groups, Hertel, Deter and Konradt (2003) found evidence of motivation gains when inferior group members were not in the physical presence of one’s partner. The finding that physical presence is not necessary for motivation gains is consistent with more current research (e.g., Lount Jr., Park, Kerr, Messé, & Seok, 2008) in which the researchers found that both physical and virtual presence of one’s partner resulted in motivation gains. In another study of computer-supported groups, Wittchen, Schlereth and Hertel (2007) found significant motivation gains for groups when feedback about one’s partner’s performance was given intermittently throughout a cognitive maximizing task. Lastly, while previous research has typically required participants to perform the task simultaneously with his/her partner, Wittchen et al. (2007) found evidence of motivation gains when the tasks were performed sequentially. While there is ample research in the group motivation literature to suggest that many of these task conditions are sub-optimal for facilitating higher levels of effort (e.g. low identifiability, anonymity; see Baron & Kerr, 2003), the fact that motivation gains are observed even under these sub-optimal conditions speaks to the robustness of these mechanisms, warranting further investigation of this phenomena in more applied contexts.

**Statement of the Problem**

While there have been some exciting discoveries in the area of motivation gains with a more capable partner in basic research and, more recently, in exercise tasks, there are several limitations and knowledge gaps. For one, Köhler motivation gains are typically studied under
highly controlled, laboratory conditions. Although Huffmeier and Hertel (2011) observed motivation gains in the field at swimming relay events, it is not clear whether these motivation gains translate into less-structured, free-living tasks. Second, many of the health problems in the U.S. are related to physical inactivity under free-living conditions. However, given the evidence of Köhler motivation gains in a wide variety of laboratory settings and conditions, and the relatively large effect sizes observed in exercise tasks (Irwin et al., in press; ES = 0.66, 1.80; Weber & Hertel, 2007; ES = 0.60), a next logical step is to attempt to systematically reproduce Köhler motivation gains in the field under free-living conditions. This study will extend previous research by examining the stability of the indispensability mechanism under free-living, ambient task settings. Practically, this study will assess the utility of Köhler effect principles in motivating people to increase free-living PA.

**Purpose of the Study**

The purpose of this study was to examine the efficacy of Köhler motivation gain principles (i.e. indispensability, social comparison) in increasing PA under free-living conditions. Based on previous research, the following hypotheses were tested:

**Hypotheses**

1. Energy expenditure in the conjunctive condition will be greater than energy expenditure in the coactive condition, and this difference will widen across weeks.

2. Energy expenditure in the partner conditions will be greater than in the individual condition, and this difference will widen across weeks

**Delimitations**

The findings are limited to a population of undergraduate students who are in good general health (i.e., healthy enough to do PA). The results of this study may not generalize to
older or younger populations, or folks of similar age but not currently in university. Lastly, results will be limited to the task of increasing free-living PA and may not be generalizable to other free-living tasks.

**Definitions**

1. *Coactive task*: Performing a task in the presence of another person who is performing the same task, independently and with no mutual group outcome.

2. *Conjunctive task*: A task where a group’s performance is defined by the performance of the least capable member (i.e. the “weak link”)

3. *Free-living PA*: Activity performed outside of laboratory conditions as part of one’s habitual, daily activities.

4. *Köhler motivation gain*: A performance within a group task that is superior to what would be expected given knowledge or one’s individual performance on the same task.
CHAPTER 2

Review of Literature

The purpose of this chapter is to provide a review of literature that is relevant to the variables and procedures used in this study. Specifically, the chapter introduces the problem of physical inactivity, social influences on PA behavior, the Köhler effect, the boundary conditions and moderators of the Köhler effect, and psychological mediators of PA.

The problem of physical inactivity

Physical inactivity is a primary risk factor of poor health (USDHHS, 2008). Over the past 50 years, health professionals and researchers have developed an empirically based set of PA recommendations that include at least 30 min of moderate-intensity PA at least 5 days per week for adults (Haskell et al., 2007). While previous estimates of self-reported PA were 45% of adults meeting these recommended levels (Macera, 2005), more recent reports of objectively measured (e.g., accelerometer) activity indicate that the adherence to the recommendation is less than 5% (Troiano et al., 2008). Furthermore, only 1.4% of all days achieved 10 min or more of vigorous PA (VPA), and in 91.1% of all days, participants accumulated less than 1 min of VPA (Metzger et al., 2008). Clearly, there is a need for Americans to be more physically active.

While many public health efforts have taken a social or environmental approach (Gordon, McDermott, Stead, & Angus, 2006; Kahn et al., 2002; Sallis, Bauman, & Pratt, 1998), others have approached it at the individual level and, specifically, as a problem of motivation. At its core, motivation is the intensity and direction of one’s behavior. Along with lack of time and resources, lack of motivation is cited as one of the strongest barriers to exercise and a physically active lifestyle (Booth, Bauman, Owen, & Gore, 1997).

Social influences on physical activity
A widely used approach to examining health behavior is through social-cognitive theory, which suggests that behavior is the product of an interaction between cognition, behavior and the environment (Bandura, 1997). Part of one’s environment is the social environment. Researchers examining social influences on PA behavior have approached the phenomenon from several levels of influence, including socio-cultural (Henderson, Ainsworth, Stolarczyk, Hootman, & Levin, 1999), community (Powell, Slater, & Chaloupka, 2004), organizational (Harris, Kuramoto, Schulzer, & Retallack, 2009), group (Burke, Carron, Eys, Ntoumanis, & Estabrooks, 2006), and interpersonal (Anderssen & Wold, 1992). While many people cite “interdependence” as a reason for participating in exercise (Anderssen & Wold, 1992), a particularly relevant level of analysis is the group and/or interpersonal level.

Physical activity interventions targeted at the group/interpersonal level have been found to be highly efficacious (Burke et al., 2006) in increasing PA. In a recent meta-analysis of 44 PA interventions (1,046 effect sizes), researchers found that group-level interventions were more effective than individual-level interventions, even when individual-level interventions included social support components (Burke et al., 2006). That social support is shown to be a highly influential factor in behavior change (Carron et al., 1996) speaks to the effectiveness of group-level interventions compared to individual-level strategies that involve social support.

A social-support approach to behavior change is largely concerned with the interaction between group members. Another approach, though, that relies less on the interpersonal skills of group members might be to focus on the situational characteristics of group PA, such as group composition, size and task demands. Indeed, basic research suggests that even the mere presence of others can influence one’s behavior, the famous example being Norman Triplett’s audience effect (Davis, Huss, & Becker, 1995; cf. Strube, 2005) and Zajonc’s (1965) social facilitation.
research which illustrated that people tend to put forth more effort when in the presence of others than they normally would when they are performing by themselves.

More recent research in the area of group psychology, however, suggests that increased effort is not a given, and has documented losses in effort when performing in the presence of others. For example, Karau and Williams (1993) have consistently found evidence of social loafing- a decrease in effort compared to what one would expect given knowledge of this person’s performance on his/her lonesome. So why are there increases in effort some cases, but losses in others?

The likely answer is that changes in effort are dependent on a number of other factors, in addition to mere presence, such as the instrumentality of one’s efforts in the group’s success (which can easily be manipulated through changing the conditions of the task) and value of the task (Vroom, 1964). Indeed, researchers have identified several conditions that hinder performance when individuals perform within the context of a group (e.g., low identifiability, low instrumentality, anonymity). However, more recently, researchers have also identified a unique set of conditions that facilitate individual performance within the context of a group (e.g., the Köhler effect). Given that group-exercise has proven to be an effective and even preferred type of health-related PA (Cohen-Mansfield, Marx, Biddison, & Guralnik, 2004; Jones & Courneya, 2002), but is also susceptible to the same process losses (e.g., social loafing) inherent in collaborative group activities, identifying these conditions and applying such knowledge to group PA contexts is warranted.

The Köhler effect

The Köhler effect was first observed by industrial psychologist Otto Köhler (1927) in a study involving university rowing team members. In his study, he first had rowers perform a
bicep curl task by themselves to exhaustion and then, after a period of rest, had them perform the same task with another, stronger team member under a conjunctive task condition. A conjunctive task is one in which group members perform collaboratively and where the team’s performance is defined by the performance of the team’s worst performer (i.e., the weak link). Köhler observed that weaker members performing under conjunctive task conditions performed better than what would be expected given his/her individual performance. Further, this motivation gain was greater under conjunctive conditions than under coactive conditions, where a weaker group member performs the same activity in the presence of another, but where there is no team/mutual outcome of the performance.

Researchers suggest that these motivation gains of inferior group members (the Köhler effect) can be explained by two mechanisms; social comparison and indispensability (Weber & Hertel, 2007). The first mechanism stresses the importance of having the opportunity to compare one’s performance with a superior partner. When such opportunities exist, (a) individual performance goals may be revised upwards and/or (b) a new performance goal of successful competition (i.e., beating one’s partner) becomes salient. Either way, it is the opportunity for comparison that makes these mechanisms possible. The second mechanism stresses the importance of feelings of indispensability. As value-expectancy and indispensability models suggest (Vroom, 1964), when one perceives his/her efforts as highly indispensable for a valued outcome (e.g., favorable peer evaluation, avoiding negative evaluation, successful team performance), one is more inclined to put forth higher effort. Indeed, there is strong evidence that suggests both of these mechanisms likely account for the motivation gains observed in laboratory settings (see Kerr et al., 2007).

**Boundary conditions and moderators of the Köhler effect**
In a recent review, Kerr & Hertel (2010) identified several likely moderators for each the indispensability and social comparison processes, as well as moderators of both processes. For the indispensability processes, first and foremost are the situational moderators and, in particular, the task structure. A consistent finding in many Köhler effect studies is that working under conjunctive tasks, compared to other individual (co-active tasks) or group tasks where one’s performance can be compensated for by others (additive tasks), has led to the greatest levels of task effort. Although it is reasonable that other conscious or dispositional processes might mediate these processes, the available research clearly indicates that when conjunctive task demands are not established, motivation and effort are mitigated (Weber & Hertel, 2007).

A second moderator of the indispensability mechanism is related to the value placed on the outcome of high effort. Along this line, gender appears to be a moderator of value. Specifically, females tend to be more sensitive to the indispensability effect than males in same-sex dyads (Kerr et al., 2007; Weber & Hertel, 2007). This observation is consistent with the assumption that women tend to place higher value on collectivistic (vs. individualistic) goals than men. Also, the nature of the relationship between group members also appears to moderate the effect (Kerr & Seok, 2011) whereby the closer the relationship between two group members, the more highly valued is the group’s success, and the stronger the effect. However, when the superior partner ostracizes the weaker member, the effect is eliminated (Kerr, Seok, Poulsen, Harris, & Messé, 2008)).

Similar to the moderators of the indispensability process, the salience of an upward social comparison and the value one places on the outcome of that comparison moderates the social comparison process. This moderation may involve both individual (e.g., gender) and situational (e.g., task conditions) factors. For example, because men have been shown to be more driven by
competition than women, the social comparison process may be more salient for men, and especially so when a male is partnered with a more capable female (Lount Jr, Messé, & Kerr, 2000). The social comparison process, thus, is the largest driver of the Köhler effect for men, whereas the indispensability process seems to be the strongest for women.

Both processes are likely moderated by one’s awareness and certainty that he/she is the inferior person in the group. That is, if inferior group members do not perceive themselves as inferior, then upward social comparison and indispensability are no longer salient (Hertel, Niemeyer, & Clauss, 2008). Accordingly, Kerr and Hertel (2010) suggest that role clarity is a necessary precondition for both of these mechanisms, and factors that directly affect such clarity should moderate the effect. Thus, performance feedback regarding one’s own and his/her partner’s performance is important, and especially the continuity of such feedback. Feedback that is received continuously throughout a performance is related to the strongest effects, whereas when feedback is given only once, before or after a performance, the effect is weakened (Hertel et al., 2008; Kerr et al., 2005; Weber & Hertel, 2008). The assumption here is that when one cannot see with his/her own eyes that the partner is performing at a level above one’s self, there is doubt about the partner’s superiority, and thus the certainty of the partner’s superior ability is mitigated. Similarly, when feedback is delayed (Hertel et al., 2008), the effect is mitigated. In some instances, though, uncertainty may actually strengthen the effect (Lount, Kerr, Messé, Seok, & Park, 2008), which may be due to the desire to make a favorable impression or for a more intrinsic assessment of one’s capabilities (e.g., “how long can I hold this weight?”).

Another moderator of both processes is likely the belief that one can keep up with his/her partner. If keeping up is seen as unattainable, or if one is already highly confident in his/her abilities, then upward social comparison is likely useless. Similarly, when confidence is low,
being indispensable for the group’s success may not be enough to motivate inferior group members. In any case, the discrepancy in ability between one’s partner and him/herself likely moderates this belief, where moderate discrepancies are likely seen as attainable and, thus, most motivating (Kerr, Feltz, & Irwin, under review; Kerr et al., 2007; Messé et al., 2002).

A third moderator is identifiability, where persons whose performances are less identifiable are less likely to put forth high effort (Hertel et al., 2008). However, when group members are anonymous, the effect is still observable (Wittchen et al., 2007). Fourth, the type of task may also moderate the effect, where the strongest effects have been observed for physical tasks (vs. cognitive tasks; Weber & Hertel, 2008). Lastly, the time that one works with a superior partner may also moderate the effect. However, time has been shown to moderate the social comparison and indispensability processes in opposite directions. That is, the longer one works with a superior partner, the social comparison process seems to weaken, but the indispensability process seems to strengthen (Irwin, Scorniaenchi, Feltz, Kerr, & Eisenmann, in press).

A recent line of research has extended the examination of the Köhler effect to exercise tasks (Feltz et al., 2011; Irwin et al., in press). These studies have shown that motivation in exercise tasks can be increased when exercising with a moderately more capable partner and, more specifically, a virtual partner- one who is a real person, but presented virtually during exercise. That the Köhler effect has been observed in exercise and a variety of other tasks and settings suggests that the Köhler effect might be observable under normal, free-living conditions, provided that the conditions previously found to moderate the effect are accounted for. A field experiment would be an appropriate methodology for such an investigation. At the same time, using a task that has direct application to a real world problem (e.g., exercise motivation) would enhance ecological validity. A logical extension of Köhler research, then, would be to (a)
examine the Köhler effect in a more natural/authentic behavioral environment (i.e., under free-living conditions) and (b) to simultaneously examine how these principles of motivation (upward social comparison and indispensability) can be applied to interventions to increase PA.

Lastly, as field experiments demand unique constraints to allow for uncontaminated observation of the phenomena of interest (i.e., control), field experiments are distinct from behavior change interventions in which the primary purpose is to change a specific health behavior with long-term adherence. Nonetheless, we might best be able to infer how field experiments might transition into authentic behavior change interventions by measuring psychosocial mediators of behavior change. At the same time, such mediators might also help identify some of the cognitive processes behind the Köhler effect. A brief discussion of basic concepts in PA and psychosocial mediators of PA is warranted.

**Psychological mediators of physical activity**

Physical activity is any bodily movement that results in energy expenditure above the body’s resting metabolic rate. The term “physical activity” (PA), then, represents a wide spectrum of movement, including both lifestyle PA (e.g., walking to work, washing the dishes, brushing one’s teeth, etc.) and exercise-PA engaged in with the purpose of improving one’s health-related fitness. Behavioral interventions have targeted both types of PA with success (Dunn, Andersen, & Jakicic, 1998; Dunn et al., 1999).

As social-ecological (McLeroy, Bibeau, Steckler, & Glanz, 1988) and social-cognitive (Bandura, 1986) behavioral models suggest, PA behavior is likely the result of complex interactions between cognitive, behavioral and environmental factors. Such models have been widely used in health-related PA research. The remainder of this section briefly introduces several behavioral theories that have been widely used to explain and predict behavior in the
domain of PA, including self-efficacy theory (Bandura, 1977), self-determination theory (Deci & Ryan, 1985), the theory of planned behavior (Ajzen, 1991), and the transtheoretical model (Prochaska & DiClemente, 1983).

