THE EFFECT OF PEER INFLUENCE ON EXERCISE BEHAVIOR AND
ENJOYMENT IN RECREATIONAL RUNNERS

A dissertation submitted to the
Kent State University College
of Education, Health, and Human Services
in partial fulfillment of the requirements
for the degree of Doctor of Philosophy

By

Andrew J. Carnes

May 2014

A dissertation written by

Andrew J. Carnes

B.S., Kent State University, 2009

M.S., Kent State University, 2011

Ph.D., Kent State University, 2014

Approved by

_____, Director, Doctoral Dissertation Committee
Dr. Jacob Barkley

_____, Member, Doctoral Dissertation Committee
Dr. Angela Ridgel

_____, Member, Doctoral Dissertation Committee
Dr. Andrew Lepp

Accepted by

_____, Director, School of Health Sciences
Dr. Lynne Rowan

_____, Dean, College of Education, Health, and Human Services
Dr. Daniel Mahony

THE EFFECT OF PEER INFLUENCE ON EXERCISE BEHAVIOR AND
ENJOYMENT IN RECREATIONAL RUNNERS (77 pp.)

Director of Dissertation: Jacob E. Barkley, Ph.D.

Fitness professionals and popular media sources frequently recommend “exercising with a partner” to increase the motivation to exercise or improve the intensity or duration of an exercise session. However, experimental research examining the impact of social factors on exercise behavior is limited. A better understanding of how exercising with others may affect exercise behavior and/or the enjoyment of exercise could lead to better recommendations regarding the potential benefits of peer interaction during exercise. Therefore, the purpose of this investigation was to determine the effect of the presence of a same sex and fitness matched peer, versus an alone condition, on recreational runners’ behavior and liking during an acute bout of submaximal exercise.

Recreational runners (n = 12 male, n = 12 female) completed three experimental trials, each under a different social condition, in a randomized order. Each trial consisted of self-paced running for a duration voluntarily determined by the participant. The three social conditions were: alone, with a sex and fitness matched familiar peer, or with a sex and fitness matched unfamiliar peer. Running duration, distance travelled, average speed, liking, and RPE were assessed in each trial.

Mixed model regression analysis showed no significant main effect of social condition or interaction effects ($p \geq 0.40$) for any of the dependent variables. The presence of either a familiar or unfamiliar peer does not appear to affect recreational runners' enjoyment or voluntarily selected duration or intensity of a single submaximal exercise session.

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to the members of my dissertation committee: Dr. Jacob Barkley, Dr. Ellen Glickman, Dr. Angela Ridgel, and Dr. Andrew Lepp, for their indispensable contributions to this project. I would also like to thank Dr. Hayley Arnold for offering her time and feedback as my graduate faculty representative and the moderator of my dissertation defense. Thank you to Jenny Petersen, who graciously provided tremendous assistance despite her own extensive commitments, and who I am happy to now call my friend and colleague.

I can easily say that none of my accomplishments to this point would be possible without the mentorship and support of the Kent State Exercise Physiology faculty. You have challenged me, inspired me, and helped shape me into young professional that I am today. Dr. Glickman, you have cared for me and looked after me not only as a student, but a member of your family. I will be forever grateful for the personal compassion you have shown me during my time as a student at Kent State. Dr. Barkley, I am prepared to start my journey as a professor and researcher because of your guidance and direction. Thank you for seeing potential in me and dedicating countless hours of your time to my academic and professional development. What you have done for me as a graduate student makes the title “mentor” seem woefully inadequate.

I owe a special thanks to the members of the Portage Lakes Running Club and Crooked River Trail Runners, who enthusiastically served as participants in this study. It

was a great pleasure working with all of these fellow runners, and I learned more from them than can be described in the pages of a research study.

Finally, there is no way for me to adequately thank my family for all they do for me and what a true blessing they are. My parents have instilled in me the work ethic that brought me to this point and have believed in me tirelessly. My wife, Theresa, inspires me every day, reminds me constantly what is truly important, and is the best partner I could ask for.

TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENTS	iii
LIST OF FIGURES	vii
LIST OF TABLES	viii
CHAPTER	
I. INTRODUCTION	1
II. LITERATURE REVIEW	5
Social Support	5
Recommendations to Runners	7
Competitive Performance in Athletes	7
Submaximal Training	8
Non-athlete Adult Studies	9
Pediatric Studies	10
Enjoyment	11
Enjoyment in Athletes	12
Research by Our Group	13
Study 1	14
Study 2	15
Study 3	16
Limitations	17
Statement of the Problem	17
Significance	18
Purpose	18
Hypothesis	18
III. METHODOLOGY	20
Participants	21
Procedures	22
Fitness Testing	22
Experimental Trials	23

Measurements.....	26
Analytic Plan	27
IV. RESULTS.....	29
Participant Characteristics	29
Social Conditions	30
Duration.....	30
Distance	31
Average Speed.....	32
Liking	33
Rating of Perceived Exertion	34
V. DISCUSSION	37
Limitations and Future Directions.....	40
Conclusions	43
APPENDICES	45
APPENDIX A. Recruitment Flyer	46
APPENDIX B. Informed Consent Form	48
APPENDIX C. Medical History	52
APPENDIX D. Participant Questionnaire	55
APPENDIX E. Participant Characteristics	57
APPENDIX F. Data Collection Form	59
APPENDIX G. Liking Visual Analog Scale	62
APPENDIX H. Borg RPE Scale	64
REFERENCES	66

LIST OF FIGURES

Figure	Page
1. Running duration (Data are Mean $\pm$ SEM).	30
2. Running distance (Data are Mean $\pm$ SEM).	31
3. Average running speed (Data are Mean $\pm$ SEM).	32
4. Liking (Data are Mean $\pm$ SEM).	33
5. Rating of perceived exertion (Data are Mean $\pm$ SEM).	34

LIST OF TABLES

Table	Page
1. Study Design	21
2. Participant Physical Characteristics	29
3. Duration, Distance, Average Speed, Liking, and RPE Across Social Conditions	35
4. Duration, Distance, Average Speed, Liking, and RPE Between Genders	36

CHAPTER I

INTRODUCTION

Fitness professionals and popular media sources frequently recommend “exercising with a partner” to increase the motivation to exercise or improve the intensity or duration of an exercise session (Dolan, 2008; Kravitz, 2011). However, experimental research examining the causal impact of social factors on exercise behavior is limited. The prevalent theme of “buddying up” (Omara, 2013) to augment the benefits of exercise or encourage habitual exercise mainly relies on survey research showing a positive correlation between “social support” and physical activity (Sherwood & Jeffrey, 2000; Trost, Owen, Bauman, Sallis, & Brown; 2002). What limited experimental studies are available suggest that exercising in the presence of others may alter physical activity behavior, enjoyment of physical activity, or athletic performance, but differ in numerous methodological aspects. Such differences include subject characteristics (age, sex, fitness), exercise mode or intensity, the exercise environment, and the familiarity of peers exercising together. A clear understanding of how exercising with others may affect exercise behavior and/or enjoyment (i.e., liking) of exercise could lead to better recommendations regarding the potential benefits of peer interaction on physical activity or athletic performance.

Research on athletes has shown mixed results and focuses on how the presence of others affects maximal performance in a competitive setting. Studies on weightlifters

(Rhea, Landers, Alvar, & Arent, 2003), swimmers (Williams, Nida, Baca, & Latane, 1989), and cyclists (Corbett, Barwood, Ouzounogluo, Thelwell, & Dicks, 2012; Wilmore, 1968) suggest that the presence of an audience or competition with other athletes can improve performance. Although competitive performance is the primary concern of athletes, they perform a substantial amount of training below maximal (i.e., submaximal) intensity. Despite this fact, the effect of athletes' training with others on their submaximal exercise behavior has been largely ignored in the previous literature.

Distance runners in particular could benefit from empirical testing of this concept, as they commonly perform training runs with other runners (Kolata, 2009) and train at variable intensities to improve performance. According to Seiler (2010) Esteve-Lanao et al. (2005), well trained endurance athletes perform the majority of their training at "light intensity," or below the ventilatory threshold. As running has become increasingly popular in recent years (Running USA, 2013) and the recommendation to train with a partner is prevalent and widely accepted as beneficial, without strong experimental evidence, empirical investigation of this notion is warranted.

Prior to preliminary work by our research laboratory (Carnes, Barkley, Williamson, & Sanders, 2013; Carnes, Barkley, & Glickman, 2013; Carnes, Barkley, & Glickman, 2014), previous studies considering how the social environment affects submaximal, "free choice" exercise were limited to studies on non-athlete adults (Grindrod, Paton, Knez, & O'Brien, 2006; Plante et al., 2010) and children (Rittenhouse, Salvy, & Barkley, 2011; Salvy et al., 2009). These non-athlete studies suggest that the

presence of others can positively impact exercise behavior and liking. Further support of these findings in the athletic population could have important implications: higher exercise intensity encouraged by the presence of a peer could result in greater fitness gains, but could also lead to overtraining if recovery is inadequate (Noakes, 2004; Sallade & Koch, 1992). Meanwhile, increased liking due to the presence of a partner could promote exercise adherence (Hagberg, Lindahl, Nyberg, & Hellenius, 2009) or prevent athletic burnout (Lemyre, Hall, & Roberts, 2007; Smith, Gustafsson, & Hassmen, 2010).

