“THE FRIEND ZONE”- FRIENDSHIP MODERATES THE IMPACT OF A WEB-BASED GROUP DYNAMICS APPLICATION ON GROUP COHESION: A RANDOMIZED TRIAL

by

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B.S., Michigan State University, 2012

A THESIS

submitted in partial fulfillment of the requirements for the degree

MASTER OF PUBLIC HEALTH

Department of Kinesiology
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KANSAS STATE UNIVERSITY
Manhattan, Kansas

2016

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Abstract

Purpose: Face-to-face group dynamics-based (GDB) programs have been shown to be effective in promoting group cohesion and physical activity (PA). Recent evidence suggests that GDB principles can be successfully translated to web-based applications to impact group cohesion. The social nature of such applications allows for interactions to occur between friends and strangers alike, potentially moderating the effects of such GDB applications. Optimal group composition within GDB web applications has yet to be determined. The present study examines the moderating effects of group composition in a GDB application on group cohesion and PA.

Methods: Participants (n = 166) were randomized into same-sex pairs and then randomly assigned to an experimental condition: stranger (no app), stranger (using app), friend (using app) or individual control. Participants in all conditions performed two sets of planking exercises. In between sets, those in partnered conditions interacted with their partner using a GDB social media app, where they participated in a series of team-building activities. The main dependent variables were group cohesion and physical activity, calculated as the total persistence during Block 2, controlling for Block 1 persistence.

Results: Results indicate that the group integration dimensions of cohesion were higher in groups that used the application than those that did not (GI-T: p= .001; GI-S: p= .004). Friends that used the app reported greater cohesion across all dimensions than strangers that did the same (ATG-T: p= .006; ATG-S: p= .003; GI-T: p= .001; GI-S: p< .001). There was also a significant difference in PA (p=.004) between the two app-using conditions. However, there was no significant difference in PA between app using conditions and strangers that did not use the app (p= .495).

Conclusions: Group cohesion can be enhanced through the use of an online GDB application. Using an online GDB application with a friend is associated with higher levels of cohesion. Further research is necessary to identify effective online GDB applications for impacting physical activity and cohesion in field settings.

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Acknowledgements

I would like to first thank my major professor, Dr. Brandon Irwin. I am grateful to have Dr. Irwin as my mentor, and to have been given the opportunity to work with him in the lab. It has been a long, challenging journey to get to where I'm at, and would not have been able to make it this far without Dr. Irwin's guidance, and mentorship. I owe much of my development as a researcher to Dr. Irwin. Thank you for your guidance over the past few years. I would also like to thank my other committee members, Dr. Emily Mailey, and Dr. David Dzewaltowski, who have given me instrumental support in the progress of my degree over my time at K-State. I would also like to thank the MPH program staff, including Barta Stevenson, Dr. Michael Cates, and Dr. Annelise Nguyen. Without their help, none of this would have been possible.

I would also like to give my thanks Dr. Patrice Chalin, who designed the application, and worked with me to make the necessary adjustments to the application. I would like to also thank Seth Galitzer for helping us get the application up and running on the K-State servers. I also would like to acknowledge my undergraduate assistants, Brendan McCluskie, Drew Detwiler, LaShae Hedstrom, and Amanda Goebel for all of the hours of data collection they helped with. I'd like to also extend a special thanks to my colleague, lab mate, and good friend, Danny Kurz. Danny's support throughout my time in this program has been crucial to my success.

Lastly, I'd like to thank all of my graduate colleagues, friends, and family. Thank you for your support over the past few years.

Dedication

For my Grandfather for inspiring my interest with science, and for my parents for teaching me the value of hard work.

Preface

This thesis report is submitted in partial fulfillment of the degree of Master of Public Health at Kansas State University. The following report presents a master's thesis study. A separate document will report my public health field experience. The first chapter is a research study examining the impact of group composition in a Group Dynamics Based web application on physical activity and perceptions of group cohesion. This chapter provides a rationale for the study, hypotheses, methods, results, and a discussion of the findings.

Chapter 1 - Master's Thesis Study

Introduction

Group dynamics-based (GDB) physical activity (PA) interventions are at least or more effective than individually tailored interventions (Kahn, et al, 2002; Dishman & Buckworth, 1996; Burke, et al, 2006), but are hampered by a variety of limitations that likely impact reach, adoption, effectiveness, and implementation. GDB interventions aim to develop group cohesion through team building activities, making the group an 'active ingredient' in the behavior change process (Estabrooks, et al, 2012). GDB interventions often place an extra burden on participants and staff to be present to manage and facilitate group activities. Further, groups are often constrained by geographic location and time due to the face-to-face nature of such programs. Strategies to overcome these challenges may help optimize group-based programs and enable broader reach and implementation.

Use of the Internet may provide an option for efficiently reaching a larger population (Riebe, et al, 2000; Vandelanotte, et al, 2007; Davies, et al, 2012) while overcoming some of the challenges related to traditional face-to-face GDB interventions. For example, internet-based interventions can decrease burdens on practitioners by fostering group interactions (Lefebvre & Bornkessel, 2013) while also aiding to overcome geographic and time constraints often faced by traditional GDB interventions.

Preliminary evidence suggests that GDB principles of behavior change can be translated into web-based applications that guide group members through cohesion building activities (Irwin, et al, 2016, in press). In a study by Irwin and colleagues (2016, in press), participants interacted with each other in a web-based GDB application based on Carron and Spink's (1993)

conceptual model of team building. It was found that the application positively impacted cohesion in comparison to a 'standard' web-based social support intervention (Irwin, et al, 2016, in press). Such findings are encouraging for the use of virtual groups for promoting PA in online interventions.

However, there are a number of potential moderating problems inherent in internet-based interventions and factors that need to be better understood to maximize the effects of such applications for promoting PA. One such factor is group composition. Since online groups are typically composed of individuals that are from different geographic areas, and have no commonalities (Jarvenpaa & Leidner, 1998), the ability to effectively build cohesion may be limited within groups of strangers. For example, individuals that have not worked together in the past, nor will do so in the future (i.e. strangers) may not be as accountable for their actions within the team, and may not place as much effort into building cohesion with group members (Kerr & Seok, 2011). A sensible way to test the effect of group composition would be to examine whether friendship moderates the impact of an online GDB intervention on cohesion and PA. To date, this has not yet been tested.