**Self-efficacy.** Self-efficacy is one’s confidence in his or her ability to execute the actions necessary to achieve certain outcomes (Bandura, 1977). In contrast to more global, personality-oriented forms of confidence, self-efficacy is situation-specific. That is, one may have confidence in his/her ability to exercise when the weather is poor, but such confidence does not necessarily transfer to his/her confidence in exercising when she/she is tired. Bandura (1997) theorizes that one’s self-efficacy has four main sources including mastery experiences, vicarious experiences, verbal persuasion, and physiological/affective states. Self-efficacy has consistently shown to mediate outcomes of health behavior for a variety of settings and populations (McAuley & Blissmer, 2000).

**Self-determination theory.** Self-determination theory (Deci & Ryan, 1985) suggests that all humans are motivated by the need for autonomy, competence and relatedness. Autonomy is the sense that one is in control of one’s own actions. Competence is the sense that one has the skills and ability necessary to execute skills that facilitate goal achievement. Relatedness is the sense that one is socially connected to others. The motivation that energized pursuit of these needs, however, varies.

Deci and Ryan (1985) make the distinction between types of motivation that are capable of energizing the pursuit of these needs; *intrinsic* and *extrinsic*. Intrinsic motivation is motivation that is derived from a genuine interest and enjoyment in participating in an activity, itself. Extrinsic motivation is motivation derived from external factors, such as peer pressure, social norms, or monetary or social incentives. Intrinsic motivation is theorized to be the most
sustainable and autonomous form of motivation. Further, Deci and Ryan suggest that there are four types of extrinsic motivation, including integrated regulation, identified regulation, introjected regulation, and external regulation. Integrated regulation refers to the process of engaging in a behavior in order to confirm one’s sense of self (e.g., “I am a runner, and this what I do”). Identified regulation refers to behavior motivated by personal goals, where the goals themselves regulate the behavior (e.g., to look good). Introjected regulation refers to behavior regulated by a self-imposed source of pressure (e.g., exercising because one feels they must in order to avoid guilt). Lastly, external regulation refers to behavior that is regulated by the desire for an external reward or avoiding an externally applied punishment (e.g., to make a favorable impression on others or to avoid social sanctions of friends). This latter type of motivation is thought to be the least self-determined type of extrinsic motivation. Lastly, the least self-determined type of motivation, overall, is amotivation- the lack or absence of motivation or intention to engage in a behavior.

In exercise and PA contexts, self-determination theory has been found to be useful in explaining PA behavior and an effective framework for designing interventions that increase PA (see Hagger & Chatzisarantis, 2008 for review). Thus, interventions that support the need for autonomy, competence and relatedness may have promising potential for behavior change.

Theory of Planned Behavior. Other theorists suggest that to understand one’s motivation to engage in health behaviors, we must understand the degree to which one intends to engage in that behavior. Such is the essence of the theory of planned behavior (Ajzen, 1991). A revision of the Theory of Reasoned Action (Fishbein & Ajzen, 1975), this theory posits that intention (and thus behavior) is the product of both behavioral and normative beliefs. Specifically, the combination of one’s attitude toward a behavior (behavioral beliefs) and
subjective norms (normative beliefs) are thought to influence one’s intention, which mediates changes in behavior. In addition, however, perceived behavioral control is theorized to influence both intention and behavior. That is, perceived behavioral control might directly affect one’s intention to exercise, but also might directly influence one’s actual behavior. This theory has been widely applied in exercise settings and, although it has some limitations in explaining long-term adherence, has been shown to be useful in predicting short term behaviors (Symons Downs & Hausenblas, 2005).

**Stage of change model.** The transtheoretical model of behavior assumes that behavior is *cyclical* in nature (Prochaska & DiClemente, 1983). That is, behavior change is best understood as a long-term process and occurs in stages. Thus, one’s behavior is dependent on which stage they are currently in. In general, there are five stages of readiness, and one can move forward and backward through these stages, hence the cyclical nature of this theory. These five stages are as follows: precontemplation, contemplation, preparation, action, and maintenance. In precontemplation (Stage 1), people have no intention to begin an exercise program, nor are even thinking about doing so, in the near future. This stage is thought to be very stable and, thus, without intervention, people in this stage are unlikely to change behavior. Contemplation (Stage 2), as the name suggests, is when people begin to have intentions to begin exercising within the next six months. People in this stage may have mixed feelings about moving forward with a program of exercise and should still benefit from intervention. Preparation (Stage 3) is when people intend to start exercising in the near future, see the pros of exercising outweighing to cons, and may have already begun to incorporate more activity into their normal daily routine (e.g., taking the stairs). In the action stage (Stage 4), people are exercising at the recommended levels (150 minutes per week of moderate intensity activity). However, this stage is thought to be
the most unstable, as exercise routines are difficult to maintain. Lastly, maintenance (Stage 5) is when people have been exercising at the recommended levels for at least six months. Maintainers are adept at working to maintain a PA routine, are less tempted to relapse, and are confident in their abilities to continue with a physically active lifestyle.

This model has often been applied in an integrated approach with self-efficacy theory. Indications of movement between stages can be tracked by observing changes in self-efficacy (as well as decisional balance) to overcome barriers to exercising. Although there is some evidence that suggests otherwise (Blissmer & McAuley, 2002), tailoring educational materials to participants’ stage of readiness has been shown to lead to greater increases in activity than general materials (Marcus et al., 1998).

Summary

The Köhler effect has been replicated in a variety of tasks and settings, including exercise tasks and (highly controlled) field settings. What is not known are the boundary conditions for the effect in an applied setting, such as a free-living setting. Such an investigation could help identify such boundaries, as well as provide an opportunity for addressing real world problems. Examining psychosocial mediators of behavior would help identify the strengths and limitations of applied uses of the effect, as well as potential psychosocial mechanisms of the effect.
CHAPTER 3

Method

To examine the Köhler effect in the field, a field experiment was conducted. This experiment utilized educational PA stimulus materials as well as virtually-presented PA partners to motivate PA behaviors.

Participants

Participants were recruited from upper-level kinesiology courses at Michigan State University. The researcher visited classrooms and delivered a recruiting script describing the study and what participating in the study would involve. The purpose of the study was cast as one meant to “examine the use of technology for increasing physical activity”. Students were then given a web address that lead to an online screening survey. There were 223 responses to this survey. From these surveys, a purposive sample was used consisting of individuals who were (a) not currently meeting recommendations for PA, (b) who were psychologically and physically ready to add more PA to their daily routine, and (c) most likely to adhere to the study protocol (i.e., to wear the armband at all times and not drop out). Thus, potential participants were asked to complete measures of stage of change (Marcus, Banspach et al., 1992), self-report PA frequency and fitness, and demographic questions. First, all respondents were screened based on their readiness of PA as assessed by the Physical Activity Readiness Questionnaire (PARQ). If participants were deemed by the researcher to have any health conditions that would prevent them or significantly impair their ability to increase their current PA level (e.g. a recently sprained ankle, dizziness during PA) they were excluded from the study. If responses on the PARQ were not clear and/or the researcher needed more information, a follow up contact email was sent to have the student explain the response. Participants were selected from the
contemplation stage (Stage 2) and then the action preparation stage (Stage 3; i.e. doing some PA) of the stages of change model. Participants were then screened for self-reported levels of PA and fitness to identify those individuals who were least active (who also had the most room for improvement and need for such an intervention). Then, respondents were screened for class year, where selection preference was given to students in upper-classes, which was thought to be a rough indicator of likelihood to adhere to the study (i.e., not drop out). When this selection criterion resulted in too small of a sample size, the criteria were relaxed in the order of (a) class, (b) self-report fitness, (c) self-report PA and (d) stage of change.

**Design**

This study used a 2 (Gender) x 3 (Condition: individual, coactive, conjunctive) x 8 (Week) experimental design. The main dependent variable was armband-assessed daily PA (expressed as energy expenditure).

**Measures**

Energy expenditure and a number of self-report measures were used. Unless otherwise noted, the internal consistency for the self-report measures was reported for the current sample.

**Demographics and screening survey.** A demographic questionnaire was used to collect background information from the participants. Specific items included age, gender, race, major, and year in school. This questionnaire was also used to assess several variables needed for calculating energy expenditure using the Sensewear Armband (see description below) including height, weight, smoker/non-smoker, and handedness (see Appendix A). Additionally, this survey included the Physical Activity Readiness Questionnaire (Adams, 1999; see Appendix B), and a questionnaire to assess stage of change (Marcus & Forsyth, 2009; see Appendix C).
**Energy expenditure.** The Sensewear Armband was used to assess habitual, free-living PA. This device is worn on the upper arm and allows continuous assessment of free-living PA expressed as energy expenditure (joules) and has been shown to provide valid and reliable estimates of energy expenditure in adults (Johannsen et al., 2010).

**Vigorous physical activity.** A self-report questionnaire, constructed by the researcher, was used to assess the mode and frequency of vigorous PA. The instrument begins with the statement, “Vigorous intensity = You are breathing rapidly and only able to speak in short phrases. Your heart rate is substantially increased and you are likely to be sweating” followed by the statement, “Please indicate how many times in the past week you have participated in the following activities at a VIGOROUS intensity for at least 20 minutes” followed by a list of 18 activities, each rated on a scale from 0 to 11 or more (α = .85). There were also two open-ended items where participants could indicate and describe activities that were not on the list (see Appendix D).

**Information-seeking behaviors.** In addition to monitoring changes in actual PA behaviors, an instrument was included to assess the number of times participants engaged in health information seeking behaviors. A researcher-constructed self-report instrument that targets specific behaviors relevant to this study was used. Items begin with the stem “How many times in the past week did you…” followed by a specific behavior. Examples include, “…visit the Center for Disease and Control website?”, “calculate your energy balance?”, “refer to your Physical Activity Toolkit?” (the Physical Activity Toolkit is one of the stimulus materials for this study). The information-seeking behaviors questionnaire (α = .87) can be found in Appendix E.

**Regulatory self-efficacy.** Regulatory self-efficacy was measured on a 7-item frequency scale that assesses how confident participants are that over the next 3 months they can exercise at
a moderate intensity for 30 minutes per day for up to 7 days per week ($\alpha = .98$). The stem is, “Over the next 3 months, I can exercise for…” followed by the number of days ranging from 0 to 7. Responses will be made on an 11-point scale ranging from 0 (not at all confident) to 10 (completely confident). The regulatory self-efficacy scale can be found in Appendix F.

**Barrier efficacy.** Confidence in overcoming common barriers to exercise and PA was assessed with a brief questionnaire (Marcus, Selby, Niaura, & Rossi, 1992), beginning with the statement, “Mark the number that indicates how confident you are that you could be physically active in each of the following situations…”, followed by five items (e.g. “when I’m tired”, “when I’m in a bad mood”) rated on a scale from 1 (not at all confident) to 5 (extremely confident). The barrier efficacy scale ($\alpha = .95$) can be found in Appendix G.

**Intention to exercise.** Intention, adapted from the scale used by Mohiyeddini, Pauli and Bauer (Mohiyeddini, Pauli, & Bauer, 2009), was measured with two scales, referred to as scales A and B. Scale A consisted of two items: “My goal is to exercise tomorrow at a moderate or vigorous intensity for at least 30 minutes” and “I intend to exercise tomorrow at a moderate or vigorous intensity for at least 30 minutes.” Ratings are on a 7-point scale, from -3 (not at all true for me) to +3 (completely true for me). The two items were averaged for an overall intention score ($\alpha = .93$). Scale B consisted of two items: “My goal is to exercise next week at a moderate or vigorous intensity for at least 30 minutes” and “I intend to exercise next week at a moderate or vigorous intensity for at least 30 minutes.” Ratings are on a 7-point scale, from 1 day to 7 days. The two items were averaged for an overall intention score ($\alpha = .95$). The intention questionnaires can be found in Appendix H.

**Team perception measure.** To assess perceptions of working as a team in the partnered conditions, items were used based on Nass et al.’s (1996) team perception measure (e.g., I felt I
was part of a team with my partner; I felt I worked collaboratively with my partner; I felt my partner and I worked together; I felt I was working separately from my partner; I felt my partner was helpful to my performance) rated on a 5-point scale ranging from “not at all” to “very much.” The team perception measure ($\alpha = .48$) can be found in Appendix I.

**Attitude toward partner.** Adapted from Nass et al.’s (1996) team perception measure, this scale includes five items assessing participants’ attitudes towards the partner, beginning with the statement “how well does each of these adjectives describe your feelings towards your partner?” followed by five adjectives (helpful, cooperative, responsible, trustful, and determined), each ranked on a 5-point scale from *describes very poorly* to *describes very well* ($\alpha = .83$) (see Appendix J).

**Goal orientation.** Goal orientation was measured using the Goal Orientation in Exercise Questionnaire (GOEQ). The instrument consists of three subscales measuring Task, Ego, and Social orientations. There are five items per subscale. All items are prefaced with the statement “While exercising, I usually feel that things have gone well when….” Responses are indicated using a 5-point Likert scale ranging from *strongly disagree* (1) to *strongly agree* (5). The Task subscale ($\alpha = .90$) measures the degree to which the participant believes successful performance is defined by self-improvement and high effort (e.g. “I make progress”). The Ego subscale ($\alpha = .80$) measures the degree to which the participant believes successful performance is defined by favorable comparison to others (e.g. “I know that I am more capable than other exercisers”). The Social subscale ($\alpha = .69$) measures the degree to which the participant believes successful performance is defined by recognition and praise (e.g. “other people tell me I did well”). The GOEQ can be found in Appendix L.

**Intrinsic motivation.** Intrinsic motivation was assessed with the Leisure Motivation Scale
(Pelletier, Vallerand, Green-Demers, Blais, & Briere, 1996; see Appendix N). This scale consists of 28 items, constituting three higher-order subscales including Intrinsic (α = .92), Extrinsic (α = .80), and Amotivation (α = .62). Lower order subscales for Intrinsic motivation include Knowledge, Accomplishment, and Experience Stimulation. Lower order subscales for Extrinsic motivation include Identified, Introjected, and External Regulation. All items began with the stem, “Indicate to what extent each of the following items presently corresponds to one of the reasons for which you practice this type of physical activity”, followed by the 28 items, ranked on a 7-point scale from does not correspond at all (1) to corresponds exactly (7).

**Post-study questionnaire.** A post study questionnaire contained items assessing the success of manipulations (e.g. “if you performed the study with anyone--besides the experimenter--what is your best estimate of how that person compared to you in ability?”), level of interest in the study, perceived difficulty of the task, effort put forth in the task, as well as two open ended questions to assess the success of the manipulation and to probe for suspicion (“was there anything odd or confusing about the study?” and “what, in your words, do you think the purpose of the study was?”). The post-study questionnaire can be found in Appendix N.

**Enjoyment of physical activity.** Enjoyment was measured using a short 8-item version (α = .88), of the Physical Activity Enjoyment Scale (PAES; Kendzierski & DeCarlo, 1991). Each item is 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”). Previous studies have shown high correlations with the complete scale (r = .94; Raedeke, 2007) and strong reliability (alpha = .91; McArthur & Raedeke, 2009). The PAES can be found in Appendix O.
Motivation for Physical Activity. Motivations for being physically active were assessed with the Motives for Physical Activities Measure – Revised (MPAM-R; Ryan, Frederick, Lepes, Rubio, & Sheldon, 1997). The measure assessed five motives including Fitness ($\alpha = .93$), Appearance ($\alpha = .88$), Competence/Challenge ($\alpha = .85$), Social ($\alpha = .81$), and Enjoyment ($\alpha = .83$). These refer to motives for being physically active with the purpose of improving health, becoming more physically attractive, improvement on/learning a skill or meet a challenge, being with friends or meet new people, and having fun and engaging in a self-rewarding, interesting and stimulating activity, respectively. The scale begins with the statement, “keeping in mind your primary physical activity/sport, respond to each question (using the scale given, on the basis of how true that response is for you”, followed by 30 items (e.g., because I want to be physically fit; because I like the challenge, etc.). All items were rated on a 7-point scale ranging from not at all true for me (1) to very true for me (7). The MPAM-R can be found in Appendix P.