Our laboratory has begun to examine the effect of peer influence on athletes' submaximal exercise behavior by observing distance runners. We first tested how the presence of a familiar peer affected self-paced, submaximal exercise in elite-level competitive runners and non runners during treadmill exercise (Carnes et al., 2013) and found no effect on exercise intensity or liking in either group. However, the use of treadmills - because they remain stationary regardless of different speeds - was deemed a limitation as participants did not need to alter running speed to remain beside their peer. Two subsequent studies by our laboratory (Carnes et al., 2013; Carnes et al., 2014) used outdoor running to address the possible constraint of treadmill use. Contrary to our hypothesis that the presence of others would increase exercise intensity, elite-level competitive male runners ran slower with a single teammate or two other teammates versus an alone condition (Carnes et al., 2013). However, athletes did report greater liking in the peer conditions versus running alone. Our most-recent outdoor running study (Carnes et al., 2014) observed recreational runners of both sexes running alone

versus running with an unfamiliar peer matched for sex and fitness. A condition by sex interaction occurred in which males ran significantly faster with an unfamiliar peer and females slowed down with an unfamiliar peer. Concurrent with our previous outdoor study on competitive male runners, participants of both sexes reported greater liking in the peer condition versus running alone.

The three studies performed by our lab, along with a limited number of previous studies on peer influence and exercise behavior, give conflicting results and possess numerous methodological limitations. Our own studies have differed in participants' competitive ability, sex, and the familiarity of peers, and either utilized treadmills (allowing participants to stay next to one another regardless of speed) or have held the distance of each running trial constant, which kept runners from modulating distance in a given condition if they so chose. The current study sought to address these discrepancies by including both sexes, considering the effect of both familiar and unfamiliar peers, and allowing participants to voluntarily adjust exercise duration as well as intensity. We investigated recreational runners in order to obtain greater applicability of our findings than the small population of elite or sub-elite athletes.

CHAPTER II

LITERATURE REVIEW

The recommendation to train or exercise with a partner or in a group is a frequent and recurring theme in today's popular media and amongst fitness professionals. Fitness related magazines and websites (Gold's Gym, 2013; Fitness Health 101, 2014; Stoppani, 2010), general interest periodicals (London Daily Mail, 2013), and publications by recognized health and fitness organizations (Dolan, 2008; Shepard, 2014) suggest recruiting an exercise partner or group as a universally beneficial means to increase the intensity, duration, or enjoyment of exercise, the motivation to exercise, or adherence to an exercise program. Media sources targeting the running public (Galloway, 2012; Kolata, 2009; O'Mara, 2013) follow this trend, suggesting that "buddying up" (O'Mara, 2013) will boost runners' motivation and training intensity, subsequently leading to greater performance gains than those achieved by training alone.

Social Support

Despite an apparent consensus on the positive effects of exercising with others, these recommendations are not strongly substantiated by experimental evidence but instead rely on anecdotal claims or survey research. Multiple authors have established that "social support" is a robust predictor of participation in physical activity (Trost, Owen, Bauman, Sallis, & Brown, 2002; Sherwood & Jeffrey, 2000; Wendel-Vos, Droomers, Kremers, Brug, & van Lenthe, 2007) or the maintenance of physical activity

(Dishman, Sallis, & Orenstein, 1985; Wankel, 1984; Carron, Hausenblaus, & Mack, 1996). “Social support” encompasses any form of support, encouragement, comfort, assistance, or reinforcement that aids reaching desired goals or behaviors (Treiber et al., 1991). It can be attained through formal or informal contact with various individuals or groups (Wallston, Alagna, McEvoy DeVellis, & DeVellis, 1983), but is most often provided by “significant others” such as a spouse, family members, physicians, work colleagues, exercise instructors, or exercise companions (Sherwood & Jeffrey, 2002). In a review of the correlates of adults’ participation in physical activity, Trost and Colleagues (2002) reported that every study which considered social support found a positive association between social support and physical activity. Carron, Hausenblaus, and Mack (1996) contend that social influence promotes physical activity behavior by positively affecting exercise adherence, intent to exercise, exercise efficacy, and attitudes regarding exercise. While these contentions support a connection between social factors and exercise behavior, they rely on survey research, thereby impeding the inference of a causal link between the presence of others and increased exercise intensity, duration, frequency, or motivation. Furthermore, studies that report social support as a correlate or determinant of physical activity are not specific to the type of exercise performed and focus mainly on adherence to an exercise program or maintenance of physical activity behavior, without examining the effect of the social environment on the intensity or duration of an acute session of exercise.

Recommendations to Runners

Recommendations in popular media sources aimed at recreational and competitive runners to “buddy up” (O’mara, 2013; Galloway, 2012) “use the buddy system” (Jarvis, 2012) or “consider a crowd” (Kolata, 2009) to improve the effectiveness of training also lack empirical support, citing survey research on general physical activity behavior, research that does not involve runners, or anecdotal arguments. For example, articles in popular running publications which suggest that training with other runners can encourage higher exercise intensity (Kolata, 2009), lead to quick improvement (O’Mara, 2013), or make running more enjoyable (Galloway, 2012), support this theme by citing studies on female aerobics class participants (Wininger, 2002) and non-athlete adults performing stationary cycling (Plante et al., 2010). As such, stronger empirical support is needed to elucidate the practical scope of these claims for competitive and recreational runners.

Competitive Performance in Athletes

The available experimental research how peer influence may affect exercise behavior is split between children and athlete and non-athlete adults. In adult athletes, this research is limited and focuses on how the presence of an audience or competition affects maximal performance. Findings of increased maximal athletic performance during competition or in front of an audience have been explained by Zajonc’s (1965) social facilitation theory, which suggests enhanced individual performance in the presence of others. Bond (1982) theorized that social facilitation occurs as a result of an

individual's "self presentation" efforts to present himself as competent, enabling improved performance in well learned tasks but causing impaired performance in complex or unfamiliar tasks while others are present. Triplett's (1898) seminal study began investigation into social facilitation theory by showing that track cyclists rode faster when competing with other riders. A later study on cyclists by Wilmore (1968) showed increased time to exhaustion during an incremental cycling test when subjects competed with a partner versus riding alone. In a study of collegiate swimmers, Williams et al. (1989) demonstrated that swimmers swam faster in relay events than individual events, but only when their times were made visible. More recently, Rhea et al. (2003) showed that weightlifters increased their maximal bench press when competing with other lifters or when viewed by an audience. Corbett et al. (2012) corroborated the findings of earlier studies on cyclists by showing that subjects increased performance in a competitive cycling time trial task relative to a solo time trial. The only study on athletes' maximal performance we are aware of that did not show enhanced performance due to an audience or competition involved trained runners completing a 5-kilometer time trial, with no performance difference between running alone or against another runner (Bath et al., 2011).

Submaximal Training

While these limited results suggest a stimulatory effect of co-actors or an audience on physical performance in athletes, they only consider this effect on maximal effort or competitive tasks. However, much of athletes' training is done at submaximal

intensity. In particular, distance runners and other endurance athletes are reported to carry out the majority of their training volume below the ventilatory threshold (i.e., at a relatively moderate intensity) (Esteve-Lanao et al., 2005; Seiler, 2010). Furthermore, current training philosophy (Daniels, 2005; Martin & Coe, 1999; Noakes, 2004) supports a polarized work - recovery model characterized by high intensity workout days being separated by light to moderate intensity “recovery” or “easy” days. Training sessions on such “recovery” days are typically unstructured and allow runners to voluntarily select a submaximal level of exertion (Daniels, 2005; Galloway, 2002; Martin & Coe, 1999; Noakes, 2004). Although submaximal training performed by runners and other athletes can cause performance changes which directly impact competitive performance, previous research has not addressed the potential for training with others to modulate athletes’ behavior or their liking of a training session.

Non-athlete Adult Studies

Prior to preliminary work by our laboratory, the impact of social interaction on submaximal “free choice” exercise had only been assessed in non-athlete adults and children. In both of these groups the presence of peers increased physical activity behavior and/or the enjoyment of exercise. Non-athlete adults walked a further distance during a six minute walk test when walking in a group with three other same-sex participants relative to walking alone (Grindrod et al., 2006). In a study by Plante et al. (2010), non-athlete adults rode at greater intensities during twenty minutes of self-paced stationary cycling when a research confederate perceived as “high-fit” rode on an

adjacent cycle ergometer versus cycling alone or next to a confederate perceived as “low-fit”. Another study by Plante’s group (Plante, Coscarelli, & Ford, 2001) also found that adult non-athlete exercisers had increased feelings of calmness and tiredness after thirty minutes of stationary cycling with a partner compared to cycling alone, suggesting that social factors may alter the psychological response to exercise in addition to physiologic effort.

Pediatric Studies

Experimental studies in children also suggest that peer influence can positively affect physical activity behavior and the liking of physical activity. Salvy et al. (2009) showed that overweight and lean youth biked further on a stationary cycle in the presence of a friend versus alone and were more motivated to be physically active in the presence of a friend. However, only overweight youth biked further when paired with an unfamiliar peer than when alone. A later experimental study by Rittenhouse, Salvy, and Barkley (2011) concurred with Salvy et al. (2009) while more closely modeling children’s play environment by using a simulated playground setting. Overweight boys were more active in the presence an unfamiliar peer, while lean boys’ physical activity did not differ between playing alone or with an unknown peer. Rittenhouse’s (2011) study also measured the liking of physical activity in each condition and found that overweight boys’ liking of physical activity increased in the presence of an unfamiliar peer versus alone. Conversely, lean boys’ liking of physical activity did not change from the alone to peer condition. The results of both experimental studies on children (Salvy

et al., 2009; Rittenhouse et al., 2011) as well as the study on non-athlete adults by Plante et al. (2010) lend support to Bond's (1982) self presentation theory. Non-athlete adults and overweight (but not lean) children increased physical activity in the presence of an unfamiliar peer, possibly suggesting that this increase was induced by a desire to "look good" or make a favorable impression to their peer. As suggested by Salvy et al. (2009), overweight youth may have been more concerned than lean youth about making a good impression to an unfamiliar peer through physical activity and avoiding potential weight criticism. Similarly, non-athlete adults in the Plante et al. (2010) study appeared to make a greater effort to project an image of competence or fitness in the presence of "high fit" peer than they did when paired with a "low fit" peer.

