

ASSESSMENT OF PERFORMANCE AND INDIVIDUAL  
EXPERIENCE DURING GROUP EXERCISE

by

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Abstract

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Every year, approximately 47 million Americans belong to a gym as a means of physical activity. Although little is known about crowding in a gym environment, research in other environments, including retail settings, has demonstrated that perceived crowding can result in negative effects such as decreased satisfaction and inhibited goal-attainment. Therefore, if perceived crowding in a gym is aversive, it may be a significant barrier to regular exercise. However, other studies in the retail crowding literature have found increased satisfaction during crowded shopping experiences in goods-based stores. These divergent outcomes of crowding may be explained by whether or not people attribute their feelings of arousal to crowding or to another source. To empirically examine the effects of crowding, arousal, and attributions on a group-exercise class within a gym setting, the present study was an experiment that used a 2 (density: high, low) X 3 (attribution given: crowding, physical activity, none) factorial design. College-aged adults ( $N = 161$ ), who met minimum health criteria to exercise and who were not regular cyclists, were randomly assigned to one of the six experimental groups. Subsequently, these groups took part in a 30-minute group-exercise cycling class according to the condition assigned. With respect to the primary hypotheses, it was found that exercisers in the high-density condition felt more crowded than those in the low-

density condition, as expected. It was also found that the crowding attribution group had a higher average heart rate than the no attribution group, and that the no attribution group felt more psychological arousal than the physical activity attribution group. Regarding changes in aroused mood, vigor-activity mood increased over time among the physical activity and no attribution groups, whereas tension decreased over time, regardless of group assignment. Expected changes in the exercise outcomes of intentions, enjoyment, and activity were not found, except for a difference in attribution group such that the crowding group displayed more activity than the no attribution group. Other results indicated that that both due to temperature moderated the relationship among density, attribution, and psychological arousal. Finally, neuroticism and density positively predicted social crowding whereas motivation negatively predicted it. The findings obtained from this study provided initial evidence in order to better understand the relationships among crowding, arousal, attributions, and exercise. These results suggest that density may not directly impact arousal and exercise outcomes, and that one's attribution regarding the cause of density may be more important than actual density in the perception of crowding. Manipulation of the attributions in this context may therefore help to reduce feelings of crowding. Future research should further examine these relationships to more clearly determine the effect of crowding on exercise behavior and adherence. Results from this research might also be used to design an intervention aimed at influencing the attributions of exercisers in order to reduce feelings of crowding as well as reduce barriers to gym use and adherence.

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## Chapter 1

### Introduction

Because a lack of physical activity has become a significant health issue in the United States and other nations, it is important to design innovative methods for increasing physical activity and reducing exercise barriers. The use of gyms to obtain exercise is a common practice among a large portion of Americans, although 45% of gym members no longer come to the gym by the one year mark (Saint Louis, 2011). Our recent systematic review of the relevant literature has noted evidence that perceived crowding in a gym should be expected to influence use of the facility as well as other important exercise outcomes. This review also included a proposed model explaining the expected effects of perceived crowding on gym users. The purpose of the current study was to test this model by experimentally manipulating exercisers' attributions of arousal under high-density conditions in order to demonstrate that when this arousal is attributed to physical activity, as opposed to crowding, feelings of crowding and their expected negative effects on arousal and exercise outcomes can be reduced.

Despite regular physical activity being implicated as one of the most health-promoting behaviors in which one can engage, physical activity rates have consistently been low among Americans. Specifically, the Centers for Disease Control and Prevention (2010) reported that approximately 52.2% of Americans in 2007 were not engaging in sufficient levels of physical activity in order to meet minimum standards, and that nearly 25% were not participating in any physical activity at all. Additionally, recent research has illuminated the many serious consequences associated with sedentary lifestyles, such as increased total cholesterol, decreased insulin sensitivity, and greater mortality (Hamburg et al., 2007; Lam, Ho, Hedley, Mak, & Leung, 2004).

When people do engage in physical activity, they often seek exercise through use of a gym. Specifically, recent reports suggest that approximately 47 million Americans possess a gym membership (Saint Louis, 2011). Unfortunately, this same report also indicates that nearly 45% of these individuals will quit going to the gym within a year. Although there are likely a variety of reasons for this level of attrition, at least a few common barriers to exercise have been associated with decreased exercise and gym use. Perceived lack of time, social embarrassment and intimidation, and perceiving exercise as difficult and adverse, can significantly affect even young and healthy exercisers in a negative manner (Dougall, Swanson, Grimm, Jenney & Frame, 2011; Grubbs, & Carter, 2002). Given the wide variety of membership demographics, architectural layouts and business philosophies among gyms in the United States, the differing environmental and social factors involved may heavily influence gym users' perceptions of many common exercise barriers. Despite other areas of research demonstrating the marked influence that social factors have on exercise outcomes in gym environments (e.g., the Köhler effect and social physique anxiety), many important social and environmental factors have gone largely unnoticed (Kerr, Forlenza, Irwin, & Feltz, 2013; Hart, Leary, & Rejeski, 1989).

Although little empirical research examining the effects of perceived crowding on gym use has yet to surface, research from retail settings may shed some light on what findings might be expected. Specifically, high-density scenarios encountered by shoppers in retail settings have been linked to decreased goal-attainment as well as to decreased satisfaction (Eroglu & Machleit, 1990). Similar studies have also demonstrated that high-density scenarios can cause shoppers to report fewer intentions to return to the applicable stores (repatronage; Machleit, Kellaris, & Eroglu, 1994). On the other hand, researchers have discovered increased satisfaction among crowded customers in

specific contexts, including big-box stores, an environment not unlike a gym (Eroglu, Machleit, & Barr, 2005). These findings suggest that crowding often serves as a deterrent, but can draw in and excite customers under certain conditions.

Although crowding among gym users has yet to be appropriately examined, high-density has been studied among exercisers in other settings, including residential and outdoor recreational and park locales. Within these environments, researchers have obtained mixed findings for residential density and physical activity, such that some studies have noted increased physical activity with increased residential density, whereas other studies have reported the opposite finding (McCormack, & Shiell, 2011).

Researchers suggest that a positive association between neighborhood density and physical activity may exist in many cities due to residents' tendencies to travel by foot and to the close proximity of many destinations. As for outdoor recreational settings, researchers have found evidence of positive associations between density and levels of park use, such that individuals perceive dense, urban parks as less crowded than dense, rural parks (Westover & Collins, 1987). However, high-density in a state park has also been shown to increase use of coping strategies (e.g., displacement, product, shift, rationalization) among visitors, suggesting that they are dealing with significant levels of stress (Manning & Valliere, 2001). The mixed nature of these findings seems to indicate that the individual characteristics of the situation are important, a notion that is also supported in the retail crowding literature (Hui & Bateson, 1991; Eroglu et al., 2005). These inconsistencies may also suggest that an unknown factor or process may be influencing individual perceptions within these situations. I suggest that this unknown process may be the attributions people make in an attempt to explain the cause of their arousal.

Although much research has been conducted on crowding in outdoor settings, reactions to crowding among indoor exercisers have received little research attention. However, one study was located that examined the impact of group size on group exercise classes within a fitness center (Carron, Brawley, & Widmeyer, 1990). This research found that attendance rates were higher and feelings of crowding were lower when class sizes were small and large versus moderate. This finding is of particular interest because the research conducted in retail settings also suggests that an inverted U-shaped relationship exists, and that shoppers generally prefer a moderate-sized crowd (Eroglu et al., 2005). More research is needed, however, to better understand these relationships within the specific environment of a gym.

To help fill the gaps in this field of research, I recently conducted a systematic review of relevant literature and proposed a conceptual model of perceived crowding among gym users (Figure 1-1). An important point discovered during this review was the key role played by perceived control within the crowding process. The perceived control approach asserts that the negative effects of crowding are attributable to a feeling of reduced control that may result from violations of personal space, undesirable interactions and/or interference experienced under high-density conditions (Baron & Rodin, 1978; Langer & Saegert, 1977). However, the exact role of perceived control within the crowding process is still not understood. Langer and Saegert (1977) and others (Bruins & Barber, 2000) found support for the effects of perceived control by successfully manipulating information control prior to encountering a crowd, whereas other researchers have gathered a great deal of evidence suggesting that perceived control is a mediator of the relationship between density and perceived crowding (Hui & Bateson, 1990; Hui & Bateson, 1991; Rodin, Solomon, & Metcalf, 1978; Rompay, Galetzka, Pruyne, & Garcia, 2008). Given these mixed findings, it is important to better understand the role

of this important construct within specific crowding scenarios. Therefore, in the current study participants' baseline perceptions of control were measured in addition to changes in perceived control from the beginning to end of the class. With these measures, the data allow the possible mediational role of perceived control to be empirically tested.

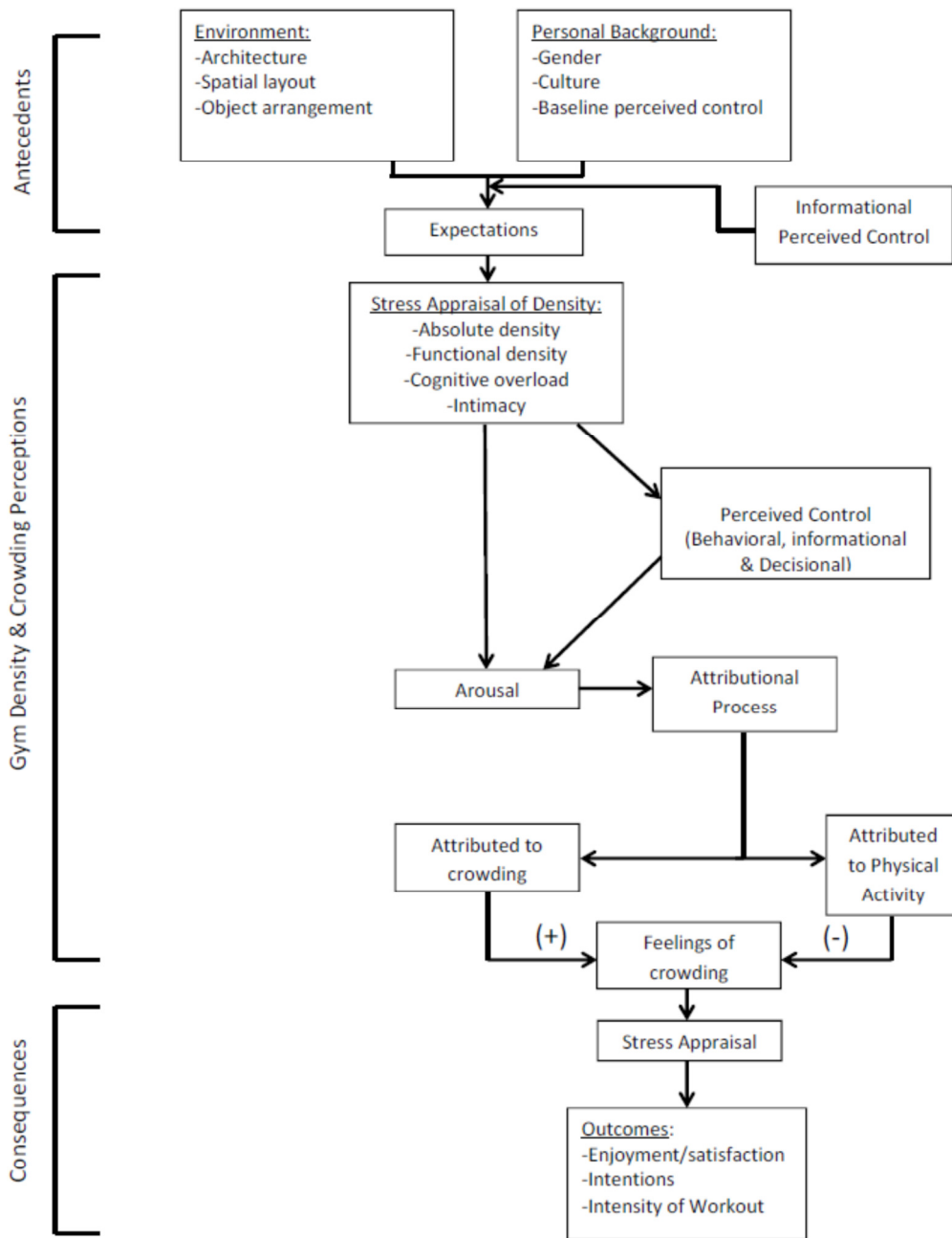


Figure 1-1 A working model for the effects of perceived crowding on gym users.

Another theory examined in my previous systematic review was the density-intensity theory (Freedman, 1975). Freedman argued that perceived crowding was not necessarily a bad phenomenon. Instead, he suggested that high levels of density simply intensify the behavior of an individual. This is said to occur because high-density makes other people and salient environmental features more important to the observer, which will result in the magnification of their reaction to them (Freedman, Birsky, & Cavoukian, 1980). This theory of density-intensity also predicted that crowding can be the cause of good behavior, but is very situation-specific. Although this theory was previously examined in my systematic review, it was not integrated into the proposed model of gym crowding (Figure 1-1) as little evidence supported its inclusion.

Another important component of the proposed model is that gym users make attributions to explain the feelings of arousal that occur due to crowding and/or exercise. This part of the model is based on Worchel and Teddlie's (1976) two-factor theory of crowding, which was modeled after Schachter and Singer's (1962) famous two-factor theory of emotion. Worchel and Teddlie's theory posits that an initial state of arousal takes place within an individual, and then a cognitive label (attribution) is applied to this arousal based on relevant environmental cues. If density is a salient cue, the arousal may be attributed to this factor, thus producing feelings of crowding. On the other hand, if exercise is a salient cue, then feelings of crowding may be reduced.

I found evidence supporting this theory in a systematic review of studies conducted in settings similar to that of a gym environment. However, the relevant articles measured the component of arousal in a variety of ways, including self-report, heart rate, blood pressure and observed behavior (Aiello, DeRisi, Epstein, & Karlin, 1977; Evans, 1979; Rousseau & Standing, 1995; Worchel & Teddlie, 1976). It seems likely that the relationships between crowding and arousal would likely be strengthened by employing



multiple measures of arousal. Researchers who have investigated the attribution process in past studies have shown pronounced group differences when attributions were manipulated. Specifically, Worchel and colleagues conducted a series of studies examining misattributions among crowded participants (Worchel & Teddlie, 1976; Worchel & Brown, 1984; Worchel & Yohai, 1979). The results of this line of research indicated that feelings of crowding could be significantly reduced if a distractor or another salient environmental cue was made available to participants. These effects were supported for a number of different activities, including watching arousing films and completing cognitive tasks.

Although research of this type has not specifically involved exercise-based arousal, studies conducted in the broader misattribution literature have examined exercise-based arousal. Specifically, White, Fishbein and Rutstein (1981) conducted a landmark study in which the researchers manipulated arousal through exercise in order to examine the attributional process in regards to feelings of attraction. They discovered that participants who became highly physiologically aroused through exercise found an attractive confederate more attractive than did participants in a low-arousal group, demonstrating that the arousal induced by exercise could be misattributed to feelings of attraction. Interestingly, the opposite results were found for an unattractive confederate. White and colleagues (1984) later built on this research by using the same research design while also manipulating the salience of the plausible cause for participants' level of attraction. They found that participants were particularly attracted to a female confederate when the cues related to meeting her were emphasized and the cues related to the exercise they performed were minimized. Collectively, these findings indicated participants' attributions could be guided by communicating salient and plausible explanations for changing levels of arousal. For example, by suggesting that a subliminal

noise was either arousing or relaxing, the participants' attributions could be manipulated to influence their feelings of crowding in a dense environment (Worchel & Yohai, 1979).