The purpose of this study is to examine the moderating effects of friendship status in a brief, web-based GDB PA intervention on PA persistence and group cohesion. Participants were randomized into one of four conditions (Friend, Stranger-app, Stranger-no app, and individual) to test the following hypotheses:

1. Participants that use the GDB application will have greater:
    a. PA persistence than those that do not use the application.
    b. Cohesion than those that do not use the application.
2. Friend groups that use the application will have greater:

a. PA persistence than strangers that use the application.

b. Cohesion than strangers that use the application.

Methods

Participants and recruitment

Participants (N= 166; 49.4% female; M_{age}= 19.82, SD= 2.71) were recruited from an introductory kinesiology course at a large Midwestern university and were given course credit for participating in the study. An alternative assignment was also available for course credit. Prior to participating in the study, participants were screened using the Physical Activity Readiness Questionnaire (PAR-Q) to determine if they were healthy enough to participate. In addition, they were screened for physical injuries that would prevent or alter performance of the plank exercises. Participants were also asked: "Please provide the names of 3-5 friends that you know and like that would be interested in participating in the study (we may lookup their names to contact them for participation)". This study was approved by the Institutional Review Board.

Design

This study used a randomized trial design in a 4 (condition) x 2 (gender) x 2 (block) with repeated measures on the last factor. Participants were randomly selected weekly from a recruitment pool, asked to provide availability for the following week, and were then randomly assigned into same-sex dyads based on the given availability. Dyad members were scheduled to participate concurrently. Each dyad member was sent to a different waiting room to avoid interaction prior to the study. Upon arrival to the lab, dyads were randomized into one of four conditions (Individual (n= 32, 16 dyads), stranger without app (n= 50, 25 dyads), stranger with app (n= 44, 22 dyads), friend (n= 40, 20 dyads).

Procedure

Upon arrival to the lab, participant consent was obtained. Participants were then led to an isolated room (separate from the experimenter and the other participant) and instructed to sit at a computer, and watch a brief instructional video explaining all procedures. The video gave instruction and demonstration of proper form for the five abdominal planking exercises that would be performed. Participants were also given the task of holding each exercise for as long as they could within their own wellbeing and comfort. Near the end of the video, the subjects were instructed to pause, and fill out a baseline measure of self-efficacy and situational motivation, then finish watching the video.

To minimize awareness of proximity to each other, all participants wore noise-cancelling headphones that doubled as speakers. In addition, all communication between the experimenter and each participant was performed through an instant messaging chat box rather than verbal communication.

Once the video was completed, participants were told to wait on an exercise mat and follow along with a virtual trainer on a larger monitor in the room. Once both participants were ready to begin, the experimenter initiated the virtual training program and participants completed the first series of exercises. Participants were able to see a live video feed of themselves performing the exercises alongside the virtual trainer, allowing for checking and maintenance of proper form. Each participant completed all exercises in the same order, with a short (40 sec) rest between each exercise.

After the first block of exercises, all participants were directed to return to the computer and await further instruction. Those in the individual condition were given a 15-minute rest

period during which they filled out a second self-efficacy and situational motivation measure, and given generic reading material until the second series.

Participants in the stranger (no app) condition were told that they would be paired up with another person as a part of a team for the second series, and that their partner would be participating in another lab simultaneously. Participants were also given a team task, in which they were working towards an additive team score (member A's time + member B's time). They were also told that for confidentiality reasons, they would not be able to see their partner. Both participants followed along with a virtual trainer that led them through an identical set of exercises. After the explanation of task and condition, participants then filled out a second self-efficacy and situational motivation measure, and were given a rest period (15-minutes).

Participants in the stranger (with app) and friend conditions were told the same information as those in the stranger (no app) condition, but rather than simply rest, they participated in the GDB web-application. Those in the friend condition were told the other participant was one of the friends that they had listed in the initial screening questionnaire. Participants were introduced to their partner through the application, where they participated in a series of team-building tasks. Participants first entered their name, gender, and selected an avatar from a generic present character list. The name was not actually shown to their partner, just the avatar and pseudonym "Partner". On the next page, each participant was asked to share a challenge that they experienced during the first block of exercises. Next, partners were able to exchange advice on how the other could overcome his or her challenge. On the following page, partners were able to vote on and select a team symbol and team name. On the following page, partners worked together to solve a cooperative puzzle that required the use of the keyboard's directional arrows to control the character on the screen. One participant controlled the left/right

movements, and the other controlled the up/down movements of the game character. The team then set an expected level of effort individually using a 1-10 scale, and collectively agreed on the collective group effort. This concluded the GDB app portion of the inter-block period. After completion of the app, participants filled out a second self-efficacy and situational motivation measure.

For the second block, all conditions followed the same procedures as the first. All participants could see a live stream of themselves exercising. Those in the partnered conditions were all told another person would be exercising at the same time and that the team's score was the combined times of the dyad members. The second block was the final block of exercises.

After the second block, participants returned to their respective computers to complete a final series of self-efficacy and situational motivation measures, and a post-trial questionnaire. Partnered conditions completed two cohesion measures in addition to the aforementioned surveys. Upon finishing, subjects were debriefed, thanked, and asked to not discuss the study with anyone else. Those in the friend condition were told that their friend was not actually participating with them. Participants were then dismissed separately to avoid them meeting each other.

Measures/Outcomes

Perceptions of Cohesion

Dyad's perception of cohesion was measured using a modified version of the Physical Activity Group Environment Questionnaire (PAGE-Q)(Estabrooks & Carron, 2000), and using the Perceived Cohesion Scale (PCS) (Bollen & Hoyle, 1990; Salisbury, et al, 2006). All perceptions of cohesion measures were assessed within partnered conditions.

Questions on the original PAGE-Q were modified to fit the context of the study (the online and dyadic nature of the study). Three items from the original PAGE-Q were removed from the modified version, as they lacked relevance within this study. The modified PAGE-Q measures perceived cohesion on four dimensions: Group Integration-Task (GI-T; α= .844), Group Integration-Social (GI-S; α= .894), Attraction to Group-Task (ATG-T; α= .830), and Attraction to Group-Social (ATG-S; α= .880). Consistent with the original, the modified PAGE-Q employed a 9-point Likert scale (i.e. 1= Very strongly disagree, 9= Very strongly agree).

The PCS measures cohesion on two dimensions: belonging (e.g. "I feel that I belong to this group"; α= .887) and morale (e.g. "I am happy to be part of this group"; α= .819). A 7-point Likert scale was employed (i.e. 1=strongly disagree, 7= strongly agree). The 6 items on the PCS were not altered.

Physical Activity

Physical activity was operationally defined as the total amount of time (in seconds) that participants persist during a block of 5 planking exercises. The sum of time spent on each exercise within one block constituted a block score. Digital stopwatches were used to measure time spent on each exercise. Time was measured for each plank exercise, from the time participants got into position for the exercise, until the time they stopped the exercise. Rest time was calculated between each exercise.