Enjoyment

In addition to addressing the potential effect of peer influence on submaximal "free choice" intensity exercise while studies on athletes neglect this issue, limited research on non-athlete adults and children also considers how social interaction affects the enjoyment (i.e., liking) of physical activity. In the aforementioned experimental study on children by Rittenhouse, Salvy, and Barkley (2011), overweight boys' increased physical activity in the presence of an unfamiliar peer was accompanied by greater liking of physical activity in the peer conditions compared to alone. Furthermore, Roemmich et al. (2008) found that children's liking of physical activity was positively associated with their physical activity behavior. These experimental results, which suggest a link between the liking of physical activity and the amount of physical activity performed,

align with previous survey research (Craig, Goldberg, & Dietz, 1996; DiLorenzo, Stucky-Ropp, Vander Wal & Gotham, 1988; Motl et al., 2001) showing an association between liking and children's physical activity behavior. In adults, empirical examination of the liking of an exercise bout and the factors mediating the level of liking is absent. However, Hagberg, Lindahl, & Hellenius (2009) showed an association between enjoyment and exercise level in a healthcare based exercise intervention. Raedeke (2007) did not assess the amount of intensity of physical activity but showed that exercise enjoyment was related to an increased positive affectual state following exercise in female fitness class participants. In addition to these survey based studies, Wankel (1993) contends that enjoyment is an important factor in exercise adherence. These findings, while not conclusive, warrant further exploration of exercise enjoyment as a potential factor in increasing physical activity behavior or facilitating adherence.

Enjoyment in Athletes

While emerging research in children (and to a lesser extent, non-athlete adults) has begun to address the issue of the role of enjoyment in physical activity behavior and how social factors influence exercise enjoyment, no research has addressed this concept in athletes. Studies by Lemyre et al. (2008) and Smith et al. (2010) suggest that an athlete's interaction with teammates can play a role in perceptions of athletic burnout - a state of mental, emotional, and physical exhaustion brought on by the pursuit of a challenging goal (DeFreese & Smith, 2013). According to these authors, a task related motivational climate - one that frames achievement in terms of effort and improvement -

is negatively associated with perceptions of burnout. By contrast, an ego related motivational climate - one that focuses on comparison with others - is positively associated with athletes' perceptions burnout. Therefore, in addition to examining how training with others can affect the intensity and duration of athletes' training sessions, it is worthwhile to also consider how exercising with others may affect their enjoyment of exercise. This may potentially have important implications in modulating exercise behavior, adherence, or the incidence of athletic burnout.

Research by Our Group

Distance running is an increasingly popular sport in US adults. According to data collected by Running USA (2013), the number of race finishers each year in the US has grown 80% from 2000 to 2012 (Running USA, 2013) with a new high of 15.5 million race finishers in 2012. Because of this popularity and the prevalence of the recommendation to recreational and competitive runners to exercise with a partner, despite a lack of evidentiary support for this notion, our research group has begun to investigate how the presence of others can affect recreational and elite-level competitive runners' submaximal exercise behavior and liking of an exercise session. We posed this question to determine if social facilitation and/or self presentation effects, as seen in adult athletes during maximal exercise and in non-athlete adults and children during submaximal, "free choice" intensity exercise, are present in adult recreational and competitive runners during submaximal exercise. This could validate or challenge the recommendation to "train with a partner" as an effective practice for runners to achieve

enhanced fitness or performance through an acute increase in training workload. We also assessed how the presence of others affects runners' liking of an exercise bout, which could likewise play a potential role in boosting intensity or volume as well as potentially promoting adherence or preventing burnout. Prior to the present investigation, our laboratory conducted three studies (Carnes, Barkley, Williamson, & Sanders, 2013; Carnes, Glickman, & Barkley, 2013; Carnes, Glickman, & Barkley, 2014) which examined elite level male collegiate runners as well as recreationally-competitive male and female runners.

Study 1

We first tested how the presence of a familiar peer affected the intensity and liking of self-paced, submaximal exercise in elite level male collegiate runners and male non-runner controls. Participants exercised on a treadmill for 30 minutes at a self-selected pace under two different social conditions, in a counterbalanced order: once alone and once with a familiar peer on an identical treadmill adjacent to their own (Carnes, Barkley, Williamson, & Sanders, 2013). Contrary to our hypothesis that the presence of a partner would increase exercise intensity and liking, there was no effect on these variables in either group. However, the use of treadmills - because they remain stationary regardless of different speeds between runners - was deemed a limitation as participants did not need to alter running speed to remain with their peer. Furthermore, the laboratory setting was anecdotally perceived as dull, with several participants commenting about being "bored." It is possible that any change in exercise liking caused

by the presence of a peer was obscured or negated by negative feelings about the dullness and boredom of the laboratory environment. In hindsight this is not completely surprising as the runners in this previous study indicated that they trained daily outdoors, where running surfaces and surroundings change throughout the course of the run - which was not the case in the laboratory environment.

Study 2

Two subsequent studies by our laboratory (Carnes, Glickman, & Barkley, 2013; Carnes, Glickman, & Barkley, 2014) tested the same hypothesis during outdoor running in order to address the possible constraint of treadmill use from Study 1. In the first of these outdoor running studies, elite level male collegiate runners completed an outdoor 6.4 kilometer course at a self-selected pace under three social conditions: alone, with a familiar peer, and with two familiar peers (in a group of 3 total runners). Participants did report greater liking when running with a partner or group compared to running alone, but ran slower in both peer conditions than they did alone. Although we hypothesized that social facilitation effects would encourage a greater exercise intensity in the presence of teammates, several participants stated that in the alone condition “I just wanted to get it done” - suggesting a negative affect which may explain the faster speed when running alone. This negative affect hypothesis is also supported by the lower liking scores in the alone versus the peer conditions. Furthermore, all participants mutually indicated being both teammates and friends with each person in their pair and group trials. As such, the desire to demonstrate competence by running faster - that is, the need for “self

presentation” (Bond, 1982) - may have been lessened relative to running with someone unfamiliar or in the context of competition. As mentioned previously in the literature review, non-athlete adults increased cycling intensity in the presence of an unfamiliar “high fit” confederate (Plante et al., 2010) and overweight boys were more active in the presence of an unfamiliar peer of the same or different weight (Rittenhouse et al., 2011), suggesting that an unfamiliar peer may present a stronger impetus to self presentation efforts (Bond, 1982).

Study 3

Because athletes at the performance level of those in our first two studies represent a highly distinctive population and the presence of familiar peers (in this case, teammates) may not have triggered participants’ need to make a favorable impression, we examined the potential effects of an unfamiliar peer on exercise intensity and liking in male and female recreational runners. Participants completed the same outdoor 6.4 km course used in the outdoor study on elite male collegiate runners (Carnes, Glickman, & Barkley, 2014), once alone and once with an unfamiliar peer matched for sex and fitness, at a voluntarily selected pace. The presence of an unfamiliar peer, relative to an alone condition, had a differential effect on voluntary running speed in men and women. Women ran significantly slower, while men ran faster, in the presence of an unfamiliar peer of the same sex. Concurrent with the previous study on elite level male collegiate athletes, both male and female participants in this study reported greater liking in the peer condition versus running alone.

Limitations

The studies performed by our laboratory possess several notable limitations. The first used treadmills, which allowed participants to remain parallel without changing speed. Although our subsequent studies were conducted on an outdoor course, the study on elite level male collegiate runners (Carnes, Glickman, & Barkley, 2013) only tested the effect of familiar peers, and this effect was only examined in male runners. Our next study considered both male and female recreationally competitive runners, but only tested the effect of an unfamiliar peer. Furthermore, the distance of each trial was held constant in both outdoor studies, precluding the possibility for the presence of others to influence the duration or distance ran. Independent or additive to altered exercise intensity, the potential for peers to encourage a higher volume of exercise - through increased duration or distance - could also impact the training stimulus and resulting adaptations.

Statement of the Problem

While exercising with a partner is frequently and widely recommended as a means to increase the motivation to exercise or enhance athletic performance, empirical support of this notion is limited. Moreover, other than that by our group, experimental research considering the effect of peer influence in athletes has previously been constrained to maximal effort or competitive performance, despite athletes performing substantial proportions of training at submaximal intensity. Studies which consider how the social environment affects “free choice” exercise have been limited to non-athlete adults (Grindrod et al., 2006; Plante et al., 2010) and children (Salvy et al., 2009;

Rittenhouse et al., 2011).

Significance

Empirical support in athlete subjects for the findings of previous studies on non-athlete adults and children - that the presence of others may positively impact exercise behavior or liking - could validate exercising with others as an effective training practice which could lead to enhanced fitness or performance. By contrast, a lack of support for these findings in athletes could challenge the ubiquitous notion that “exercising with a partner” is universally beneficial to the amount or intensity of exercise performed during an exercise session.

Purpose

The purpose of this investigation was to determine the effects of the presence of a sex and fitness matched peer, versus an alone condition, on recreational runners’ voluntary running duration, distance, and intensity during a single training session, as well as their subjective liking of the exercise session.

Hypothesis

Based on the results of our previous studies (Carnes et al., 2013; Carnes et al., 2014) and prior research on non-athlete adults (Grindrod et al., 2006; Plante et al., 2010) and children (Salvy et al., 2009; Rittenhouse et al., 2011), we hypothesized that the presence of both a familiar and an unfamiliar peer will increase liking of an exercise bout in both sexes. As liking has been shown to be predictive of physical activity behavior (Hagberg et al., 2009; Roemmich et al., 2008), we also predict that increased liking will

be accompanied by greater amount of physical activity (i.e., running distance), as measured by GPS. Parallel to the findings of our previous study on recreational runners of both sexes (Carnes et al., 2014), we hypothesize that the presence of an unfamiliar peer will increase exercise intensity (running speed) in male runners but decrease intensity in female runners.

