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Rachael Sundland Date

The Effect of Learning Styles on the Use of Health Education Materials in a Physical Activity Intervention

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Master of Public Health
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THE EFFECT OF LEARNING STYLES ON THE USE OF HEALTH EDUCATION MATERIALS IN A PHYSICAL ACTIVITY INTERVENTION

By

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Bachelor of Science
Biology
2012

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Abstract

The Effect of Learning Styles on the Use of Health Education Materials in a Physical Activity Intervention
By: Rachael Sundland

Objective: The objective of this study was to evaluate the association between individuals learning styles and use of educational materials in the Physical Activities and Lifestyles Study (PALS) conducted at Emory University.

Methods: Emory University employees (n = 410) from 60 departments were randomized into four treatment groups. Of interest to this study are the two treatment groups: Education+Gym and Education + Gym + Time groups (n=195, of whom 189 had information on educational material use). Participants filled out a Learning Style Inventory (Kolb, 1984) questionnaire and assessed the usefulness of educational materials provided. For this study, converging and assimilating learning styles were combined due to sparse data. This formed three levels of the exposure learning styles: Accommodating, Diverging, and Assimilating + Converging. There were eight educational materials provided to participants: an activity log-book, education booklet, emailed tips, gym brochure, mailed tips, walking groups, walking map, and website. In addition to assessing use of each educational material, the overall rating of all the materials was also assessed. The outcomes were collapsed upon to form dichotomous variables, used versus did not use. Using logistic regression the data was analyzed to determine whether or not participants used the provided educational materials differentially based on the three types of learning styles.

Results: The covariate adjusted analyses showed only one significant association. The odds of those with an accommodating learning style using the activity log-book was 0.4 times (95% CI 0.2, 0.7) the odds of those with a diverging learning style using the activity log-book. The data was too sparse to model the association of learning styles with the emailed tips, gym brochure, mailed tips and overall use when controlling for the other covariates.

Conclusion: Learning styles may have an effect on the use of educational materials. Future studies should attempt to enroll larger populations and focus on examining the impact of learning styles on educational material use. These health education studies should explore the impacts of learning styles on technology use and provide data to ensure that, regardless of learning style, easily understood educational materials are being provided to all patients.

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Introduction:

An individual's preferred learning style affects the way in which they absorb and process information. It has been found that students with different learning styles tend to prefer different learning strategies or classroom formats (Ellsworth, 1991; Reiff & Powell, 1992). It follows that learning styles may have an effect on the preference for educational materials both in academics and health education (Sadler-Smith & Riding, 1999; Quintiliani, 2005). If individuals do indeed prefer one type of education material to another, then educators (teachers and health professionals) should provide individuals with the opportunity to learn through their preferred mechanisms. Providing individuals with the opportunity to utilize their preferred method of learning is important because many researchers have found that when educational materials align with an individual's preferred learning style, comprehension is improved (Buch and Bartley, 2002; Kolb, 1984). This would not only be important in classroom education but also in health education. Public health professionals and other health professionals need to ensure that they are able to communicate health information to their target populations in the most effective way possible. If it is true that individuals will find different educational materials more useful, then as health professionals it will be important to disseminate information in multiple formats that are designed to be useful for all learning styles.

Learning Style Definitions and Models:

Learning is considered to be an active process, rather than a passive process, in which the individuals needs to relate the material to personal goals and to real life

examples in order for optimum learning to occur (Jordan, 2008, p.139). The ways in which students learn best, referred to as learning styles, have been defined in many ways although they are invariably considered to be defined as one's preferred method for processing information (Jonassen, 1993). There are many models describing learning styles, each with its own theory and supportive evidence to show how students tend to prefer certain learning materials and classroom formats over others.

Learning Modalities: Visual, Auditory, Read/Write, & Kinesthetic

One set of learning styles, more often considered perceptual modalities, are auditory, visual, or kinesthetic learning styles. In many studies there is a fourth learning style included for read/write learners. In general, auditory learners prefer lectures and discussions to learn; visual learners prefer to learn through drawings, pictures or other teaching tools that utilize imagery; kinesthetic learners learn best by touching and being physically involved with the manipulation of objects; and read/write learners learn best with textual presentations and through the act of writing out information (Zapalska, 2006; Tanner, 2004).

Gregorc's Learning Styles:

In a second set of learning styles described by Gregorc (1984), there are two perceptual qualities (concrete or abstract) and two ordering qualities (random and sequential). These qualities combine to give four different learning styles: *concrete sequential, concrete random, abstract sequential, and abstract random* (Jonassen, 1993). The *concrete sequential* learner prefers to extract information through hands on

experiences and they tend to use "if-then" logic. They also tend to look to authority for guidance, to strive for perfection, and to be well-organized. The *concrete random* learner needs to experiment with ideas through trial and error, they do not tend to like black and white approaches to learning. These learners tend to grasp information quickly, to make broad judgments and to easily relate concepts to the real world. The *abstract sequential* learner is adept at storing conceptual mental pictures and tends to prefer presentations that have substance, are sequential and are rational. Like the concrete sequential learner, they respond well to authority but they are more adept at understanding theories and coming to new conclusions. The *abstract random* learner tends to learn best by communicating with peers and they are more in tune with human behavior and emotions. They tend to learn best in unstructured environments and they need time to reflect upon and process information (Jonassen, 1993).