Rating of Perceived Exertion

Rating of Perceived Exertion (RPE) was measured using a 10-point Borg RPE scale (Borg, 1982). A score of 1 represented "no exertion at all", while a score of 10 represented "maximal exertion". Participants recorded RPE immediately after each exercise by circling a

number on a sheet provided. Participants were asked to rate how they felt towards the end of the exercise.

Trust

Trust was measured using the Dyadic Trust Scale (Larzelere & Huston, 1980). The scale consisted of 8 statements (α= .851), using a 7-point Likert scale (from *very strongly disagree* to *very strongly agree*). Examples of statements included: "I feel that I can trust my teammate completely", "I feel that my teammate can be counted on to help me". Trust was only assessed within partnered conditions.

Motivation

Motivation was measured with the Situational Motivation Scale (SMS) (Guay, et al, 2000). The SMS consisted of 16 items, which reflected different reasons participants might be motivated to perform the exercises. Each item was rated on a 7-point bipolar scale beginning with the stem: "Please indicate the answer that best describes the reason why you are currently engaged in the abdominal exercises you are performing. Answer each item according to the following scale" (e.g. 1-"corresponds not at all"; 7-"corresponds exactly"). Four items each were based on four types of motivation within Self-Determination Theory (SDT): Intrinsic Motivation (α= .967), Introjected Regulation (α= .943), External Regulation (α= .957), and Amotivation (α= .950). The questionnaire was administered at three different time points: pre block 1, post block 1, and post block 2. Four different scores for each time point were calculated to represent each motivation type.

Attitude Towards Partner

Attitude towards one's partner (ATP) was assessed using 4 statements (α= .833), which participants responded to using a 5-point Likert scale (from *strongly disagree* to *strongly agree)*. Statements included: "I liked my partner", "I would be glad to exercise with my partner again in the future", "I felt comfortable with my partner", and "I would like to get to know my partner better". ATP was only measured within partnered conditions.

Data Analysis

Sample Power

An a priori power analysis following *F* index recommendations indicated that a sample size of n=32 per condition would be sufficient for detecting a moderate (*F*=0.25) effect with probability >.80. Effect size was determined by a power analysis based on the findings of similar studies (Feltz, et al, 2011; Irwin, et al 2012) using G-power software.

Hypothesis Testing

To test the main hypotheses for PA, a 4 (condition) x 2 (gender) ANCOVA was used with block 1 time as a covariate, with a Helmert planned contrast. To test the cohesion hypotheses, separate 3 (condition) x 2 (gender) MANOVAs were used with each subscale of the PAGE-Q and PCS as the dependent variables, with a Helmert planned contrast.

Ancillary analyses

Ancillary analyses were conducted using a series of ANOVAs, all of which are described within the results section.

Results

Sample population

The total sample consisted of 166 (84 male, 82 female) college-aged participants (M_{age} = 19.82, SD = 2.71). 30 participants were excluded from analyses due to failed manipulations (i.e. did not understand who their partner was, or how they were scored), eight were excluded due to a failed session (i.e. technology failing), and two were excluded as outliers for the persistence measure (i.e. fell outside of 3 SD's of the mean for physical activity performance), giving a final sample of 126 (59 male, 67 female, M_{age}= 19.94, SD = 2.99).

Preliminary analysis

An intraclass correlation (ICC) analysis was done to detect potential 'clustering' of PA and cohesion scores within the dyads. Results for perceptions of cohesion were analyzed according to recommendations by Carron and colleagues (2003) for determining the degree that perceptions were shared among group members. Criteria for detecting a small 'groupness' effect was set at an (ICC) of greater than or equal to .40 for ATG-S and ATG-T and greater than or equal to .50 for GI-S and GI-T. Based on these criteria, there was no evidence of grouping for cohesion scores (ATG-T: ICC = -.031, p = .599; ATG-S: ICC = .214, p = .040; GI-T: ICC = .197, p = .054; GI-S: ICC = .267, p = .014; Belonging: ICC = .144, p = .121; Morale: ICC = .229, p = .030). Results for PA indicated that scores were not clustered into dyads for any conditions (Individual: ICC = .164, p = .265; Stranger-no app: ICC = -.068, p = .629; Stranger-with app: ICC = .278, p = .099; Friend: ICC = .492, p = .012). All following analyses were conducted at the individual level.

Perceptions of Cohesion- PAGEQ

A Helmert planned contrast between app using conditions and the stranger-no app condition revealed a significant difference for GI-T ($p = .001$) and GI-S ($p = .004$;) between conditions, but no significant difference for ATG-T ($p = .761$;) and ATG-S ($p = .111$). Between app-using conditions, there were significant differences for all PAGE-Q measures (ATG-T: $p = .006$; ATG-S: $p = .003$; GI-T: $p = .001$; GI-S: $p < .001$). The friend condition was higher for all PAGE-Q dimensions than the stranger-app condition. Table C.1 displays the means and standard deviations for all dimensions of cohesion (see Appendix C).

Perceptions of Cohesion- PCS

Among partnered conditions, a Helmert planned contrast revealed a significant difference between app using and non-app using conditions for both belonging ($p = .026$) and morale ($p = .033$). Participants in app using conditions had higher perceptions of belonging and morale than did those in the non-app condition. The differences between the app using conditions were significant for morale ($p = .005$), and approached significance for belonging ($p = .051$).

Physical Activity

A Helmert planned contrast between individual and partnered conditions revealed a significant difference between individual and partnered conditions ($p = .001$). Partnered conditions were more physically active (EM = 259.59; 95% CI: 245.86, 273.32) than individuals (EM = 231.04, 95% CI: 217.19, 244.88). There was also a significant difference between the two app using conditions ($p = .004$). Those in the friend condition were more physically active (EM = 272.462, 95% CI: 258.32, 286.59) than strangers that used the app (EM = 242.93, 95% CI: 229.06, 256.79). However, there was no significant difference between app using conditions

and strangers that did not use the app (p = .495). In fact, strangers that did not use the app were more physically active (EM = 263.38, 95% CI: 250.19, 276.58) than strangers that did.

Ancillary Analyses

Motivation

All situational motivation subscales were analyzed in a series of 3 (time) x 4 (condition) x 2 (gender) ANOVAs with repeated measures on the first factor. In light of a Mauchly's test of sphericity violation, a Greenhouse-Geisser correction was applied to all of the following repeated measures tests on motivation.