Health behavior measure. A series of researcher-constructed questionnaires was used to assess several dimensions of health behavior throughout the study. Particularly, this questionnaire included measures of alternative health choices, partnered exercise, group exercise/gym membership, and disruptive events. This measure can be found in Appendix S.

Alternative health choices. To assess positive changes in health behaviors, a researcher-constructed instrument was used consisting of six items, each on a 12-point scale ($\alpha = .86$). The instrument began with the stem, “Think about a normal week for you, prior to your participation in this study. How many times in the past week have you chosen to…”, followed by items such as “walk when you would normally have driven/taken the bus” and “take the stairs when you normally would have taken the escalator/elevator”. There was also one open ended response to allow for other behaviors.
**Exercise mode.** This measure included three items assessing the frequency and mode of activity in the past week ($\alpha = .83$). Items began with the stem, “How many times in the past week have you…” followed by “exercised alone”, “exercised with a friend(s)” and “exercised in the presence of other exercisers (where friends were not present)”. Each item was accompanied by a scale from 0 to 7+.

**Group exercise/gym membership.** To assess whether participants were a member of a gym and/or an exercise group, a short 5-item questionnaire was constructed, containing items such as “do you currently have a membership to a fitness facility?” and “are you currently enrolled/attending a fitness/exercise class?”.

**Disruptive events.** The number of disruptive events that may have affected normal daily activity was assessed each week with an open-ended question, “Have there been any external events/forces (i.e., out of your control), in the past week that have affected your physical activity? Briefly explain (e.g., sick, weather, family, etc.)”. Responses were coded in a binary fashion to reflect the presence of such an event within each week.

**Stimulus Materials**

**Orientation Video.** An orientation video was used to educate participants on strategies to safely incorporate more PA into their daily lives. The video was posted on YouTube.com (with privacy settings allowing only users with the link to view the video) and included content based on the CDC’s “Be Active Your Way: A Guide for Adults”, which is intended to help people at different stages of change increase their PA. The video was approximately 25 min long and presented in a Microsoft Office Powerpoint format. It includes three main sections (1. What is physical activity?, 2. Strategies to increase physical activity, and 3. Additional resources). The second section includes subsections tailored specifically for (a) people who are not regularly
active and need to gradually incorporate more PA into their lives, (b) people who are already somewhat active, but want to be more active or more consistent, and (c) people who are regularly active, but want to find ways to maintain and/or increase their PA. The video can be found at http://www.youtube.com/watch?v=2qx66PauSOs&feature=related (Part 1) and http://www.youtube.com/watch?v=CEoMxtBDD3o&feature=related (Part 2).

**Physical activity toolkit.** As part of the orientation, participants received a packet of information and worksheets designed to help them identify and implement strategies to assist them in increasing their PA. The toolkit was designed based on the CDC’s “Be Active Your Way: A Guide for Adults,” and includes several worksheets, containing short questions that participants answered while watching the orientation video. The toolkit also included information on context-specific strategies for increasing PA for students living in East Lansing (e.g. fitness facilities, walking paths, group exercise classes), strategies for overcoming common barriers to PA (e.g., lack of time, lack of energy, family obligations, travel), activity logs/charts to self-monitor their PA, and additional resources (links to helpful information from the American College of Sports Medicine, Center for Disease Control, and MyPyramid). The Toolkit can be found in Appendix Q.

**Procedure**

A flowchart of the procedure used can be found in Figure 6. Before conducting this study, approval was obtained from the Institutional Review Board for Human Subjects Research. The study was cast as a project intended to help people increase their PA. An initial pool of 195 respondents to the recruiting survey (given to them during an in-class visit by the researcher, or emailed by the instructor) was narrowed down to include 38 undergraduate students using the selection criteria. Although it would have been highly advantageous to include more than just 38
of these subjects for statistical power, the researcher was (a) limited by the amount of SenseWear Armbands and could not include more than 40 subjects and (b) did not want to relax the selection criteria to the point of including students who were already meeting or exceeding national recommendations for PA. Three participants who were selected for the study did not show up for their first appointment, resulting in a final sample of 35 participants.

After screening and signing an informed consent form, habitual PA was assessed using Sensewear armbands for a continuous 8-week period. On the first visit to the lab, participants were assigned an armband, followed by a 1-week period to assess baseline habitual PA. Baseline levels of regulatory self-efficacy, intention to exercise, and health behaviors were also assessed prior to Week 1, and again at the end of each week for the remaining 8 weeks. Participants also completed the goal orientations (GOEQ) and demographic instruments for this first visit, only.

After wearing the armband for the first week, all participants returned to the lab and exchanged armbands (one with a new battery). At this time (2\textsuperscript{nd} visit), participants watched a brief orientation video designed to educate participants on ways to increase their habitual PA and given a PA “toolkit” (educational packet of information) to take home with them, which included strategies for increasing PA and safety information. The task for all participants from this point on was to increase his/her PA (simply stated “your task is to increase your PA”).

After watching the video, participants were randomly assigned to one of the three conditions. Those in the individual (control) condition were instructed to increase their PA, using the information they have been given, and that they will return to the lab once per week for the remaining 7 weeks to exchange armbands. During these visits, barrier efficacy, regulatory-self efficacy and intention were measured. Following these instructions, participants in the partner conditions were paired with a confederate virtual partner, who was ostensibly a student at
another university with about the same fitness level. Specifically, subjects were told, “over the next few weeks you are going to be partnering up with another person who is participating in the study at a different location. Again you task is to increase your PA”. In the coactive conditions, subjects were then told, “you and your partner are not on a team, per se, but you will be able to see how many calories the other has burned at the end of every week”. In the conjunctive condition, subjects were told, “you and your partner will be working together to try and achieve the greatest score possible. Your score will be defined by the person who burns the least amount of calories each week”. Lastly, whether in the coactive or conjunctive conditions, participants were told, “we have partnered you up based on several factors including your age, gender, and habitual PA”.

Participants in partner conditions then met their partner over a Skype video chat, which was actually a pre-recorded video, and shared basic personal information (age, year in school, major, career plans, favorite TV shows). At the end of the session, subjects were told, “the device and software that we are using will automatically make adjustments for any differences in metabolism, height, and weight. Thus, any differences in calories burned can be attributed solely to differences in effort rather than to any physiological differences”, which was meant to create the perception of equal ability between the participant and partner. Performance feedback (for both the participant and the partner, if in one of the two partner conditions) was sent via email and text message to the participant shortly (within 10 min.) after they left the lab for each visit (e.g., “Last week, you burned an average of 2,000 calories per day. Your partner burned an average of 2,800 calories per day”). The confederate’s prior-week energy expenditure was manipulated to always be greater than that of the participant, the exact difference depending on a researcher-derived algorithm (see Partner physical activity algorithm, below).
**Partner physical activity algorithm**

Microsoft Excel spreadsheet software was used to create an algorithm that would calculate the partner’s energy expenditure for each week of the study. At Week 2, and based on the partner’s PA from baseline, the partner’s energy expenditure was calculated to be either 40%, 30%, or 20% greater than the subject’s, the exact discrepancy depending on how active the subject was in Week 1 (EE ≤ 2,500 cal/d, 2,5001 cal/d ≤ EE ≤ 3,000 cal/d, or EE ≥ 3,001 cal/d, respectively). This graded approach was used to account for the increasing difficulty in further increasing one’s PA the more active one becomes. That is, the higher one’s EE, the harder it is to be more active. Likewise, the more active the subject is in Week 1, the lower the discrepancy should be in Week 1, with the working assumption that a lower discrepancy between the subject and the partner (based on a high baseline level of subject EE) will be weighed more heavily.

After Week 1, the partner’s activity was set to increase at a diminishing function beginning in Week 2 with a 6% increase over Week 1, 5% at Week 3, and so on. This was done to mimic increased effort and fitness. A floor for the discrepancy was set to always be at least 20% greater than the subject’s within any given week. Thus, if a subject’s energy expenditure came within 20% of the partner’s score, the partner’s score was re-adjusted upwards to be 20% greater than the subject’s and a new trajectory based on the same diminishing function used to calculate the partner’s scores at the beginning of Week 2. There was no ceiling set on this discrepancy. A random factor (random number between -40 and +40 calories) was also added to each score, to mimic natural fluctuations in PA behavior and to disguise the function. The researcher presumed that ±40 calories would not be enough to alter the basic structure of the feedback algorithm, as 40 calories would only account for 2% of someone burning 2,000 calories/d, a generic amount of daily activity for healthy adults. Ultimately, this function was part of a manipulation to establish
the partner as one who is putting forth moderately more effort at the task, (the task being to “increase normal daily PA”), but who is not entirely dependent on the performance of his/her weaker partner (i.e., the subject).

**Incentives**

In order to encourage subjects to wear the armband and return to the lab each week for their scheduled appointments, a random drawing was organized where for each hour that subjects wore the armband, their name would be entered into a drawing (e.g., 1hr = 1 ticket, 2hr = 2 tickets, etc.) for which there were three prizes: a $100, $75, and $50 prize. Also, each time they returned to the lab for their regularly scheduled appointment, their name would be entered into the drawing another one hundred times. It was emphasized that the participant’s chances of winning were not affected by how many calories he/she burned, but only by how long they wore the armband and whether or not they returned to the lab.

**Treatment of the Data**

Before conducting the primary analyses, the data were screened for outliers, normality, and linearity. Data screening was conducted in accordance with the recommendations of Warner (2008). Boxplots and standardized scores were used to identify univariate outliers. Outliers were defined as values more than three standard deviations away from the grand mean. Normality was evaluated by histograms and skewness and kurtosis statistics. A non-normal distribution was defined as a skewness statistic that exceeds ± 2. Bivariate scatterplots were used to evaluate linear relationships between the variables. Linearity was identified by oval-like plot patterns.

**Data Analysis**

Following data screening, descriptive statistics (i.e., mean, standard deviation) and bivariate correlations were calculated for all independent and dependent variables. Planned
contrasts were used to examine the hypotheses. As an exploratory analysis, a full-factorial 2
(gender) x 3 (condition) x 7 (week) RM ANCOVA was used with week as the within-subjects
factor and Week 1 energy expenditure as the covariate. All statistical analyses were conducted in
SPSS 20. An alpha level of .05 was used for all statistical tests.
CHAPTER 4

Results

The purpose of this study was to examine the Köhler effect under free living conditions. This chapter is organized into four main sections. The first section provides results on demographic, descriptive, and manipulation check statistics. The second section provides results on preliminary analyses used to inform the main analyses. The third section provides results on the main hypotheses. A final, fourth section presents results on ancillary analyses used to help interpret the main hypotheses.

**Demographics, Descriptive Statistics, and Manipulation Checks**

Descriptive statistics for all subjects are presented in Table 1. Means and standard deviations for all dependent variables are presented in Table 2. Participants consisted of 35 ($M_{age} = 20.98, SD = 1.47$) individuals, with 17 males and 18 females, distributed across the three conditions (individual = 6 males, 6 females, coactive = 6 males, 5 females, conjunctive = 5 males, 7 females). Roughly 83% ($n = 29$) were Kinesiology majors, 94% ($n = 33$) Caucasian, with an average BMI of 24.15 ($SD = 3.83$). The selection criteria based on class, self-reported fitness, self-reported exercise frequency, and stage of change resulted in an even distribution of subjects on these criteria across the three conditions. On average, subjects were in their third year of school ($M = 3.20, SD = 1.18$), reported themselves as having “average” fitness (on a scale from 1-5, $M = 3.14, SD = .77$), exercised twice per week ($M = 2.03, SD = 1.01$) and were in the preparation stage of readiness for change (Stage 3; $M = 3.23, SD = 1.00$), meaning that they were somewhat active, but were not meeting recommended guidelines. Subjects burned an average of 2,842.61 calories ($SD = 449.63$) per day throughout the 8-week field experiment.
Correlations. Bivariate correlations were calculated between all study variables. Because of the large number of variables, only correlations for the main predictor and criterion (continuous) variables are presented, including self-regulatory efficacy (see Table 3), barrier efficacy (see Table 4), intention to exercise (A; see Table 5), intention to exercise (B; see Table 6), and enjoyment (see Table 7).

Outliers. The data were assessed for univariate and then multivariate outliers, where appropriate (i.e., depending on the statistical model used to test the hypothesis). A univariate outlier was a score that fell outside of $\pm 3 SD$ from the overall mean or was outside the adjacent values in a box plot. Based on the boxplots and z-scores, several univariate outliers were identified. For the main dependent variable, average daily energy expenditure (expressed in calories burned per day), two raw scores (358 and 792) were deemed impossible because they were so low. Six univariate outliers were identified for information seeking behaviors, one outlier for intention to exercise, two values for enjoyment, and five values for the alternate choice variable. All analyses were conducted twice; once including these outliers (except for those deemed impossible) and again without and, if the results were the same, then analyses including outliers were reported.

Missing data. For the main dependent variable, there were 39 counts of missing data (14%). Little’s test showed that these were missing completely at random (MCAR), $\chi^2 (36) = 35.46, p = .494$. Cases with missing data were deleted list-wise.

Normality. There were several instances of univariate normality violations, based on skewness statistics. Specifically, the appearance (-2.72) and fitness (-2.76) subscales of the motivation for activity scale, and enjoyment for Week 1 (-2.65) were all significantly negatively skewed. Information seeking for Week 1 (4.84), Week 4 (2.68), Week 5 (2.53), Week 6 (3.60)
and Week 7 (3.84), as well as alternative choice behavior at Week 6 (2.07) were all positively skewed. Following the recommendations of Rakov & Marcoulides (2008), square root transformations were applied to positively skewed variables. For negatively skewed variables, and for any positively skewed variables for which a square root transformation was unsuccessful, a progressively more powerful set of logarithmic transformations was applied until normality was achieved. This procedure resulted in a normal distribution for information seeking at Weeks 4, 5, and 7 as well as for alternate choice at Week 6. All remaining variables remained skewed.

Another statistical assumption that was explored was linearity. For repeated measures analyses, relationships between repeated measures should be linear (Warner, 2008). All combinations displayed an oval-like pattern, indicating that the data met the assumption of linearity. Sphericity was also assumed for all repeated measures analyses. In any cases where sphericity was violated, adjustments were made to the degrees of freedom (Warner, 2008).

**Manipulation checks.** There were four manipulation checks throughout the 8-week period (at the end of Weeks 2, 4, 6 and 8 during visits 3, 5, 7, and 9, respectively) to assess whether subjects knew how their score was being calculated (i.e., which condition they were in). At Visit 3, one out of 11 coactive subjects thought that their score was determined by the average between his/her score and the partner’s score. One person in the conjunctive condition thought his/her score was determined by the teammate who burned the *most* calories. At Visit 5, three out of nine participants in the coactive conditions thought they were in an additive condition, as did one out of seven subjects in the conjunctive condition. In Visit 7, one subject in the coactive condition thought they were in an additive condition and two subjects in the conjunctive condition (n = 8) thought they were in an individual condition. At Visit 9, one respondent in the individual condition (n = 9) thought they were in an additive condition, one in the coactive
condition \((n = 10)\) thought they were in an additive condition, and two in the conjunctive \((n = 9)\) thought they were in an individual condition. In total, 31 of 35 subjects were correct for at least 3 of 4 testings. Seven subjects did not know the correct way their score was calculated at least once out of the four manipulation checks, four of those subjects choosing incorrectly twice. Out of 78 responses (not including missing data), 14\% \((n = 11)\) were incorrect. Subjects were reminded at the end of each lab appointment how their score was being calculated.