Although giving participants information to influence their attributions has been supported by past literature, it is possible that this action may also impact cognitive control. In the classic study conducted by Langer and Saegert (1977), participants were either given or not given information about the arousing effects (i.e., physiological and anxiety-related) of crowding to shape their expectations before they were sent into a crowded (or uncrowded) grocery store to complete a task. Ultimately, participants given information were seen to perform significantly better at the task, apparently overcoming the performance decrements caused by crowding. This effect was interpreted to mean that the information increased cognitive control by allowing the participants to shape their expectations and coping strategies using the information provided. Considering this evidence, it seems apparent that attribution manipulations given before crowding is encountered offer individuals both a plausible explanation for the cause of their arousal as well as information by which cognitive control might be increased. It can therefore be argued that these two constructs are linked within the crowding process and may complicate research employing these specific types of attribution manipulations.

Another relationship in the crowding literature that is not fully understood is the one linking expectations and attributions. Although there is not a full consensus about their conceptual definitions, it is likely that expectations and attributions have some degree of overlap and may even possess a reciprocal relationship. Specifically, it is possible that expectations help to shape attributions. As demonstrated in past research, making certain cues salient by altering expectations can change the attributions made by individuals (White & Kight, 1984). These findings suggest that expectations play a key role in attribution decisions. Moreover, past attributions may also shape future

expectations for similar scenarios. Although this relationship likely exists, it is difficult to measure it empirically, as attribution manipulations are largely measured indirectly. For example, exercise-induced arousal misattributed to attraction has been inferred from marked increases in self-report attraction scores (White et al., 1981) whereas attributions made following density-induced arousal were measured using observations of decreased crowding reports (Worchel & Teddlie, 1976). Within these studies, a logical jump was made when interpreting the changes in outcome measures (i.e., attraction, crowding). By comparing these scores to control groups given different attributions while employing strict measures to control other influential variables, these authors can safely conclude that differing attributions account for changes in cognitive and behavioral outcomes just as physicists infer the presence of black holes through their effects on nearby matter.

Considering the aforementioned points surrounding the conceptualization, measurement, and manipulation of attributions and their relationships with informational perceived control and expectations, there is much still to learn regarding the processes which involve these constructs. Although it may not be currently possible to properly separate attributions and expectations, the inherent cognitive control given during attribution manipulations should be controlled in research employing these methods. However, separating attributions and expectations is not necessary in order to conduct research with the potential to discover meaningful relationships within this area of study. Thus, the current study employed measures such as baseline assessments of crowding expectations and preferences in order to control for these factors within the analyses, but took no other action to attempt to separate expectations and attributions.

Although evidence exists to suggest that misattributions to density can reduce feelings of crowding and that exercise can be used to generate arousal in misattribution paradigms, little is known about the attribution process that takes place among crowded

exercisers. Moreover, the overall effects of density and perceived crowding have been largely ignored. To examine these relationships, I conducted an experiment to determine the relationship between the arousal of crowded exercisers in a gym environment and the attributions they made to explain it. As this is a novel area of study, the larger experiment was preceded by a smaller-scale pilot study. The purpose of this smaller study was to provide initial data to support the creation of a larger experiment designed to determine if engaging in a group exercise class in conditions of high-density (several people in a small room) would lead to decreased levels of enjoyment, future intentions for physical activity, and activity (as measured by accelerometer counts), while increasing perceptions of crowding and physiological arousal. The purpose of the pilot study was also to gather early evidence as to whether or not attributing one's arousal to physical activity, as opposed to perceived crowding, could ameliorate the negative effects associated with high-density and crowding. Given the number of mixed findings and points of contention on the conceptualization of the role of perceived control, as well as the definitions of expectations and attributions within the crowding process, the pilot and larger studies also took actions to address some of these issues. Although it was not an aim of this research to attempt to conceptually separate expectations and attributions, both studies did control for the cognitive control inherently provided by the attribution manipulation given at the beginning of the experimental session. As such, all participants within the study (regardless of experimental condition) were given a high degree of control over their level of exercise by receiving repeated instruction that they were to self-pace their activity while participating in the study. This provided all groups with a consistently high level of control, thus allowing for the researchers to parse out the effects of the attribution manipulation while controlling for the effects of the information also inherently given.

## Pilot Study

To provide initial evidence that the crowding and attribution manipulations designed for this novel experiment would work in a manner consistent with their design, a pilot study was conducted on a sample of 53 undergraduate participants from a large, Southwestern University. The design of this study included four different groups; a high-density group told that their level of arousal was due to crowding, a high-density group told that their level of arousal was due to physical activity, a high-density group that was not given an explanation for their arousal, and a low-density group that was also not given an explanation for their arousal. This experiment randomly assigned the participants into one of the four conditions. The participants took part in a 30-minute spinning class (group exercise cycling class), during which the researcher suggested different plausible explanations for participants' level of arousal in order to manipulate the attributions of the participants in the experimental groups. If the aims of this study could be met with evidence from this pilot study as well as with a larger-scale future study, it would be demonstrated that perceived crowding had distinct effects on exercise outcomes that may influence individual's use of the gym. Additionally, these results would indicate that an intervention designed around influencing attributions of arousal during exercise could aid in ameliorating the negative effects of gym crowding. This method might reduce potential exercise barriers caused by crowding and increase gym use and satisfaction, thereby, promoting greater engagement in physical activity.

To test the previously proposed model of perceived crowding among gym users, the hypotheses for the pilot study were centralized around testing the expected outcomes and the attributional process within this model. First, it was a primary aim of the study to find initial evidence that increased density in a group exercise class would result in increased feelings of crowding. As such, it was expected that participants in the high-

density with no attribution group would have increased feelings of crowding when compared to the low-density with no attribution group (Hypothesis 1). Examining this relationship would also serve as a manipulation check for the density and attribution manipulations employed in the study. Another aim of the current study was to link increased density to increased arousal (i.e., heart rate, self-report arousal and aroused mood) and to show that this arousal could be tempered by manipulating attributions. As such, it was expected that those in the high-density conditions would have higher arousal than those in low-density conditions. Moreover, it was expected that those in the high-density with crowding attribution group would have higher arousal than those in the high-density with physical activity attribution group, followed by the high-density with no attribution group (Hypothesis 2). An additional aim of this study was to find evidence that increased feelings of crowding could lead to negative effects, such as decreased activity (as measured by accelerometer), enjoyment and future intentions, and that attributing ones' arousal to physical activity instead of crowding would ameliorate these negative effects. Thus, it was expected that those in the high-density with crowding attribution group would report reduced enjoyment, future intentions and activity levels when compared to all other conditions. Additionally, those in the high-density with physical activity attribution group would report more enjoyment, intentions, and activity when compared to the high-density with no attribution group; while both of these groups were expected to have lower levels of enjoyment, intentions and activity than the low-density group (Hypothesis 3). Collectively, these hypotheses were expected to provide initial evidence for the expected relationships that perceived crowding may have on key exercise outcomes in a group exercise, gym environment. Additionally, these findings were also expected to show whether or not attributing arousal to physical activity, as

opposed to crowding, would ameliorate the negative effects of crowding on exercise outcomes.

## Methods

A sample of 53 participants was recruited. Eligibility criteria for participation required individuals to (1) be enrolled in the Psychology participant pool or in at least one of two professor-approved Kinesiology courses in which extra credit was given for research participation, (2) be at least 18 years of age (or signed parental consent if under 18), (3) be able to read, write and speak the English language, (4) meet minimum health requirements to perform physical activity, and (5) not regularly engage in cycling as part of a spin class, through the use of an exercise bike, or through the use of an actual bicycle. Participants who wished to enroll in the study first met minimum criteria set in place by a prescreen questionnaire. The relevant questions determined if individuals met minimum health requirements to perform physical activity as assessed by the physical activity readiness questionnaire (PAR-Q). These health requirements were mostly related to risk of cardiac event and inquired about symptoms such as angina, shortness of breath at rest, fainting, blood pressure, past exercise, physician recommendations, smoking status, and diabetes. Additionally, four items assessed the participant's experience with cycling in order to ensure that participants were not regular or competitive cyclists by profession or in their leisure time.

Demographic characteristics of the participants were similar to that of a previous study of physical activity that was also conducted by our research group and recruited from the same participant pools (Jenney, Wilson, Swanson, Perrotti, & Dougall, 2013). This sample had a mean age of  $20.66 \pm 3.0$  years and consisted of 35 (66%) females and 18 (34%) males. For ethnicity, a representation of 13 (24.5%) Hispanic and 40

(75.5%) non-Hispanic was seen while racial group representation was comprised of 27 (52.9%) White, 10 (19.6%) Black, 6 (11.8%) Asian, and 8 (15.7%) other.

This study was placed on the SONA system for Psychology students and presented in-person and via Blackboard to Kinesiology students in order to allow interested students the opportunity to hear about the study and to obtain the link to the prescreen questionnaire. After completing the prescreen survey, qualified participants were invited to attend a one-hour orientation session, after which the group exercise class session was held on the following week. Psychology participants received three and one half credits towards their required hours if they completed all phases of the study. However, partial credit was given to those who only completed the prescreen survey or who only attended the orientation session. Participants received .5 credits for completing the prescreen questionnaire, 1 credit for attending the orientation session (which included the baseline assessment) and 2 credits for attending the one required exercise session. Kinesiology participants received extra credit as assigned by the professor of their class for completion of all phases of the study. Partial completion was communicated to the professor of each course, who then assigned an appropriate number of points for the respective amount of the study completed by the participant.

Participants were protected through several avenues. Sources of identifiable data including informed consent forms and electronic spreadsheets were kept in a locked cabinet, behind a locked door, and/or protected with encryption and password. Only those individuals approved by the IRB to assist in research efforts were given access to the locked files. Coercion of participants was avoided by allowing students to have a free choice of which research studies to participate within the participant pool, giving information about the study up front, providing an option to read research articles and write summary essays instead of study participation, and allowing participants to



withdraw at any time from any study that was begun in good faith. Because exercise was required in this study, all participants who engaged in physical activity for the purposes of this study were monitored during sessions by a researcher who was certified in personal training, CPR/AED, emergency oxygen administration, and first aid.

### *Design*

The design for this pilot study consisted of an experimental design employing four distinct groups to assess changes in the dependent variables of perceived crowding, accelerometer counts, heart rate (physiological arousal), enjoyment, self-report arousal, future intentions for physical activity, and mood. These groups included a group that exercised under high-density conditions and was told that the crowded room they were in can cause them to feel worked-up and to have an increased heart rate, a group that exercised under high-density conditions and was told that the physical activity they were about to perform can cause them to feel worked-up and to have an increased heart rate, a group that exercised under high-density conditions and was not given any explanation (attribution), and a group that exercised under low-density conditions and was not given any explanation. The independent variable of attributions was manipulated by statements made to the exercise class as part of a group of instructions, which were given just prior to the cycling part of the class. Additionally, density was operationally defined as participants undergoing a group-exercise cycling class in a group of six individuals in a room that measured 25', 7" x 37', 7" (low-density), or using a similar group size within the same room that was reduced to 8', 9" x 22', 9" (high-density) through the use of partitions. Group size was held constant for both conditions in order to produce an environment that provides 137.15 square feet per person (low-density condition) or 28.3 square feet per person (high-density condition). Although past studies have allowed for lower square footage when operationalizing high-density conditions (2.67 sq. ft./person &

9.6 sq. ft./person; Epstein & Karlin, 1975; Evans, 1979), the proposed study must allow for more room as the high-density room must also contain 7 exercise bikes as well as other study equipment that will take up substantial room. Additionally, the investigator's previous review of the literature revealed that a key factor in the generation of arousal due to high-density was intimacy (close proximity to others). As such, the design of the current study ensured that participants in the high-density conditions were close in proximity to other exercisers.

### *Procedures*

Participants for the study were recruited from the Psychology Human Subjects Participant Pool or from two professor-approved Kinesiology classes by screening participants who completed the prescreen assessment. This prescreen survey was administered online and was provided as a hyperlink to interested students through the SONA system for Psychology students and through Blackboard or email request for Kinesiology students. Prescreening questions were used to ensure a sample that met minimum health guidelines for engaging in physical activity (particularly screening for risk of cardiac event) and did not take part in cycling on a regular basis. For the purposes of this study, "regular cycling" was defined as those individuals who ride a bicycle for travel or in their leisure time on a regular basis, or those who regularly engage in spinning classes or other activities that use upright exercise bikes or cycle ergometers. For this determination, "regular" use was considered three or more days per week, as based on ACSM exercise standards (Garber et al., 2011). The health screening asked participants about their blood pressure, smoking status, family histories of medical issues, orthopedic problems, and a variety of questions regarding cardiac health. Participants were considered eligible if they were not regular cyclists (i.e., they cycled less than three days per week) and reported no serious health risks, including risk of cardiac event, orthopedic

problems, metabolic disease, hypertension, or any reasons the participant's physician had for not recommending they take part in exercise.

Students who met pre-screen criteria (69/89) were invited to take part in the second part of the study, whereas those who did not qualify were given credit (either SONA credit or extra credit) for having completed the pre-screen survey and were then released from the study. Participants who met the criteria were contacted by a researcher and were scheduled to attend the study orientation as well as the subsequent exercise session. Participants then attended the orientation session during which they learned about the study, were allowed to ask questions, signed a hard copy of the informed consent and completed the first assessment. This orientation took place in a computer lab at the on-campus fitness center, consisted of no more than six individuals, and lasted approximately one hour. Directly after signing the informed consent, participants were given 30 minutes to take the first assessment which included taking physical measurements of the participants' resting heart rate as well as waist and hip circumference. After completion of the first assessment, researchers confirmed the schedule and location of the remaining exercise session with the group, which took place on the same day of the week and time as the orientation session during the following week. Random assignment of the groups of participants into their respective conditions occurred after orientation was completed. A researcher who was on the protocol, but who was not running any orientations, handled all randomization procedures. This researcher randomly assigned all potential groups into their conditions before the study began and then placed the condition assignments of the groups in separate, sealed envelopes. After an orientation session was completed, this researcher gave the envelope for that particular session to the researcher who conducted it in order to reveal the condition in which that group had been randomized. All participants within a particular session time

were randomly assigned (as a group) into one of four conditions: 1) high-density with crowding attribution, 2) high-density with physical activity attribution, 3) high-density with no attribution, and 4) low-density with no attribution. Participants remained in these groups for the rest of the study.

During orientation, participants were also provided with a safety guidelines checklist (See the Appendix). This document detailed the appropriate guidelines to follow before and during the exercise sessions in order to ensure the participants' safety. These guidelines were adapted from recommendations disseminated by the Department of Health and Human Services and covered topics such as appropriate attire and how to gauge the correct exercise intensity (USDHHS, 2008). The exercise sessions were also held in the on-campus fitness center, but took place in a different room that was specially selected for the study's purpose. This room contained no windows, mirrors, hanging pictures, or any other type of significant distractors, but instead contained only seven upright, mechanical exercise bikes and other necessary study equipment (e.g., partitions, accelerometers, survey documents, etc.). In the low-density condition sessions, the room was used in its natural form and involved arranging the exercise bikes with ample room between individual bikes or any wall (4' or more from any object). However, the same partitions used in the high-density condition were also present in this room during the low-density condition but were pushed against the wall as to not reduce the size of the room. In the high-density conditions, partitions were placed in the room in order to reduce its size by approximately three-fourths. Each individual exercise bike was placed approximately 1.5' from other bikes and/or side walls. As previously indicated, three groups engaged in the exercise class under high-density conditions, whereas one engaged in the class under low-density conditions.