Intrinsic motivation

There was a time main effect for intrinsic motivation ($F_{1.796, 211.924} = 4.148$, p = .021, partial eta squared = .034). Participants were most intrinsically motivated prior to block 1 (M = 3.80, SD = 1.11), and were less motivated after the first set of exercises (M = 3.68, SD = 1.30), and remained relatively consistent after the second block of exercises (M = 3.65, SD = 1.37).

External Regulation

There was a time main effect for extrinsic regulation ($F_{1.734, \mathbf{204.665}} = 12.303$, p < .001, partial eta squared = .094). Participants had high external regulation scores before participating in the first block of exercises (M = 4.30, SD = 1.34). A decrease in external regulation was observed after the first block of exercises (M = 4.00, SD = 1.65), followed by a marginal decrease after the second block of exercises (M = 3.96, SD = 1.72).

Attitude Towards Partner

A 3 (condition) x 2 (gender) ANOVA revealed a condition main effect for attitude towards partner ($F_{2, 89} = 11.367$, $p < .001$). Participants in the friend condition had the highest/best attitude towards their partner (M = 4.04, SD = .57), followed by those in the stranger-no app condition (M = 3.43, SD = .51). Participants in the stranger-with app condition had the lowest attitude towards their partner (M = 3.37, SD = .69). There was no gender effect ($F_{1,89} = .962$, $p = .329$).

Rating of Perceived Exertion

Ratings of perceived exertion (RPE) were averaged across all exercises within each block, and analyzed in a 2 (block) x 2 (gender) x 4 (condition) ANOVA with repeated measures on the first factor. A significant block main effect was found ($F_{1, 118} = 30.074$, $p < .001$, partial eta squared = .204). Participants reported greater exertion during the second block (M = 5.60, SD = 1.47) than during the first block (M = 5.21, SD = 1.40).

There was also a significant interaction effect between gender and block ($F_{1, 118} = 5.664$, $p = .019$,). During block 2, males reported slightly greater exertion (M =5.72, SD = 1.44), than in block 1 (M = 5.51, SD = 1.38). Females however, reported greater exertion on block 2 (M = 5.50, SD = 1.50) than on block 1 (M = 4.95, SD = 1.37).

Trust

A 3 (condition) x 2 (gender) ANOVA revealed a significant condition effect for trust ($F_{2, 89} = 16.809$, $p < .001$). Those in the friend condition had the lowest trust scores (M = 3.01, SD = .636), followed by those in the stranger-app condition (M = 3.47, SD = .674). Those in the stranger-no app condition had the highest trust scores (M = 3.94, SD = .595).

Discussion

The primary purpose of this study was to examine the effects of a web-based GDB physical activity (PA) intervention on PA and cohesion. We hypothesized that use of the GDB app would elicit higher cohesion and PA than those that did not use the app. We also hypothesized that friend groups using the app would have higher cohesion and PA than stranger groups. Our hypotheses were partially supported.

Principal results

Cohesion

The hypothesis that app users would have higher perceived cohesion than non-app users was partially supported. Significant differences were found between app users and non-app users for all measured domains of cohesion except for each of the attraction to group (ATG) domains (social and task). One possible explanation for this is the fact that non-app users did not have any interaction with, or 'access' to their partners whatsoever, possibly resulting in a feeling of isolation from the group, resulting in decreased feelings of belonging, morale and integration with the group. An explanation for the ATG findings is that simply interacting within the app was not enough to make app users more attracted to the group. Perhaps the omission of most of the personal information, or censoring of names made the user on the other end of the app seem less like an actual person, which may have diminished feelings/perceptions of social attraction to the group. The non-app using group may have also simply not had enough interaction with their partner to gather information and make an appropriate judgment about their partner.

The hypothesis that friend groups that used the app would have higher perceived cohesion than strangers that did the same was supported**.** Friend groups had significantly higher

perceived cohesion scores than strangers using the app for all domains. One possible explanation is that friend groups, although they were not completely identifiable, may have had higher existing cohesion with the partner that was present. This could be resultant of years, months, or weeks of bonding in a relationship with the friend. Another explanation could be that individuals in the friend condition were more attracted to the group (higher ATG-T, ATG-S) as a whole because of the fact they were on a team with a friend. Strangers using the app may have simply not cared about developing a relationship with someone they would never again interact with, and were not attracted to the group in a social manner. This is reflected in the stranger-app condition having the lowest attitude towards partner (ATP) score.

Strangers using the app may have been less 'socially concerned' as a result of the group composition. One of the scales on which strangers scored lowest, group integration-social, reflects "...perception of similarity, closeness, and bonding within the group as a whole" (Carron, et al, 1985), related to developing and/or maintaining relationships (Carron et al, 1985). Strangers using the app may not have felt close to, or bonded with their group after interacting with someone they did not know. On the other hand, those strangers that did not use the app did not have any kind of interaction from which to gauge concern for developing or maintaining a relationship with their partner, likely leading to inflated scores. Friends should almost certainly be the most concerned group with maintaining social relationships with someone they will interact with again.

Physical Activity

The hypothesis that those using the GDB application would have greater PA persistence than those not using the app was not supported. Those that used the app did not persist significantly longer than those that did not use the app. This finding is inconsistent with previous

literature examining internet-delivered interventions aimed at increasing PA levels (Davies et al, 2012; Vandelanotte, et al, 2007; Irwin et al, 2016, in press), which shows a small positive effect on PA. Traditional internet-delivered interventions commonly include features meant to deliver information, feedback, and social support. For instance, using discussion boards in attempts to provide opportunity for users to offer social support to one another. Our application differed in that it utilized multiple GDB components meant to enhance social interaction within the team, and thereby foster increased perception of group cohesion, which may have positively impacted PA persistence.

The findings are also inconsistent with literature citing the positive effects of GDB interventions on physical activity (Burke, et al, 2006, Estabrooks et al., 2012). Those in the app-using conditions did have greater contact with their partner, which is suggested by Burke and colleagues (2006) to promote positive effects of group interventions. However, our intervention did differ from traditional GDB interventions in a few ways. First, our intervention was entirely online, whereas other GDB interventions have largely been in-person, or only partially online (Harden, et al, 2015). Our intervention also targeted a different type of PA behavior. Traditional GDB interventions often target PA adherence and frequency, whereas we targeted PA duration. Our intervention was also brief (one-hour session, with 7-10 minutes spent using the app) in comparison to other interventions, which can last weeks to months (Harden, et al, 2015).