![Figure 1. Energy Expenditure Discrepancy](image)

Next, an analysis was conducted on the scores produced by the partner PA algorithm. Because using this algorithm resulted in a discrepancy, expressed by a ratio of partner: subject score, that varied over time (but was never less than 20\%, in favor of the partner), a 2 (condition) x 7 (week) RM ANOVA was conducted with the latter as the within-subjects factor to detect any group differences over time in the level of discrepancy. There was no significant interaction effect, \(F(6, 102) = 1.40, p = .22\). However, a significant week effect was found, \(F(6, 16) = 19.43, p < .001\). This main effect was characterized by a significant linear \((p < .001)\) and
quadratic trend ($p = .007$), showing that discrepancies increased over time (Figure 1). Also note that because there was no condition main effect, the discrepancies between conditions were roughly equivalent.

Furthermore, for subjects in the partner conditions, perceptions of partner ability and partner effort were examined at the end of the study. Responses were rated on a scale from 0-8, however, it should be noted that the anchors of these items were not congruent with the stems. That is, the question asked, “if you performed the task with another person (besides the researcher), what is your perception of how that person compared to you in (effort/ability)”, followed by the items, anchored with the other person was much (more/less) capable. To be more congruent with the stems, the anchors should have read, “…was much (higher/lower) in ability than me” and “…put for the much less/more effort than me”, making interpretations of these results difficult. Neither the mean of perceived partner effort ($M = 5.53, SD = 2.83$) or ability ($M = 5.58, SD = 3.04$) were different from the scale midpoint (4.5), $p = .13$. Although, 74.7% and 79.9% of subjects scored above the midpoint for perceptions of ability and effort, respectively, these were not significant, $p \geq .35$. This midpoint was intended to represent “approximately equal in [ability/effort]”, although it was not explicitly indicated on the scale, but implied from the anchors. Assuming the subjects interpreted the questions the way in which the researcher intended, subjects did not perceive their partner to be any different from themselves in terms of ability or effort. These perceptions were the same between partner conditions. In favor of the success of the manipulation, though, in an open-ended post-study question, five subjects explicitly indicated that they were aware that the partner was burning more calories than they were (e.g., “my partner burned a ton of calories every week”). Thus, even though subjects received performance feedback every week via text message and email, there was no check to
make sure they looked at this feedback and, according to these results, no clear indication of how subjects interpreted this feedback. A working assumption for this study from this point on is that subjects both saw the feedback sent to them via text and email and perceived their partner to be superior to them in some fashion (either in ability or effort).

**Suspicion.** Two subjects raised suspicion, but did not assert, that their partner was not real. One subject was in the coactive condition, the other in the conjunctive condition. Both finished all 8-weeks of the study. In previous laboratory studies (Feltz et al., 2011), suspicion has also been raised, but has not been correlated with any reductions in actual effort in the task. That is, a little doubt has not been detrimental to the manipulation, as evidenced through actual behavior. In light of this, and because both of these subjects remained in the study for the entire 8 weeks, and neither raised concerns in any of their lab visits, their data were retained for the analyses.

**Dropouts.** Of the initial pool of 38 selected subjects, three did not show up for their first appointment. The remaining 35 signed an informed consent form. A subject who signed the informed consent form and (a) verbally indicated he or she did not want to further participate and/or (b) did not show up for a scheduled appointment and did not return through the end of the study was considered to have dropped out. Four subjects dropped out after Week 1 of the study (before being randomly assigned to a condition), one subject after Week 2 (conjunctive), one after Week 4 (individual), one after Week 5 (coactive), and four after Week 7 (two conjunctive, 2 coactive) for a total of 11 dropouts. A total of three subjects from the conjunctive, two from the coactive, and one from the individual condition dropped out. A Mann-Whitney U test within each week showed that discrepancy scores between dropouts and non-dropouts were equal, .12 ≤
Three males and eight females dropped out. Dropouts were evenly distributed across conditions ($\chi^2 = .902, p = .637$) and gender ($\chi^2 = 2.91, p = .088$).

**Preliminary analyses**

**Compliance.** The SenseWear armband kept track of the percentage of time that the armband was on the person’s body compared to the total time that the subject possessed the armband (time observed). To assess if there were differences between groups and/or over time regarding the total time observed within each week and the percentage of time the armband was worn, two separate 3 (condition) x 8 (time) RM ANOVAs were run with the latter as the within-subjects factor. No main or interaction effects were found and, thus, all subjects were assessed for the same amount of time each week (estimated marginal means: Grand mean = 8583.24min, $SE = 94.05$, $M_{\text{individual}} = 8708.10$, $SE = 170.15$, $M_{\text{coactive}} = 8534.06$, $SE = 159.16$, $M_{\text{conjunctive}} = 8507.56$, $SE = 159.16$, and, within that time, wore the armband for approximately the same amount of time within and across weeks (estimated marginal means: grand mean = 90%, $SE = .026$, $M_{\text{individual}} = 85\%$, $SE = .047$, $M_{\text{coactive}} = 94\%$, $SE = .044$, $M_{\text{conjunctive}} = 92\%$, $SE = .044$).

**Disruptive events.** From open-ended responses to the question, “Have there been any external events/forces (i.e., out of your control) in the past week that have affected your physical activity? Briefly explain (e.g., sick, weather, family, etc.)”, each week was coded as either including a disruptive event or not. The total number of weeks with disruptive events was then summed for each participant and a one-way ANOVA was run to examine differences between conditions. No differences were found, $F (2, 26) = 2.65, p = .09$. Further, eight separate one-way ANOVAs were run for each week between subjects experiencing a disruptive event and those without with EE as the dependent variable. An effect approached significance in Week 7, $F (1,
(27) = 4.14, \( p = .052, \eta_p^2 = .13 \), where those reported no disruptive events (\( n = 19; \ M = 2607, SD = 554 \)) were less active than those reporting a disruptive event (\( n = 10; \ M = 3017, SD = 427 \)). No other significant differences were found within any week, all \( F \leq 1.88, \ p \geq .18, \eta_p^2 \leq .06 \).

**Hypothesis testing**

The main hypotheses made predictions regarding group differences in EE and changes in EE between groups over time. Hypothesis 1 stated that EE in the conjunctive condition will be greater than EE in the coactive condition, and this difference will widen across weeks. Hypothesis 2 stated that EE in the partner conditions will be greater than in the individual condition, and this difference will widen across weeks.

Because previous studies have found gender to moderate motivation gains (Weber & Hertel, 2007; Weber, Wittchen, & Hertel, 2009), and to reduce error variance, gender was included as an exploratory factor in this analysis. Because missing data were deleted list-wise, the 11 dropouts and four subjects with missing data were excluded from the analysis. This left 21 subjects for this analysis including five in the individual condition (4 females, 1 male), eight in the coactive condition (5 females, 3 males), and eight in the conjunctive condition (4 females, 4 males). [Although approaches that more adequately address missing data (value estimation) are being conducted for revisions of this manuscript, note that an a priori power analysis following \( f \) index recommendations indicated that this sample size (\( n = 21 \)) would be sufficient for detecting a moderate (\( f = .25 \)) Köhler effect with probability > .80].

To examine H1, a 2 (gender) x 2 (condition) x 7 (week) RM ANCOVA analysis was run, but without the individual condition, to compare the partner conditions. Planned polynomial contrasts between conditions revealed the null Week, \( F (6, 14) = 1.70, \ p = .21 \), and Week x Condition interaction effects, \( F (6, 60) = 1.75, \ p = .21 \). To further explore, the overall RM
ANCOVA model was run, but revealed no significant effects for Condition, $F(1, 14) = .42, p = .53$; Week, $F(6, 11) = 1.89, p = .19$; Gender, $F(1, 14) = 4.08, p = .06$; Week x Condition, $F(6, 60) = .51, p = .79$; or Week x Gender, $F(6, 60) = .62, p = .81$. Thus, H1 was not supported.

There were no differences between the conjunctive and coactive conditions in EE.

This null effect justified combining the two partner conditions (“dyads”) in an additional RM ANCOVA, identical to the former, but comparing individuals and dyads. There were no condition effects, $F(1, 21) = 1.76, p = .20$; nor gender effects, $F(1, 21) = 2.07, p = .17$. There was, however, a significant Week x Condition interaction, $F(6, 96) = 5.01, p < .001$ (see Figure 2). There was also a polynomial Week x Condition quadratic trend, $F(1, 16) = 11.73, p = .003$, $\eta^2_p = .22$. This was interpreted as the two conditions each having quadratic trends over weeks, but with opposite concavity. To further explore, separate RM ANCOVAs and polynomial contrasts were performed for each condition. For the individual condition, there was no week main effect $F(6, 18) = 1.40, p = .27$; nor any significant polynomial trends, all $F \leq 3.18, p \geq .17$. Energy expenditure may have surged in the middle of the study, but did not increase or decrease significantly from pre to post, as evidenced by the lack of a linear trend.

The same RM ANCOVA was run for the dyad condition, only, along with a polynomial contrast. A week main effect approached sig, $F(6, 78) = 1.88, p = .09$, but there were no significant polynomial trends. Nonetheless, a 95% CI using marginal means showed that PA in Week 2 ($M = 2969.92, SE = 55.81$) was greater than in Weeks 5 ($M = 2764.18, SE = 63.66$), 7 ($M = 2763.26, SE = 74.30$), and 8 ($M = 28.09, SE = 64.58$). Energy expenditure in the dyad conditions, then, seemed to decrease over time. Looking at the plotted means, though, suggests that this decrease was only evident in weeks 2-3, whereas EE may have remained stable in weeks 5-8. Indeed, when polynomial trends are examined for each of those periods, separately, there is
a decrease from Weeks 2-3, $F(1,17) = 7.92, p = .01$, but no change from Weeks 5-8 and, in fact, approached a significant positive linear trend, $F(1, 16) = 4.12, p = .06$. Energy expenditure, then, may have decreased initially but was then maintained and may have even increased over the latter stages of the study.

Figure 2. Energy Expenditure Between Individual and Partner Conditions (estimated marginal means with Week 1 as covariate)

As an exploratory analysis, a full factorial 2 (gender) x 3 (condition) x 7 (weeks) RM ANCOVA was conducted with Week 1 EE as the covariate and Weeks as the within-subjects factor. There were no significant main effects for Condition, $F(2, 14) = .91, p = .42$. Thus, overall mean energy expenditure was the same across conditions. Also, there was no Week effect, $F(6, 84) = 1.78, p = .11$, suggesting that EE did not significantly change over the course of the 8-week study. A gender main effect approached significance, $F(1, 14) = 4.33, p = .056$,
where males (marginal mean = 2908.28 cal/day, \( SE = 52.25 \)) were more active than females (marginal mean = 2685.56 cal/day, \( SE = 82.51 \)). This marginally significant main effect, however, was superseded by a significant Gender x Week interaction, \( F(6, 84) = 2.29, p = .043, \eta^2_p = .140 \) (see Figure 3). A polynomial contrast of trends, however, failed to indicate any significant interaction effects. Thus, to tease out the effects within this interaction, separate polynomial contrasts were conducted for males and females. There were no significant trends for males, all \( F \leq 1.46, p \geq .26, \eta^2_p \leq .14 \), or females, all \( F \leq 9.27, p \geq .09, \eta^2_p \leq .82 \).

**Figure 3.** *Male and Female Energy Expenditure Over Time (estimated marginal means with Week 1 as covariate)*

Although there was a significant Gender x Week interaction, the lack of significance in either of these post-hoc analyses was likely due to lack of power on account of the low sample size. A visual examination of the plotted means suggests that females “spiked” in energy expenditure around Week 4 of the study, where males did not. Second, it suggests that males and females may have spiked around Week 6. Also, it suggests that, despite the non-significant Week main effect, that energy expenditure may have gradually decreased across weeks, although,
again, high variance and low sample size may have masked these effects. Because Thanksgiving fell around the middle of the study (Weeks 4-6), this may suggest that females are more likely to anticipate sedentary time and prepare accordingly. Second, both males and females may react similarly to disruptive health events by compensating after the fact.

Figure 4. *Energy Expenditure Between Conditions within Weeks (estimated marginal means with Week 1 as covariate)*

Referring back to the full factorial, there was also a significant Week x Condition interaction, $F (12, 89) = 4.02, p < .001, \eta_p^2 = .365$ (see Figure 4). A visual examination of the plotted data suggested that EE for the individual condition may have “spiked” in Weeks 4 and 6 and that, for dyads (and especially the coactive condition), EE may have “dipped” in Week 5. Indeed, a follow up polynomial contrast revealed a significant Condition x quadratic Week trend, $F (2, 18) = 5.28, p = .02, \eta_p^2 = .43$. Two separate post hoc analyses were conducted to tease out
within and between group effects for this interaction. First, eight separate RM ANCOVAs were conducted to compare differences between groups, within weeks. No differences were found between groups within any given week (a finding likely attributable to lack of power and small sample size). Second, three separate polynomial contrasts were conducted within each condition to assess trends over time, controlling for Week 1 EE. A significant negative linear trend was found for the coactive condition, $F(1, 6) = 7.73, p = .032, \eta_p^2 = .563$. [Note that when Week 5 is excluded from the analysis, the trend disappears, $F(1, 6) = 0.20, p = .67$.] There were no significant trends found for either the individual, $F(6, 18) = 1.40, p = .27$, or conjunctive, $F(6, 36) = 2.15, p = .07$, conditions.

To help simplify some of the trends observed in the former analyses, EE scores were collapsed into blocks (Block 1 = Week 2 EE + Week 3 EE/2; Block 2 = Weeks 4+5+6/3; Block 3 = Weeks 7+8/2). First, a 2 (gender) x 2 (condition: coactive, conjunctive) x 3 (block) RM ANCOVA was performed with the latter as the within subjects factor and EE as the dependent variable. There were no significant main or interaction effects, all $F < 2.35, p > .118, \eta_p^2 < .174$. Second, a similar block analysis was run, but contrasting the individual condition and dyads. There were no significant main, interaction, or polynomial effects, all $F < .36, p > .70, \eta_p^2 < .03$.

In summary, H1 (EE in the conjunctive condition will be greater than energy expenditure in the coactive condition, and this difference will widen across weeks) was not supported. Second, H2 (EE in the partner conditions will be greater than in the individual condition, and this difference will widen across weeks) was partially supported. EE in the partner conditions remained steady over the eight weeks, while EE dropped in the individual condition. Also, in exploratory analyses, EE for females seemed to spike in Weeks 4 and 6 (as did the individual
condition, comprised mostly of females), and EE for the coactive condition decreased across weeks (attributable to Week 5 EE) but remained stable in the conjunctive condition.

**Ancillary analyses**

Several ancillary analyses were conducted to help interpret the results found in the analyses for the main hypotheses. Between- and within-subjects effects were of main interest [a future set of mediation analyses may be run, where appropriate (e.g., self-efficacy, intention, and enjoyment]. Variables included motives for PA, intrinsic motivation, goal orientation, gender identity, attitude towards partner, attitude towards working in a group, barrier efficacy, regulatory self-efficacy, intention to exercise (A and B), enjoyment, information seeking behaviors, alternate choice behaviors, exercise mode, exercise classes, joining an exercise class/group, and fitness facility membership.