In addition to their arrangement, the exercise bikes were also individually numbered to track the seating positions of each participant and were arranged in a rectangular pattern, such that the bikes were placed in three total rows of two bikes per row. The seventh bike faced the group and was to be ridden by the instructor during exercise sessions. Upon their arrival to each session, the participants were asked to fill out a short, pre-exercise survey assessing mood, and were then fit with an accelerometer and heart rate monitor. Once these devices had been fitted, participants were allowed to select a bike and stand next to it. In the event that an inadequate number of participants showed up in order to fill all six bikes, a confederate previously scheduled to standby took the missing participant's place. After all participants and/or confederates were situated on their bikes, the 30-minute spinning class began by the instructor introducing himself and describing what to expect from the class; including that it was to last approximately 30 minutes, and that it did not require a particular intensity of exercise. Following these instructions, the participants were asked to adjust the seat of their exercise bike to accommodate their height. Next, the researcher made a statement regarding the group's assigned attribution manipulation, if one was necessary. Specifically, the instructor mentioned to participants in the crowding explanation condition that "One last thing, as you know, we are really crowded in here today. Being crowded may cause your heart to beat faster and for you to feel worked up". Conversely, participants in the physical activity explanation condition were told "One last thing, as you know, we are going to perform some exercise today. Cycling may cause your heart to beat faster and for you to feel worked-up". Participants randomized into the groups that did not receive any information at this point simply continued on with beginning the class. Next, the researcher ensured that everyone was ready to begin and then to started the session.

The classes began by allocating the first five minutes of each session to a gradual warm-up period in order to safely adjust the body's temperature and cardiovascular activity of the participants to exercise levels. For the purpose of mundane realism, the researcher instructed the class with a microphone/PA system, played upbeat (but non-popular) music in the background, and instructed the class in a manner consistent with real-world spin classes. Classes were led by an experienced personal trainer, were designed to encompass moderate intensity physical activity and included two seated break periods. These breaks involved 2-3 minute periods of very light pedaling. At the end of the cycling session, the class was concluded with a 5-minute cool-down period (similar to the warm up). Following this period, participants were asked to stay seated on their exercise bikes and complete a short post-exercise survey assessing mood, perceived crowding, perceived control, and enjoyment. After completion of this survey, participants returned their accelerometers and heart rate monitors. They were then dismissed, given that they were not displaying any serious warning signs of fainting, illness, or over-exertion. Subsequently, accelerometer data were uploaded and stored after each session.

### *Measurements*

The pilot study aimed to incorporate participant-report surveys alongside physical measures, such as heart rate and activity levels as measured by an accelerometer. The first, long assessment was administered during orientation and measured demographic and background data, general health, previous experience with cycling, participation in physical activity, expectations and preferences for crowding, baseline levels of perceived control, future intention for physical activity, self-efficacy for exercise, personality traits, and the physical measures of resting heart rate and hip and waist circumference. Short surveys administered immediately before the exercise sessions measured mood,

whereas short surveys administered immediately after these sessions measured mood, perceived crowding, self-report arousal, future intention, perceived control and enjoyment, specifically pertaining to the class in which they had just taken part. Heart rate and activity, as measured by accelerometry, were also taken during the 30-minute spin classes in order to gauge physiological arousal, activity levels, and intensity of exercise. In addition to these measures, researchers also recorded the seating position of each individual during each exercise class.

#### Demographics

The demographic survey asked participants for information about their age, gender, ethnicity/race, marital status, student status, income level, and employment status. Participants responded to the demographic questions by selecting categories or filling in open-ended spaces.

#### Previous Activity Experience

The scale assessing previous cycling participation contained items which required the participants to rate their experience with cycling in general using a Likert scale of 1 to 10, where 1 is no experience and 10 is a large amount of experience. This question was followed by several more specific questions that asked for experience ratings with spin classes, cycling for transportation, and cycling for exercise. These questions were then followed by a set of items that measured fitness center use (including on-campus and off-campus fitness centers). In these items, participants selected whether or not (yes/no) they used a fitness center, and, for those who did, asked about their frequency of use (Jenney, et al., 2013). Physical activity was measured using the Godin Leisure-Time Physical Activity Questionnaire (Godin & Shephard, 1997). This scale allowed participants to rate how often they engaged in leisure time physical activities by answering open-ended questions concerning how many days per week they engaged in

vigorous, moderate, or light physical activity. Participants also reported how often they engaged in vigorous activities in a usual week by selecting a categorical option (0=never/rarely, 1=sometimes, 2=often; Cronbach's alpha = .60). These measures were used to assess the validity of the background items used in the prescreen survey.

#### Enjoyment of Spinning

Enjoyment, specific to the spinning class, was measured using the Sport Enjoyment sub-scale within the Sport Commitment Model (Scanlan, Carpenter, Schmidt, Simons, & Keeler, 1993). Past studies have successfully modified this scale to reflect a different specific activity (Casper & Stellino, 2008; Jenney et al., 2013). For the present study, the specific activity in question was modified for spinning class (Cronbach's alpha = .92). This survey was scored by summing the four items assessing participants' enjoyment of the class, which were measured on a Likert scale that ranged from 1 (Not at all) to 5 (Very much).

#### Future Intention for Physical Activity

Future intention to perform physical activity was measured by having participants rate the likelihood in which they would engage in physical activities using a Likert scale that ranged from 1 to 10 (1= will not do at all, 10=highly certain will do; Cronbach's alpha = .79). This seven-item scale was modified for future intention from the Godin Leisure-Time Questionnaire (Godin & Shepard, 1997). This scale also included items that specifically gauged participants' intentions to engage in spinning classes, cycling and MAC use.

#### Perceived Crowding

Perceptions of crowding were assessed using a slightly modified version of Machleit, Kellaris and Eroglu's (1994) survey for measuring perceived crowding in retail settings. This instrument was selected because a retail setting is the closest proxy to that



of a gym in the current crowding literature. This scale was also selected because it has been shown to differentially predict the effects of crowding attributable to separate spatial and social components through its two subscales (Machleit et al., 1994). These items asked participants their level of agreement with a list of statements on a Likert scale that ranged from 1 to 7 (1 = strongly disagree, 5 = strongly agree).

#### Self-report Arousal

Self-report arousal was measured by asking participants seven items that were rated on a scale of 1 to 6, where each end of the scale represented a specific descriptive term (Cronbach's alpha = .67). Specifically, these items read: aroused-not aroused, calm-agitated, at ease-worked up, peaceful-stressed, heart pounding-heart at rest, feel exerted-don't feel exerted, and perspiring-not perspiring, where the latter four items assessed self-report physiological arousal distinctly. This scale has been adapted from White and colleagues (1981).

#### Perceived Control

Participants' feelings of control over their participation in a group exercise class were measured at baseline and after each exercise session with a single item asking participants their level of agreement with a statement which read "One doesn't have very much control over what happens in a group exercise class." This item was adapted from when it was used by Fleming, Baum and Weiss (1987) and was rated on a Likert scale from 1 to 5 (1 = strongly disagree, 5 = strongly agree).

#### Mood

The profile of mood states short form 37 (POMS-SF 37, Shacham, 1983) assessed participants' mood at the moment they were completing it. This survey asked participants to indicate the degree to which a list of 37 words, such as "tense", "discouraged" and "lively," described how they felt at that exact time. Subscales for this

instrument included tension-anxiety, depression-dejection, anger-hostility, fatigue-inertia, vigor-activity, and confusion-bewilderment. For the purposes of this pilot study, the tension-anxiety (Cronbach's alpha: Before cycling = .73, After cycling = .49) and vigor-activity (Cronbach's alpha: Before cycling = .83, After cycling = .74) subscales were of interest. Participants indicated their agreement with each word listed by selecting a number on a Likert scale from 0 – 4 (0 = not at all; 4 = extremely). This survey was administered before and after the exercise sessions in order to test for any changes in mood due to engagement in activity and/or manipulations of attributions of arousal.

#### Physical Measures

During orientation sessions, participants' waist and hip circumference measures were taken by an experienced researcher using a standard measuring tape. These measurements were taken at the smallest part of the waist and the largest part of the hips for both males and females. Resting heart rate was taken at orientation by placing a stethoscope over the heart and was measured in beats per minute. This method was used to measure resting heart rate at orientation as opposed to a polar heart monitor for reasons of feasibility, as the polar monitors require several minutes to pick up a subject's heart rate and are more obtrusive to the participants than using a stethoscope.

Past research has found that levels of activity during cycling activities can be effectively measured using an accelerometer (Parkka et al., 2007). This instrument measured activity through changes in acceleration due to movement. The device could be worn on the wrist, the arm, the ankle or on the waistband and was similar in size to a large wrist-watch or pager. Due to its small size, light weight, and unobtrusive nature, it has been frequently used while measuring movement during physical activity, and can provide a feasible and accurate way to compare activity levels between groups during cycling. For the present research, this device was worn on the ankle, as it has been

found to measure outcomes more accurately in this position during cycling activities (Parkka et al., 2007). Additionally, another accelerometer was worn on the arm to wirelessly record heart rate as measured by a Polar heart rate monitor strap. The data from these units were produced in a minute-by-minute format and were uploaded to a research computer following each exercise session.

## Results

Analyses conducted for the purposes of this research were done using the SPSS statistical package, version 19. All data were examined to ensure satisfaction of the assumptions of the proposed analyses, used .05 as a criterion for significance with Bonferroni post-hoc corrections as appropriate, and were run as intent to treat. Seven participants were excluded from analyses due to concerns of participant bias, as these individuals were enrolled in the primary researcher's class. Thus, a final sample size of 46 individuals was used for analyses. Additionally, intergroup comparisons were conducted using chi-squares and t-test statistics to ensure that randomization procedures did not unintentionally result in baseline group differences. These analyses showed no significant group differences. In order to check for signs of dependency among individual classes within each respective experimental condition, intraclass correlations (ICC) were also calculated. Although most coefficient values fell below the suggested threshold of 0.05 (Heck, Thomas, & Tabata, 2014), some were above; suggesting that some effects of group dependency may have occurred within these data. Although no dependency appears to have taken place for the outcomes of perceived crowding, average heart rate or enjoyment, certain group coefficient values surpassed the threshold for the outcomes of peak heart rate, activity and future intentions (See Table 1-1 for ICC coefficient values).

Table 1-1 Intraclass Correlation Coefficients for Major Pilot Study Outcomes

Outcome	Rho ( $\rho$ )
<b>Perceived Crowding</b>	
Low-density, NA	0.00
High-density, NA	0.04
High-density, CA	0.00
High-density, PA	0.00
<b>Average Heart Rate</b>	
Low-density, NA	0.00
High-density, NA	0.04
High-density, CA	0.00
High-density, PA	0.00
<b>Peak Heart Rate</b>	
Low-density, NA	0.00
High-density, NA	0.38
High-density, CA	0.00
High-density, PA	0.00
<b>Activity</b>	
Low-density, NA	0.37
High-density, NA	0.00
High-density, CA	0.39
High-density, PA	0.43
<b>Future Intentions</b>	
Low-density, NA	0.18
High-density, NA	0.51
High-density, CA	0.01
High-density, PA	0.30
<b>Enjoyment</b>	
Low-density, NA	0.00
High-density, NA	0.00

Table 1-1—*Continued*

High-density, CA	0.00
High-density, PA	0.02

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Note. NA = no explanation given, CA = crowding explanation given, PA = physical activity explanation given

However, these values may not accurately represent the values that were expected from a larger study, as each condition within the pilot study only contained three individual classes. Thus, differences between groups were weighted more heavily on the ICC calculations because so few classes were included in the analysis. Moreover, values obtained for the outcome of activity (accelerometer counts) indicated that dependency was seen for all experimental conditions except for the high-density with crowding attribution group. According to past literature, some degree of group dependency should be expected for this outcome as the literature on social facilitation and crowding suggested that individuals may significantly increase their effort when performing within a group in which they are individually accountable (Epstein & Karlin, 1975). Considering the ICC analysis for activity within these pilot data, it was possible that the effects of social facilitation were overridden when a crowding attribution was made. However, it was concluded that a larger sample was needed to confirm this result.

Hypothesis 1, stating that those in the high-density with no attribution group would have increased feelings of crowding when compared to the low-density with no attribution group, was tested with a univariate analysis of variance (ANOVA) in order to test for experimental group differences. The results of this test showed a significant main effect of experimental group,  $F(3, 42) = 10.24, p < .000, \eta_p^2 = .42$ . Subsequent post-hoc comparisons revealed that the low-density group perceived significantly less crowding than all other conditions (See Table 1-2). Overall, this result provides support for the

expected group differences in perceptions of crowding as put forth by Hypothesis 1 and provided evidence that the manipulation worked as intended.

Table 1-2 Experimental Group Means and Standard Errors for Key Pilot Study Variables (N = 46)

Variable	Low-density, NA			High-density, NA			High-density, CA			High-density, PA		
	<i>n</i>	<i>M</i>	( <i>SE</i> )	<i>n</i>	<i>M</i>	( <i>SE</i> )	<i>n</i>	<i>M</i>	( <i>SE</i> )	<i>n</i>	<i>M</i>	( <i>SE</i> )
Perceived Crowding												
Spatial	9	9.00	1.49	14	16.29	1.19	11	19.64	1.35	12	16.08	1.29
Social	9	5.0	1.22	14	8.43	0.98	11	12.46	1.10	12	9.00	1.06
Total	9	14.00	2.43	14	24.71	1.95	11	32.09	2.20	12	25.08	2.10
Arousal												
Peak HR	9	145.00	7.83	14	154.64	6.28	11	168.36	7.08	12	162.92	6.78
Avg. HR	9	123.11	5.96	14	130.49	4.78	11	136.85	5.39	12	132.31	5.16
Psyc	9	19.67	1.75	14	21.79	1.40	11	22.36	1.58	12	22.92	1.52
Activity	9	23821.65	1274.63	14	24324.08	1021.98	11	22022.33	1152.94	12	24064.32	1103.86
Intentions	9	43.00	4.01	14	50.86	3.21	11	43.91	3.63	12	49.17	3.48
Enjoyment	9	17.33	0.99	14	16.00	0.79	11	15.82	0.89	12	16.42	0.85

Note: NA = no explanation given, CA = crowding explanation given, PA = physical activity explanation given, avg. = average,

HR = heart rate, psyc = psychological (arousal), intentions = future intentions to engage in physical activity.

Additional ANOVA tests were conducted to test Hypothesis 2, which stated that participants in the high-density conditions would have higher arousal than those in low-density conditions and that those in the high-density with crowding attribution group would have higher arousal than those in the high-density with physical activity attribution group, followed by the high-density with no attribution group. These ANOVAs tested for group differences in physiological arousal (peak and average heart rate), self-report (psychological) arousal and aroused mood. Tests for peak heart rate, average heart rate and self-report arousal did not reach significance,  $F(3, 42) = 1.90, p = .144, \eta_p^2 = .12$  and  $F(3, 42) = 1.00, p = .401, \eta_p^2 = .07, F(3, 42) = 0.72, p = .547, \eta_p^2 = .05$ , respectively. Furthermore, changes in aroused mood from the beginning of the exercise session to the end were analyzed using a mixed (2 time x 4 group) multivariate ANOVA test. Specifically, the vigor-activity and tension-anxiety subscales of the POMS were analyzed. This analysis revealed only a main effect of time, Wilk's Lambda  $F(2, 41) = 13.57, p < .000, \eta_p^2 = .40$ . Upon inspection of post hoc comparisons following this result, it was discovered that all participants decreased in tension-anxiety from the beginning ( $M = 4.46, SE = 0.68$ ) to the end ( $M = 2.25, SE = 0.36$ ) of the exercise class, regardless of group. Although significance was not reached for these analyses, the means and effects sizes for these outcomes were in the expected direction (See Table 2 for physiological and psychological arousal means) and suggest that a larger study would find support for Hypothesis 2.