CHAPTER III

METHODOLOGY

The current investigation used a three social condition (alone, familiar peer, unfamiliar peer) by two group (males, females) mixed factorial design with social condition serving as the within-subjects variable and group serving as the between subjects variable. Participants completed three experimental trials, each under a different social condition, in a randomized order. Each trial consisted of self-paced running for a duration voluntarily determined by the participant. Participants ran alone during one trial while the other two trials were run with a same sex, fitness matched peer. In one peer trial, two participants who were familiar with each other ran together, while in the other peer trial two unfamiliar participants ran together. The following dependent variables were assessed under each condition: running duration (minutes), total distance traveled (km), average running speed ($\text{km} \cdot \text{hr}^{-1}$), liking of the activity (mm), and rating of perceived exertion (RPE). These dependent variables were compared across the three social conditions to determine the effects of the presence of a peer on behavior and liking during unstructured, submaximal exercise in recreational adult runners.

Table 1.

Study Design

	Alone	Familiar Peer	Unfamiliar Peer
Female (N=12)	X	X	X
Male (N=12)	X	X	X

Participants

Twenty-four recreationally competitive runners (12 male, 12 female) between the ages of 24 and 60 participated in the current study. Participants were recruited from two separate running clubs open to participants of any age, sex, or ability which met weekly in the Northeast Ohio area: the Portage Lakes Running Club and Crooked River Trail Runners. The principal investigator met separately with each running club prior to a weekly group meeting to recruit participants by verbally explaining the study and distributing paper flyers to the club members. To be considered a “recreational runner” and be eligible to participate in the study, participants were required to fulfill the following criteria: report running at least 3 days per week, compete in 3 or more organized running events per year, and be free of any medical complications (e.g. metabolic, orthopedic, cardiovascular disorders) that could be considered contraindications to physical activity. While it was not a prerequisite for participating, all participants had run in an event of at least half marathon distance (21.1 km) or longer.

Prior to participation, all participants provided written informed consent (Appendix B) and completed a medical health history questionnaire (Appendix C). All study procedures were approved by the Kent State University Institutional Review Board. At the completion of the study, all participants were compensated with a \$40.00 gas card and were invited to the Kent State University Applied Physiology Laboratory for a complimentary fitness assessment including VO₂ max and body composition testing. This fitness assessment was offered as a service to participants but was not required for participation in the study.

Procedures

Participants first reported to the Kent State University Applied Physiology Laboratory for anthropometric measurements and completion of written informed consent, followed by fitness testing and classification. They subsequently completed three experimental trials beginning at a trailhead of the Portage County Bike and Hike Trail (Kent, OH) with access to various trails and footpaths closed to vehicular traffic.

Fitness Testing

Each participant performed a 3,200m time trial at maximum effort to determine aerobic fitness and to match peers for fitness during the peer condition running trials. Participants were instructed to prepare for the time trial as they would for a race, by performing only light exercise or resting the day before the test and consuming their customary pre-race foods and beverages. Members of the same running club reported at a common time to an outdoor synthetic 400m track located on the Kent State University

campus in Kent, OH. Time trials for both clubs were conducted at 7:00 pm on separate days. Participants were given 20 minutes to warm up and prepare for the trial, after which all runners of a club started the time trial simultaneously in a race format. Each club completed the time trial separate from the other club so that each participant's "unfamiliar peer" from the different club was not introduced until the experimental trial. Individual finish times were recorded in minutes and seconds.

Experimental Trials

Experimental trials took place in June and July, as many of the participants reported following structured training schedules in the spring and fall months to prepare for a goal race of half or full marathon distance. These "racing seasons" were avoided to prevent fatigue from a recent race or high intensity workout, or anticipation of one in the near future, from influencing participants' exercise behavior during the experimental trials. Each participant verified that during the study, he or she was in a "base training" phase - that is, not preparing for a specific race and having no structured or race-specific workouts planned. During this time, participating runners' training predominantly consisted of voluntarily paced, easy to moderate intensity aerobic running, which matched the exercise structure this study aimed to investigate. The order of the three experimental trials was randomly assigned and consisted of self-paced, submaximal running under three conditions: alone, with a familiar same-sex peer belonging to the same running club, and with an unfamiliar same-sex peer belonging to a different running club. Pairs of participants were matched for fitness based on the time required to

complete the 3,200m time trial, with each member of the pair having run times within 30 seconds of each other. Participants were instructed to refrain from any other physical exercise on the day of each trial, and to perform only light intensity exercise lasting no longer than 60 minutes the day before and the day after each trial. Exercise was allowed on the days prior and subsequent to each trial because maximal performance was not being assessed and many participants reported being accustomed to running on most days of the week. Because each trial was intended to resemble participants' normal training runs as closely as possible, they were not asked to modify their weekly exercise routine. Participants were instructed to follow their normal diet and were permitted to consume coffee if they normally did so on the day of each trial and the day before, but were instructed to abstain from alcohol or energy supplements for 24 hours prior to each trial. All experimental trials were conducted as close to the same time of day possible (± 2 hours) for each participant, and all trials were conducted between 4:00 PM and 8:00 PM. Each participant completed the three experimental sessions within a 14 day period. Ambient temperature, relative humidity, and wind speed were recorded at the start of each session. All sessions were completed in temperatures between 21°C and 29°C, with wind speed below 7 m·s⁻¹ and no precipitation. Each run was concluded when participants returned to the starting point and verbally indicated being finished. Elapsed time, total distance, and average running speed were tracked throughout each running trial and recorded at its conclusion. Participants' liking of the activity and rating of perceived exertion (RPE) were also assessed at the conclusion of each running trial.

Participants were permitted to wear a digital stopwatch, but were not allowed to wear or carry music players, mobile phones, or other monitoring devices visible to them.

Alone condition. The participant reported alone to a specified trailhead of the Portage County Bike and Hike Trail in Kent, OH. The principal investigator contacted participants two days prior each trial to remind them of the exercise restrictions for the day before and after the session and confirmed participants' compliance to the restrictions at the start of each session. The following instructions were given:

“Today you will complete a run just like any of your normal daily runs when you are not doing a specific or structured workout - such as intervals, a ‘tempo run’, or a ‘long run’. You may run at any pace you choose, change your pace at any time, and you are free to run as long or far as you wish. This is not a time trial or performance test. Do not run with anyone else you encounter on the path. When you wish to end your run, return here and tell us that you are done. Do you have any questions?”

Peer conditions. Two participants simultaneously completed the same exercise trial described in the alone condition. At the beginning of a “familiar peer” trial, both participants mutually indicated familiarity with the other participant and confirmed that they had previously run together at a meeting of their respective running club. At the beginning of an “unfamiliar peer” trial, participants were introduced and mutually indicated that they did not know the other participant and had not previously run together. The following instructions were given:

“Today you will complete a run just like any of your normal daily runs when you

are not doing a specific or structured workout - such as an intervals, a ‘tempo run’, or a ‘long run’, and you will do the run with a partner. You may talk to each other if you wish. You may run at any pace you choose, change your pace at any time, and you are free to run as long or far as you wish. This is not a race, competition, or performance test. Do not run with anyone else you encounter on the path. When you wish to end your run, return here and tell us that you are done. Do you have any questions?”

Measures were identical to the alone condition. Each participant rated his liking reported his RPE in a private area separate from the other participant.

Measurements

Anthropometrics. Body mass was assessed to the nearest 0.2 kg and height to the nearest 1.0 mm using a balance beam scale (Health O Meter, Alsip, IL) and calibrated digital stadiometer (Charder Medical, Da Li City, Taiwan, China), respectively.

Distance. Total distance of the run was measured using a wrist worn GPS (global positioning satellite) receiver (Garmin Forerunner 10, Olathe, Kansas). Wrist mounted GPS tracking devices are popular amongst athletes and accurately monitor distance and speed (Townshend, Worringham, & Stewart, 2008). A GPS monitor was provided to each participant, with the display window covered in black electrical tape. The participant was instructed not to look under the tape. All audible notifications were switched off. Total distance ran was recorded in kilometers (km) and average speed was calculated as $\text{km}\cdot\text{hr}^{-1}$ by dividing the distance by the elapsed time in hours (i.e., 30 minutes = 0.50 hours).

Liking. Participants rated their liking of each exercise session using a visual analog scale (VAS) consisting of a continuous 100 millimeter line anchored by “do not like it at all” on the left and “like it very much” on the right. The participant was shown the scale and instructed to make a mark on the line to indicate his level of enjoyment of the session. The position of the mark was measured in millimeters from the left anchor of the line, with a higher millimeter measurement indicating greater enjoyment. Liking or hedonics is an affective rating of a behavior that, when assessed in this manner, directly correlates with physical activity participation (Motl et al., 2001).

Rating of Perceived Exertion. Undifferentiated, whole-body RPE was obtained at the conclusion of each run using the validated Borg RPE scale (Borg, 1982). The RPE scale was explained to the participant, who was then asked to rate his average exertion over the course of the run.

Analytic Plan

All statistical analyses were conducted using SPSS for Windows (version 18.0, SPSS Inc, Evanston, IL) with an a-priori α level of ≤ 0.05 . Means and measures of variability (standard deviation is reported in the text and all tables, standard error is reported in the figures) were calculated for all physical characteristics (height, body mass, age, time trial) and the primary dependent variables (duration, distance, average speed, liking, and RPE) for each social condition (alone, familiar peer, unfamiliar peer). Because all individuals in the study were participants, there was interdependence within each pair and group of participants who completed these peer conditions together.