**Motives for physical activity.** Although all subjects were recruited based on their interest in increasing their PA, the motives for such activity could vary greatly across participants and possibly confound differences in EE. Thus, motives for PA were measured (at baseline). A 2 (gender) x 3 (condition) x 5 (motivation type) MANOVA was conducted using the subscales from the Motivation in Physical Activity Measure (Interest/Enjoyment, Competence, Appearance, Fitness, and Social). There were no differences between conditions, Wilks’ $\lambda = .66$, $F (10, 54) = .36, p = .29$ or gender, Wilks’ $\lambda = .95, F (5, 27) = .30, p = .91$ in motivations for being physically active.

**Intrinsic motivation.** Intrinsic and extrinsic motivation (measured at baseline) were examined with two separate 3 (condition) x 2 (gender) x 2 (motivation type) MANOVAs using the intrinsic (Knowledge, Accomplishment, Experience Stimulation) and extrinsic (Identified, Introjected, and External Regulation) subscales of the Leisure Motivation Scale. There were no
significant condition effects (extrinsic: Wilks’ $\lambda = .90, F (6, 54) = .52, p = .79$; intrinsic: Wilks’ $\lambda = .85, F (6, 54) = .77, p = .60$). There was no gender effect for extrinsic motivation, Wilks’ $\lambda = .92, F (3, 27) = .75, p = .53$. A gender effect for intrinsic motivation approached significance, Wilks’ $\lambda = .75, F (3, 27) = .77, p = .052$. Looking at estimated marginal means (see Table 8), males were higher than females on all intrinsic motives, but a post hoc using 95% CI showed that only motives for accomplishment for males (marginal mean = 2.31, $SE = .27$) were significantly higher than females (marginal mean = 1.75, $SE = .26$). Thus, intrinsic and extrinsic motives for being physically active (as a leisure activity) were equal across groups and genders.

**Goal orientation.** Between group differences in goal orientation (measured at baseline) were assessed with a 3 (condition) x 2 (gender) x 3 (orientation type) MANOVA, using the Ego, Task, and Social subscales of the Goal Orientations in Exercise Measure. There were no significant main (gender: Wilks’ $\lambda = .86, F (3, 26) = 1.38, p = .271$; condition: Wilks’ $\lambda = .88, F (6, 52) = .61, p = .73$) or interaction (Gender x Condition: Wilks’ $\lambda = .88, F (6, 52) = .77, p = .76$) multivariate effects for this set of variables. Univariate, between-subjects tests, though, showed that a gender effect for the Ego subscale approached significance, $F (1, 28) = 4.05, p = .054$. Post hoc analysis using 95% CI showed males reported slightly higher Ego scores ($M = 3.04, SD = .71$) than females ($M = 2.53, SD = .84$), meaning that they were more motivated by normative comparison. That there were no multivariate effects suggests that motives for exercise were the same between genders and conditions, although males may have been more ego-motivated (e.g., motivated to achieve a favorable social comparison, outcompete his partner, or avoid an unfavorable comparison) than females.

**Attitude towards partner.** A one-way ANOVA between partner conditions was run with attitude towards partner as the dependent variable (scale from 0-5; e.g., “how well do each
of these adjectives describe your attitude towards your partner?...’helpful’, ‘cooperative’,
‘trustful’, etc.”. Items were collapsed into a composite score). No differences were found, $F (1, 17) = .00, p = .98$, indicating that attitudes towards the partner were equal between the conjunctive and coactive conditions. On average, attitudes towards the partner were “neutral”, $M = 3.37$, $SD = .66$.

**Team perception measure.** Because the reliability for the measure was low (alpha = .48), each item was analyzed separately. Items were scored on a scale from 1 (*not at all*) to 5 (*very much*). To examine if means were different from the midpoint (3), five one-sample t-tests were run. Means for all items were significantly lower than the midpoint ($p < .001$; see Table 9) for both the coactive and conjunctive conditions, indicating subjects felt as though they and the partner were not working together as a team (for means, see Table 10). To examine mean differences between groups, five separate 2 (condition) x 2 (gender) ANOVAs were conducted, one for each item. Females perceived to be working more collaboratively with the partner than males, $F (1, 15) = 4.97, p = .04, \eta_p^2 = .25$. There were no significant differences between the coactive and conjunctive conditions on any of the other items, $F \leq 2.31, p \geq .15$.

**Barrier efficacy.** To examine BE, and subsequent mediating variables (intention, enjoyment), analyses were conducted using the same basic procedure used for the main analysis of EE. That is, a direct comparison was first made between the partner conditions, and then a second analysis including the individual condition. First, a direct comparison between partner conditions was conducted using a 2 (gender) x 2 (condition) x 8 (Week) RM ANCOVA. No main or interaction effects were found (all $F \leq 1.32, p \geq .25, \eta_p^2 \leq .96$), indicating that subjects in the conjunctive and coactive conditions were equally confident in their ability to overcome barriers to exercise.
The two partner conditions were then combined and a 2 (gender) x 2 (condition) x 8 (Week) RM ANCOVA was performed with BE as the dependent variable and Week as the within-subjects factor. There was a significant condition effect, $F(1, 17) = 7.07, p = .02, \eta_p^2 = .34$. The individual condition (marginal $M = 2.53, SE = .18$) was significantly lower than the partner condition (marginal $M = 3.11, SE = .12$). However, this was superseded by a significant Gender x Condition interaction, $F(1, 17) = 10.45, p = .006$ (see Figure 6). Using 95% confidence intervals, females in the partner condition (marginal $M = 3.41, SE = .19$) had significantly higher BE than females in the individual condition (marginal $M = 2.11, SE = .25$). Barrier efficacy for females in the individual condition was also lower than BE for males in both the individual (marginal $M = 2.96, SE = .25$) and partner conditions (marginal $M = 2.82, SE = .17$). Barrier efficacy for females in the partner condition, however, was greater than for males in the partner condition. There were no differences between males in the individual and partner conditions. There were also no other main or interaction effects, all $F < 1.45, p > .19, \eta_p^2 < .09$.

In summary, females tended to have lower confidence in overcoming barriers in the individual condition than the partner condition, while condition had no effect on BE for males.

To help simplify the analysis, block scores were calculated (Block 1 = average of Visit 2, 3 and 4; Block 2 = average of Visit 5, 6; Block 3 = average of Visit 7, 8, and 9) and, first, a 2 (gender) x 2 (condition: coactive, conjunctive) x 3 (block) RM ANCOVA was run with block as the within subjects factor and baseline BE (Visit 1) as the covariate. There were no significant main, interaction, or polynomial effects, all $F \leq .81, p \geq .47, \eta_p^2 \leq .12$. Second, a similar block analysis was run, but contrasting BE between the individual condition and dyads (coactive +
conjunctive). There were no significant main, interaction, or polynomial effects, all $F \leq 1.82, p \geq .19, \eta^2_p \leq .15$.

![Figure 5. Marginal Means for Barrier Efficacy Between Individual and Partner Conditions](image)

**Regulatory self-efficacy.** To assess differences in regulatory self-efficacy, a 3 (condition) x 2 (gender) x 8 (week) RM ANCOVA was run, with the latter as the within-subjects factor and Week 1 as a covariate. No main or interaction effects were found, $F < .93, p > .55, \eta^2_p \leq .45$.

**Intention to exercise (A).** To assess changes in participants’ intention to exercise “tomorrow” over the course of the 8-week study, a 2 (gender) x 3 (condition) x 8 (week) RM ANCOVA was run, with time as the within-subjects factor and baseline intention as the covariate. A significant week effect was characterized by a negative linear trend, $F(1, 26) = 6.50, p = .017, \eta^2_p = .200$. Intention to exercise “tomorrow” significantly decreased over time. No other significant effects were found, all $F \leq 1.02, p \geq .43, \eta^2_p \leq .07$. 

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Intention to exercise (B). To assess changes in participants’ intention to exercise “next week” over the course of the 8-week study, a 2 (gender) x 3 (condition) x 9 (week) RM ANCOVA was run with week as the within-subject factor as Week 1 intention as the covariate. No significant effects were found, all $F < 1.11, p > .36, \eta^2_p < .08$. Thus, intention to exercise “next week” was the same between males and females, as well as between conditions, and did not change over the course of the 8-week study.

Alternative health choices. To assess changes in alternate health choices over time, a 2 (gender) x 3 (condition) x 7 (week) RM ANCOVA was run with week as the within subjects factor and Week 1 as the covariate. Because the assumption of sphericity was violated, an adjustment to degrees of freedom was made using Wilks’ $\lambda$. There were no significant main or interaction effects, all Wilks’ $\lambda \leq .83, F \leq 1.24, p \geq .30, \eta^2_p \leq .33$. The number of alternative health choices, then, was the same between genders and conditions and did not change within weeks.

Information seeking. To assess changes in information seeking behaviors over time, a 3 (condition) x 2 (gender) x 7 (time) RM ANCOVA was run with the latter as the within-subjects factor and Week 1 information seeking behaviors as the covariate. Because the assumption of sphericity was violated, an adjustment to degrees of freedom was made using Wilks’ $\lambda$. There were no significant effects, suggesting that information seeking behaviors were the same males, females and conditions, and did not change over time, all Wilks’ $\lambda \leq .81, F \leq 1.06, p \geq .43, \eta^2_p \leq .33$.

Exercise mode. To assess differences between groups in mode of activity (alone, with a friend, with others), three separate 2 (gender) x 3 (condition) x 7 (week) RM ANCOVAs were
run, one for each mode, with the number of times exercised in the mode in Week 1 used as a
covariate and Weeks as the within subjects factor. Where the assumption of sphericity was
violated, an adjustment to degrees of freedom was made using Wilks’ $\lambda$. There were no
significant effects for mode of activity (Exercising alone: all Wilks’ $\lambda \leq .60$, $F \leq 2.74$, $p \geq .11$,
$\eta_p^2 \leq .70$; Exercising with a friend: all $F \leq 1.73$, $p \geq .08$, $\eta_p^2 \leq .24$; Exercising with others: all $F$
$\leq 1.32$, $p \geq .26$, $\eta_p^2 \leq .15$).

**Exercise classes.** The number of subjects who were enrolled in or attending exercise
classes during the study was assessed each week. To examine whether there were any differences
between conditions in the total number of weeks where subjects were enrolled or attending
exercise classes, the number of weeks enrolled was summed within participants, across weeks,
and entered into a Chi-square test, assessing independence of number of weeks enrolled from
condition. The Chi-square test was non-significant, $\chi^2 (10, n = 19) = 9.95$, $p = .44$, supporting
the null hypothesis that the number of weeks that subjects were enrolled in exercise classes was
equal between conditions.

**Joining an exercise class/group.** Subjects were asked each week if, in the past week,
they had joined an exercise class (which may have been inspired by working with a partner
and/or made a comparison with the partner less salient). Note that this is not the same as asking
if they had actually participated in an exercise group, whether subjects joined multiple groups
over time, or joined, dropped out, and then re-joined. Thus, for one subject who reported joining
an exercise class five times over the course of the study, it is quite possible that the question was
misinterpreted and/or the wording of the question was ambiguous. There were only two subjects
who responded that they had joined more than once. A Chi-square analysis was carried out to
assess any group differences in the number of times subjects joined an exercise class/group over the course of the study. The Chi-square test was non-significant, $\chi^2 (10, n = 19) = 9.95, p = .44$, supporting the null hypothesis that the number of subjects who joined exercise classes/groups was equal across conditions. Only five subjects joined exercise classes/groups.

**Fitness facility membership.** To assess whether there were equal numbers of subjects who had memberships to fitness facilities between conditions, a Chi-square analysis was run with total number of weeks with a membership as the dependent variable and condition as the independent variable. The Chi-square analysis was non-significant, $\chi^2 (4, n = 19) = 5.01, p = .29$, supporting the null hypothesis that number of weeks that subjects had memberships was equal across conditions. It is also worth noting that only two subjects who at the beginning of the study did not have a membership acquired one within the first week of the study (one of those subjects dropped out in Week 2, the other subject adhered throughout the 8-weeks).
CHAPTER 5

Discussion

Previous researchers have observed the Köhler effect under a variety of experimental tasks and settings. What is not yet clear is under what conditions the Köhler effect might be observed in a natural, free-living setting. Therefore, the purpose of this study was to examine the Köhler effect in a field experiment where the task was to increase one’s PA under free-living conditions. This chapter discusses the findings of the current study, identifies practical implications of these results, and outlines future research directions.

A consistent finding across previous studies examining the Köhler effect has been that when an inferior group member was given an opportunity for social comparison (i.e., coactive conditions) between his/her more capable partner, inferior group members increased task effort above and beyond what would be expected given his/her individual performance (Weber & Hertel, 2007). Furthermore, in most, but not all (e.g. Feltz, Kerr, & Irwin, 2011) previous studies, indispensability in a group task has led to greater effort in simple motor and cognitive tasks (Weber & Hertel, 2007). Thus, in the current study, the researcher predicted that (a) opportunities for social comparison would lead to increases in effort in a complex task under free-living conditions (H2) and (b) the indispensability process would also lead to increases in effort, but using a more complex task performed in the natural, behavioral-environment (H1). In the current study, contrary to what was expected in H1, the conjunctive condition failed to produce any differences in energy expenditure above and beyond social comparison alone. However, although there were no overall differences in EE between dyads (average of coactive + conjunctive) and individuals, dyads maintained PA over the last 3 weeks (in partial support of
H2). Although not significant (likely due to power constraints), PA in the individual condition appeared to decrease over the course of the study.

**Hypothesis 1**

At first blush, that indispensability did not lead to higher overall EE, nor a different pattern of EE over time, suggests that there is no functional advantage of performing conjunctively with a partner in increasing one’s PA. This contradicts the bulk of previous Köhler research (Kerr & Hertel, 2010; Weber & Hertel, 2007) including similar longitudinal Köhler effect studies (Irwin et al., in press; Lount Jr, Kerr, Messé, Seok, & Park, 2008). Given the strength of the Köhler effects observed in previous research (Irwin et al., in press; Weber & Hertel, 2007), null effects in this study were likely due to limitations in the paradigm in establishing the conditions within which this effect has been observed in previous studies. Indeed, this explanation is highly likely, given some of the major methodological differences between this study and ones previous.

One major departure from previous Köhler studies is in the conjunctive task structure. In prior studies, the actual physical performance of the partner has been constrained by the performance of the subject (Feltz et al., 2011; Irwin et al., in press; Lount Jr et al., 2008). That is, during the performance of a discrete motor persistence task, if the subject quit, the partner also had to quit, and both the subject and the partner would, therefore, receive the same performance score. In the current study, both the subject and partner were working conjunctively, but because increasing PA is a continuous (vs. discrete) task, there was no clear indication of when the subject “quit” and, thus, no constraints placed on the partner. Psychologically, this may be very different from prior studies. Although one’s superior partner may be receiving a lower score than what he/she could achieve on his/her own, a low score in
itself does not restrict the partner from continuing to work towards increasing daily PA. Thus, the efficacy of the indispensability manipulation in this study likely relied almost entirely on the value of the team score. Functionally, the team score was an arbitrary measure of team performance that had no monetary or extrinsic value, both of which have eliminated the effect when offered in previous studies (Kerr, Feltz, & Irwin, In preparation). Social concerns may also affect the value of the team score, such as making a favorable/avoiding an unfavorable impression or not letting the other person down, especially when the partner is perceived to highly value the team score. However, because (a) there was no indication given to the subject that his/her partner highly valued the team score, (b) attitudes towards the partner were generally neutral, and (c) subjects did not feel as they and their partner were working together as a team, it is then not surprising that no differences in EE between the conjunctive and coactive conditions were observed. One who does not perceive the score as being important to the partner, has a generally neutral feeling towards the partner, and who does not perceive themselves to be a part of a team with the partner has little incentive to increase one’s daily PA (an already challenging task) for either the benefit of the group or for impression management. Thus, the conditions created in this study did not entirely meet the conditions for the Köhler effect to be observed. Because it would be difficult to constrain the partner’s performance in a continuous task such as the one used in this study, future studies might focus more on bolstering group member relations (Kerr & Seok, 2011), introduce intra-group competition, or both, which may increase the value of high effort and a favorable team score.