To test for the specific attribution group differences stated in Hypothesis 3, additional ANOVA tests were conducted to investigate experimental group differences in activity (as measured by accelerometer counts), enjoyment and intentions. However, the results for these tests were not significant,  $F(3, 42) = 0.86, p = .469, \eta_p^2 = .06, F(3, 42) = 0.52, p = .672, \eta_p^2 = .04$ , and  $F(3, 42) = 1.18, p = .330, \eta_p^2 = .08$ , respectively. Although



significant differences were not found, the means and effect sizes of the outcomes in these analyses were also in the expected direction (See Table 2 for mean values) and helped to justify conducting a larger study to further investigate these relationships.

Additionally, experimental group differences in perceived control after taking part in the group exercise class were examined using an ANOVA. However, no significant differences were discovered among the groups,  $F(3, 49) = 1.12$ ,  $p = .350$ ,  $\eta_p^2 = .06$ .

### Discussion

The primary aims of this pilot research were to provide initial evidence that the current study's methods for manipulating density would bring about increased feelings of crowding in high-density situations as compared to low-density situations. We also sought evidence to support the use of different attributions that might influence one's perception of crowding and its effects on exercise outcomes in these situations. These pilot data provided clear support that the density manipulation worked as planned, as significant differences were seen between low and high-density groups for social, spatial, and total crowding reports. Although few significant differences were discovered among the different high-density attribution groups, the means and effect sizes observed among these groups provided support for the study's design (See Table 2).

For the outcomes of total and social crowding, peak heart rate and average heart rate, a pattern emerged such that the high-density crowding explanation group reported the highest values, followed by the high-density physical activity explanation group, high-density no explanation group, and, finally, the low-density no explanation group. This pattern followed expectations closely, as our recent systematic review suggested that crowding in a gym environment should be expected to be a significant stressor, especially among those attributing their arousal to crowding directly. Although this exact pattern was not seen among other outcome variables, it was observed that for measures

of intentions for future activity and enjoyment the high-density crowding explanation group reported the lowest values of all groups, suggesting that being crowded in an exercise context with a matching explanation may hinder repatronage intentions and satisfaction.

Translation of the pilot study design into a larger study was also strongly supported by the observed effect sizes collected from these data. A medium to large effect size was obtained for the majority of key outcomes analyzed. These robust effects suggested that, despite the pilot study being underpowered, the relationships have a large enough effect that one should expect to find significance for these outcomes given a full-powered study. Overall, these data provided clear initial evidence that the study's density manipulation worked as designed and that differences among attribution groups should be expected; thus providing sufficient evidence to warrant a larger study.

## Chapter 2 The Current Study

The current study implemented a larger-scale version of the pilot study design while including slight modifications in order to better understand the relationships and improve measurement of outcomes. These modifications included adding two more conditions in order to have a full factorial experimental design, with the inclusion of a low-density with crowding attribution group and a low-density with physical activity attribution group. Additionally, scales assessing personality traits, dispositional motivation, crowding expectations and preferences, as well as questions regarding participant bother due to smell and temperature, additional perceived control questions, and physical measurements of room temperature were added. These constructs were examined in order to understand and identify potential mediators or moderators within the proposed model (See Figure 1-1). Measurements covering temperature and smell were added because of the frequency of comments made by participants and research staff regarding

the bad smell and rising temperatures, which increased as time elapsed within the high-density classes. Specifically, it was frequently heard that these factors made exercisers feel “on edge.” Although these issues may be expected in an exercise class, they may also be magnified by the addition of high-density. The increase in temperature and presence of foul odors due to human crowding may also be associated with other high-density contexts and may make the arousal associated with the crowding manipulation that much more noticeable. Furthermore, including measures of personality, motivation, and preferences/expectations for crowding expanded the study by allowing measurement of factors that could be potential moderators and/or covariates to be included in important analyses. Overall, these additional measures were included in order to determine if these outcomes might be influential moderating factors or possible mechanisms through which crowding is experienced.

With the current study, we sought to empirically test components of the proposed working model of the effects of perceived crowding on gym users. Specifically, the pathways that were tested within this model can be seen in Figure 2-1. These included a pathway indicating arousal as a mediator of the relationship between experimental group density and exercises outcomes, as well as a pathway suggesting that attributions can influence the experience of arousal after being placed in a low or high-density scenario. Additionally, I tested how the combination of density, attribution, and arousal might lead to changes in perceptions of crowding. Thus, the hypotheses for this study served to test the validity of the proposed model of perceived crowding on gym use and exercise as well as to test the application of the theories from which the model was created.

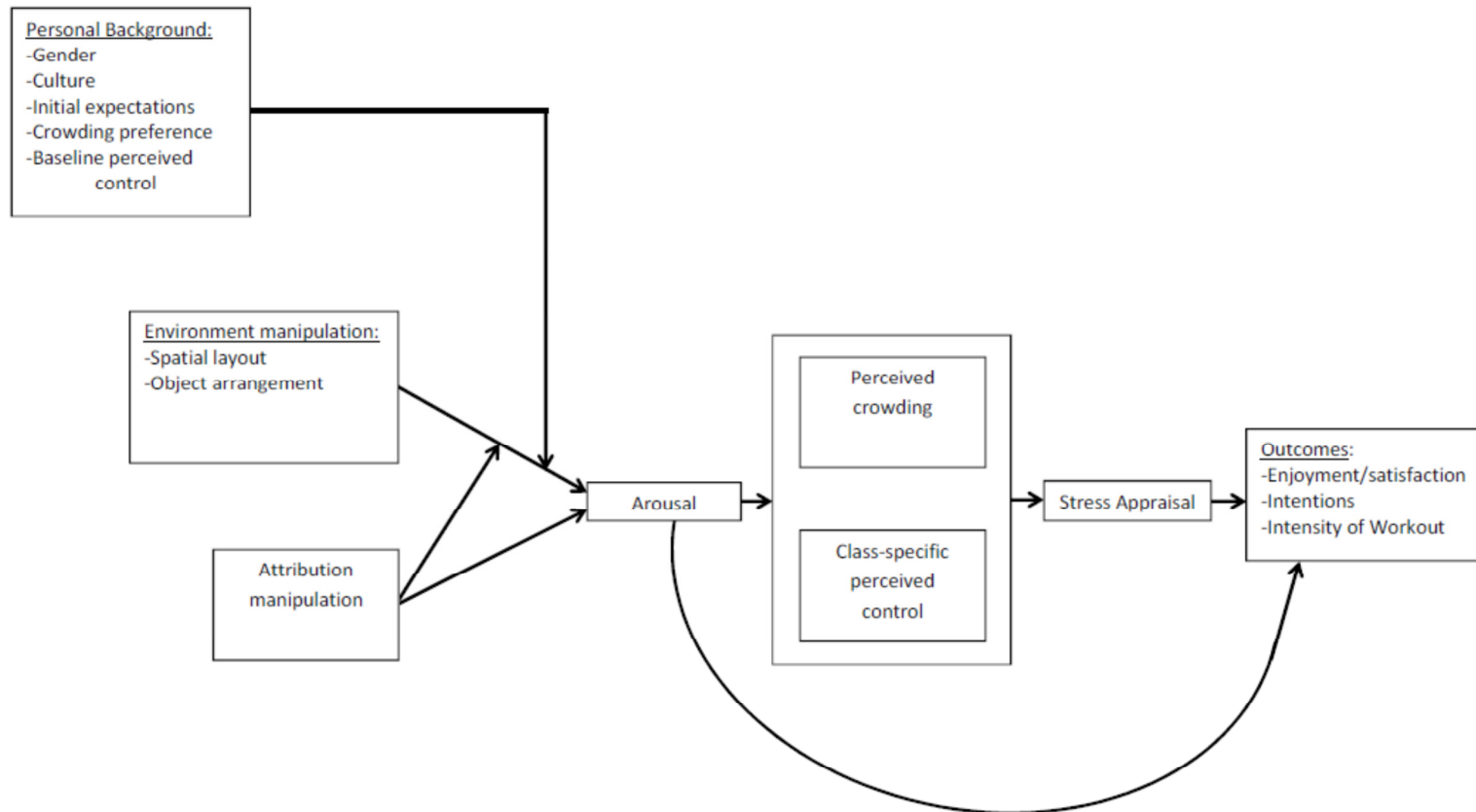


Figure 2-1 The specific components of the proposed model of gym crowding to be tested in the research.

## Hypotheses

### *Primary Hypotheses*

Based on pilot data and previous literature, I predicted similar results as those seen in the pilot study results, with some additional expectations relating to the new experimental conditions. I also included additional analyses to better understand the mediators and moderators of the perceived crowding process. Hypotheses 1 – 3, the primary hypotheses for this study, addressed the effects of density and attribution manipulations on perceptions of crowding, arousal, and exercise outcomes, and were similar to those stated in the aforementioned pilot study. Because the design became a full factorial, the hypotheses included expected interaction effects of density by attribution. Specifically, the main effect of density (Hypothesis 1) was expected to be moderated by the attribution manipulations (Hypotheses 2 and 3).

Regarding Hypothesis 2, although arousal was expected to be higher in the high-density conditions than in the low-density conditions, arousal within the density conditions was expected to vary based on the attribution condition. In general, the crowding attribution groups were predicted to have higher arousal than the physical activity attribution groups which were predicted to both have higher arousal than the no attribution groups. However, these differences were expected to be larger in the high-density condition.

Regarding Hypothesis 3, it was expected that those in the high-density condition would report reduced enjoyment, future intention and activity levels when compared to the low-density condition. For this hypothesis, the crowding attribution groups were expected to report lower values, followed by the physical activity attribution groups, then the no attribution groups. These values were also expected to show greater differences within the high-density conditions (Hypothesis 3a). Little was known about the effects of

crowding on activity levels in a group exercise class. Based on evidence put forth by earlier crowding-performance literature showing decrements in task performance under high-density, it was possible that activity may have been reduced when exercising under high-density (Paulus et al., 1976). However, others have found no performance decrements in similar situations (Freedman et al., 1971; Rousseau & Standing, 1995). Another relevant crowding theory is density-intensity theory (Freedman, 1975). Freedman argued that perceived crowding does not necessarily imply negative outcomes. Instead, he suggested that high levels of density simply intensify the behavior or affect of an individual. This is said to occur because high-density makes other people and salient environmental features more important to the observer, which will result in the magnification of their reaction to them (Freedman, Birsky, & Cavoukian, 1980). This theory of density-intensity also predicted that crowding can be the cause of good behavior, but it is very situation-specific. Furthermore, findings within the area of crowding and social facilitation have shown that participating in a high-density, simple group task raised individual performance (Epstein & Karlin, 1975). Thus, an alternate hypothesis was also proposed which stated that activity levels would be greater in the high-density conditions than in the low-density conditions. For this prediction, the order of the attribution group would be opposite to that described in the previous hypothesis such that the crowding attribution groups would display the highest values and the no attribution groups would report the lowest values (Hypothesis 3b).

In addition to these hypotheses, other secondary hypotheses were proposed to test key mediational pathways within the proposed model of crowding as well as to explore individual factors as antecedents of crowding that might serve as moderators.

### *Pathways in the Crowding Process*

Within the proposed model of gym crowding (Figure 1-1), several specific pathways were suggested to connect the experience of density to one's perceptions of crowding and the resulting consequences on exercise outcomes. As seen in Figure 2-1, the proposed model asserted that arousal is experienced after the experience of density, but before exercise outcomes, such as intentions, enjoyment and, activity intensity. Thus, it was predicted that arousal would mediate the relationship between experimental group density and attribution, and exercise outcomes (Hypothesis 4).

As discussed previously, many crowding scholars have different views regarding the precise role of perceived control within the perceived crowding process. Specifically, previous research influenced perceptions of crowding by manipulating levels of control through information given before a crowded situation was experienced (Bruins & Barber, 2000; Langer & Saegert, 1977; Paulus & Matthews, 1980). However, strong evidence also exists which suggests that perceived control serves as a mediator of the density-perceived crowding relationship (Hui & Bateson, 1990; Hui & Bateson, 1991; Rodin, Solomon, & Metcalf, 1978; Rompay, Galetzka, Pruyn, & Garcia, 2008). In order to address both possibilities, it was hypothesized that perceived control would not mediate the relationship between arousal and the exercise outcomes of activity, future intentions, and enjoyment (Hypothesis 5a) while it was also hypothesized that perceived control would mediate this relationship (Hypothesis 5b).

The classic study conducted by Langer and Saegert (1977) provided evidence that information given to participants before encountering a high-density scenario could increase cognitive control and reduce the negative effects associated with perceived crowding. Given this evidence, it was also hypothesized that the information inherently given as part of the attribution manipulation would reduce arousal through an increase in

perceived control (Hypothesis 6). Although pilot data informing the proposed study did not support Langer and Saegert's findings, Hypothesis 6 addressed this possibility within the larger study.

An additional exploratory hypothesis tested possible relationships that could potentially be added to the model. Based on pilot study observations, the possibility of perceiving bad smell and increasing temperature in high-density group exercise classes was examined to determine if they may contribute to the crowding process by enhancing arousal. As such, it was expected that both due to bad smell and temperature (self-report measures) would mediate the relationship between density and attribution group, and arousal (Hypothesis 7).

#### *Individual Antecedents of Crowding*

In addition to the pathways put forth in the proposed model of gym crowding (Figure 1-1), several individual factors were suggested to be antecedents of the factors within these pathways. These individual factors were thought to be potential moderators within the crowding process. Specifically, the model proposed that differing levels of baseline perceived control and expectations (including situation expectations and crowding preferences) could influence perceptions of density. Thus, it was expected that these variables would serve to moderate the relationship between density group membership and arousal. Specifically, participants with low levels of baseline perceived control, low density preferences and low expectations for density would experience more arousal than those with high values for these variables. Moreover, it was also expected that levels of past exercise and cycling experience would moderate this relationship (due to the task being performed) such that those with less experience would experience more arousal than those with greater experience (Hypothesis 8).



Although not specifically mentioned within the model, it may also have been beneficial to understand if personality-based factors could influence individual's perceptions of crowding. Based on definitions within the Big 5 personality index (John & Srivastava, 1999), it was expected that personality characteristics would moderate the relationship between density and attribution groups, and perceived crowding. Specifically, it was expected that increased feelings of social crowding would be seen among participants high in neuroticism or introversion, and that this relationship would be greater among those in the high-density with crowding attribution group than all other conditions. Moreover, similar relationships were expected for extraversion and openness, such that those low in extraversion and openness would feel more crowded. Lastly, it was predicted that dispositional motivation would also act as a moderator, such that those low in this factor would feel more crowded than those high in motivation (Hypothesis 9).

Collectively, these hypotheses were designed to build on pilot data and help to support the expected relationships that density likely has on key exercise outcomes in a group exercise, gym environment. Additionally, these hypotheses were also expected to support the effects of differing attributions on the experience of crowding and its negative effects on exercise outcomes. Finally, these hypotheses might also serve to identify important pathways and individual risk factors for the experience of crowding in this context.

## Methods

### *Participants*

A minimum sample size of 145 was calculated from an *a priori* power analysis for a multivariate analysis of variance using an effect size of  $f = .22$ , alpha of .05, and power of .80. However, in order to have a sample size that divided evenly by our 6 group design, recruitment was targeted at obtaining a total sample of 144 participants. The

effect size for this power analysis was determined by reviewing relevant, past literature in combination with using effect sizes from the pilot data (See Table 2-1). However,  $f = .22$  was ultimately selected because it was a more conservative estimate of effect size. Recruitment procedures and eligibility criteria for the current study was done in a similar fashion as described in the pilot study, with the exception that more participants were recruited and all study procedures occurred during the Fall 2014 semester.