Therefore, mixed-effects regression models were utilized to examine all dependent variables over the three social conditions. Mixed models assume that the data within participants are dependent among the observations and can therefore be utilized to analyze data such as these where interdependence must be accounted for (Gibbons & Hedeker, 1994; Hedeker & Gibbons, 1994). The social conditions and groups were dummy-coded as either 0 (alone), 1 (familiar peer), or 2 (unfamiliar peer), while sex was coded as 0 (female) or 1 (male). Separate models were performed for each of the dependent variables (duration, distance, average speed, liking, RPE). For each dependent variable, participant age and ambient temperature were entered into the model. All regression analyses utilized the following model:

$$\text{Dependent variable} = \alpha + \beta_1 (\text{social condition}) + \beta_2 (\text{sex}) + \beta_3 (\text{social condition} * \text{sex})$$

Post-hoc paired *t*-tests were performed between social conditions for any dependent variable which had a main effect of social condition.

CHAPTER IV

RESULTS

Participant Characteristics

Participant characteristics are listed in table 2. There were no significant differences ($p \geq 0.82$) in age between men and women. Men were significantly taller ($t = 5.731$, $p < 0.001$), had significantly higher body mass ($t = 5.03$, $p < 0.001$) and completed the 3,200m time trial significantly faster ($t = 3.14$, $p \leq 0.005$) than women.

Table 2.

Participant Physical Characteristics

	Men	Women
Age (yr)	37.50 ± 11.97	36.50 ± 9.54
Weight (kg)	78.59 ± 10.54	57.99 ± 6.36
Height (cm)*	178.64 ± 5.36	164.57 ± 8.05
Time Trial (min)*	12.90 ± 1.14	14.52 ± 1.32

Data are Means $\pm$ SD

Social Conditions

Duration

The mixed-effects model testing the effects of social condition and sex on voluntary running duration showed a significant main effect of sex ($F = 13.66$, $p < 0.001$, Figure 1, Table 4) as women (55.40 ± 20.79 min) ran for a longer time than men (40.04 ± 11.07 min) overall across the three social conditions. There was no significant main effect of social condition ($F = 0.146$, $p = 0.865$) or condition by sex interaction ($F = 0.438$, $p = 0.647$) for voluntary running duration (Figure 1, Table 3).

Figure 1. Running duration (Data are Mean $\pm$ SEM).

Distance

The mixed-effects model testing the effects of social condition and sex on voluntary running distance showed a significant main effect of sex ($F = 9.89$, $p \leq 0.003$, Figure 2, Table 4) as women (10.03 ± 3.93 km) ran for a longer distance than men (7.58 ± 1.95 km) overall across the three social conditions. There was no significant main effect of social condition ($F = 0.04$, $p = 0.961$) or condition by sex interaction ($F = 0.435$, $p = 0.649$) for voluntary running distance (Figure 2, Table 3).

Figure 2. Running distance (Data are Mean $\pm$ SEM).

Average Speed

The mixed-effects model testing the effects of social condition and sex on average running speed showed a significant main effect of sex ($F = 11.19$, $p \leq 0.001$, Figure 3, Table 4) as men ($11.51 \pm 1.36 \text{ km} \cdot \text{hr}^{-1}$) ran faster than women ($10.67 \pm 0.50 \text{ km} \cdot \text{hr}^{-1}$) overall across the three social conditions. There was no significant main effect of social condition ($F = 0.269$, $p = 0.765$) or condition by sex interaction ($F = 0.436$, $p = 0.649$) on average running speed (Figure 3, Table 3).

Figure 3. Average running speed (Data are Mean $\pm$ SEM).

Liking

The mixed-effects model testing the effects of social condition and sex on liking of the exercise showed no significant main ($F \geq 0.185$, $p = 0.649$) or interaction ($F = 0.923$, $p = 0.403$) effects for liking of the exercise bout (Figure 4, Table 3).

Figure 4. Liking (Data are Mean $\pm$ SEM).

Rating of Perceived Exertion

The mixed-effects model testing the effects of social condition and sex on participants' rating of perceived exertion showed a significant main effect of sex ($F = 5.90$, $p \leq 0.018$, Figure 5, Table 4) as women (12.41 ± 1.46) indicated lower perceived exertion than men (13.39 ± 1.83) overall across the three social conditions. There was no significant main effect of social condition ($F = 0.528$, $p = 0.593$) or condition by sex interaction ($F = 0.777$, $p = 0.464$) on RPE (Figure 5, Table 3).

Figure 5. Rating of perceived exertion (Data are Mean $\pm$ SEM).

Table 3.

Duration, Distance, Average Speed, Liking, and RPE Across Social Conditions

		Alone	Familiar Peer	Unfamiliar Peer
Time (min)	Women	53.85 ± 20.18	54.58 ± 23.43	57.75 ± 20.25
	Men	38.98 ± 14.29	43.73 ± 9.49	37.41 ± 8.59
Distance (km)	Women	10.00 ± 3.95	9.73 ± 4.33	10.37 ± 3.81
	Men	7.50 ± 2.33	8.19 ± 1.86	7.06 ± 1.59
Pace (km·hr ⁻¹)	Women	10.62 ± 0.67	10.66 ± 0.45	10.71 ± 0.41
	Men	11.80 ± 1.46	11.32 ± 1.52	11.40 ± 1.14
Liking (mm)	Women	79.25 ± 23.97	79.33 ± 14.28	84.58 ± 15.14
	Men	83.09 ± 13.11	88.90 ± 10.07	81.00 ± 17.98
RPE	Women	12.00 ± 1.47	12.66 ± 1.43	12.58 ± 1.50
	Men	13.54 ± 1.86	13.72 ± 2.05	12.90 ± 1.64

Data are Means ± SD

Table 4.

Duration, Distance, Average Speed, Liking, and RPE Between Genders

	Men	Women
Time (min)	40.04 ± 11.07	55.40 ± 20.79
Distance (km)	7.58 ± 1.95	10.04 ± 3.93
Pace (km·hr ⁻¹)	11.51 ± 1.36	10.67 ± 0.50
Liking (mm)	84.33 ± 14.07	81.05 ± 17.97
RPE	13.39 ± 1.83	12.41 ± 1.046

Data are Means ± SD

CHAPTER V

DISCUSSION

The present study is the first to experimentally assess how the presence of a familiar or unfamiliar peer affects recreational runners' behavior and liking during submaximal exercise bout of self-determined intensity and duration. The findings of this study contradict our hypothesis that the presence of a peer would increase the liking, distance run, and duration of exercise, as well as the results of two prior studies by our laboratory which found sex specific effects on voluntary intensity. Compared to running alone, neither males nor females altered volitional speed, duration, or distance when running with a familiar or unfamiliar peer matched for sex and performance ability. The presence of either type of peer also had no significant impact on runners' liking of the exercise session or their perceived exertion.

Based on the results of our previous studies on runners, we hypothesized in the current study that running with a familiar peer would cause reduced speed in both sexes compared to running alone, while the presence of an unfamiliar peer would cause increased speed in male runners but decreased speed in female runners. However, the presence of either a familiar or unfamiliar peer had no effect on either sex's voluntary running intensity relative to running alone. While this conflicts with results from our previous studies, the present investigation differs in several notable ways. Elite male collegiate runners who ran a 6.4 km course slower with a single teammate or as part of a

group (Carnes et al., 2013) were at a significantly higher performance level than the recreational athletes presently studied, and were accustomed to daily training sessions as a team. Conversely, recreational participants in the current study anecdotally reported only running with others when meeting with their respective running club on a weekly basis. While we previously found that recreational males increased speed but females decreased speed in the presence of an unfamiliar peer (Carnes et al., 2014), the distance of each trial in that study was held constant. In accordance with Deaner's (2012) hypothesis of higher competitiveness in male sub-elite and recreational runners, the explicit distance of each trial and participants' awareness of the distance to be run may have invoked a competitive response in male runners, causing them to run faster as a means of "self presentation" (Bond, 1982) in the presence of the unfamiliar peer. By contrast, female runners may not have felt a need to complete the course faster to make a favorable impression to the unfamiliar peer. Anecdotal support of this is provided by several female participants stating that they had been talking during the peer condition or wished to be "friendly" or "nice". The present study differed from the former by allowing participants to voluntarily alter the distance of the run, just as they would be able to on one of their customary running sessions. The lack of a defined distance may have prevented male participants' desire to complete the run faster when another male was present or female participants' desire slow down as a means to socialize or project friendliness to their peer.

Although the constant distance of each trial in our previous studies (Carnes et al.,

2013; Carnes et al., 2014) may have played a role in a sex specific effect on speed, it also precluded the ability to observe if the presence of a peer could potentially alter the distance/duration that participants chose to run. Independent of or in addition to an effect on intensity, the potential for a partner or group to encourage a greater volume of exercise (i.e., greater distance) could likewise have implications on training outcomes. Only a small amount of empirical evidence exists to indirectly suggest a link between peer influence and exercise duration. In athletes, an early study by Wilmore (1968) showed an increased time to exhaustion in cyclists during a maximal effort task when competing against another cyclist. However, this prior study examined the duration of maximal effort instead of the duration of a submaximal exercise bout. In children, Salvy et al. (2009) showed that children were more motivated to be physically active in the presence of a peer. However, neither of these studies or any other experimental research has directly assessed the effect of peer influence on athletes' or non-athletes' voluntary duration of submaximal exercise. The current investigation, which is the first to do so, found no difference on the duration or distance participants chose to run between an alone, familiar peer, or unfamiliar peer condition.