The hypothesis that friend groups that used the app would have greater PA persistence than strangers that did the same was supported. Friends persisted significantly longer than did strangers that also used the app. There are several possible explanations for this. Kerr and Seok (2011) found that working in a group with a friend can boost performance on a physical task. Dunton and colleagues (2009) also found that adults performing PA with friends tended to work

out for a greater duration than when alone, which could be explained by increased perceptions of social support. Friends may have also been more motivated to perform positively because of the likelihood of interaction with their partner in the future, holding them more accountable for their actions, whereas strangers are less likely to interact in the future, leading to increased social loafing, or the tendency to exert less effort towards a task when an individual's performance is not identifiable to other group members (Latane, et al, 1979; Karau & Williams, 1997). Yet another possible explanation is that friends and strangers differed in the quality of their relationships, which has been found to impact health and health behaviors (Berkman & Syme, 1979; Umberson et al, 2010; Holt-Lunstad, et al, 2010). Perhaps friends felt greater social support, than did strangers, which may have acted as a buffer to any potential negative impact of the app on PA. Conversely, lower quality relationships between strangers may have had a negative effect on physical activity performance, due to a perceived lack of social support. This could also be explained by the fact that friend groups were much more cohesive than stranger groups using the app. Previous research has shown that groups that are more cohesive tend to have greater group performance (Carron & Spink, 1993; Carron & Spink, 1994).

Implications

Our data suggests that friendship status may moderate the impact of a GDB app on group cohesion and PA. This study suggests that group composition and formation should be considered when intervening using web-based team-building applications. Further research is needed to clarify the optimal group composition for web-based GDB apps, and other factors that might moderate the effects of such apps. Optimally, through continued development, perhaps future research can make strangers more 'like' friends through continued development of GDB apps. It is also necessary for researchers to test the effects of such an app over time and in real-

world settings, examining effects on PA adherence and frequency in addition to, or in place of PA persistence.

Limitations

This study has several limitations. First, this was a brief intervention conducted in a lab setting, with only one bout of exercise, and one use of the app. We also used a convenience sample of college students majoring in Kinesiology, who may respond differently to a web-based intervention than other populations (e.g. elderly). Further research is needed to determine whether or not the effects of this intervention can be sustained over time, or with other populations, and in real-world settings.

Second, the participants in the friend condition were not truly friends. Simply telling participants that they were paired up with a friend may have instilled a sense of doubt or skepticism and potentially altered the behavior of the participants, especially because the partner was not visually apparent, which has been shown to moderate PA (Irwin et al, 2016, in press).

Third, the lack of a non-app using friend condition limits our ability to determine if cohesion effects were resultant of being in a friend group, the app, or some synergistic effect of both. One possibility is that participants in the friend group had existing cohesion with the person that they were thought to be on a team with.

Fourth, we modified the app from its original state to exclude any kind of performance feedback, or personal information. The modification of the app may have affected perceptions of group structure or environment, leading to altered effects of the app on cohesion.

Fifth, we did not measure cohesion before participants used the app. Given that cohesion is a "dynamic process…" (Carron, et al, 1998, p. 213), it could have been beneficial to take both pre and post assessments in order to determine the magnitude of change of cohesion.

Conclusions

The present study tested the moderating effects of friendship status in a brief, web-based GDB PA intervention on PA persistence and group cohesion. Friendship status did appear to impact group cohesion and physical activity.

In summary, practitioners may need to consider group composition when implementing an online GDB intervention for increasing PA. Further studies are needed to identify the effects of such an application over time, in real-world settings, and on exercise adherence and frequency.

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Appendix A - Measures

Cohesion measures

Figure A.1-Physical Activity Group Environment Questionnaire

	Very Strongly Disagree	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree	Very Strongly Agree	Prefer not to answer
I like the amount of exercise I got in this session.	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
My group was important to me.	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
My group provided me with a good opportunity to improve in areas of fitness I consider important.	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
I enjoyed my social interactions with my group.	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
I was happy with the intensity of the exercise in this session.	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
I liked meeting my online partner.	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
I liked the exercise done in this group.	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
I will miss my contact with my partner.	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
My partner provided me with a good opportunity to improve my personal fitness.	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
The social interaction I had online in this exercise group was important to me.	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

	Very Strongly Disagree	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree	Very Strongly Agree	Prefer not to answer
My partner and I were united in our belief about the benefits of the exercises offered in this program.	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
My partner and I often socialized during time spent online.	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
My partner and I are satisfied with the intensity of exercise in this program.	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
My partner and I would likely spend time together after the program ends.	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
My partner and I enjoyed helping to improve our exercise group.	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
My partner and I would probably socialize together outside of activity time.	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
We encouraged each other in order to get the most out of the program.	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
My partner and I would probably spend time socializing with each other before and after our exercise sessions.	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

Figure A.2- Perceived Cohesion Scale

	Strongly Disagree	Somewhat Disagree	Slightly Disagree	Neutral	Slightly Agree	Somewhat Agree	Strongly Agree	Prefer not to answer
I feel that I belong to this group	❍	❍	❍	❍	❍	❍	❍	❍
I am happy to be part of this group	❍	❍	❍	❍	❍	❍	❍	❍
I see myself as part of this group	❍	❍	❍	❍	❍	❍	❍	❍
This group is one of the best anywhere	❍	❍	❍	❍	❍	❍	❍	❍
I feel that I am a member of this group	❍	❍	❍	❍	❍	❍	❍	❍
I am content to be part of this group	❍	❍	❍	❍	❍	❍	❍	❍

Figure A.3- Borg RPE Scale

Rating	Description
0	No Exertion at all
0.5	Very, Very Light
1	Very Light
2	Fairly Light
3	Moderate
4	Somewhat Hard
5	Hard
6	
7	Very Hard
8	
9	
10	Very Very Hard (Maximal)

Please Circle the number that best represents your feeling of exertion for each exercise.