Table 2-1 Power Analysis Effect Sizes Taken from Relevant Research Articles for  
MANOVA Analysis at Power = .80

Articles	Effect Size (Cohen's $f$ )	Sample Size Requirement	Observed Power at $n = 108$	Observed Power at $n = 144$
Perceived Crowding				
Kuykendall & Keating, 1984	.47	30	1	1
Worchel & Yohai, 1979	1.37	9	1	1
Pilot data	.86*	12	1	1
Future Intentions/ Repatronage				
Pilot data	.29	85	.90	.97
Activity Levels				
Pilot data	.25*	113	.78	.90
Self-report Arousal				
Webb, Worchel, Riechers & Wayne, 1986	.31	75	.94	.99
Webb, Worchel & Brown, 1986	.30	80	.92	.98

Table 2-1—*Continued*

Pilot data	.23*	133	.70	.84
Enjoyment/Satisfaction				
Machleit, Eroglu, & Mantel, 2000	.25	113	.78	.90
Carron, Brawley, & Widmeyer, 1990	.22	112	.65	.80
Pilot data	.19*	192	.50	.65

Note. Effect size interpretations, small = .10, medium = .25, large = .40 ; \* data could be biased because they were taken from an underpowered pilot study

Participants were screened using the same prescreen instrument used in the pilot, with the exception of its location for Psychology participant pool students. For the current study, we included this prescreen survey on the SONA general prescreen questionnaire, which was administered in the first few weeks of the Fall semester and remained open until the end of the semester. Therefore, credit granted to SONA participants changed, such that one credit was granted for attending the orientation session and two credits were granted for attending the exercise session. This change was made because the SONA administrators granted credit values for completing the SONA general prescreen questionnaire at their discretion, instead of researchers granting credit for an individual prescreen. However, the prescreen procedures for those recruited from Kinesiology were identical to the pilot study procedures.

The final sample for the current study resulted in useable data for 155 individuals. These participants had a mean age of  $20.64 \pm 3.62$  years and consisted of 95 (62.1%) females and 58 (37.9%) males. For ethnicity, a representation of 35 (23%) Hispanic and 117 (77%) non-Hispanic was observed while the sample consisted of racial groups of 61 (41.5%) Whites, 33 (22.4%) Blacks, 38 (25.9%) Asians, and 15 (10.2%) from other races. Demographic representation per condition can be found in Table 2-2.

Table 2-2 Demographic Characteristics by Experimental Group

Demographic Characteristic	High-density, CA		High-density, PA		High-density, NA		Low-density, CA		Low-density, PA		Low-density, NA		
	<i>n</i>	<i>M(SE)</i>	<i>n</i>	<i>M(SE)</i>	<i>n</i>	<i>M(SE)</i>	<i>n</i>	<i>M(SE)</i>	<i>n</i>	<i>M(SE)</i>	<i>n</i>	<i>M(SE)</i>	
Age	23	21.39 (5.07)	27	20.63 (2.96)	26	19.77 (1.92)	25	19.64 (2.80)	26	20.85 (3.61)	26	21.62 (4.49)	$F = 1.29, p = .271$
BMI	22	26.61 (5.33)	27	23.85 (4.37)	25	22.14 (3.43)	25	23.33 (4.52)	25	24.24 (3.37)	26	24.29 (3.50)	$F = 2.97, p = .014^*$
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
Gender													$\chi^2 = 2.78, p = .735$
Male	9	39.1%	11	40.7%	9	34.6%	8	32%	13	50%	8	30.8%	
Female	14	60.9%	16	59.3%	17	65.4%	17	68%	13	50%	18	69.2%	
Ethnicity													$\chi^2 = 4.24, p = .516$
Not Hispanic	15	65.2%	19	70.4%	22	84.6%	19	76%	21	84%	21	80.8%	
Hispanic	8	34.8%	8	29.6%	4	15.4%	6	24%	4	16%	5	19.2%	
Race													$\chi^2 = 23.51, p = .265$
White	13	59.1%	11	42.3%	8	32%	12	48%	11	44%	6	25%	
Black	2	9.1%	7	26.9%	4	16%	6	24%	7	28%	7	29.2%	
Asian	6	27.3%	6	23.1%	10	40%	2	8%	6	24%	8	33.3%	
Native American / Alaskan	0	0%	0	0%	1	4%	0	0%	1	4%	0	0%	
Other	1	4.5%	2	7.7%	2	8%	5	20%	0	0%	3	12.5%	

Table 2-2—Continued

Employed												$\chi^2 = 2.85, p = .723$
Yes	8	34.8%	12	44.4%	13	50%	9	37.5%	14	53.8%	13	50%
No	15	65.2%	15	55.6%	13	50%	15	65.2%	12	46.2%	13	50%
Household Income												$\chi^2 = 34.05, p = .514$
Under \$10,000	0	0%	1	3.7%	1	3.8%	2	8%	0	0%	0	0%
\$10,001-\$20,000	0	0%	2	7.4%	2	7.7%	0	0%	1	3.8%	0	0%
\$20,001-\$30,000	8	34.8%	3	11.1%	4	15.4%	3	12%	3	11.5%	1	3.8%
\$30,001-\$40,000	3	13%	3	11.1%	5	19.2%	2	8%	3	11.5%	4	15.4%
\$40,001-\$50,000	3	13%	3	11.1%	3	11.5%	3	12%	5	19.2%	7	26.9%
\$50,001-\$70,000	2	8.7%	5	18.5%	3	11.5%	5	20%	2	7.7%	7	26.9%
\$70,001-\$90,000	4	17.4%	3	11.1%	2	7.7%	2	8%	5	19.2%	3	11.5%
Over \$90,000	3	13%	7	25.9%	6	23.1%	8	32%	7	26.9%	4	15.4%
Marital Status												$\chi^2 = 4.05, p = .542$
Not Married	22	95.7%	26	96.3%	24	92.3%	25	100%	23	88.5%	25	96.2%
Married	1	4.3%	1	3.7%	2	7.7%	0	0%	3	11.5%	1	3.8%

Note: CA = crowding attribution, PA = physical activity attribution, NA = no attribution given; \* - difference was driven by a

single individual.

### *Design and Procedures*

The experimental design for the current study was similar to that described in the pilot study, while adding two conditions in order to have a full factorial design. Specifically, two more low-density groups were added, including a low-density crowding explanation group and a low-density physical activity explanation group. Therefore, more comparisons were able to be made among attribution groups in order to further understand the relationships. These new conditions took place in a low-density room identical to that described previously with the low-density no explanation group. However, the only change to these two new conditions was the inclusion of the attribution manipulation statements which previously only took place under high-density conditions. These statements were added to the procedures and were stated just before beginning the cycling class, as was done in the other attribution manipulation groups.

### *Measurements*

Other changes in procedures included the addition of several measurements in order to understand and identify potential mediators or moderators. These additions included scales assessing personality traits, dispositional motivation, crowding expectations and preferences, as well as questions regarding participant bother due to smell and temperature, additional perceived control questions, and physical measurements of room temperature.

#### Personality Traits

Personality traits were measured using the 44-item Big Five Inventory (John & Srivastava, 1999), a short-form version of the original Big Five Inventory. This scale surveyed participants on the degree to which they felt a list of adjectives described them on a Likert scale from 1 to 5 (1 = disagree strongly, 5 = agree strongly; Cronbach's alpha

= .58). This scale served to determine the five personality traits including openness, conscientiousness, extraversion, agreeableness, and neuroticism.

#### Motivation

The participants' baseline levels of motivation were measured using the self-motivation scale originally created and validated by Dishman and Ickes (1980) within an exercise context. This instrument asked participants to read a series of 40 statements such as "I'm not very good at committing myself to doing things" and "I generally take the path of least resistance" and then rate how characteristic each statement is of them on a Likert scale from 1 to 5 (1 = extremely uncharacteristic of me, 5 = extremely characteristic; Cronbach's alpha = .56). Negatively worded items were reverse coded and then a sum score was calculated.

#### Crowding Expectations and Preferences

Four items administered at baseline assessed expectations and preferences for crowding in a group exercise class environment. Similar to the perceived crowding measurements, these items were also designed to individually assess both spatial and social components (Spatial: Cronbach's alpha = .75; Social: Cronbach's alpha = .66).

#### Smell and Temperature Bother

The question regarding smell was added to the crowding questionnaire, which was presented as an "environmental perceptions" survey (See the Appendix). To measure temperature, a magnetic thermometer was placed on the front of the middle row of exercise bikes so that the instructor could see its display clearly. This objective measure of temperature was then recorded before the session began, in the middle of the exercise session, and at the end. Another thermometer was placed on the wall of the room, away from the group of cycles in order to measure ambient room temperature during the class. This temperature was also recorded at the same times as the

aforementioned temperature measurement. Additionally, a subjective measure of temperature was also added to the environmental perceptions survey, asking participants how bothered they were by the temperature during the cycling class and if they were bothered by it being too hot or too cold.

#### Changes to Perceived Control

In addition to the single item assessing perceived control within the final survey, participants were also administered three additional questions asking how much control they felt they had over the pace they kept, how much resistance they used, and how much overall effort they put forth while taking part in the class. These items were also answered on a Likert scale from 1 to 5 (1 = strongly disagree, 5 = strongly agree) and were assessed before and after the exercise session. These additional items were added to better measure the inherent behavioral control given to all participants, allowing them to self-pace their activity.

#### Changes to Physiological Measures

Lastly, the cycling instructor also wore an accelerometer in order to measure the consistency of the activity performed by the instructor among the classes. Aside from these changes, all other measurements were conducted in a similar manner as described in the pilot study.

## Results

### *Recruitment*

Although the majority of participants who attended orientation finished the study, some attrition was seen between the orientation and exercise sessions. A total of 161 participants were recruited and subsequently completed orientation (See Figure 2-2). Of this total, three participants were lost to attrition before the exercise session. All other participants completed all sessions. Thus, 158 participants were considered completers,



resulting in a minimal attrition rate (1.9%). Five classes were conducted for each of the high-density with crowding attribution ( $n = 24$ ), low-density with crowding attribution ( $n = 25$ ), and low-density with no attribution ( $n = 26$ ) conditions. Concurrently, six classes were conducted for each of the high-density with physical activity attribution ( $n = 27$ ), high-density with no attribution ( $n = 26$ ), and low-density with physical activity attribution ( $n = 27$ ) conditions. However, one class in the low-density with physical activity attribution condition did not reach the minimum attendance of at least four participants, which resulted in a bike being open during exercise. The session for this group of three participants was conducted as normal; however, the data collected from this class were excluded from analysis; resulting in useable data for 155 participants.

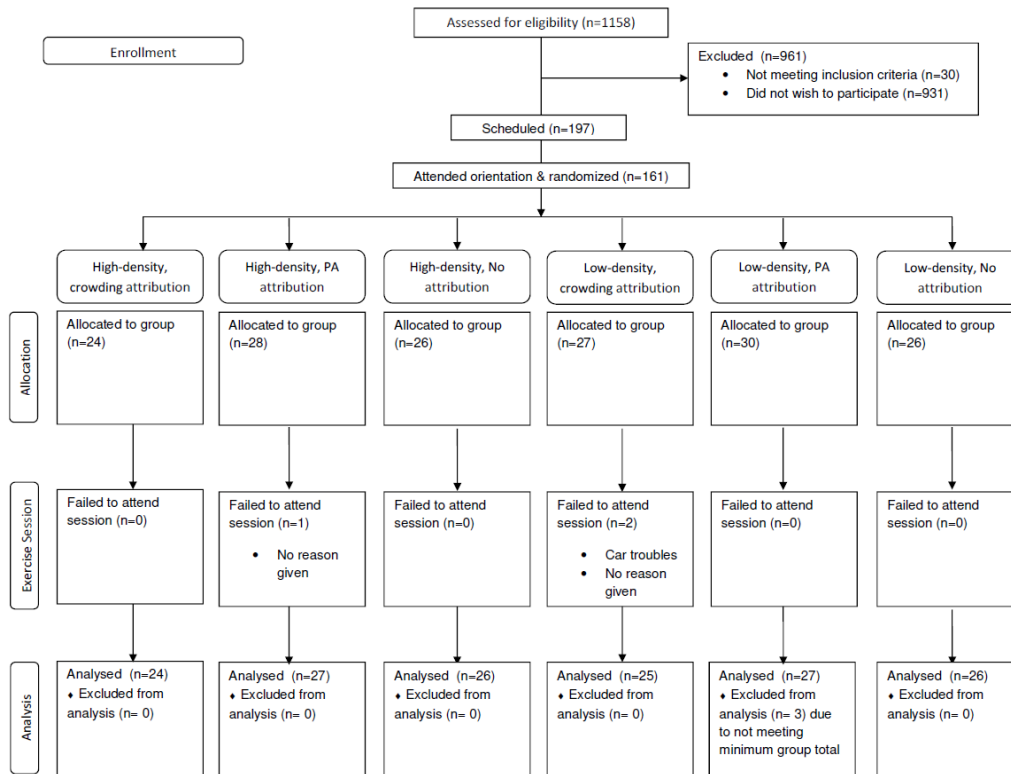


Figure 2-2 Consort flow chart for the current study.

Participants were recruited for the present study using the Psychology Department Participant Pool SONA system as well as three professor-approved classes housed within the Kinesiology department. Participants were recruited between the months of September to November 2014. Participants from the Psychology Participant Pool were all students taking courses within the Psychology Department which required research study participation for course completion, or for extra credit points within their respective classes. Participants recruited from Kinesiology were students taking at least one of three courses approved for recruitment by the instructor of record, as well as by

the University's IRB. These students were allowed to participate in a number of different local research studies in exchange for extra credit points.

Between experimental groups, differences of baseline perceived control and cycle experience were found, but were very minor in nature and were accounted for as covariates in hypothesis testing. Experimental groups did not differ on demographic factors (See Table 2-2), except for BMI. However, upon inspection of the data, it was discovered that this difference was driven by a single case. This outlier was also examined specifically before and during analyses, however, this individual did not prove to be an outlier for any other variable. Baseline differences in sociodemographic characteristics were also examined. Expected gender differences were observed, such that males were higher in age (Males:  $M = 21.88$ ,  $SE = .46$ ; Females:  $M = 19.91$ ,  $SE = .36$ ) and BMI (Males:  $M = 24.91$ ,  $SE = .55$ ; Females:  $M = 23.50$ ,  $SE = .43$ ) than did females,  $F(1, 154) = 11.71$ ,  $p = .001$ ,  $\eta_p^2 = .07$  and  $F(1, 151) = 4.06$ ,  $p = .046$ ,  $\eta_p^2 = .03$ , respectively. No other significant differences in sociodemographic characteristics were seen at baseline among the experimental groups.

#### *Data Analysis*

Analyses conducted for the purposes of this research were done using the SPSS statistical package, version 19. Frequency, descriptive, and distribution data were inspected for all outcome variables to insure plausible means and standard deviations, proper filling of cells for testing, and normal distributions. Skewness statistics and histograms were examined to consider variable distribution. These tests found skewed distributions for enjoyment and Godin leisure time activity. Transformations for these variables were necessary, resulting in a squared transformation being applied to enjoyment and a square root transformation being applied to Godin activity. All data were examined to ensure satisfaction of the assumptions of the proposed analyses, used .05

as a criterion for significance with Bonferroni corrections, and were run as intent to treat. Additionally, intraclass correlation coefficients were calculated to inspect the data for signs of dependency. As such, select ICC results obtained from these data suggested that some group dependency effects may have occurred (See Table 2-3). In order to account for this within the analyses, nested analysis of covariance (ANCOVA) models were used in order to nest the factor of individual exercise class inside the larger group of experimental condition. However, upon running these models, the aforementioned nested variables did not reach significance; suggesting that the factor of individual class did not have a significant effect. Thus, this factor was dropped from the final models and non-nested analyses were conducted.