Our current hypothesis, that the presence of a peer would increase the volitional duration and/or distance of a running session in recreational runners of either sex, was associated with our complementary hypothesis that the peer running conditions would increase participants' liking of the exercise bout relative to running alone. Elite male collegiate runners (Carnes et al., 2013) and recreational runners of both sexes (Carnes et

al., 2014) in our two prior outdoor running studies reported greater liking of the exercise bout when running with a peer or in a group. Although participants' greater liking during the peer conditions of these previous studies was not associated with a consistent increase in exercise intensity (recreational males ran faster with a peer while elite collegiate males and recreational females ran slower with peers), we predicted that greater liking in the company of a peer could positively impact voluntary exercise duration or running distance in the current study. Survey research has shown that liking is predictive of physical activity behavior in children (Craig et al., 1996, DiLorenzo et al., 1998; Dishman et al., 1985) and non-athlete adults (Hagberg et al., 2009), and the experimental study by Rittenhouse et al. (2011) showed that boys' increase in physical activity with a peer was concomitant with an increase in their liking of that bout of physical activity. The findings of the present study conflicted with our previously observed increase in runners' liking with peers (Carnes et al., 2013; Carnes et al., 2014), as the presence of a familiar or unfamiliar peer did not affect male or female recreational runners' liking of exercise bout.

Limitations and Future Directions

Several limitations of the current study should be duly noted. First, while all participants fulfilled the criteria for inclusion in the study, the sample of participants was highly diverse in age and performance level. However, the aim of the study was to evaluate widespread recommendations which are frequently given in general to the population of recreational runners as a whole, which is likewise highly diverse in these

aspects. Also, the study was conducted in Northeast Ohio in June and July, when the weather is typically warm and humid. Although such environmental conditions can limit endurance performance or hasten the onset of fatigue (Noakes, 2004), all participants reported being accustomed to running in the heat during these months. This time of the year was chosen as runners were least likely to be in a specific race preparation phase of training. As such, it was less likely that unstructured, “free choice” runs would be influenced by recovery from or preparation for a race or specific workout. Despite wide variation in age and warm conditions, co-varying for age, temperature, and relative humidity did not influence the results. Another limitation of the study is that each participant only ran with peers of the same sex. However, it is possible that an individual could exercise with an opposite sex partner or in a group including both sexes. Because the current study only tested the effect of a same sex peer, its results cannot be used to infer about the possible effect(s) of an opposite sex peer on the duration, intensity, or liking of a submaximal exercise bout. As well as only running with same sex peers, participants were only matched with peers of similar aerobic fitness. Running with a partner who possesses significantly greater or lesser fitness could produce different effects on submaximal running behavior and liking than observed in this study, in which peers were matched for competitive ability. In addition, the effect of a peer was examined only during unstructured, “free choice” intensity running. While this type of effort comprises a large proportion of runners’ training (Esteve-Lanao, 2005; Seiler, 2010), they also undertake challenging structured workouts which elicit intensities

between the lactate threshold and VO₂ max (Daniels, 2005; Noakes, 2004). The potential for a peer to increase the amount of work that can be performed at a certain intensity or the absolute intensity that can be maintained during such training sessions was not explored in this study. Furthermore, only a single exercise bout was observed under each social condition. This does not permit inferences to be made about the potential for regularly training with others to cause variation in cumulative intensity or volume over a period of time, or if performance changes will be different over time between those who train alone or with others. Lastly, the findings of this study were only observed in runners, which precludes their application to other forms of exercise.

Because of the limitations of this study and the possibility for peer influence to affect physical activity in ways not explored herein, further experimental research is needed to better elucidate this relationship. Future studies should assess how exercising with a peer or in a group of peers who are a different sex or at a different fitness level may affect the intensity, duration, and liking of voluntary exercise. Ongoing research should also consider if exercising with a partner or group could benefit performance during challenging, structured workouts involving specific pace or distance targets. Furthermore, longitudinal investigation of runners could determine if the social environment during training can impact their cumulative training load or performance gains over the course of a training period. Additional experimental research to elucidate the potential effect of peer influence during other physical activities is also warranted.

Conclusions

Runners and non-athlete exercisers alike are often recommended to exercise with a partner in order to increase the motivation to exercise or to increase the duration or intensity of an exercise session. Although this notion is widely accepted as beneficial, it lacks a strong basis of experimental support and instead draws from anecdotal arguments and non-experimental research. The current study was the first to empirically examine how exercising with a partner can affect recreational runners' self-selected running speed, distance, duration, and liking during an unstructured, submaximal exercise session. Contrary to our hypothesis, the presence of a same sex peer of similar ability, whether familiar or unfamiliar, had no effect on these variables in recreational runners of either sex. This not only contradicts our hypotheses - that the presence of a peer would increase the liking, distance, and duration of exercise in this sample and have sex specific effects on voluntary intensity - but also challenges prevalent assumptions that exercise with a partner or group will universally increase the intensity and duration of a workout. However, these findings must be addressed with caution. As the presence of a peer was not shown to have a consistent effect in this group of participants, recreational runners should be advised that they are neither obstructing improvement or missing out on potential performance benefits by following their personal preference of running alone or with others. However, exercise partners could have other effects not considered herein, such as promoting a higher frequency of exercise through a sense of accountability or social ties, promoting adherence to an exercise program, or providing psychological

benefits like encouragement, affirmation, or friendship. In addition, these results only apply to unstructured, volitional effort exercise. It remains possible that a running partner or group could be facilitative during structured, high intensity training sessions that involve challenging pace or distance goals. Lastly, the present investigation only considers the effect of peer influence on running, and additional research is needed before applying its findings to other forms of exercise. However, this study is the first to provide experimental evidence to suggest that for recreational runners performing a noncompetitive and unstructured run, the presence or absence of a partner may not be as significant as widely believed. As such, the best option for these individuals may be whichever suits their personal preference.

APPENDICES

APPENDIX A
RECRUITMENT FLYER

Appendix A

Recruitment Flyer

Join a study on distance runners' training!

Andrew Carnes is a doctoral student in exercise physiology at Kent State University and a competitive runner. He wants YOU to take part in a new study on recreationally competitive runners.

\$40 and free VO₂ Max + Body Composition tests for participating!

Do you: Run 3+ days per week?

Participate in 3+ organized races per year?

Have a 5k PR of 18:00 - 21:00 (men) or 20:00 - 23:00 (women)?

Then you are perfect for this study!

- Must be in “base training”, NOT in a specific race preparation phase of training OR willing to commit to a 2 week period of no specific/structured workouts or races (Tempo runs, intervals, repeats, speed work, etc.)
- Initial session at Kent State University main campus
- Three running sessions in Kent, OH between 4:00 and 8:00 P.M. within a 2 week period
- All sessions will take place in June and early July

APPENDIX B

INFORMED CONSENT FORM

Appendix B

Informed Consent Form

Title: Activity Monitoring in Adult Runners

Principal Investigator: Andrew Carnes, Jacob Barkley (Co-Investigator)

1 Introductory Statement.

You are being invited to participate in a research study. This consent form will provide you with information on the research project, what you will need to do, and the associated risks and benefits of the research. Your participation is voluntary. Please read this form carefully. It is important that you ask questions and fully understand the research in order to make an informed decision. You will receive a copy of this document to take with you.

2 Purpose/Research Methods of the Study.

The purpose of this study is to monitor the activity levels of runners during training and to test the accuracy of a new distance tracking device that will be less expensive than GPS. If you decide to participate in this study, you will first be asked to report to the Kent State University Exercise Physiology Laboratory. Trained researchers will measure your height and weight. You will then be asked to run a 3200m (2 mile) time trial quickly as possible. Subsequently, you will participate in three outdoor running sessions. Each session will take begin at a trailhead to the Portage County Bike and Hike Trail, and you will be free to choose your own course. You will be free to run at whatever pace you choose; it is not a time trial or performance test. You must return to the starting point to finish the run. At the end of each session, we will ask you some questions about the run and refreshments will be provided. Following the study, you will be provided complimentary laboratory assessments of VO₂ max and body composition, two important factors in endurance performance. These tests are optional and provided as a service to you, but are not required to participate in the study.

The ultimate objective of this study will be to publish the findings in a scholarly journal, as well as present these findings at a scientific research conference. Your identity is confidential and the experimental results are anonymous. All data, including yours, will only be presented in summary.

3 Duration of the Project.

The initial laboratory visit will take approximately 60 minutes. Each running session will

require 60 minutes and will be completed within two weeks.

4 Potential Benefits of Participation.

VO₂ max is one of the principal determinants of endurance running performance. The information we find in your test can help you gauge your fitness level, set goals for your competitive season, and more precisely determine individually appropriate training paces.

Your participation in the study will also expand the current knowledge of optimal training for athletes and possibly help develop improved training methods.

5 Potential Risks of Participation.

As with any type of physical activity, there are some risks to participation. These risks are minimal and will not differ from those in your routine training habits. You are free to stop exercising at any point due to abnormal discomfort. Only trained and experienced staff will supervise each exercise session, minimizing any risks to you.

6 Alternate Methods of Treatment.

The alternative is not to participate.

7 Cost to the Participant.

There is no cost to you participating in this study.

8 Compensation and Medical Care.

You will receive an \$80 gift certificate to a local store. This gift certificate will be given upon the completion of your participation in the study. Medical Assistance or emergency medical treatment by the University Health Center is provided only to currently registered students. Please be advised that for all others, "911" will be called for physical injuries occurring on the Kent State University main campus. You or your medical insurance will be billed for this service. No other medical treatment or financial compensation for injury from participation in this project is available.

9 Right to Withdraw Any Time.

Your participation in this study is voluntary and you may stop your participation at any time without prejudice.