Hypothesis 2

That none of the conditions increased in PA throughout the study highlights a truism of behavior change: habits are hard to break. Indeed, a great amount of resources are directed
towards interventions to change habitual health behaviors (e.g., physical inactivity, smoking, drinking, etc.), and are often grounded in health behavior change theory. It is worth reiterating, then, that the current study is not a behavior change intervention, nor based on health behavior change theory, but rather a field experiment, the purpose of which was to examine group dynamics principles of motivation previously observed in laboratory (and highly controlled field) conditions in the natural, behavioral environment. That dyads simply maintained PA over the last 3 weeks of the study while individuals may have dropped (partially supporting H2) is encouraging for future exercise partner field studies and applications to health promotion practices. This is also encouraging considering the timing of this study, running through both Thanksgiving and the final weeks of the semester (in which workloads tend to augment), both times during which exercise and other normal routines can be easily disrupted. This finding loosely corroborates previous longitudinal Köhler studies (Irwin et al., in press; Lount Jr et al., 2008), where effort in partner conditions has been greater than individual conditions. Interestingly, however, when trends between conditions were examined separately, both the coactive and conjunctive conditions decreased in EE over time.

The decrease in effort attributable to the social comparison mechanism over the course of the 8-week study differs from the findings of two previous longitudinal Köhler effect studies. In both prior studies (Irwin et al., in press; Lount Jr et al., 2008), effort attributable to the social comparison mechanism remained relatively stable over repeated sessions whereas effort attributable to the indispensability mechanism either increased initially and then attenuated over time (Lount Jr et al., 2008) or simply increased monotonically over time, without attenuation (Irwin et al., in press). At face value, the decrease in effort over time in the coactive condition may suggest that there is something inherently demotivating about coactive performance within
the current paradigm. When one’s goal is to outcompete a superior partner, as may be the case in exercise tasks (Feltz et al., 2011) and after repeatedly receiving feedback indicating a coactor’s superior performance, one might gradually relax his/her efforts over time as one realizes the futility in trying to accomplish such a goal, especially when the discrepancy between the target exerciser and the partner is widening. Although there was no significant main difference between the coactive and individual task conditions, as there has been in previous studies (e.g., Lount Jr et al., 2008), this gradual decrease in effort following repeated trials of inferior performance corroborates previous findings. Interestingly, though, when Week 5 was excluded from the trend analysis for the coactive condition (because it was a visual outlier), the negative trend disappeared. For this, there are at least two possible explanations. First, one might speculate that there is something uniquely de-motivating about performing coactively with a superior partner around the midpoint of a series of tasks (e.g., a lack of interdependence) or, second, that an external event occurred around the midpoint of the task that disrupted those performing the task coactively, but not those performing individually or conjunctively. Indeed, Thanksgiving occurred around this very point in the study- a time typically regarded as disruptive for exercise and other normal routines. That no prior studies have observed a negative trend for only the coactive condition argues in favor of the latter explanation, which suggests that the lack of interdependence may actually be disadvantageous in the face of disruptive life events. On the other hand, performing conjunctively with a superior partner may actually have protective benefits in the face of disruptive life events (although, statistically, no more protective than individual tasks). That there were no differences in EE within Week 5 prevents a firm assertion of the protective benefits of conjunctive performance during disruptive life events, but might be a fruitful inquiry for future research.
A more complete interpretation of these trends, though, must take into consideration the relative numbers of males and females within each condition. That is, four of five subjects in the individual condition were females, as were five of the eight subjects in the coactive condition (the conjunctive condition was split evenly, 4/4). Thus, females were highly over-represented in the individual condition. That the pattern in energy expenditure over weeks in the individual condition (Figure 4) is strikingly similar to the pattern for all females in the study (Figure 3) suggests that females generally shared the same PA patterns throughout the study and, thus, may have been less sensitive to the task conditions imposed on them as they were to other behavioral influences. Second, this suggests that the significant negative linear trend for the individual condition observed in the Condition x Week polynomial trend (Figure 2) is attributable to changes in energy expenditure unique only to females (especially in Weeks 7 and 8). That EE in the individual condition from Weeks 4 (Figure 4), 7 and 8 (Figure 2) appear extreme compared to the partner conditions, and that the timing of the study (Thanksgiving fell around the middle of the study while the final week of the regular semester fell during the last week of the study), it is reasonable to suggest that females may have responded differently to these events than males (e.g., exercise more to make up for indulging in sedentary behavior and high-calorie meals characteristic of the Thanksgiving holiday, and abandoning one’s exercise routine in times of high stress characteristic of the end of the semester). Lastly, that females were over-represented in the individual condition suggests that the individual condition may not be a reasonable control group with which to make comparisons between the more gender-balanced coactive and conjunctive conditions. It is quite possible, then, that had the individual condition been more gender-balanced, that we might have observed a more stable pattern of PA similar to those in the partner conditions, although the negative trend in the coactive condition argues against this.
Clearly there is a need for future research to ensure more gender-balanced conditions to support or refute these speculations.

At face value, that no increases in EE (or other pertinent psychosocial and behavioral outcomes) were observed in the current study might suggest that the Köhler effect, despite the rather robust effects found in previous laboratory research (Feltz et al., 2011; Irwin et al., in press), may simply not be observable in the natural behavioral environment, although recent research argues against this (Huffmeier & Hertel, 2011; Osborn, Irwin, Skogsberg, & Feltz, In press). An important understanding, though, is that the Köhler effect is the product of psychological processes (social comparison and indispensability) observable within a set of specific conditions (e.g., the partner is moderately superior, the weaker group member receives feedback regarding the superior partner’s performance, the weaker partner perceives he/she is a team member who is indispensable to the team task, and the task is well-defined). Therefore, the failure to observe the effect in this study is likely not due to inherently weak psychological processes, but rather attributable to a set of suboptimal conditions. In addition to the conjunctive task structure (mentioned above), the main conditions that deviate the most in the current study from those previously employed in studies where the effect has been observed involve (a) the discrepancy in partner ability, (b) the complexity of the task and (c) the schedule and mechanism of performance feedback.

**Partner ability.** Previous Köhler research has identified a moderate discrepancy (40%) between partner abilities as optimally motivating (Hertel et al., 2000; Irwin, Feltz, & Kerr, 2010; Köhler, 1926). In the current study, in order to mimic natural fluctuations in performance, this discrepancy was allowed to vary within a set of pre-determined parameters (see description of algorithm in methods for full explanation). This resulted in discrepancies that began in Week 1 at
28% and progressively increased up to 74% in Week 7, where a moderate discrepancy was observed only in Week 2 (39%). The partner’s absolute PA was increased each week to mimic improvements in health and fitness, an increase that the researcher expected to see for the subjects, as well. However, subjects in this study did not increase their PA over the course of the study and, therefore, this discrepancy widened over each consecutive week. As Hertel, Kerr & Messé (2000) observed in a prior study, when keeping up with one’s partner is seen as unachievable, one has less incentive for giving a maximal effort and reduces his/her effort. Therefore, a plausible explanation for the null effects in this study is the fact that the discrepancies, for the majority of the study, were greater than those previously found to be optimally motivating and, thus, keeping up with the partner was seen as unachievable. This might be avoided in the future by altering the algorithm to produce estimates of partner performance more closely aligned with the subject’s.

Secondly, part of this manipulation involves leading subjects to the perception of a moderately superior partner in terms of effort, but equal in ability. Despite the efforts of the research team to create the perception of a moderately superior partner in terms of effort, subjects believed that their partner was equal in terms of both ability and effort. It should be noted, however, that this may be attributable to a limitation in the questionnaire. That is, although the initial stem of the two questions that assessed these perceptions asked about their perceptions of the partner’s ability and effort, the anchors on the scales for both items were phrased as, “the other person was much less capable than me” and “the other person was much more capable than me”, rather than “the other person put forth much more effort/was much more able than me”. This inconsistent wording may have confused the subject, as is likely the case given that these means contradict some of the open-ended responses (e.g., “my partner burned a
ton of calories every week”). In any case, it is uncertain whether the manipulation was successful and, thus, a plausible explanation for null effects.

**Task characteristics.** After completing Week 1 and being randomly assigned to conditions, subjects were given the task of “increasing their daily PA.” Information was provided as to what a safe level of activity might be for them, in terms of energy balance but, necessarily, no goal or performance level was given. However, the wording of this task may have been rather ambiguous. Participants may have been confused as to whether (a) they were supposed to increase their PA *each week* to a daily average higher than the previous week or (b) increase PA to a point above Week 1, and simply maintain that level (the former being the intended message of the researcher). Regardless of interpretation, there was no check to make sure the subjects understood the task. In fact, one participant at the end of the study indicated that the task was not clearly defined. Task ambiguity, then, was a concern and may have stymied efforts to increase one’s PA.

**Partner feedback schedule.** As Lount and colleagues (2008) suggest, the frequency, direction and magnitude of performance feedback is paramount in sustaining motivation within this paradigm, rather than the actual duration of group work. In many previous experiments, feedback has been most effective when provided on a continuous schedule where the participant could watch the performance of his/her superior partner as they performed the task synchronously. In a study by Lount and colleagues (2008), although the partner was not physically present, a computer screen indicated to the participant when the partner quit. The same was also true in another study (Irwin et al., in press), except that the partner was virtually present (i.e., the participant could see a live video feed of the partner) for the entire duration of the task. In the current study, the task was also performed synchronously, as in these previous
studies, but feedback was provided only once per week, at the beginning of each week, via text message and email. There was no check to assess how many times the subject viewed this feedback, if at all (although partner conditions reported greater perceived partner ability and effort than individual controls in a one-time measurement at the end of the study). Had feedback been provided on a daily basis, that may have provided enough information to be effective, but that needs to be empirically tested in future research. However, given that the task was being performed in the natural environment, information about the partner’s performance was also part of a milieu including a variety of other stimuli making strict experimental control, and thus attention to feedback stimuli, extremely difficult.

**Implications**

This study has a few interesting implications for (a) Köhler research and (b) health promotion practice. First, this study identifies a specific set of conditions in which the Köhler effect is (likely) not observable in the field. Although one might argue that the sustained level of PA observed in the partner conditions signifies a heightened level of motivation (analogous to “motivation gains” in previous studies), there were no differences between the partner and individual conditions, suggesting that there are no additional benefits to participating with a partner. More studies are needed to establish a set of conditions in which the Köhler effect is observable and determine in what ways working conjunctively or coactively with a more capable partner influences behavior fielding a way that improves upon individual participation.

Educating participants on the benefits of and strategies to increase PA is a part of many PA interventions (Van Der Bij, Laurant, & Wensing, 2002), as it was in the current study. In terms of health promotion, this study suggests that education, alone, is not enough to increase or simply maintain one’s activity over the course of 8 weeks. This was evidenced by the pattern of
PA in the individual condition. Again, though, the reader should keep in mind that this condition was composed of mostly females and, thus, may not generalize to males. Second, many interventions based on group dynamics principles in some way promote *interaction* between group members (e.g., social support) or have group members exercise *with* each other, simultaneously. This study showed that simply participating with a partner in an educational lifestyle PA intervention (although not *exercising with*), and without any type of social support between partners may have protective benefits for maintaining PA routines during disruptive life events. That is, subjects in the partner conditions maintained their PA levels over the last 3 weeks of the study during the end of the academic term.

**Limitations**

The limitations of this study coincide with several of the explanations given above for the null effects including the small sample size, the over-representation of females in the individual condition (and, less seriously, in the coactive condition), the feedback schedule, the conjunctive task structure, task ambiguity, limitations of the algorithm in producing a moderate discrepancy, and a partially unsuccessful attempt to create the perception of a moderately superior partner in terms of effort. An additional limitation, however, includes the handling of missing data.

A total of 15 subjects were omitted from the main analyses on account of missing data. Eleven of them were dropouts while four of them simply had missing data for at least one week during the study. Although case-wise deletion is a straightforward procedure for handling missing data, the major cost of such a procedure is the loss of power and discarding of valid data points that are thrown out possibly due to one case of missing data. An alternative way to handle missing data is to estimate it using a regression analysis or multiple imputation. These methods may prove useful in a revision of this manuscript (in progress).
Lastly, as has been customary in previous Köhler research and other pre-post designs, difference score analyses should also be performed to corroborate the covariance analyses. A difference score analysis may also lead to slightly different findings, although these two methods have typically led to the same or similar patterns of results.

**Future Directions**

Although the main hypotheses set forth were not supported, this study has identified several fertile areas for future research. First, from a basic science perspective, the most pressing need is to identify the boundary conditions for the Köhler effect in the field. The conditions in the current study are obviously not representative of these boundaries, but correcting for some of the limitations in the current study regarding task clarity/structure, performance feedback and partner discrepancy will likely to lead to progress in identifying such boundaries. Second, as this line of research evolves into health promotion interventions, future researchers would be wise to consult other strategies used in interventions that apply group dynamics principles to inform design and the targeting of mediating variables. Specifically, consideration should be given to how Köhler principles of motivation interact with perceptions of team cohesion.

**Cohesion.** Carron and Spink (1993) suggest that when group dynamics principles are being applied in behavior change interventions (many of which occur in free-living conditions; e.g., home-based), the effectiveness of such programs relies largely on the group’s sense of cohesion. Indeed, a meta-analysis of 44 physical activity interventions (1,046 effect sizes) indicated that interventions including cohesion-building components (termed by the authors as “true groups”) were more effective in positively changing participant adherence, social interactions, quality of life, physiological effectiveness and functional effectiveness, than group-level interventions without cohesion-building (“collectives”), collectives that received social
support, and individual-level interventions with and without social support (Burke et al., 2006). In the current study, cohesion-building activities were, necessarily, not included, which allowed for a more direct examination of the indispensability and social comparison mechanisms in the natural, behavioral environment. An interesting line of future research, though, would be to examine the mediating role of individual perceptions of group cohesion between task conditions and PA behavior, and then systematically introduce elements to the paradigm that may bolster and/or hinder aspects of team cohesion, including manipulations of team-identification (Lount Jr & Phillips, 2007), ostracism (Kerr et al., 2008), and friendship (Kerr & Seok, 2011).

**Mobile technologies.** A particularly interesting and promising methodological approach to understanding psychological processes as they occur in the field is to measure them using mobile devices. Using mobile phones to measure mediating variables, as well as to deliver stimulus materials (e.g., feedback, as was done in this study) would be a useful addition to the paradigm used in this study.

**Qualitative study.** Finally, while the researcher has made a set of reasonable explanations for the results of this study, an addition approach to further understanding and explaining these results is to consult the actual participants, themselves. That is, a rich understanding of psychological phenomena can be gained from a line of guided questioning intended to elicit the subjective experiences of the participants, which may then inform future studies and interventions. An interesting follow up study, then, would be to interview subjects from the current study and create a narrative of their experiences, which would help the researcher more fully understand the results of this study, in what ways it “worked”, and in what ways it did not work.