Table 2-3 Intraclass Coefficients for Major Study Outcomes

Variable	High-density, CA	High-density, PA	High-density, NA	Low-density, CA	Low-density, PA	Low-density, NA
	Rho ( $\rho$ )	Rho ( $\rho$ )	Rho ( $\rho$ )	Rho ( $\rho$ )	Rho ( $\rho$ )	Rho ( $\rho$ )
Social Crowding	0.04	0.04	0.03	0.00	0.00	0.01
Spatial Crowding	0.35	0.00	0.42	0.00	0.00	0.05
Average HR	0.00	0.20	0.09	0.21	0.00	0.07
Peak HR	0.06	0.35	0.35	0.37	0.00	0.00
Activity	0.04	0.00	0.13	0.03	0.00	0.00
Enjoyment <sup>†</sup>	0.16	0.00	0.39	0.05	0.00	0.02

<sup>†</sup>Squared transformation applied to normalize distribution. Note: HR = heart rate, CA = crowding attribution, PA = physical activity attribution, NA = no attribution given.

Covariates for the following analyses included gender, age, perceived control, expectations for crowding, preferences for crowding, and background activity experience. Baseline differences were discovered for the variables of cycle experience (Crowding attribution:  $M = 11.15$ ,  $SE = .73$ ; Physical activity:  $M = 8.25$ ,  $SE = .70$ ) and baseline perceived control (Low-density:  $M = 1.88$ ,  $SE = .12$ ; High-density:  $M = 2.39$ ,  $SE = .12$ ),  $F(2, 150) = 4.17$ ,  $p = .017$ ,  $\eta_p^2 = .05$  and  $F(1, 150) = 9.45$ ,  $p = .003$ ,  $\eta_p^2 = .06$ , respectively. All other covariates were included based on theoretical justifications. Previous research has demonstrated the propensity of males to have a greater organic ability for physical activity than females, as well as a greater decline in ability over the life span (De Moor et al., 2007). Moreover, past research has shown that variations in expectations and preferences for crowding can impact individual's perceptions of crowding in dense environments (Aiello et al., 1977; Hui & Bateson, 1991). Thus, the inclusion of these variables as covariates within the statistical models will help to account for their expected effects.

Hypotheses 1, 2, 3a, and 3b (the primary hypotheses) were intended to be tested using a multivariate analysis of covariance (MANCOVA) after standardizing the crowding subscale scores (Z-scores). However, the dependent variables were observed to have multicollinearity, thus violating a crucial assumption of the analysis. Therefore, individual univariate analyses of covariance (ANCOVA) models were used to test these hypotheses instead.

Analyses for the secondary hypotheses were conducted using separate models for each hypothesis. Hypothesis 4 was tested using a hierarchical multiple regression analysis. This analysis used the Preacher and Hayes method to test mediation using SPSS (Preacher & Hayes, 2004). It was expected that arousal would mediate the relationship between the predictors (density and attribution) and criterion (activity,

enjoyment and intentions) variables by showing a significant relationship between the predictor and the mediator, showing that the mediator predicted the criterion variable while controlling for the predictor, and by showing that the relationship between the predictor and the criterion variables were reduced when the mediator was in the model.

Hypotheses 5a and 5b were tested with hierarchical regression analyses using the Preacher and Hayes method (Preacher & Hayes, 2004). These analyses tested whether or not perceived control mediated the relationship between arousal and the exercise outcomes of activity, future intentions, and enjoyment. These tests were conducted in similar manner as described for Hypotheses 4.

Hypothesis 6 was tested in a mediation model using hierarchical regression analysis and the Preacher and Hayes method (Preacher & Hayes, 2004). This analysis tested whether or not perceived control mediated the relationship between attribution groups and arousal.

Hypothesis 7 was also tested with a hierarchical regression analysis using the Preacher and Hayes method (Preacher & Hayes, 2004) in order to test if bother due to smell and temperature mediated the relationship between density and attribution group (3-way interaction), and arousal. This analysis was run in a similar manner as described for Hypotheses 4-6 above.

Hypothesis 8 was tested using moderated multiple regression (MMR), which served to test if low or high levels of baseline perceived control, crowding expectations/preferences, and background exercise and cycling experience would moderate the relationship between the predictors (density and attribution groups) and criterion (arousal) variables. For this test, moderation was said to exist only if significant cross-products were discovered, followed by differences observed between the groups after testing simple slopes.

Lastly, Hypothesis 9 was also tested using MMR, such that two models were created. The first model tested whether personality characteristics, including all variables of neuroticism, openness, and extroversion, moderated the relationship between the predictors of density and attribution (3-way interaction) and the outcome of perceived crowding. However, the second model tested whether dispositional motivation was a moderator in a different model.

### *Statistical Results*

#### Manipulation Checks

Manipulation checks were conducted to confirm that all experimental groups felt a similar level of perceived control coming into the exercise sessions as well as to ensure that the group exercise instructor maintained a similar level of activity across all classes. A significant difference was not discovered for perceived control as measured by the before-session short survey,  $F(5, 140) = 2.14$ ,  $p = .064$ ,  $\eta^2 = .07$ . Because this finding was marginal, post-hoc comparisons were examined. However, no group differences were observed; suggesting that all groups felt a similar level of perceived control upon entering the exercise session. Additionally, a coefficient of variance (CV) was calculated for the activity performed by the group exercise instructor within each individual exercise class for each condition. No individual CV was seen to exceed 6% variance, including the overall CV calculated across all groups. Thus, it can be concluded that the level of activity performed by the group exercise instructor from class to class was similar. Additionally, the relationship examined in Hypothesis 1 also served as a manipulation check for the density and attribution manipulations.

#### Primary Hypotheses

Hypothesis 1, which predicted that the high-density with no attribution group would feel more crowded than the low-density with no attribution group, was tested using



two ANCOVA models including both the spatial and social perceived crowding variables as outcomes. Significant main effects for density were discovered in both spatial and social crowding models,  $F(1, 138) = 168.41, p < .001, \eta_p^2 = .55$  and  $F(1, 138) = 50.91, p < .001, \eta_p^2 = .27$ , respectively. Subsequent post-hoc tests revealed that high-density groups reported significantly greater crowding than did low-density groups (See Figure 2-3).

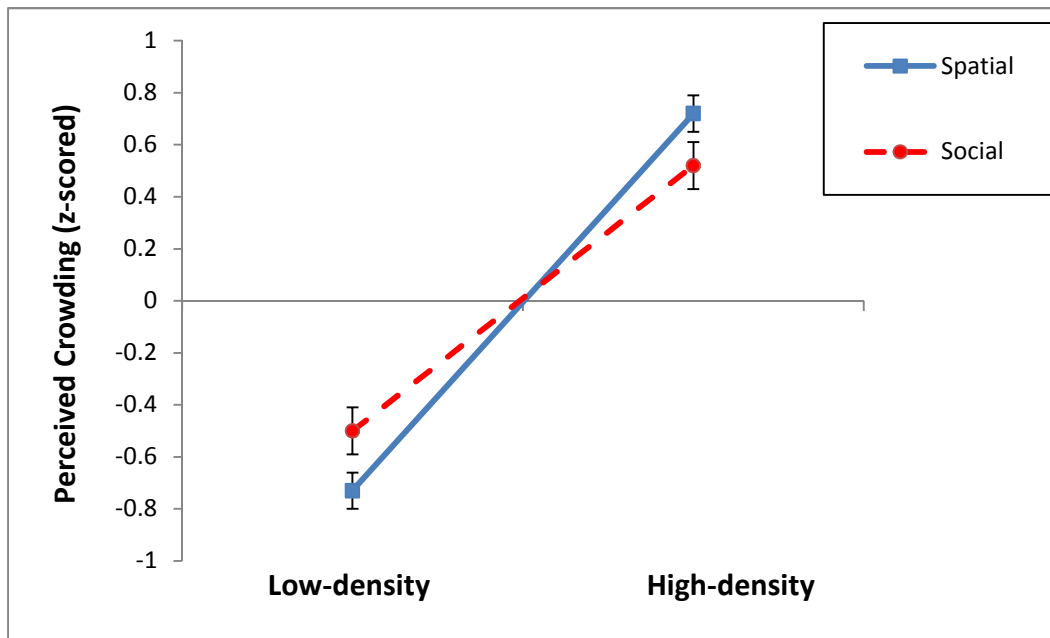


Figure 2-3 Density group differences for spatial and social crowding outcomes.

However, the model testing spatial crowding differences also showed a significant main effect of attribution,  $F(2, 138) = 4.46, p = .013, \eta_p^2 = .06$ . Post-hoc tests for this effect showed that crowding attribution groups reported greater perceived spatial crowding than those in the physical activity attribution groups (See Figure 2-4). Despite these effects, significant interactions of density by attribution were not seen for either

spatial or social crowding models,  $F(2, 138) = 0.50$ ,  $p = .607$ ,  $\eta_p^2 = .01$  and  $F(2, 138) = 0.17$ ,  $p = .845$ ,  $\eta_p^2 = .00$ , respectively. Additionally, a significant main effect of the covariate of crowding expectations was found for spatial crowding,  $F(1, 138) = 7.08$ ,  $p = .009$ ,  $\eta_p^2 = .05$ , suggesting that those with high expectations of crowding ( $M = 7.13$ ,  $SE = 1.46$ ) felt less crowded than those with low expectations ( $M = 13.00$ ,  $SE = 1.70$ ). Overall, these findings partially supported Hypothesis 1 and also suggested that the density and attribution manipulations worked as intended.

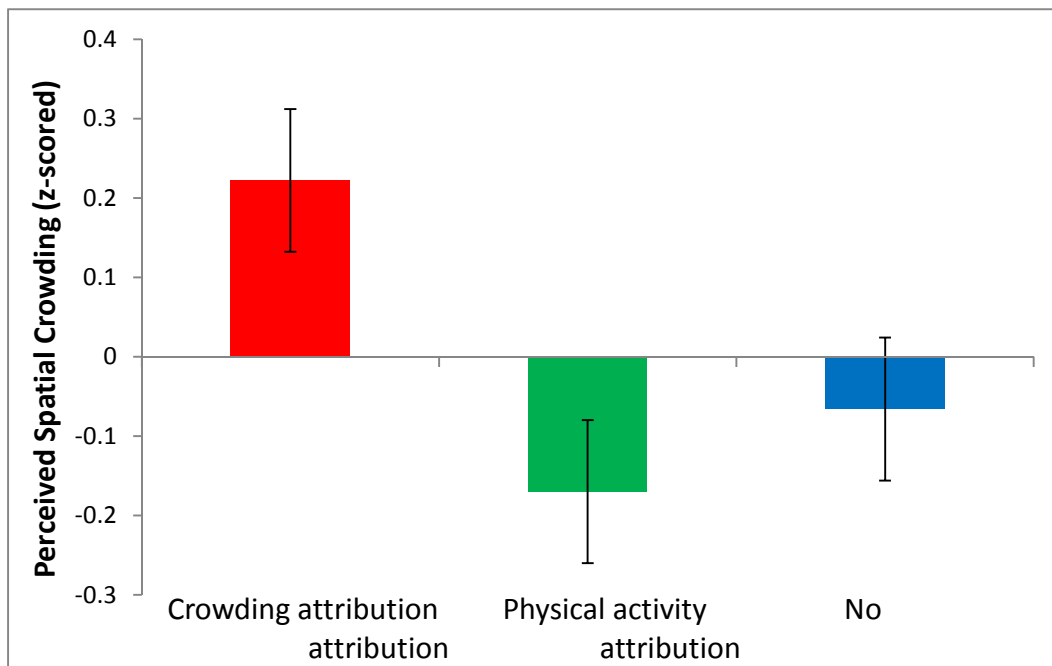


Figure 2-4 Attribution group differences for spatial crowding.

Hypothesis 2, which predicted that the participants in the high-density conditions would have higher arousal than those in low-density conditions and that participants in the crowding attribution groups would have higher arousal than participants in the physical activity attribution groups, followed by the no attribution groups, was tested with

multiple models using all of the relevant arousal outcome variables, including psychological arousal, average heart rate, peak heart rate, and changes over time in aroused mood. Among the variables measured only after the cycling session (See Table 2-4), a significant main effect of attribution was found for only the models including average heart rate and psychological arousal,  $F(2, 129) = 4.11, p = .019, \eta_p^2 = .06$  and  $F(2, 138) = 5.59, p = .005, \eta_p^2 = .08$ , respectively. Pairwise comparisons for these effects showed that the crowded attribution groups had higher average heart rates than the no attribution groups and that the no attribution groups reported more psychological arousal than the physical activity attribution groups. Moreover, a significant main effect of the covariate of gender was found for average heart rate,  $F(1, 129) = 12.69, p = .001, \eta_p^2 = .09$ . Posthocs for this effect showed that females ( $M = 131.29, SE = 1.81$ ) displayed higher average heart rates than males ( $M = 121.14, SE = 2.37$ ).

Table 2-4 Experimental Condition Means and Standard Errors for Primary Hypotheses Outcomes (N = 161)

Condition	Psychological Arousal			Average Heart Rate			Peak Heart Rate			Activity			Intention			Enjoyment <sup>†</sup>			
	<i>n</i>	<i>M</i>	( <i>SE</i> )	<i>n</i>	<i>M</i>	( <i>SE</i> )	<i>n</i>	<i>M</i>	( <i>SE</i> )	<i>n</i>	<i>M</i>	( <i>SE</i> )	<i>n</i>	<i>M</i>	( <i>SE</i> )	<i>n</i>	<i>M</i>	( <i>SE</i> )	
Density																			
High-density	75	20.65	0.48	71	125.78	2.07	71	155.14	1.11	73	24423.96	1.12	75	6.83	0.19	75	17.47	0.73	
Low-density	77	20.78	0.48	72	129.38	2.06	72	158.50	0.84	73	25247.44	0.85	77	6.79	0.19	77	18.12	0.72	
Attribution																			
CA	48	20.53	0.60	48	132.09 <sup>1</sup>	2.52	48	159.79	3.26	48	25887.77 <sup>1</sup>	504.97	48	6.50	0.24	48	17.06	0.91	
PA	52	19.45 <sup>1</sup>	0.58	47	128.58	2.54	47	157.76	3.26	49	24581.15	485.40	52	7.01	0.23	52	19.24	0.87	
NA	52	22.15 <sup>1</sup>	0.57	48	122.07 <sup>1</sup>	2.48	48	152.91	3.18	49	24049.32 <sup>1</sup>	476.55	52	6.93	0.22	52	17.09	0.86	
Total	152			143			143			146			152			152			

<sup>†</sup>Squared transformation applied to normalize distribution. Note: CA = crowding attribution, PA = physical activity attribution, NA = no attribution given, Activity measured by accelerometer counts, Means in the same column with the same superscript number are significantly different.

In addition to these tests, a repeated measures multivariate ANCOVA model was used to test changes over time in aroused mood, including the POMS subscales of vigor-activity and tension-anxiety. Main effects of time and attribution were qualified by a significant interaction of time by attribution group, Wilk's Lambda  $F(4, 296) = 2.64, p = .034, \eta_p^2 = .03$ . Upon probing post-hocs for this interaction, it was discovered that the no attribution and physical activity attribution groups increased in vigor-activity from the beginning to the end of the exercise class (See Figure 2-5). Moreover, it was also seen that all attribution groups decreased in tension-anxiety over the same time period (See Figure 2-6). Additionally, no interaction effects were discovered for any model tested in Hypothesis 2. Overall, Hypothesis 2 can be considered partially supported. Finally, the ANCOVA analyses testing hypotheses 3a and 3b (above) included the cognitive exercise outcomes of future intentions for physical activity and enjoyment, as well as activity (as measured by accelerometer counts). However, all models failed to reach significance, except a main effect of attribution for the outcome of activity,  $F(2, 131) = 3.46, p = .034, \eta_p^2 = .05$ . Subsequent examination of the relevant pairwise comparisons found that the crowding attribution group had more accelerometer counts than did the no attribution group (See Table 2-4). Additionally, significant main effects of the covariates of gender and crowding expectations were found for the outcome of activity,  $F(1, 132) = 4.74, p = .031, \eta_p^2 = .04$  and  $F(1, 132) = 11.32, p = .001, \eta_p^2 = .08$ , respectively. Pairwise comparisons for gender revealed that males ( $M = 25770.40, SE = 469.78$ ) displayed more activity than females ( $M = 24246.58, SE = 363.23$ ). As for crowding expectations, it was seen that individuals with higher expectations for crowding ( $M = 28140.75, SE = 904.36$ ) displayed more activity than those with lower expectations ( $M = 23169.94, SE = 1020.25$ ). Furthermore, a main effect of crowding expectations was also found for future intentions,  $F(1, 138) = 4.14, p = .044, \eta_p^2 = .03$ ; suggesting a similar result such that those with

higher crowding expectations ( $M = 8.01$ ,  $SE = 0.47$ ) reported more future intention to take part in physical activity than those with low expectations ( $M = 6.43$ ,  $SE = 0.49$ ). Given this evidence, Hypothesis 3a was not supported whereas Hypothesis 3b was partially supported by these data.