Plank 1 (Circle One) 0 1 2 3 4 5 6 7 8 9 10
Plank 2 (Circle One) 0 1 2 3 4 5 6 7 8 9 10
Plank 3(Circle One) 0 1 2 3 4 5 6 7 8 9 10
Plank 4 (Circle One) 0 1 2 3 4 5 6 7 8 9 10
Plank 5 (Circle One) 0 1 2 3 4 5 6 7 8 9 10

Figure A.4- Dyadic Trust Scale

	Very Strongly Disagree	Strongly Disagree	Mildly Disagree	Neutral	Mildly Agree	Strongly Agree	Very Strongly Agree
My teammate is primarily interested in his/her own welfare	❍	❍	❍	❍	❍	❍	❍
There are times when my teammate cannot be trusted	❍	❍	❍	❍	❍	❍	❍
My teammate is perfectly honest and truthful with me	❍	❍	❍	❍	❍	❍	❍
I feel that I can trust my teammate completely	❍	❍	❍	❍	❍	❍	❍
My teammate is truly sincere in his/her promises	❍	❍	❍	❍	❍	❍	❍
I feel that my teammate does not show me enough consideration	❍	❍	❍	❍	❍	❍	❍
My teammate treats me fairly and justly	❍	❍	❍	❍	❍	❍	❍
I feel that my teammate can be counted on to help me	❍	❍	❍	❍	❍	❍	❍

Figure A.5- Situational Motivation Scale

	Does not correspond at all	Corresponds very little	Corresponds a little	Corresponds moderately	Corresponds enough	Corresponds a lot	Corresponds exactly	Prefer not to answer
Because I think that this activity is interesting	❍	❍	❍	❍	❍	❍	❍	❍
Because I am doing it for my own good	❍	❍	❍	❍	❍	❍	❍	❍
Because I am supposed to do it	❍	❍	❍	❍	❍	❍	❍	❍
There may be good reasons to do this activity, but personally I don't see any	❍	❍	❍	❍	❍	❍	❍	❍
Because I think this activity is pleasant	❍	❍	❍	❍	❍	❍	❍	❍
Because I think that this activity is good for me	❍	❍	❍	❍	❍	❍	❍	❍
Because it is something that I have to do	❍	❍	❍	❍	❍	❍	❍	❍
I do this activity but I am not sure if it is worth it	❍	❍	❍	❍	❍	❍	❍	❍
Because this activity is fun	❍	❍	❍	❍	❍	❍	❍	❍
By personal decision	❍	❍	❍	❍	❍	❍	❍	❍
Because I don't have any choice	❍	❍	❍	❍	❍	❍	❍	❍
I don't know; I don't see what this activity brings me	❍	❍	❍	❍	❍	❍	❍	❍
Because I feel good when doing this activity	❍	❍	❍	❍	❍	❍	❍	❍
Because I believe that this activity is important to me	❍	❍	❍	❍	❍	❍	❍	❍
Because I feel that I have to do it	❍	❍	❍	❍	❍	❍	❍	❍
I do this activity, but I am not sure it is a good thing to pursue it	❍	❍	❍	❍	❍	❍	❍	❍

Figure A.6- Team Perception Measure

	Strongly Disagree	Disagree	Somewhat Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Somewhat Agree	Agree	Strongly Agree	Prefer not to answer
I felt I was part of a team.	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
I thought of my partner as a teammate.	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
I felt I worked collaboratively with my partner.	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
I felt my partner and I worked together.	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
I felt I was working separately from my partner.	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

Figure A.7- Group Attraction

	Strongly Disagree	Disagree	Somewhat Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Somewhat Agree	Agree	Strongly Agree	Prefer not to answer
I consider this exercise group to be important	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
I identified with this exercise group	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
I felt strong ties with this exercise group	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
I was glad to belong to this exercise group.	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
I saw myself as	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

Figure A.8- Attitude Towards Partner

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I liked my partner	❍	❍	❍	❍	❍
I would be glad to exercise with my partner again in the future	❍	❍	❍	❍	❍
I felt comfortable with my partner	❍	❍	❍	❍	❍
I would like to get to know my partner better	❍	❍	❍	❍	❍