**Conclusion**
Field experiments may have tremendous value for both testing theory and for systematically translating basic research into applied research and practices (Harrison & List, 2004; Salovey & Williams-Piehota, 2004). In addressing our nation’s health problems, strategies for motivating people to be physically active are needed. The current field study highlights the difficulty in translating basic laboratory science into field settings and, at the same time, points to some encouraging applications of the Köhler effect to motivation in dyads performing physical activity. Specifically, motivation during times of stress may be preserved by being partnered with someone else. Future research should identify the boundary conditions for the Köhler effect in the field and continue to move towards a translation of such knowledge into PA interventions.
TABLES
Table 1. *Subject demographics* (N = 35)

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*Note:* * 18 ≤ BMI ≤ 25 is generally healthy
**1 = poor, 2 = below average, 3 = average, 4 = above average, 5 = excellent
*** 1 = 1x per week, 2 = 2x per week, etc…
Table 2. *Raw Means and Standard Deviations for all Dependent Variables*

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Note. \* P < 0.05; **P < .01.
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*Note.* *. p < 0.05; **p < 0.1. Base. = Baseline, EE = energy expenditure
Table 5. Correlations Between Intention to Exercise (A) and Energy Expenditure

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*Note.* *P* < 0.05; **p** < .01. EE = energy expenditure
Table 6. Correlations Between Intention to Exercise (B) and Energy Expenditure

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Note. *. $P < 0.05$; **$p < 0.01$. EE = energy expenditure
Table 7. Correlations Between Enjoyment of Physical Activity and Energy Expenditure

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Note. * p < 0.05; **p < .01. EE = energy expenditure
Table 8. *Means and Standard Deviations (SD) for Intrinsic Motivation Subscales Between Males and Females.*

<table>
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<th>Females</th>
<th>95% Confidence Interval</th>
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Table 9. *One-sample t-tests for items on the team perception measure*

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<th>df</th>
<th>$p$</th>
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<th>95% CI of the Difference</th>
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<tr>
<td>I felt I was part of a team with my partner</td>
<td>-11.34</td>
<td>18</td>
<td>.000</td>
<td>-1.58</td>
<td>-1.87 to -1.29</td>
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<td>I felt I worked collaboratively with my partner</td>
<td>-15.37</td>
<td>18</td>
<td>.000</td>
<td>-1.68</td>
<td>-1.91 to -1.45</td>
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<tr>
<td>I felt my partner and I worked together</td>
<td>-26.19</td>
<td>18</td>
<td>.000</td>
<td>-1.90</td>
<td>-2.05 to -1.74</td>
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<tr>
<td>I felt I was working separately from my partner (rev scored)</td>
<td>-9.55</td>
<td>18</td>
<td>.000</td>
<td>-1.52</td>
<td>-1.86 to -1.19</td>
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<tr>
<td>I felt my partner was helpful to my performance</td>
<td>-4.85</td>
<td>18</td>
<td>.000</td>
<td>-1.10</td>
<td>-1.58 to -0.63</td>
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</table>
Table 10. *Item means between conditions for team perception measure (coactive n = 10, conjunctive n = 9)*

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<td>I felt I was part of a team with my partner</td>
<td>1.40</td>
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<tr>
<td>my partner</td>
<td>(.70)</td>
</tr>
<tr>
<td>I felt I worked collaboratively with my partner</td>
<td>1.30</td>
</tr>
<tr>
<td>with my partner</td>
<td>(.48)</td>
</tr>
<tr>
<td>I felt my partner and I worked together</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>(.00)</td>
</tr>
<tr>
<td>I felt I was working separately from my partner (rev scored)</td>
<td>1.50</td>
</tr>
<tr>
<td></td>
<td>(.71)</td>
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<tr>
<td>I felt my partner was helpful to my performance</td>
<td>2.20</td>
</tr>
<tr>
<td></td>
<td>(1.14)</td>
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</table>
FIGURES
Figure 6. Flowchart of Procedure

Recruiting
- (KIN classes)

Screening (online survey)

Visit 1
- consent
- Psychosocial measures

Week 1
- Baseline PA

Visit 2
- Orientation
- Task: "increase your daily PA"
- Random assignment
- Skype (dyads)
- Psychosocial measures
- Week 1 Feedback (text/email)

Weeks 2-8 (visits 3-9)
- 1 visit per week
- Psychosocial measures
- Feedback (text/email)

Visit 9 (post Week 8)
- Psychosocial measures
- Debriefing
APPENDICES
Appendix A: Demographic Questionnaire  
(administered on Survey Monkey)

The following is a screening instrument to see if you are eligible to participate in the study. Your participation in this survey is completely voluntary. By participating in this survey, you are under no obligation to participate, nor are you enrolled in the study. If you are eligible, we will contact you using the information you provide to us. If you have any questions, please contact Brandon Irwin (irwinbra@msu.edu).

1. Last name: _________
2. First name: _________
3. DOB: _______________
4. What is your height in centimeters? (use this website to convert Inches to CM:  
http://www.manuelsweb.com/in_cm.htm) _________
5. What is your weight in kilograms? (use this site to convert lbs to kg:  
http://www.convertunits.com/from/lb/to/kg) _________

Circle one
6. Gender: Male Female
7. Handedness: Right Left
8. Smoker: Yes No
9. Class: First Second Third Fourth Fifth >5years
10. Race: Caucasian Hispanic Asian African American Mixed Other
11. Will you be on or around campus for the next 8 weeks (and be able to come to the lab in IM Circle once per week at a time of your convenience)?
   Yes No Other (please specify):
<table>
<thead>
<tr>
<th>YES / NO</th>
<th>Question</th>
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<tr>
<td></td>
<td>Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?</td>
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<tr>
<td></td>
<td>Do you feel pain in your chest when doing physical activity?</td>
</tr>
<tr>
<td></td>
<td>In the past month, have you had chest pain when you were not doing physical activity?</td>
</tr>
<tr>
<td></td>
<td>Do you lose your balance because of dizziness or do you ever lose consciousness?</td>
</tr>
<tr>
<td></td>
<td>Do you have bone or joint problems that could be made worse by a change in your physical activity?</td>
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<tr>
<td></td>
<td>Is your doctor currently prescribing medication for your blood pressure or heart condition?</td>
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<tr>
<td></td>
<td>Do you know of any other reason why you should not do physical activity?</td>
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If you answered “YES” to any of the above, please explain:
Appendix C: Stage of Change Questionnaire

For each of the following questions, please indicate either Yes or No. Please be sure to read the questions carefully.

Physical activity or exercise includes activities such as walking briskly, jogging, bicycling, swimming, or any other activity in which the exertion is at least as intense as these activities.

1. I am currently active  Yes  No

2. I intend to become more physically active in the next 6 months  Yes  No

For activity to be REGULAR, it must add up to a TOTAL of 30 minutes or more per day and be done at least 5 days per week. For example, you could take one 30-min walk or take three 10-minute walks for a daily total of 30 minutes.

3. I currently engage in REGULAR physical activity  Yes  No

4. I have been REGULARLY physically active for the past 6 months  Yes  No
Appendix D: Vigorous Physical Activity

Vigorous intensity = you are breathing rapidly and only able to speak in short phrases. Your heart rate is substantially increased and you are likely to be sweating.

Circle the number of times in the past week you have participated in the following activities at a VIGOROUS intensity for at least 20 minutes:

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Appendix E: Information seeking behaviors

How many times in the past week have you done the following:

- Visited the CDC website ("Physical Activity for Everyone")
- Consulted your PA Toolkit
- Visited the MyPyramid Tracker website
- Calculated your energy balance on the MyPyramid Tracker website
- Consulted an educational health resource besides the ones above
Appendix F: Regulatory Self-Efficacy Scale

Please indicate how confident you are that over the next 3 months you can exercise at a moderate intensity for 30 minutes per day for the number of days per week listed below.

Over the next 3 months, I can exercise for:

0 = not confident at all

10 = completely confident

**Moderate intensity** = working hard enough to raise your heart rate and break a sweat, but still be able to carry on a conversation (e.g. a brisk walk).

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</tbody>
</table>
Appendix G: Barrier Efficacy Scale

Circle the number that indicates how confident you are that you could be physically active in each of the following situations:

<table>
<thead>
<tr>
<th>Situation</th>
<th>Not at all confident</th>
<th>Slightly confident</th>
<th>Moderately confident</th>
<th>Very confident</th>
<th>Extremely confident</th>
</tr>
</thead>
<tbody>
<tr>
<td>When I’m tired</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>When I’m in a bad mood</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>When I feel I don’t have time</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>When I am on vacation</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>When it is raining or snowing</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
Appendix H: Intention to Exercise Scales

Intention A

Please respond to the following statements:

1. “My GOAL is to exercise tomorrow at a moderate or vigorous intensity for at least 30 minutes”

   Not at all true for me
   -3   -2   -1   0   1   2   3

   Completely true for me

2. “I INTEND to exercise tomorrow at a moderate or vigorous intensity for at least 30 minutes”

   Not at all true for me
   -3   -2   -1   0   1   2   3

   Completely true for me

Intention B

1. “My GOAL is to exercise next week at a moderate or vigorous intensity for at least 30 minutes on…”

   1 day   2 days   3 days   4 days   5 days   6 days   7 days

2. “I INTEND to exercise next week at a moderate or vigorous intensity for at least 30 minutes on…”

   1 day   2 days   3 days   4 days   5 days   6 days   7 days
Appendix I: Team Perception Measure

For each of the following statements, please indicate how well or poorly each statement describes your feelings:

15) I felt I was part of a team with my partner

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td>Very much</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. I felt I worked collaboratively with my partner

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td>Very much</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. I felt my partner and I worked together

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td>Very much</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. I felt I was working separately from my partner

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td>Very much</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. I felt my partner was helpful to my performance

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td>Very much</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix J: Attitude Toward Partner Scale

How well does each of these adjectives describe your feelings toward the partner (circle)?

1) Helpful

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
</table>

Describes very poorly  
Describes very well

2. Cooperative

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
</table>

Describes very poorly  
Describes very well

3. Responsible

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
</table>

Describes very poorly  
Describes very well

4. Trustful

<table>
<thead>
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<th>1</th>
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<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
</table>

Describes very poorly  
Describes very well

5) Determined

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<th>1</th>
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<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
</table>

Describes very poorly  
Describes very well
Appendix L: Goal Orientation in Exercise Questionnaire

Read the following statement and circle the most appropriate response:

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strongly disagree</td>
<td></td>
<td></td>
<td></td>
<td>Strongly agree</td>
</tr>
</tbody>
</table>

While exercising, I usually feel that things have gone well when…

1) I please people important to me (Social 1)

2) I make progress (Task 1)

3) I prove to myself that I am the only one who can do a certain exercise task (Ego 1)

4) I make other people happy (Social 1)

5) I know that I am more capable than other exercisers (Ego 2)

6) I exercise at a level that reflects personal improvement (Task 2)

7) I receive recognition/prestige (Social 3)

8) I feel like I’ve improved (Task 3)

9) I can show other exercisers that I’m better than everyone else (Ego 3)

10) Other people tell me I did well (Social 4)

11) I exercise to the best of my ability (Task 4)

12) I can prove to others that I’m the best (Ego 4)

13) I demonstrate my worth to others (Social 5)

14) I achieve the exercise goal I set for myself (Task 5)

15) Other exercisers don’t do as well as me (Ego 5)
Appendix M: Leisure Motivation Scale

(LMS-28)

Luc G. Pelletier, Robert J. Vallerand, Marc R. Blais & Nathalie M. Brière, 1991

ATTITUDE IN LEISURE

Indicate the leisure activities that you do most often, and to which you will refer throughout the questionnaire (e.g., reading, going out):

Using the scale below, indicate to what extent each of the following items presently corresponds to one of the reasons for which you practice this leisure.

<table>
<thead>
<tr>
<th>Does not correspond at all</th>
<th>Corresponds a little</th>
<th>Corresponds moderately</th>
<th>Corresponds a lot</th>
<th>Corresponds exactly</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

WHY DO YOU GENERALLY DO YOUR LEISURE ACTIVITIES?

1. To avoid doing other tasks.
   1 2 3 4 5 6 7

2. Because I experience a lot of pleasure and satisfaction in learning new things.
   1 2 3 4 5 6 7

3. Because in my opinion, it is a good way to develop social, physical or intellectual abilities that will be useful to me later.
   1 2 3 4 5 6 7

4. For the pleasure I feel in living exciting experiences.
   1 2 3 4 5 6 7

5. I can't come to see why I do leisure activities, and frankly I don't really care.
   1 2 3 4 5 6 7
6. For the satisfaction I feel when I try to overcome interesting challenges.

7. Because it is very important for me to fill my free time.

8. Because I don't like to appear as someone who does nothing.

9. For the pleasure of knowing more about subjects that appeal me.

10. Because it's one of the ways that I have chosen to make improvements on a personal level.

11. For the sense of freedom that I experience while doing the activity.

12. I don't really know; I don't think that leisure activities suit me.

13. For the pleasure I feel when I outdo myself in interesting activities.

14. Because in life you absolutely need leisure activities to be happy.

15. Because sometimes it allows me to be appreciated by others.

16. Because it allows me to deepen my understanding of subjects that interest me.

17. Because it's the way I've chosen to acquire abilities in other areas that are important to me.

18. Because my leisure activities give me a real "high".
19. I don't really know; I have the impression that there isn't any activity that I could do very well.
   1 2 3 4 5 6 7

20. For the pleasure of surpassing myself while doing activities that are challenging for me.
   1 2 3 4 5 6 7

21. Because I absolutely must feel busy.
   1 2 3 4 5 6 7

22. To show others that I am a dynamic person.
   1 2 3 4 5 6 7

23. Because it allows me to explore many interesting domains.
   1 2 3 4 5 6 7

24. Because doing leisure activities is one of the ways that allows me to develop other aspects of myself.
   1 2 3 4 5 6 7

25. For the simple of pleasure of feeling deeply relaxed.
   1 2 3 4 5 6 7

26. Honestly, I don't know; I have the impression that I'm wasting my time when I do leisure activities.
   1 2 3 4 5 6 7

27. For the satisfaction I get while trying to master complex activities.
   1 2 3 4 5 6 7

28. Because I absolutely must have my leisure time to be in a good mood.
   1 2 3 4 5 6 7

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KEY FOR LMS-28

# 2, 9, 16, 23 Intrinsic motivation - to know

# 6, 13, 20, 27 Intrinsic motivation - to accomplish
# 4, 11, 18, 25 Intrinsic motivation - to experience stimulation

# 3, 10, 17, 24 Extrinsic motivation - identified

# 7, 14, 21, 28 Extrinsic motivation - introjected

# 1, 8, 15, 22, Extrinsic motivation - external regulation

# 5, 12, 19, 26 Amotivation
Appendix N: Post Study Questionnaire

1. How much interest would you have in participating in another study like this one?

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<thead>
<tr>
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<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None at all</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>Very much</td>
</tr>
</tbody>
</table>

2. How difficult did you find the task of increasing your daily physical activity?

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<th>1</th>
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<th>3</th>
<th>4</th>
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<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not at all difficult</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>Extremely difficult</td>
</tr>
</tbody>
</table>

3. How much effort did you put forth in increasing your daily physical activity?

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<tr>
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<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>My absolute minimum</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>My absolute maximum</td>
</tr>
</tbody>
</table>

4. How capable to increase your physical activity do you feel?

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<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Extremely incapable</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>Extremely capable</td>
</tr>
</tbody>
</table>

5. If you performed the study with anyone (besides the research assistant), what is your best estimate of how that person compared to you in ability?

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<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not applicable, I didn’t perform the study with anyone (besides the research assistant)</td>
<td>1</td>
<td>The other person was much less capable than me</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
6. If you performed the study with anyone (besides the research assistant), what is your best estimate of how that person compared to you in the amount of effort put forth?

0 Not applicable, I didn’t perform the study with anyone (besides the research assistant)
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

7. In which of the following conditions did you perform the study (circle one)?

1 Except for the experimenter, I performed the study alone
2 I performed the study with another person, remotely
3 I performed the study with two other persons, remotely
4 I performed the study as part of a two-person team
5 I performed the study as part of a three-person team

8. How was your total score determined during the study (circle one)?

1 My score was the amount of calories I burned every day, averaged over the course of a week
2 My score was the average of my daily energy expenditure and my partner’s daily expenditure
My score is the sum of my team’s score each week, where the team’s score is the number of calories burned by the team member who burned the fewest calories.