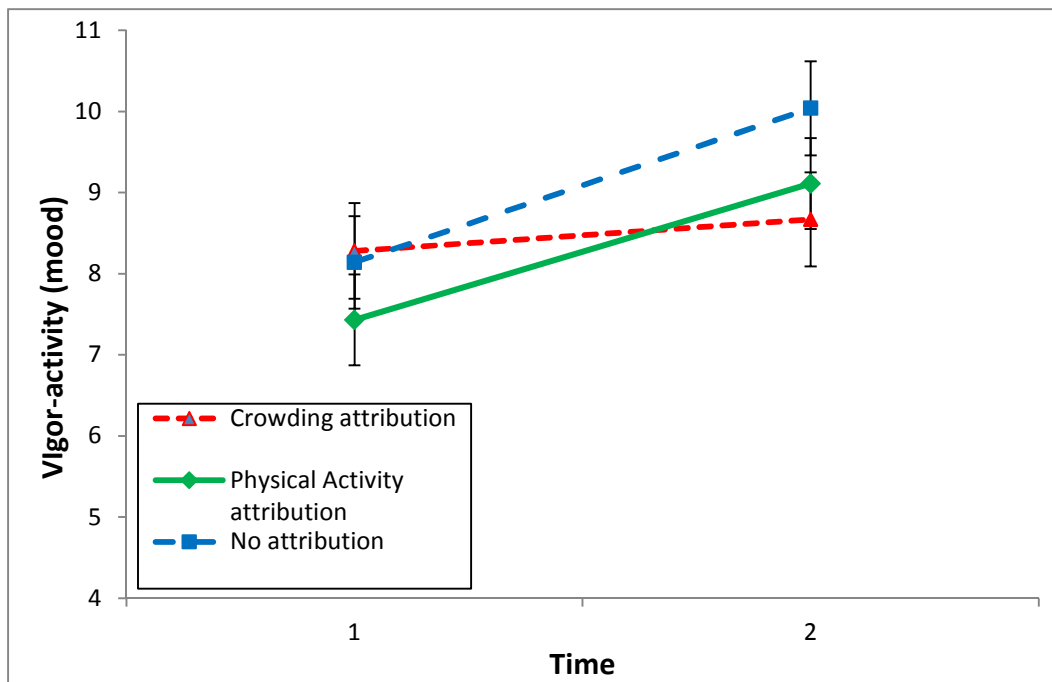


Figure 2-5 The interaction of time by attribution group for the POMS vigor-activity mood subscale.

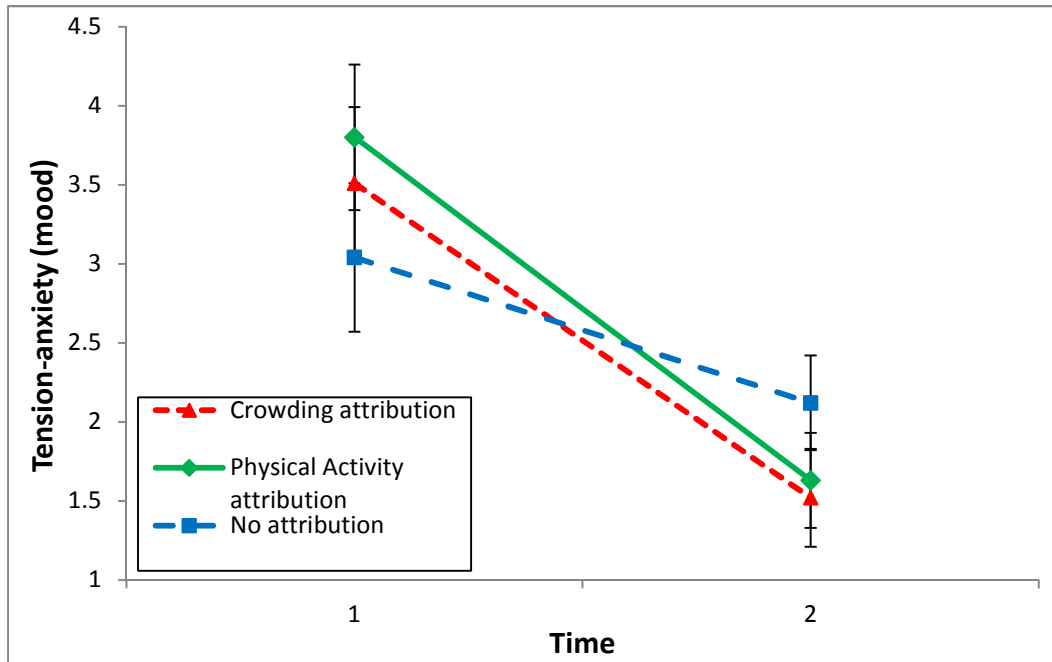


Figure 2-6 The interaction of time by attribution group for the POMS tension-anxiety mood subscale.

#### Pathways in the Crowding Process

Hypothesis 4, which predicted that arousal would mediate the relationship between the predictors (density and attribution) and criterion variables (activity, enjoyment and intentions) was tested using a hierarchical multiple regression analysis. However, while attempting to establish the necessary relationships between the predictor, mediator, and criterion variables, it was seen that no relationship existed between density and arousal, and arousal and the exercise outcomes (See Table 2-5). Therefore, a mediation analysis was not able to be conducted. Following this result, it was then tested whether arousal served as a moderator between density and attribution

groups, and the exercise outcomes. Individual analyses were conducted for each outcome, including enjoyment, intentions, and activity. For all outcome variables, including enjoyment, intentions, and activity, the model including the cross-products was not significant,  $R^2 = .10$ ,  $\Delta F(13,115) = 1.45$ ,  $p = .149$ ,  $R^2 = .33$ ,  $\Delta F(13,115) = 1.33$ ,  $p = .203$ , and  $R^2 = .28$ ,  $\Delta F(13,112) = 0.73$ ,  $p = .731$ , respectively. Thus, arousal did not moderate the expected relationship and, overall, Hypothesis 4 was not supported.



Table 2-5 Bivariate Correlations between Major Study Outcomes (N = 155)

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Density	.000	-.118	-.102	.006	.008	-.001	-.155	-.109	.170*	.230*	.732*	.534*	
2. Attribution		.120	.081	-.268*	.002	.080	.077	-.075	-.106	-.072	-.026	-.027	
3. Average HR			.879*	.153	-.070	.127	.007	-.045	-.032	.105	.158*	.100	
4. Peak HR				.118	.024	.131	.081	-.028	-.035	.072	-.020	.096	
5. Psyc. Arousal					-.155	.017	.005	.030	.003	.120	-.019	.073	
6. Intention						.423*	.215*	.112	-.255*	-.184*	-.167*	.152	
7. Enjoyment							-.079	.047	-.145*	-.232*	-.261*	.121	
8. Activity								-.001	-.060	-.093	-.155	.046	
9. Perceived Control									-.091	-.112	-.028	-.030	
10. Bother (smell)										.373*	.361*	.496*	
11. Bother (heat)											.285*	.492*	
12. Spatial Crowding												.714*	
13. Social Crowding													

\*p < .05, HR = heart rate, psyc. = psychological.

Hypotheses 5a and 5b predicted that perceived control did/did not mediate the relationship between arousal and the exercise outcomes of activity, future intentions, and enjoyment. However, many of the initial relationships that must be established between the predictor, mediator, and outcome variables were not significant (See Table 2-5). Thus, mediation analyses could not be conducted. Again, possible moderation relationships were tested for these variables using MMR. For the outcomes of future intentions, enjoyment, and activity, no significant interactions were discovered. However, perceived control, cycle experience, and crowding expectations predicted higher future intentions,  $B = .12$ ,  $t(125) = 1.82$ ,  $p = .072$ ,  $sr^2 = .03$ ,  $B = .10$ ,  $t(125) = 3.90$ ,  $p < .001$ ,  $sr^2 = .11$ , and  $B = .76$ ,  $t(125) = 2.14$ ,  $p = .034$ ,  $sr^2 = .04$ , respectively. Furthermore, direct effects of gender and crowding expectations were seen for the outcome of activity,  $B = -1507.37$ ,  $t(130) = -2.37$ ,  $p = .020$ ,  $sr^2 = .04$  and  $B = 2242.66$ ,  $t(130) = 2.81$ ,  $p = .006$ ,  $sr^2 = .06$ , respectively. Given this evidence, no moderation or mediation relationship existed for the relationship between arousal and exercise outcomes; thus, neither Hypotheses 5a nor 5b was supported.

Hypothesis 6 predicted that the effect of attribution on arousal would be mediated by perceived control. However, the expected relationship between perceived control and arousal, and attribution groups and perceived control were not found (See Table 2-5). Moderation relationships were subsequently tested; however, no significant interaction effects were discovered. For the model testing the outcome of average heart rate, a significant effect of attribution group was found,  $B = 11.24$ ,  $t(124) = 3.03$ ,  $p = .003$ ,  $sr^2 = .07$ ; which suggested that the crowding attribution group displayed higher average heart rate than did other groups. Similarly, an effect of attribution group was also discovered for the model testing the outcome of psychological arousal,  $B = -3.00$ ,  $t(133) = -3.52$ ,  $p = .001$ ,  $sr^2 = .09$ . This finding suggested that the physical activity attribution group had higher psychological arousal than did other groups. This model also showed several significant covariate predictors, including age,  $B = .31$ ,  $t(133) =$

2.53,  $p = .013$ ,  $sr^2 = .05$ , and crowding expectations,  $B = -1.95$ ,  $t(133) = -2.02$ ,  $p = .045$ ,  $sr^2 = .03$ . Given these results, it was concluded that Hypothesis 6 was not supported.

Hypothesis 7 tested whether bother due to smell and temperature mediated the relationship between density and attribution groups, and arousal. Again, the necessary relationships between the predictor, mediator, and criterion variables could not be established; particularly for the relationship between attribution and bother due to smell or temperature, as well as for density and arousal (See Table 2-5). As such, a mediation analysis was not able to be conducted. Upon exploring if a moderation relationship existed, a significant 3-way interaction of bother due to temperature by density group by attribution group was discovered for the outcome variable of psychological arousal,  $B = 2.73$ ,  $t(140) = 2.33$ ,  $p = .021$ ,  $sr^2 = .04$ . Subsequent simple slopes testing revealed that, under conditions of high-density, those in the crowding attribution group reported less psychological arousal than those in other attribution groups at high levels of bother due to temperature. Despite this relationship being discovered, Hypothesis 7 was not supported.

#### Individual Antecedents of Crowding

Hypothesis 8 was tested using MMR, which served to test if baseline perceived control, crowding expectations/preferences, and background exercise and cycling experience would moderate the relationship between the density and attribution groups, and arousal. However, no significance was found for any model containing the cross-products for the arousal variables of average heart rate, peak heart rate, and psychological arousal,  $R^2 = .08$ ,  $\Delta F(17,90) = 0.87$ ,  $p = .610$ ,  $R^2 = .02$ ,  $\Delta F(17,90) = 0.61$ ,  $p = .880$ , and  $R^2 = .01$ ,  $\Delta F(17,99) = 0.49$ ,  $p = .952$ , respectively. No other model showed any significant predictors of arousal. Thus, the expected moderation relationship did not exist in these data and Hypothesis 8 was not supported.

Hypothesis 9 predicted that personality characteristics would moderate the relationship between density and attribution groups, and perceived crowding. Specifically, it was expected that increased feelings of social crowding would be seen among participants high in neuroticism

or introversion, and that this relationship would be greater among those in the high-density with crowding attribution group than all other conditions. Moreover, similar relationships were expected for extraversion and openness, such that those low in extraversion and openness would feel more crowded. Lastly, it was predicted that dispositional motivation would also act as a moderator, such that those low in motivation would feel more crowded than those high in motivation. This hypothesis was tested using two MMR analyses. The first model included all personality variables of extroversion, openness, and neuroticism. Contrary to expectations, results for this model revealed no significant interactions. However, significant effects of neuroticism and density were found,  $B = .04$ ,  $t(140) = 3.03$ ,  $p = .003$ ,  $sr^2 = .06$  and  $B = 1.08$ ,  $t(140) = 7.75$ ,  $p < .001$ ,  $sr^2 = .30$ , respectively. Subsequently, another analysis using a similar model was conducted in order to test if dispositional motivation predicted perceived crowding. Again, no significant interactions were found. Within this model, a significant effect of motivation and density were discovered,  $B = -.01$ ,  $t(142) = -2.36$ ,  $p = .020$ ,  $sr^2 = .04$  and  $B = 1.02$ ,  $t(142) = 7.27$ ,  $p < .001$ ,  $sr^2 = .28$ , respectively. These findings suggest that increased neuroticism and density independently predicted increased perceived social crowding, whereas extroversion, openness, and attribution condition did not. Additionally, decreased motivation was found to predict increased feelings of crowding. Thus, Hypothesis 9 was partially supported. It should also be noted that the variables of neuroticism and motivation were added as covariates to the models described in the primary hypotheses to test if additional results could be discovered. However, the pattern of findings remained the same.

#### Discussion

The purpose of this study was to determine if engaging in a group exercise class in conditions of high-density would lead to decreased levels of enjoyment, future intentions for physical activity and activity (as measured by accelerometer counts), while increasing perceptions of crowding, and physiological arousal. The purpose of this study was also to determine whether or not attributing one's arousal to physical activity, as opposed to perceived

crowding, could ameliorate the negative effects associated with high-density and crowding. Furthermore, this study also served to test the major components of a proposed model explaining crowding in a gym context (See Figure 2). However, the results of this study only partially supported expectations.

Hypothesis 1 was given partial support, as the data showed that the high-density conditions felt more spatially and socially crowded than did the low-density conditions. Furthermore, it was also discovered that the crowding attribution group perceived greater levels of crowding than did the physical activity attribution group; although no interaction of density by attribution group was found. Hypothesis 1 also showed that the density and attribution manipulations were successful. Hypothesis 2 was partially supported in that the crowding attribution group had a higher average heart rate than did the no attribution group. Furthermore, a time by attribution group interaction was found for aroused mood such that the physical activity and no attribution groups increased in vigor-activity mood and all attribution groups decreased in tension-anxiety mood from the beginning to the end of the exercise class; suggesting that attribution condition moderated these changes over time. However, expectations were not supported in that the no attribution group reported higher psychological arousal than the physical activity attribution group, and no effect of density was discovered. Hypothesis 3a did not receive support whereas Hypothesis 3b received partial support such that the crowding attribution group engaged in higher levels of activity than did the no attribution group. However, an effect of density was also not seen in this analysis.