Appendix B - Figures

Figure B.1 Participant Flow Chart

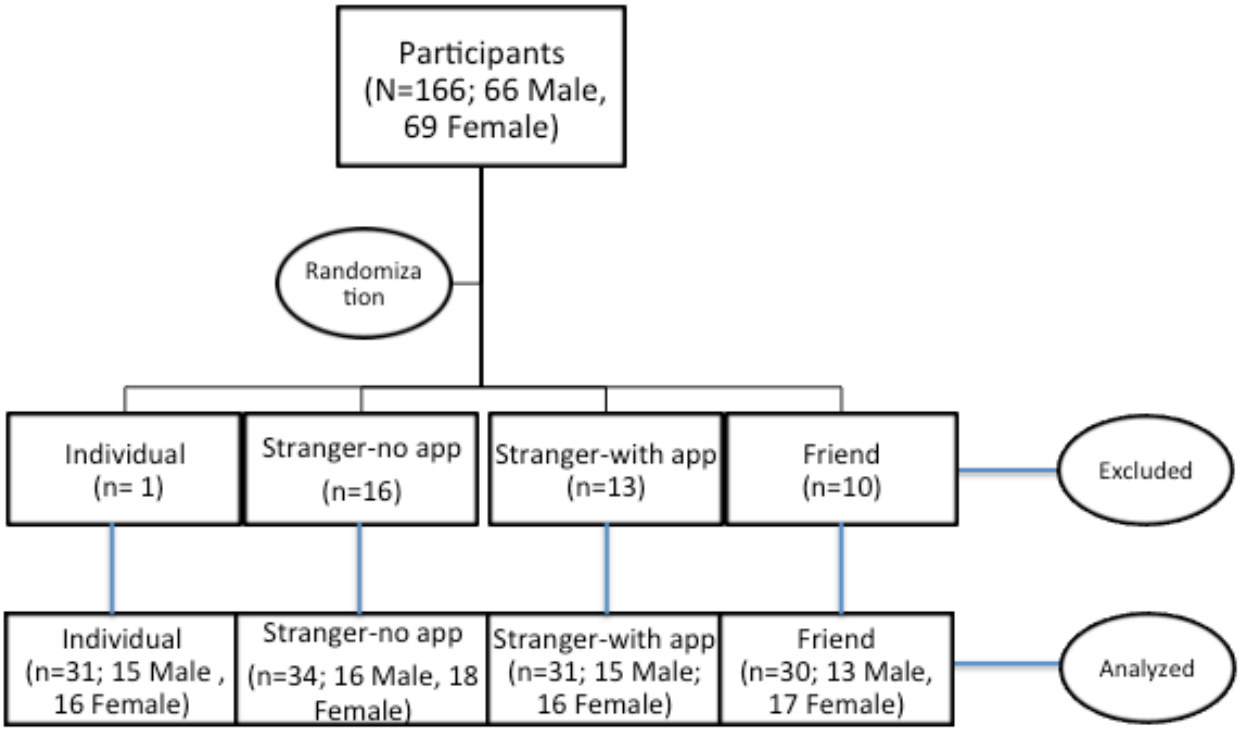


Figure B.2 PAGE-Q Scores for App vs. No App

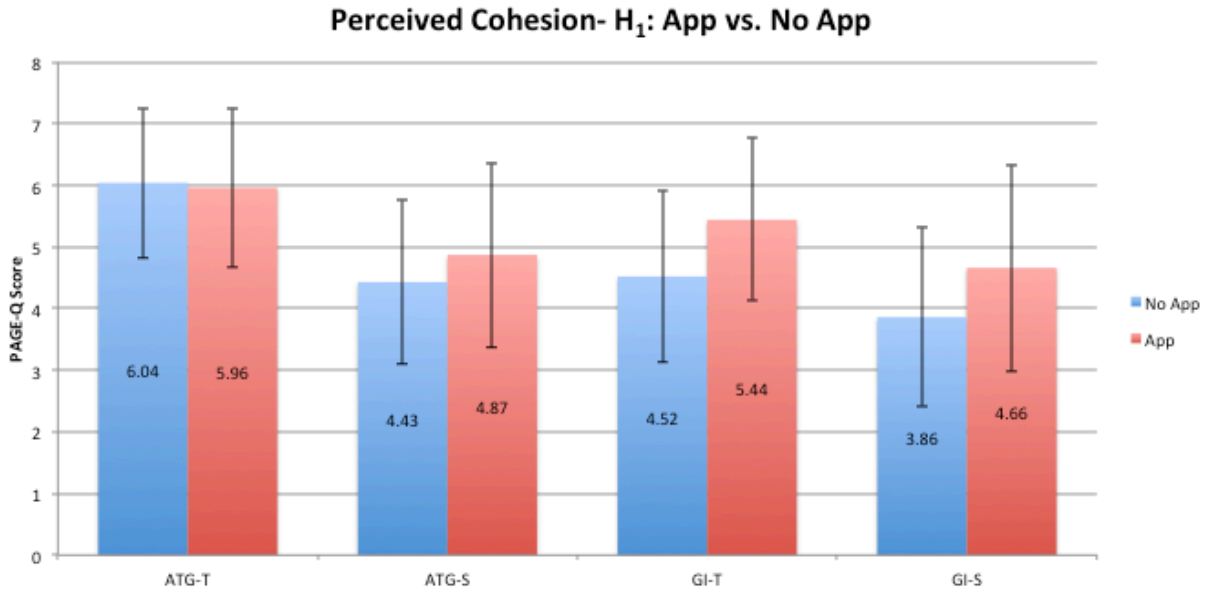


Figure B.3 PCS Scores for App vs. No App

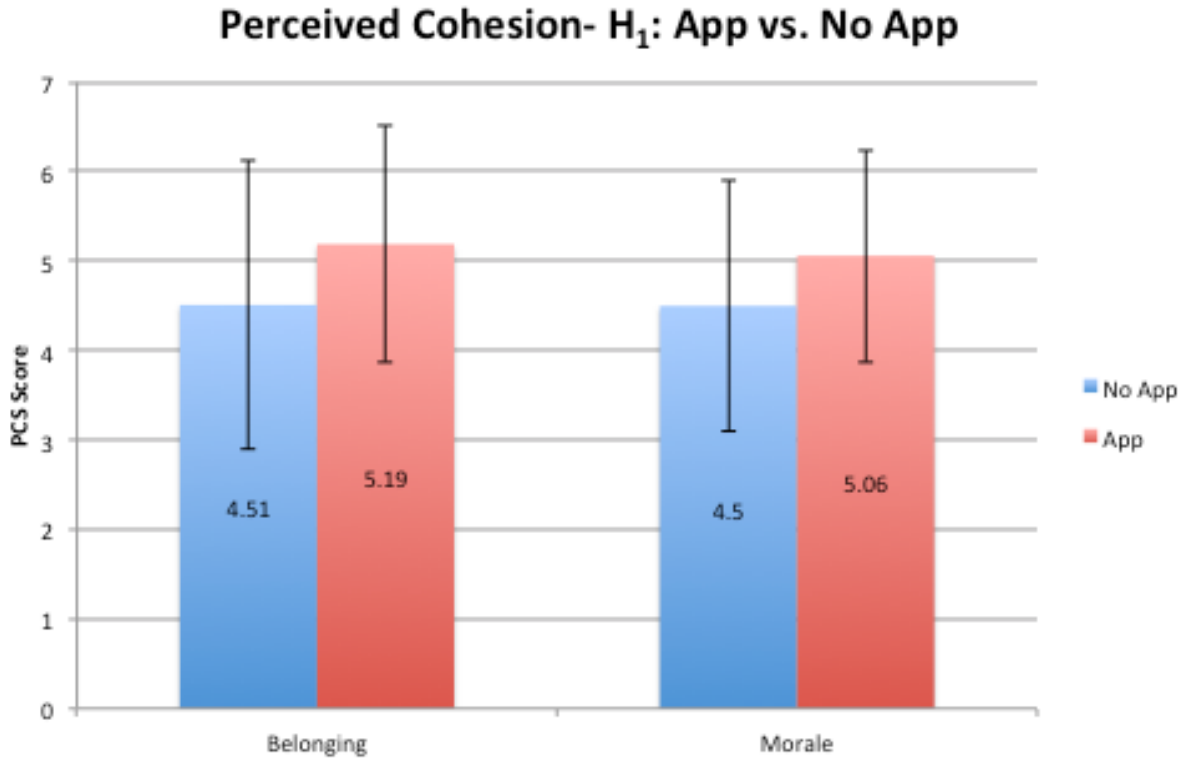


Figure B.4 Physical Activity for App vs. No App

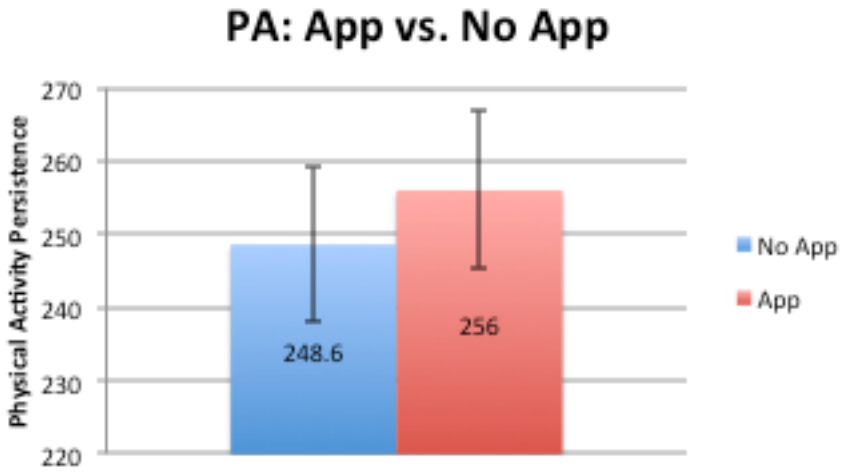


Figure B.5 PAGE-Q Scores for Friend vs. Stranger-App

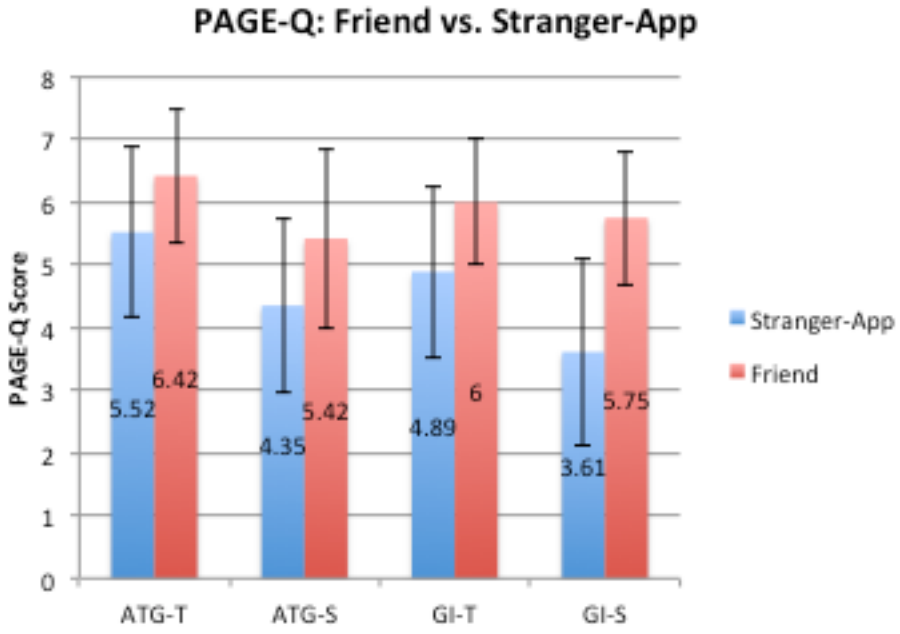


Figure B.6 PCS Scores for Friend vs. Stranger-App

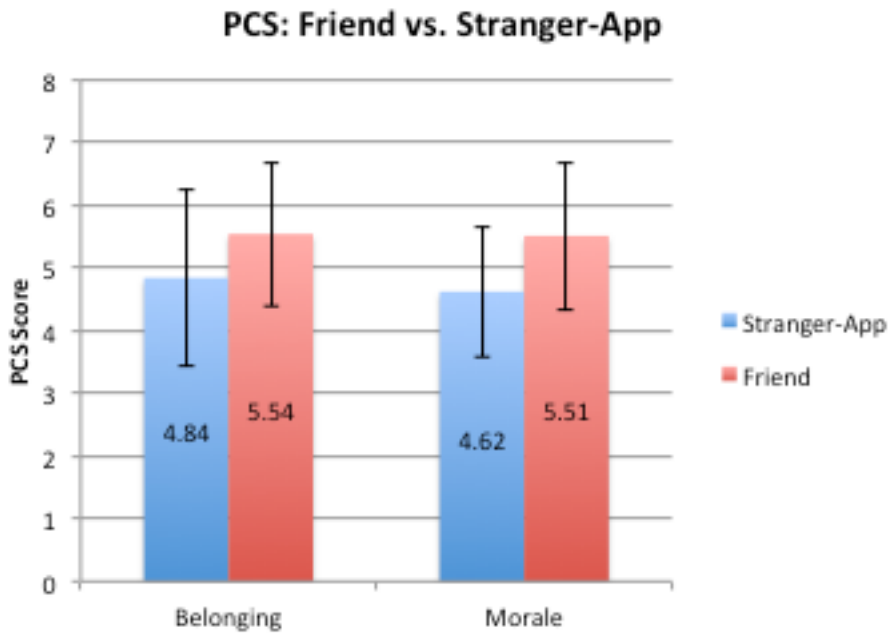
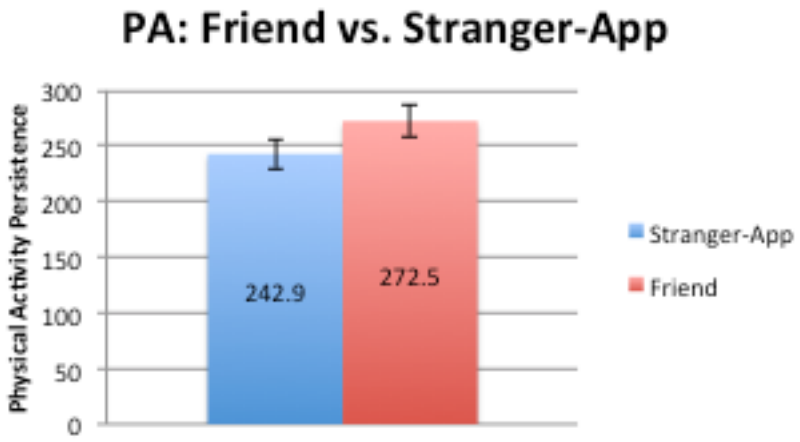


Figure B.7 Physical Activity for Friend vs. Stranger-App



Appendix C - Appendix C- Tables

Table C.1- Cohesion Means

Cohesion dimension	Condition	N	Mean (SD)
Attraction to Group-Task			
	Stranger-No App	34	6.04 (1.22)
	Stranger-App	31	5.52 (1.35)
	Friend	30	6.42 (1.07)
Attraction to Group-Social		.	
	Stranger-No App	34	4.43 (1.33)
	Stranger-App	31	4.35 (1.39)
	Friend	30	5.42 (1.43)
Group Integration-Task			
	Stranger-No App	34	4.52 (1.39)
	Stranger-App	31	4.89 (1.37)
	Friend	30	6.00 (1.00)
Group Integration-Social			
	Stranger-No App	34	3.86 (1.46)
	Stranger-App	31	3.61 (1.49)
	Friend	30	5.75 (1.07)
Belonging			
	Stranger-No App	34	4.51 (1.61)
	Stranger-App	31	4.84 (1.41)
	Friend	30	5.54 (1.15)
Morale			
	Stranger-No App	34	4.50 (1.40)
	Stranger-App	31	4.62 (1.04)
	Friend	30	5.51 (1.18)