10 Contact Person.

Jacob E. Barkley, Ph.D. Assistant Professor Exercise Science, School of Health Science, MAAC Annex, Room 163E, 350 Midway Dr., Kent, Ohio 44242, (330-672-0209).

11 Institutional Review Board Approval

This project has been approved by the Kent State University Institutional Review Board to use human research subjects. If you have any concerns involving the research methods or protocol that you do not wish to discuss with the principal investigator or faculty advisor, you may contact the Institutional Review Board Compliance Assistant: Laurie B. Kiehl, Office of Safety and Research Compliance, Research and Graduate Studies, 122 Cartwright Hall. (330-672-2704).

12 Confidentiality.

Information related to you will be treated in strict confidence to the extent provided by law. Your identity will be coded and will not be associated with any published results. Your code number and identity will be kept at the Kent State University in a locked file of the Principal Investigator.

13 Statement of Voluntary Agreement to Participate.

All of the above has been explained to me and all of my current questions have been answered. I understand that I am encouraged to ask questions about any aspects of this research study, and that future questions will be answered by the researchers listed below:

Andrew Carnes, M.S. School of Health Sciences, MACC Annex, Room 163, 350

Midway Dr., Kent, Ohio 44242 (330-327-6385)

Jacob E. Barkley, Ph.D. Assistant Professor of Exercise Science, School of Health Sciences, MACC Annex, Room 163E, 350 Midway Dr., Kent, Ohio 44242, (330-672-0209)

By signing this form I understand that I do not waive any of my legal rights. I agree to participate in this research study. A signed copy of this consent form will be given to me.

_____	_____	_____
Participant's Name	Participant's Signature	Date
_____	_____	_____
Principal Investigator's Name	Principal Investigator's Signature	Date

APPENDIX C
MEDICAL HISTORY

Appendix C

Medical History

Subject # _____ Date ____/____/____

Name _____

Address _____

Phone Number _____

Age _____ (must be 18) DOB ____/____/____ Sex m f

Height _____ in Wt _____ lbs

Height _____ cm (inches *2.54) Wt _____ kg (lbs/2.2) BMI _____ kg/m²

Weight percentile _____

Which ethnic group do you most identify with (circle response):

American Indian or Alaskan Native

Asian or Pacific Islander

Black, not of Hispanic Origin

Hispanic White, not of Hispanic Origin

Other _____

Y/N

_____ Has a doctor ever said that your blood pressure was too high or too low?

_____ Have you ever had pain in their heart or chest?

_____ Have you ever notice extra heart beats, skipped beats or a racing heart?

_____ Has a doctor ever said that you have heart trouble, an abnormal electrocardiogram

(ECG or EKG), heart attack, or coronary?

_____ Do you often have trouble breathing?

_____ Have you ever been diagnosed with asthma?

_____ Have you ever been diagnosed with diabetes?

_____ Do you have any orthopedic limitations to physical activity?

Do you have any other medical conditions that affect your ability to safely participate in physical activity? If yes, explain.

Have you experienced any injuries, sport related or otherwise, during the last six months? If yes, explain.

Are you currently taking any medication(s)? Y N

If yes, please describe the

medication(s)_____

Do you have any questions?

APPENDIX D

PARTICIPANT QUESTIONNAIRE

Appendix D
Participant Questionnaire

- 1 Answer questions on medical history
- 2 Are you between the ages of 18 and 35? Y or N
- 3 How many days per week do you typically run? _____
- 4 Please list your recent PRs (personal records) for any race distances from 5k to marathon.

- 5 On average, how many miles per week do you run? This shouldn't be your lowest or your peak mileage, but an estimate of your average weekly running.

- 6 Do you regularly participate in organized running events or races? Y or N

What are they?

- 7 Are you able to visit the Kent area 3 times in a 2 week period, between 4:00 and 8:00 PM, for experimental trials? Y or N

APPENDIX E

PARTICIPANT CHARACTERISTICS

Appendix E
Participant Characteristics

Baseline Data	_____
Date:	_____
Subject #:	_____
Birth Date:	_____
Age:	_____
Sex:	_____
Height (cm):	_____
Weight (kg):	_____
Time Trial:	_____

APPENDIX F

DATA COLLECTION FORM

Appendix F

Data Collection Form

Kent State University - Exercise Physiology

Distance Running Research 2014

Participant name and #: _____

Condition 1: Alone F. Peer U.F. Peer **Date:** _____

If peer condition peer name and #: _____ F or U.F.

Time: _____ Temp, % Humidity, Wind: _____

Elapsed Running Time: _____

GPS Distance: _____

Accelerometer Counts: _____

Average Speed: _____

Liking: _____

Condition 2: Alone F. Peer U.F. Peer **Date:** _____

If peer condition peer name and #: _____ F or U.F.

Time: _____ Temp, % Humidity, Wind: _____

Elapsed Running Time: _____

GPS Distance: _____

Accelerometer Counts: _____

Average Speed: _____

Liking: _____

Condition 3: Alone F. Peer U.F. Peer **Date:** _____

If peer condition peer name and #: _____ F or U.F.

Time: _____ Temp, % Humidity, Wind: _____

Elapsed Running Time: _____

GPS Distance: _____

Accelerometer Counts: _____

Average Speed: _____

Liking: _____

APPENDIX G

LIKING VISUAL ANALOG SCALE

Appendix G

Liking Visual Analogue Scale

Name: _____

Date: ____/____/____

Condition: Alone F. P. U.F.P.

A horizontal line with vertical end caps, representing a scale. Below the left end cap is a solid black rectangular box. Below the right end cap is another solid black rectangular box. The boxes are intended for labeling the two ends of the scale.

APPENDIX H

BORG RPE SCALE

Appendix H

Borg RPE Scale

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

REFERENCES

REFERENCES

- Anshel, M. (2003). *Sport psychology: From theory to practice*. San Francisco: Benjamin Cummings.
- Bath, D., Turner, L.A., Bosch, A.N., Tucker, R., Lambert, E.V., Thompson, K.G., and St. Clair Gibson, A. (2011). The effect of a second runner on pacing strategy and RPE during a running time trial. *International journal of sports physiology and performance*, 7, 26-32.
- Bond, C.F. (1982). Social facilitation: a self-presentational view. *Journal of Personality and Social Psychology*, 42, 1042–1050.
- Bond, C. F., & Titus, L. J. (1983). Social facilitation: a meta-analysis of 241 studies. *Psychological Bulletin*, 94, 265–292.
- Borg, G. (1982). Psychophysical bases of perceived exertion. *Medicine and Science in Sports and Exercise*, 14, 377-381.
- Carnes, A., Barkley, J.E., Williamson, M., and Sanders, G. (2013a). The presence of a familiar peer does not affect intensity or enjoyment during treadmill exercise in male distance runners or non-runners. *Journal of Athletic Enhancement* 2(4).

- Carnes, A., Barkley, J.E., and Glickman, E. (2013b). The effect of peer influence on exercise intensity and enjoyment during outdoor running in collegiate distance runners. *Medicine and Science in Sport and Exercise*, 45 Supplement, S123.
- Carnes, A., Barkley, J.E., and Glickman, E. (2014). Gender differences in the effect of peer influence on outdoor running in recreational runners. *Medicine and Science in Sport and Exercise*, 46 Supplement. (Abstract accepted for presentation).
- Carron, A., & Burke, S. (2004). Self-presentation and group influence. *Journal of Applied Sport Psychology*, 16, 41-58.
- Carron, A., Hausenblas, H., & Mack, D. (1996). Social influence and exercise: A meta-analysis. *Journal of Sport and Exercise Psychology*, 18, 1-16.
- Cohen, E., Ejsmond-Frey, R., Knight, N., & Dunbar, R. (2010). Rowers' high: behavioral synchrony is correlated with elevated pain thresholds. *Biological Letters*, 6, 106–108.
- Corbett, J., Barwood, M.J., Ouzounoglu, A., Thelwell, R., and Dicks, M. (2012). Influence of competition on performance and pacing during cycling exercise. *Medicine and Science in Sports and Exercise*, 44, 509-515.
- Costill, D.L., and Fox, E.L. (1969). Energetics of marathon running. *Medicine and Science in Sports and Exercise*, 1, 81-86.

- Craig, S., Goldberg, J., and Dietz, W.H. (1996). Psychosocial correlates of physical activity among fifth and eighth graders. *Preventive Medicine*, 25, 506-513.
- Daniels, J. (2005). *Daniels' Running Formula*. Champaign: Human Kinetics.
- Deaner, R.O., and Mitchell, D. (2011). More men run relatively fast in US Road Races, 1981-2006: A stable sex difference in non-elite runners. *Evolutionary Psychology*, 9, 600-621.
- Deaner, R.O., Masters, K.S., Ogles, B.M., and LaCaille, R.A. (2011). Marathon performance as a predictor of competitiveness and training in men and women. *Journal of Sport Behavior*, 34, 325-342.
- DeFreese, J.D., Smith, A.L. (2013). Teammate social support, burnout, and self-determined motivation in collegiate athletes. *Psychology of Sport and Exercise*, 14, 258-265.
- DiLorenzo, T.M., Stucky-Ropp, R.C., Vander Wal, J.S., and Gotham, H.J. (1998). Determinants of exercise among children: A longitudinal analysis. *Preventive Medicine*, 27, 470-477.
- Dishman R., Sallis J., & Orenstein, D. (1985) The determinants of physical activity and exercise. *Public Health Reports*, 100(2), 158-171.
- Dolan, S. (2008). Benefits of group exercise. *ACSM Fit Society Page*, Winter 2008/2009. American College of Sports Medicine.