The group of secondary hypotheses which examined the pathways in the crowding process, including Hypotheses 4, 5, 6, and 7, were not supported due to not discovering expected relationships between the variables of interest (See Table 2-5). Although Hypothesis 7 was not supported, examination of possible moderation relationships led to the discovery that both due to temperature moderated the relationship between density and attribution condition, and psychological arousal. Specifically, under conditions of high-density, those in the crowding

attribution group experienced less psychological arousal when temperature bother was high. This finding was puzzling as it suggested that those in the crowding attribution group were less psychologically aroused as bother due to temperature increased, when compared to other groups. It may have been that bother due to increasing temperature may have drawn some of their attention away from feeling crowded. While the current study could not answer this question, future research may be able to. Although these hypotheses did not support the expected mediational pathways, the subsequent examination of possible moderation relationships did reveal bother due to increasing temperature as a moderator.

In addition to these expectations, another group of secondary hypotheses examined individual antecedents of crowding by testing for moderators. Although Hypothesis 8 did not receive support from these data, Hypothesis 9 received partial support in that neuroticism and density were seen to positively predict perceived social crowding, whereas motivation negatively predicted this outcome. Despite this, the expected 3-way interactions (including attribution groups) and effects of openness and extraversion were not discovered.

Within this study, the expected effects of density on arousal and exercise outcomes were not seen. Despite the density manipulation resulting in large group differences in perceived crowding, sufficient evidence that crowding has a positive or negative effect on arousal and exercise outcomes was not obtained. This finding was contradictory to those of previous studies that have linked high-density and arousal in past literature (Epstein & Karlin, 1975; Evans, 1979; Worchel & Brown, 1984). However, these studies did not involve the context of a gym, or group exercise. Because the gym environment and exercise inherently involve increases in arousal, the independent effect of density may have been reduced.

Likewise, a greater influence of attribution group was found for several variables. The findings showing that the attribution manipulation influenced perceptions of crowding, psychological arousal, aroused mood, and even heart rate support the effectiveness of attributions in influencing the cognitive, emotional, and physiological states of exercisers. These

findings lend support to Worchel and Teddlie's (1976) two-factor theory of crowding as well as Schachter and Singer's (1962) two-factor theory of emotion.

Although these data showed that the crowding attribution group experienced greater average heart rate and did not experience the increase in vigor-related mood that the other attribution groups did, it was also discovered that the crowding attribution group engaged in greater levels of activity while exercising than did the no attribution group. These findings make it difficult to definitively determine if perceived crowding has a negative or positive effect on exercise-related outcomes. It is possible that these mixed findings could be explained by individual differences that are currently unknown. Rompay and colleagues (2008) found different reactions to density based on levels of one's desire for control. Although this factor has received relatively little attention since this study, it serves as an example of individual factors that can influence perceptions of crowding.

Despite this, the overall results of the present study suggested that, in the context of a group exercise class, the attribution to crowding may be more important than the actual density. Although it has yet to be sufficiently proven whether or not density is a negative factor among exercisers, the present data suggest that intervening to manipulate exercisers' attributions in a high-density gym may reduce their perceptions of crowding and state of arousal. In light of this, more research needs to be done in order to determine the effects of density on gym users, as well as to test the influence of attributions on these effects.

Although past research has found evidence that increased density in retail settings usually results in decreased feelings of satisfaction and intentions to return (Eroglu & Machleit, 1990; Machleit, Kellaris, & Eroglu, 1994), the current study did not support these findings in a gym context; as no significant differences were discovered for either enjoyment or future intentions within these data. However, the differences between these environments may explain the differences in the results. From the previous systematic review of the literature, it became evident that the consequences of perceived crowding were highly dependent upon the situation.

Thus, the factors which make one feel satisfied (and willing to return) in a retail setting may be very different from those which predict satisfaction in a gym. Just as a great deal of past research was conducted to determine the predictive factors of satisfaction in a retail setting (Eroglu & Machleit, 1990), more will need to be done to discover these same factors in a gym setting.

Testing major components of the proposed model of gym crowding (See Figure 2) was an initial purpose of this study. This aim led me to test hypotheses about potential pathways within the crowding process, as well as individual antecedents of crowding. However, due to the expected relationships among density, arousal, attribution groups, perceived control, and the exercise outcomes not being found, the analyses intended to test the key pathways in the model were unable to be conducted. The difficulty in finding the relationships involving perceived control may have been due to the inherent control given to all research participants. Although strict measures were employed in order to keep perceptions of control constant across the experimental groups, it is possible that the right of the participants to leave the experiment at any time may have provided them with an artificially high level of control; thus reducing the influence of perceived control in this experiment. Given that the mediation relationships were unable to be tested, it was difficult to draw many conclusions from these particular analyses. Researchers have debated the role of perceived control within the crowding process. Many have argued that perceived control acts as a mediator of the experience of density and feeling crowded (Hui & Bateson, 1990; Hui & Bateson, 1991; Rodin, Solomon, & Metcalf, 1978; Rompay, Galetzka, Pruyne, & Garcia, 2008), whereas others did not find evidence of this relationship (Bruins & Barber, 2000; Langer & Saegert, 1977; Paulus & Matthews, 1980). Unfortunately, the present data do not clearly support either side of this controversy.

Despite not finding many of the expected relationships among the secondary hypotheses, it was discovered that both due to temperature was a significant moderator of the relationship among density and attribution groups, and arousal. This result suggests a possible



addition to the proposed model. The factor of temperature could be arguably added to the environmental antecedents, or the factor of bother due to temperature could be added to the appraisal of density process; or perhaps both. However, more research should be conducted on these factors in order to confirm these findings.

Possible moderators within the proposed model were also tested by examining the individual antecedents of crowding. It was seen that baseline levels of perceived control, crowding expectations/preferences, and previous activity experience were not significant moderators. Because the current study did not select for individuals with any specific level of experience with exercise or group exercise classes, it is possible that the participants did not have a good idea of what to expect or prefer from the spinning class. In the current study, crowding expectations were found to be related to only certain outcomes. Specifically, expectations were seen to positively predict levels of activity and future intentions, and negatively predict perceived spatial crowding and psychological arousal. However, expectations were not related to many outcomes, while crowding preferences were not related to any. Past research has also found that attributions to crowding were made more frequently among those whose expectations were specifically disconfirmed (Gochman & Keating, 1980). Thus, if participants did not have a well-established representation of expectations for a group exercise class, it may have weakened the effects of the attribution manipulation. Future research could test this assertion by selecting individuals with specific levels of experience with group exercise. Despite this, the significant relationships that were discovered for crowding expectations in the present study lend some support to past research arguing that expectations may support better coping and that they may play a role in responding to environmental cues (Langer & Saegert, 1977; White & Kight, 1984). Again, this discovery provides fodder for future research.

Regarding other expected moderation relationships, it was discovered that neuroticism and dispositional motivation independently predicted perceptions of social crowding. However, the expected interaction for these significant predictors was not seen, thus, they did not

moderate the relationship between density and social crowding. However, the discovery of these factors predicting crowding opens up possibilities for their inclusion in future crowding research; especially in a gym context. Furthermore, this finding gives credence to previous research supporting the importance of individual factors in the assessment of human crowding (Aiello et al., 1977; Ruback & Pandey, 1996) and provided support for future use of this variable as an individual difference factor.

Although there are many reasons why specific hypotheses were not supported, not finding many of the expected relationships may have been due to the choice of paradigm in this experiment. Density was manipulated in the current study by primarily decreasing space between the exercise bikes and by reducing the size of the room. However, past crowding researchers have found greater effects when focusing more on social density, by increasing the number of participants in a given space and by decreasing social distance (Aiello, Thompson, & Brodzinsky, 1983; Schaeffer & Patterson, 1980). The use of a less impactful paradigm may have made it difficult to parse out effects in the present study. Furthermore, past research has found that the negative effects associated with crowding are more pronounced when consequences are involved. For example, Paulus and colleagues (Paulus, Cox, McCain, & Chandler, 1975; Schaeffer, Baum, Paulus, & Gaes, 1988) found a number of strong negative effects (e.g., increased illness reports, poorer health, increased stress) due to increased density among prisoners. Within these populations, increased density holds the consequence of an increased likelihood of inmate-on-inmate assault. However, cycling involves few, if any, consequences; thus likely diminishing the effects of high-density. Additionally, strong negative effects due to crowding have been particularly associated with competitive environments (Epstein & Karlin, 1975). Even the nature of crowding in ecological systems usually results in a competitive environment for scarce resources. However, the group dynamic within the current study was more cooperative than competitive. Thus, the expected effects of this study may have been dampened.

Another broad factor that may explain the lack of findings in the present study is the theoretical foundation. Despite not finding sufficient evidence to include Freedman's (1975) density-intensity theory in the proposed model of gym crowding (Figure 1-1) in the past systematic review, the findings from the current study might actually be explained by this approach. Freedman put forth that crowds in a positive environment can be exciting, whereas the negative effects associated with crowding occur primarily in a negative context. As a group exercise class can largely be considered a positive context, the perceptions of crowding associated with the class may have also been positive. Additionally, Freedman argued that density tends to magnify feelings and behaviors in a given environment. Regarding the present study, Freedman's magnification assertion may explain why participants in the crowding attribution condition displayed greater levels of activity and average heart rate. Without manipulating contexts or designing a study around Freedman's theory, it is difficult to draw more conclusions at this time. However, his theory remains a possible explanation for the findings of the current study and could be incorporated into future research.

Although more could not be done to test relationships within the proposed model, there remains much potential for future research to investigate other components of the model as well as to test the major components using different environments and populations. These data provided support for the existence of a relationship (on some level) between attributions and arousal, as well as for attributions and the exercise outcome of activity. Future studies should also take special care to include the personality-based factors and expectations of crowding discussed above.

### *Limitations*

Although a previous systematic review supported the notion that exercising in high-density conditions would result in negative effects on exercise outcomes, including activity levels, future intentions, and enjoyment, support for this expectation was not discovered within these data. Several possible reasons for this lack of support have been discussed, however,

another plausible explanation may be the participants themselves. Although the current sample was readily available in large enough numbers to provide ample power for this study, individuals in this sample may have possessed an unexpected tolerance to crowding. Although past crowding studies have frequently sampled undergraduate students and have not put forth evidence of increased tolerance among this group (Aiello et al., 1977; Epstein & Karlin, 1975; Worchel & Brown, 1984), many of these studies are decades old and may be out of date for the modern generation. As colleges around America see increasing enrollment numbers, the class sizes and use of campus resources increase. Therefore, students may be becoming accustomed to high-density conditions within their college activities. Whether or not this is the truth has yet to be determined, however, it remains a plausible explanation for the aforementioned findings.

Future research in this area should test the hypothesized relationships among other populations, including undergraduates at small and moderate-sized colleges. Another possible limitation of this study was the class size. Although the sizes of group exercise classes vary greatly, cycling classes are known to typically consist of numbers greater than six. The smaller group size may have decreased the effects of density to some degree, although the density manipulation proved to be quite effective (See Figure 2-3). Despite this, the class size was chosen due to feasibility. By the end of the data collection, it was clear that a larger group size would not have been feasible, as it was frequently difficult to schedule six participants for the same session, two weeks in a row.

In addition to these points, many of the secondary hypotheses depended upon finding the expected relationships within the primary hypotheses which were largely not found in the current study. Consequently, this study was not able to thoroughly test the proposed model of gym crowding by assessing more of the mediation relationships proposed. Regardless of the inability to conduct several hypotheses, the possibility remains that the expected relationships predicted within the secondary hypotheses simply do not exist. Lastly, the expected group

differences among the physiological measurement of activity levels may have not been discovered due to the instruments not being sensitive enough to detect them. Although accelerometers have been validated for use with individuals riding stationary exercise cycles (Parkka et al., 2007); employing measures such as average revolutions per minute, distance covered, and the level of resistance engaged may have been better measures to detect group differences. However, such equipment was not available for this study, and accelerometer counts were expected to discover group differences based on past studies. Future studies should benefit from using multiple measurements of activity, including those previously mentioned.

#### *Future Directions and Conclusions*

The results of this research built upon pilot data by demonstrating that increased density in a group exercise class resulted in increased feelings of crowding. However, expected increases in arousal and expected decreases in exercise outcomes, including enjoyment, future intention and activity levels, among those exercising in high-density were not seen. Nevertheless, some evidence was gathered to support the notion of reducing feelings of crowding through the manipulation of attributions. Additionally, frequent effects of attribution group were discovered, whereas expected effects of density were not. Despite the results being somewhat mixed as to whether increased density and feelings of crowding result in negative or positive changes to arousal and exercise outcomes, this research took a first step down the path of discovery for a novel area of research. As such, the findings from this research provide a foundation for future studies to build. Not only did this study increase the scope of knowledge in the areas of gym crowding research, but it also provided initial evidence that attributions (and misattributions) may trump physical density in the crowding process within this context. In order to properly assess the predicted relationships and to test the proposed model, replication of this study is needed. However, future researchers can improve their methods by sampling other populations, using additional measurements of activity, and by increasing class size, if possible.

Even more could be learned from this area of research if it were to take place within the larger gym areas, and not held solely in a group exercise class environment. Additionally, ancillary studies could be conducted to test the presence and magnitude of crowding tolerance among differing groups of exercisers in a gym setting. Other future directions could also focus on testing other components of the proposed model, including the effects of varying architectural layouts and changes in functional density, or the effective use of space and object placement within gyms.

Despite not finding several of the hypothesized relationships, this study helped to advance the knowledge on the topic of gym crowding by covering novel ground using a pair of effective experimental manipulations. Although recent crowding research has frequently investigated density in retail settings (Eroglu et al., 2005; Hui & Bateson, 1991; Machleit et al., 1994), research examining density in a gym or exercise context has received little attention. This study served to pave inroads into this area by aiming to assess the effects of density and differing attributions on a group of important psychosocial and physiological outcomes. From these data, evidence was obtained to support the use of attributions in influencing feelings of spatial crowding among group exercisers. Moreover, it was also discovered that crowding attributions may raise heart rate and activity levels. Although the exact impact of density on exercise outcomes is not yet clear, these findings do provide some initial evidence supporting the use of attribution manipulations for reducing feelings of crowding in a gym setting.

Thus, it will be important to further assess the utility of manipulating attributions to reduce feelings of crowding. If future research ultimately confirms expectations that perceived crowding acts as an exercise barrier, it will be important to find novel ways to combat this issue. The present study provided initial evidence that a simple statement may be able to manipulate exercisers' attributions away from crowding. This feat may be accomplished by methods as simple as posting a sign with an appropriate message, or having gym staff make periodic announcements to draw gym users' attributions in a positive direction. By building upon the

foundations established in this research, future studies can potentially aid in our nation's goal of increasing levels of physical activity in order to improve the health, longevity and quality of life among Americans.

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### Biographical Information

Colin Jenney began research in the area of Health Psychology as an undergraduate at the University of Texas at Arlington. After completing a Bachelor of Science degree in interdisciplinary studies in 2010, Colin entered graduate school at the University of Texas at Arlington directly thereafter. While continuing to study Health Psychology, Colin specialized in the area of self-care behaviors, especially those impacting physical activity. During his graduate years, Colin developed a passion for teaching while holding several different roles as an instructor, including graduate teaching assistant and adjunct professor. Colin completed his master of science degree in 2012 and continued his research into his doctoral years while adopting a number of concepts from Social Psychology into his work. Colin's dissertation quickly developed into a collaborative project, which involved faculty from multiple departments and specializations. Over his graduate career, Colin has gained a number of certifications ranging from an ACSM personal trainer certification, to a certification in phlebotomy while working on a variety of projects investigating sedentary populations, type 2 diabetics, and patients with cardiovascular disease. Colin's training and research have consistently reflected his interdisciplinary training, as he has worked to integrate psychological, social, and physiological measures into his scholarly projects. Following his graduate education, Colin has chosen to accept a position in academia and wishes to continue working in various teaching and research roles.