My score is the sum of my team’s score each week, where the team’s score is the number of calories burned by the team member who burned the most calories.

(Open ended responses):

9. Was there anything odd or confusing about the study?

10. What, in your words, do you think the purpose of the study was?
### Appendix O: Physical Activity Enjoyment Survey (PAES)

Please rate how you feel at the moment about the physical activity you have been doing over the past week according to the following scales:

1.  
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<tr>
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<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loved it</td>
<td>Hated it</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.  
<table>
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<tr>
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<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>I felt bored</td>
<td>I felt interested</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.  
<table>
<thead>
<tr>
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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>I disliked it</td>
<td>I liked it</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.  
<table>
<thead>
<tr>
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<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>I found it pleasurable</td>
<td>I found it unpleasurable</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

5.  
<table>
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<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>I was very absorbed in the activity</td>
<td>I was not at all absorbed in the activity</td>
<td></td>
<td></td>
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<td></td>
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</tbody>
</table>

6.  
<table>
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<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>It was no fun at all</td>
<td>It was a lot of fun</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
7.

<table>
<thead>
<tr>
<th></th>
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<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>It was very pleasant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>It was very unpleasant</td>
<td></td>
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</tbody>
</table>

8.

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<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I felt as though</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>I would rather</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>be doing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>something else</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>I felt as though there</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>was nothing else I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>would rather be doing</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
Appendix P: Motives for Physical Activities Measure – Revised

(MPAM-R)

The following is a list of reasons why people engage in physical activities, sports and exercise. Keeping in mind your primary physical activity/sport, respond to each question (using the scale given), on the basis of how true that response is for you.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>not at all</td>
<td>very true for me</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

___ 1. Because I want to be physically fit.
___ 2. Because it’s fun.
___ 3. Because I like engaging in activities which physically challenge me.
___ 4. Because I want to obtain new skills.
___ 5. Because I want to look or maintain weight so I look better.
___ 6. Because I want to be with my friends.
___ 7. Because I like to do this activity.
___ 8. Because I want to improve existing skills.
___ 9. Because I like the challenge.
___10. Because I want to define my muscles so I look better.
___11. Because it makes me happy.
___12. Because I want to keep up my current skill level.
___13. Because I want to have more energy
___14. Because I like activities which are physically challenging.
___15. Because I like to be with others who are interested in this activity.
___16. Because I want to improve my cardiovascular fitness.
___17. Because I want to improve my appearance.
18. Because I think it’s interesting.
19. Because I want to maintain my physical strength to live a healthy life.
20. Because I want to be attractive to others.
22. Because I enjoy this activity.
23. Because I want to maintain my physical health and well-being.
24. Because I want to improve my body shape.
25. Because I want to get better at my activity.
26. Because I find this activity stimulating.
27. Because I will feel physically unattractive if I don’t.
28. Because my friends want me to.
29. Because I like the excitement of participation.
30. Because I enjoy spending time with others doing this activity.

**Scoring Information**

**Interest/Enjoyment:** 2, 7, 11, 18, 22, 26, 29
**Competence:** 3, 4, 8, 9, 12, 14, 25
**Appearance:** 5, 10, 17, 20, 24, 27
**Fitness:** 1, 13, 16, 19, 23
**Social:** 6, 15, 21, 28, 30
Appendix Q: Health Behavior Measure

Alternative health choices

The following items are rated on a scale from 0-11+.

*Think about a normal week for you, prior to your participation in this study. How many times in the past week have you chosen to:*

1. Walk when you would normally have driven/taken a walk? ___
2. Ride a bike when you would normally have driven/taken the bus? ____
3. Take the stairs when you normally would have taken the elevator/escalator? _
4. Abstain from drinking alcohol when you normally would have drank? ___
5. Chosen a healthier food option than what you normally would have? ___
6. (Open ended) Other (please specify number of times) ___

Partnered exercise

How many times in the past week have you:

<table>
<thead>
<tr>
<th></th>
<th>Exercised alone</th>
<th>Exercised with a friend</th>
<th>Exercised in the presence of others (where friends were not present)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exercised alone</td>
<td>0 1 2 3 4 5 6 7</td>
<td>0 1 2 3 4 5 6 7 8+</td>
<td>0 1 2 3 4 5 6 7 8+</td>
</tr>
<tr>
<td>Exercised with a friend</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exercised in presence of others (where friends were not present)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Group exercise/gym membership

Do you currently have a membership to a fitness facility? Yes No
Are you currently enrolled/attending a fitness/exercise class? Yes No
Are you currently taking a KIN activity course? Yes No

Joining a center/class

In the past week, have you:

<table>
<thead>
<tr>
<th>Joined a fitness center?</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joined a physical activity class/group (e.g., spinning, yoga)?</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
Disruptive events

Have there been any external events/forces (i.e., out of your control) in the past week that have affected your physical activity? Briefly explain (e.g., sick, weather, family, etc.).
Appendix R: Physical Activity Toolkit

The purpose of this Toolkit is to provide you with information that can help you increase your physical activity. This Toolkit will be useful for those who a) want to be more physically active but are not sure where to begin and b) for those who are physically active but would like to keep it up or step it up.

Where am I? (Check one)

- I’m just getting started and want to add physical activity to your life?
- Are you already doing a small amount of activity and want to be more active?
- Or perhaps you have been active for a while but would like to increase your activity level.

Busting barriers
Write down some things you could do to get past what may be holding you back from becoming more physically active:

My reasons
Check off which of these benefits you hope to get from active living:

- Be healthier
- Increase my chances of living longer
- Feel better about myself
- Have less chance of becoming depressed
- Sleep better at night
- Help me look good
- Be in shape
- Get around better
- Have stronger muscles and bones
- Help me stay at or get to a healthy weight
- Be with friends or meet new people
- Enjoy myself and have fun

Moderate-level activities- Check off the ones you will try

- Biking slowly
- Canoeing
- Dancing
General gardening (raking, trimming shrubs)
Tennis (doubles)
Using your manual wheelchair
Using hand cyclers—also called arm ergometers
Walking briskly
Water aerobics

**Vigorous Level Activities** – Check off the ones you will try
- Aerobic dance
- Basketball
- Fast dancing
- Jumping rope
- Martial arts (such as karate)
- Race walking, jogging, or running
- Riding a bike on hills or riding faster
- Soccer
- Swimming fast or swimming laps
- Tennis (singles)

**Muscle-strengthening activities** – check off the ones you will try
- Heavy gardening (digging, shoveling)
- Lifting weights
- Push-ups on the floor or against the wall
- Sit-ups
- Working with resistance bands (long, wide rubber strips that stretch)

**Tip:** Some people like resistance bands because they find them easy to use and put away when they are done. Others prefer weights you can use common grocery items, such as bags of rice, vegetable or soup cans, or bottled water.

**Staying safe:**
- If you haven’t been active in a while, start slowly and build up.
- Learn about the types and amounts of activity that are right for you.
- Choose activities that are appropriate for your fitness level.
- Build up the time you spend before switching to activities that take more effort.
- Use the right safety gear and sports equipment.
- Choose a safe place to do your activity.
- See a health care provider if you have a health problem.
For everyone…

**Finding out what kind and how much physical activity you need**

**How do I do it?**
It’s your choice. Pick an activity that’s easy to fit into your life. Choose *aerobic* activities that work for you. These make your heart beat faster and can make your heart, lungs, and blood vessels stronger and more fit. Also, do *strengthening* activities which make your muscles do more work than usual.

**Why should I be physically active?**
Physical activity can make you feel stronger and more alive. It is a fun way to be with your family or friends. It also helps you improve your health.

**How many times a week should I be physically active?**
It is up to you, but it is better to spread your activity throughout the week and to be active at least 3 days a week.

**How do I build up more physical activity?**
Do a little more each time. Once you feel comfortable, do it more often. Then you can trade activities at a moderate level for vigorous ones that take more effort. You can do moderate and vigorous activities in the same week.

**How can I tell an activity at a moderate level from a vigorous one?**
Vigorous activities take more effort than moderate ones. In general, moderate activities are ones where you can talk while you do them, but can’t sing. Vigorous intensity activities are ones where you can only say a few words without stopping to catch your breath.

**How do I know if I’m doing muscle-strengthening activities correctly?**
To gain health benefits, muscle-strengthening activities should be done to the point where it’s hard for you to do another repetition without help. A repetition is one complete movement of an activity, like lifting a weight or doing a sit-up. Try to do 8—12 repetitions per activity that count as 1 set. Try to do at least 1 set of muscle-strengthening activities, but to gain even more benefits, do 2 or 3 sets.

**Keeping track of what you do each week**
Make copies of the forms on page 7 to track your activities each week. There are examples on page 6. The first form is for aerobic activities. The second form is for strengthening activities. Be active your way by choosing activities you enjoy!

**Physical activity in East Lansing**
There are many opportunities and resources for you right here in East Lansing that can help you increase your physical activity. Here are just a few of them:

1. Use the bike paths and river trails on campus
2. Walk or bike to class/work instead of driving or riding the bus
3. Take the stairs instead of the elevator or escalator when the opportunity presents itself
4. Use the fitness center in IM West (http://www.imsports.msu.edu/)
   a. Basketball courts
   b. Indoor pool
   c. Outdoor pool
   d. Weight room/cardio equipment
5. Walk around campus (http://prod.gis.msu.edu/loops/)
6. Go to one of the East Lansing parks
7. Do work standing up
8. Dancing

Suggestions for Overcoming Physical Activity Barriers

Lack of time
• Identify available time slots. Monitor your daily activities for one week. Identify at least three 30-minute time slots you could use for physical activity.
• Add physical activity to your daily routine. For example, walk or ride your bike to work or shopping, organize school activities around physical activity, walk the dog, exercise while you watch TV, park farther away from your destination, etc.
• Select activities requiring minimal time, such as walking, jogging, or stairclimbing.

Social influence
• Explain your interest in physical activity to friends and family. Ask them to support your efforts.
• Invite friends and family members to exercise with you. Plan social activities involving exercise.
• Develop new friendships with physically active people. Join a group, such as the YMCA or a hiking club.

Lack of energy
• Schedule physical activity for times in the day or week when you feel energetic.
• Convince yourself that if you give it a chance, physical activity will increase your energy level; then, try it.

Lack of motivation
• Plan ahead. Make physical activity a regular part of your daily or weekly schedule and write it on your calendar.
• Invite a friend to exercise with you on a regular basis and write it on both your calendars. Join an exercise group or class.

Fear of injury
• Learn how to warm up and cool down to prevent injury.
• Learn how to exercise appropriately considering your age, fitness level, skill level, and health status.
• Choose activities involving minimum risk.

Lack of skill
• Select activities requiring no new skills, such as walking, climbing stairs, or jogging.
• Take a class to develop new skills.

Lack of resources
• Select activities that require minimal facilities or equipment, such as walking, jogging, jumping rope, or calisthenics.
• Identify inexpensive, convenient resources available in your community (community education programs, park and recreation programs, worksite programs, etc.).

Weather conditions
• Develop a set of regular activities that are always available regardless of weather (indoor cycling, aerobic dance, indoor swimming, calisthenics, stair climbing, rope skipping, mall walking, dancing, gymnasium games, etc.)

Travel
• Put a jump rope in your suitcase and jump rope.
• Walk the halls and climb the stairs in hotels.
• Stay in places with swimming pools or exercise facilities.
• Join the YMCA or YWCA (ask about reciprocal membership agreement).
• Visit the local shopping mall and walk for half an hour or more.
• Bring your mp3 player your favorite aerobic exercise music.

Family obligations
• Trade babysitting time with a friend, neighbor, or family member who also has small children.
• Exercise with the kids-go for a walk together, play tag or other running games, get an aerobic dance or exercise tape for kids (there are several on the market) and exercise together. You can spend time together and still get your exercise.
• Jump rope, do calisthenics, ride a stationary bicycle, or use other home gymnasium equipment while the kids are busy playing or sleeping.
• Try to exercise when the kids are not around (e.g., during school hours or their nap time).
**Aerobic activity chart: Example**

<table>
<thead>
<tr>
<th>What I did</th>
<th>Effort</th>
<th>Mon</th>
<th>Tue</th>
<th>Wed</th>
<th>Thu</th>
<th>Fri</th>
<th>Sat</th>
<th>Sun</th>
<th>Total hrs or min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walked</td>
<td>Moderate</td>
<td>30 min</td>
<td>30 min</td>
<td>30 min</td>
<td>30 min</td>
<td>30 min</td>
<td>2 hrs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biked fast</td>
<td>vigorous</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>30min</td>
</tr>
</tbody>
</table>

This is the total number of hours or minutes I did these activities this week: *2 hrs and 30min*

**Muscle-strengthening activity chart: Example**

<table>
<thead>
<tr>
<th>What I did</th>
<th>When I did it</th>
<th>Total days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sit ups</td>
<td>yes</td>
<td>1 day</td>
</tr>
<tr>
<td>Stretch bands</td>
<td>yes</td>
<td>1 day</td>
</tr>
</tbody>
</table>

This is the total number of days I did these activities this week: *2 days*
### My aerobic activities

<table>
<thead>
<tr>
<th>What I did</th>
<th>Effort</th>
<th>When I did it and for how long</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mon</td>
</tr>
</tbody>
</table>

This is the total number of hours or minutes I did these activities this week:

### My strengthening activities

<table>
<thead>
<tr>
<th>What I did</th>
<th>When I did it</th>
<th>Total days</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mon</td>
<td>Tue</td>
</tr>
</tbody>
</table>

This is the total number of days I did these activities this week:
Armband Care

Proper Wearing: NEW Armband
1. Be sure the upper left arm is clean, dry, and free of lotion or oil then slide the Armband onto your LEFT arm.
2. Adjust the strap so that it fits comfortably, and then secure the Velcro pull-tab. Ensure that the sensors on the underside of the Armband maintain continuous contact with your skin and that the Armband does not slide off your arm.
3. Do not secure the strap too tightly. You should be able to place two fingers beneath the strap. Once the strap is adjusted to a comfortable fit, there is no need to readjust the Velcro tab. Simply slide the Armband on and off your arm by stretching the strap.
4. Wear the armband no more than 23 hours a day. **Be sure to leave it off 1 hour per day.**
5. Do not wear the armband in the shower or the pool. Take it off before you do either one of these. It is not to be submerged in water.
6. You CAN wear this to bed. In fact, we would like for you to wear it while you are sleeping. Just make sure you take it off for one hour per day.

Proper Wearing: OLD Armband
1. Slide the device on your RIGHT arm and adjust the tightness using the Velcro strap. It should be tight enough so that it won’t move around during exercise.
2. The sensor part of the device should be on the BACK (i.e. tricep) of your RIGHT arm.
3. The button on the device should be facing UP.
4. The device will automatically activate itself once you have put it on, going through a “turning on” sequence. The sequence is as follows:
   - **Welcome:** Four distinct notes (do-de-do-deet) ascending in tone. This sound indicates that the SenseWear Armband has made contact with your skin.
   - **Warming up:** Two second vibration. You’ll feel a series of light vibrations as it settles to your body.
   - **Ready:** Three notes (de-de-deet). This sound indicate that the Armband is collecting your body data.

Cleaning
1. Gently wipe the side of the Armband that touches the skin with a soft cloth or towel moistened with a mild soap and water.
2. Wipe with a clean damp cloth to remove any excess soap.
3. Use a dry, soft cloth or towel to completely dry before wearing it.

Other Helpful Resources
American College of Sports Medicine
http://www.acsm.org/AM/Template.cfm?Section=Brochures2
Center for Disease Control (videos)
http://www.cdc.gov/physicalactivity/everyone/videos/index.html#MuscleHome
MyPyramid (for calculating energy balance and tracking physical activity)
http://www.mypyramidtracker.gov/
behavior (McAuley & Blissmer, 2000)
REFERENCES


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