- Duncan, S.C. (1993). The role of cognitive appraisal and friendship provisions in adolescents' affect and motivation toward activity in physical education. *Research Quarterly for Exercise and Sport*, 64, 314-323.
- Esteve-Lanao, J., Foster, C., Seiler, S., Lucia, A. (2007). Impact of training intensity distribution on performance in endurance athletes. *Journal of Strength and Conditioning Research*, 21, 943-949.
- Esteve-Lanao, J., San Juan, A., Earnest, C.P., Foster, C., Lucia, A. (2005). How do endurance runners actually train? Relationship with competition performance. *Medicine and Science in Sports and Exercise*, 37, 496-504.
- Fitness Health 101. (2014, January). Benefits of having a workout partner. Retrieved from <http://www.fitnesshealth101.com/fitness/general/getting-started/benefits-of-workout-partner>
- Frederick-Recascino, C.M., & Schuster-Smith, H. (2003). Competition and intrinsic motivation in physical activity: A comparison of two groups. *Journal of Sport Behavior*, 26(3), 240-254.
- Galloway, J. (2002). *Galloway's Book on Running*. Bolinas: Shelter Publications.
- Galloway, J. (2012, February). Join the crowd. *Runner's World*, 47(2), 22.
- Galloway, J. (2012, March). Go in a crowd. *Runner's World*, 47(3), 23.

- Gibbons, R.D., and Hedeker, D. (1994). Application of random-effects prohibit regression models. *Journal of Consulting & Clinical Psychology*, 62, 285-296.
- Gold's Gym. (2013, September). *The perks of partnering up*. Retrieved from <http://www.goldsgym.com/article/the-perks-of-partnering-up/>
- Grindrod, D., Paton, C.D., Knez, W.L., and O'Brien, B.J. (2006). Six minute walk distance is greater when performed in a group than alone. *British Journal of Sports Medicine*, 40, 876-877.
- Hagberg, L.A., Lindahl, B., Nyberg, L., and Hellenius, M.L. (2009). Importance of enjoyment when promoting physical exercise. *Scandinavian Journal of Medicine and Science in Sports*, 19, 740-747.
- Halsen, S., and Jeukendrup, A. (2004). Does overtraining exist? An analysis of overreaching and overtraining research. *Sports Medicine*, 34, 967-981.
- Hedeker, D., and Gibbons, R.D. (1994). A random-effects ordinal regression model for multilevel analysis. *Biometrics*, 50, 933-944.
- Jarvis, L. (2012, February). Buddy System. *Runner's World*, 47(2), 35.
- King, A.C., Blair, S.N., Bild, D.E., and Dishman, R.K. (1992). Determinants of physical activity and interventions in adults. *Medicine and Science in Sports and Exercise*, 24 Supplement, S221-S236.

Kolata, G. (2009, September 16). To train harder, consider a crowd. *New York Times*, E1.

Kravitz, L. (2011). What motivates people to exercise? Reasons and strategies for exercise adherence. *IDEA Fitness Journal*, 8, 25-27.

Leary, M.R. (1992). Self presentational processes in exercise and sport. *Journal of Sport and Exercise Psychology*, 14, 339-351.

Lehmann, M.J., Lormes, W., Opitz-Gress, A., Steinacker, J.M., Netzer, N., Foster, C., & Gastmann, U. (1997). Training and overtraining: an overview and experimental results in endurance sports. *Journal of Sports Medicine and Physical Fitness*, 37, 7-17.

Lemyre, P.N., Hall, H.K., and Roberts, G.C. (2007). A social cognitive approach to burnout in elite athletes. *Scandinavian Journal of Medicine & Science in Sports*, 18, 221-234.

London Daily Mail Online. (2013, January). *Looking for a fitness boost? Work out with a friend*. Retrieved from <http://www.dailymail.co.uk/health/article2263099/Looking-fitness-boost-Workout-friend--research-shows-women-train-harder-exercise-partner.html>

Martin, D., and Coe, P. (1999). *Better Training for Distance Runners*. Champaign: Human Kinetics.

- Motl, R.W., Dishman, R.K., Saunders, R., Dowda, M., Felton, G., & Pate, R.R. (2001). Measuring enjoyment of physical activity in adolescent girls. *American Journal of Preventive Medicine*, 21(2), 110-117.
- Murcia, J.A.M. (2008). Peers' influence on exercise enjoyment: A self-determination theory approach. *Journal of Sports Science and Medicine*, 7, 23-31.
- Noakes, T. (2004). *Lore of Running*. Champaign: Human Kinetics.
- O'Mara, K. (2013, September). Buddy up: The benefits of training partners. *Competitor Running*. Retrieved from http://running.competitor.com/2013/09/training/buddy-up-the-benefits-of-training-partners_58448
- Plante, T.C., Coscarelli, L., & Ford, M. (2001). Does exercising with another enhance the stress- reducing benefits of exercise? *International Journal of Stress Management*, 8, 201-213
- Plante, T.G., Madden, M., Mann, S., Lee, G., Hardesty, A., Gable, N., Terry, A., and Kaplow, G. (2010). Effects of perceived fitness level of exercise partner on intensity of exertion. *Journal of Social Sciences*, 6, 50-54.
- Raedeke, T. (2007). The relationship between enjoyment and affective responses to exercise. *Journal of Applied Sport Psychology*, 19, 105-115.

- Rhea, M.R., Landers, D.M., Alvar, B.A., and Arent, S.M. (2003). The effects of competition and the presence of an audience on weight lifting performance. *Journal of Strength and Conditioning Research*, 17, 303-306.
- Rittenhouse, M., Salvy, S.J., and Barkley, J.E. (2011). The effect of peer influence on the amount of physical activity performed in 8- to 12-year-old boys. *Pediatric Exercise Science*, 23, 49-60.
- Roemmich, J.N., Barkley, J.E., Lobarinas, C.L., Foster, J.H., White, T.M., and Epstein, L. (2008). Association of liking and reinforcing value with children's physical activity. *Physiology & Behavior*, 93, 1011-1018.
- Running USA. (2013, July). 2013 State of the sport - part 3: US race trends. Retrieved from <http://www.runningusa.org/state-of-sport-2013-part-III?returnTo=annual-reports>
- Sallade, J.R., and Koch, S. (1992). Training errors in long distance running. *Journal of Athletic Training*, 27, 50-53.
- Salvy, S.J., Bowker, J.W., & Roemmich, J.N. (2008). Peer influence on children's physical activity: an experience sampling study. *Journal of Pediatric Psychology*, 33, 39-49.

- Salvy, S.J., Roemmich, J.N., Bowker, J.C., Romero, N.D., Stadler, P.J., and Epstein, L.H. (2009). Effect of peers and friends on youth physical activity and motivation to be physically active. *Journal of Pediatric Psychology*, 34, 217-225.
- Seiler, S. (2010). What is best practice for training intensity and duration distribution in endurance athletes? *International Journal of Sports Psychology and Performance*, 5, 276- 291.
- Shepard, B. (2014, January). Energize your workouts with social support. ACE Fitness. Retrieved from <http://www.acefitness.org/acefit/fitness-programs-article/3112/ACEFit-workout-advice-and-exercise-tips/>
- Sherwood, N.E., and Jeffery, R.W. (2000). The behavioral determinants of exercise: implications for physical activity interventions. *Annual Review of Nutrition*, 20, 21-44.
- Smith, A.L., Gustafsson, H., and Hassmen, P. (2010). Peer motivational climate and burnout perceptions of adolescent athletes. *Psychology of Sport and Exercise*, 11, 453-460.
- Strauss, B. (2002). Social facilitation in motor tasks: a review of research and theory. *Psychology of Sport and Exercise*, 3, 237–256.
- Stoppani, J. (2010, July). Buddy up: Train with a partner to blast through the pain barrier. *Flex* 27(7), 90.

- Triplett, N. (1898). The dynamogenic factors in pacemaking and competition. *American Journal of Psychology*, 9(4), 507-533.
- Townshend, A.D., Worringham, C.J., and Stewart, I.B. (2008). Assessment of speed and position during human locomotion using nondifferential GPS. *Medicine and Science in Sports and Exercise* 40, 124-132.
- Treiber, F.A., Baranowski, T., Braden, D.S., Strong, W.B., Levy, M., and Knox, W. (1991). Social support and for exercise: Relationship to physical activity in young adults. *Preventive medicine*, 20, 737-750.
- Trost, S., Owen, N., Bauman, A.E., Sallis, J.F., & Brown, W. (2002). Correlates of adults' participation in physical activity: review and update. *Medicine and Science in Sports and Exercise*. 34(12), 1996-2001.
- Wallston, B.S., Alagna, S.W., McEvoy Devellis, B., DeVellis, R.F. (1983). Social support and physical health. *Health Psychology*, 2, 367-391.
- Wankel, L. (1984). Decision-making and social-support strategies for increasing exercise involvement. *Journal of Cardiac Rehabilitation*, 4, 124-135.
- Wankel, L. (1993). The importance of enjoyment to adherence and psychological benefits from physical activity. *International Journal of Sport Psychology*, 24, 151-169.

Wendel-Vos, W., Droomers, M., Kremers, S., Brug, J., & van Lenthe, F. (2007).

Potential environmental determinants of physical activity in adults: a systematic review. *Obesity Reviews*, 8, 425-440.

Williams, K.D., Nida, S.A., Baca, L.D., and Latane, B. (1989). Social loafing and swimming: Effects of identifiability on individual and relay performance of intercollegiate swimmers. *Basic and Applied Social Psychology*, 10, 73-81.

Wilmore, J. (1968). Influence of motivation on physical work capacity and performance. *Journal of Applied Physiology*, 24, 459-463.

Wininger, S.R. (2002). Instructors' and classroom characteristics associated with exercise enjoyment by females. *Perceptual & Motor Skills*, 94, 395-398.

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