Kolb's Learning Styles: The Experiential Learning Theory

Kolb (1984) described a third set of learning styles, similar to that of Gregorc in that they combine two modes of grasping experience (concrete experience and abstract conceptualization) and two modes of transforming experience (reflective observation and active experimentation). These modes combine in various ways to give the four experiential learning styles: Accommodation, Assimilation, Divergence, and Convergence.

Accommodation. This person approaches learning using concrete experience and active experimentation. These people tend to be hands on in their approach to learning and enjoy new, challenging experiences. They tend to rely on others for information and

to act on their gut feeling rather than technical analysis. They ultimately prefer to work with others in order to do field work and complete projects (Kolb, 1984).

Assimilation. People operating under this learning style utilize abstract conceptualization and reflective observation. They are skilled at understanding a wide range of information and compiling it into a concise and logical arrangement. These individuals tend to place more weight on logical soundness and are less interested in people or practical applications of ideas. They tend to be adept in exploring analytical models or abstract concepts, prefer lectures or readings and enjoy having time to think things through (Kolb, 1984).

Divergence. People using a diverging learning style operate using concrete experience and reflective observation. This means that these people tend to be able to view concrete situations from many different points of view. The ability to view a situation from many different perspectives promotes these individuals to be adept in generating ideas and being imaginative. This type of person tends to prefer working in groups and is capable of listening to different perspectives and receiving personal feedback with an open mind (Kolb, 1984).

Convergence. This learning style uses abstract conceptualization and active experimentation. A person with this learning style tends to be good at applying ideas and theories to practical situations. However, they tend to prefer applying these theories to technical tasks and problems rather than social or interpersonal issues. These individuals are proficient in experimenting with new ideas or laboratory experiments and the practical applications of these ideas and experiments (Kolb, 1984).

Learning Style Implications and Study Aims:

There are many factors that contribute to shaping the ways in which individuals prefer to learn and based on these preferences individuals may be partial to one classroom format over another. Given what is known about the influence of learning styles on preference for educational materials, this study will examine the effects of learning styles on the use of physical activity education materials. Learning style preference will be measured using Kolb's Learning Styles. Eight different physical activity education materials were provided to participants in the Physical Activities and Lifestyles Study (PALS). Participants evaluated each of these items based on their usefulness and then also evaluated the overall quality of the education materials that were provided. This study will be using this feedback to assess whether or not the use of the materials varied by learning style preference.

This study expects to find that individuals of each learning style will use one type of educational material more than others. Assimilators prefer lecture-type, factual information and thus should be more likely to use the education booklet, mailed tips, emailed tips and PALS website. Convergers prefer information that allows individuals to experiment with new ideas or practically apply information and should be more likely to use the emailed and mailed tips, activity log-book, walking map and walking groups. Divergers prefer group discussions or activities and should be more likely to use the walking map, walking groups, and activity log-book. Accommodators prefer active learning or situations in which individuals can learn hands-on and should be more likely to use the activity log-book, gym brochure, walking groups and walking map. If the use

of these materials does vary by learning style, this could have implications for the design of education materials in future physical activity studies.

Literature Review:

The purpose of this literature review is to detail the importance of identifying individuals' learning styles and to highlight the importance of learning styles in health studies. In this section, several studies are discussed that demonstrate how individuals with different learning styles prefer to learn information in different ways. Logically it follows that if individuals prefer learning information in one way they will be more likely to utilize that method and find that material more useful. This literature review will first present studies relating to the application of learning styles in academics, showing that students of different learning styles tend to prefer different educational methods, and then will demonstrate how learning styles are important to research in the field of health.

Application to Academics:

There has been a great deal of research to determine what classroom format and educational materials students of different learning styles prefer. Carrier et al. (1988) found that students with different learning styles had different note taking preferences. Using Kolb's Learning Style Inventory, they assessed whether or not students preferred to take notes. Students who were accommodating or diverging learners did not take notes, while those who were assimilators or convergers preferred to copy information from the lecturer exactly.

Not only does learning style affect students' behaviors in the classroom, it also affects the ways in which they prefer to have information presented to them. Ellsworth (1991) found that concrete experience and active experimentation learners were more likely to select electronically mediated learning strategies than individuals operating

using reflective observation and abstract hypotheses. With the increasing availability of technological teaching tools it is important to consider how individuals with various learning styles will respond when presented with alternate forms of education. The end goal of education, whether it be for patients or students, is comprehension and retention of the material presented; understanding how individuals respond to different presentations of material is essential.

There have been many suggestions for how to tailor course materials and assignments to be more conducive to the different styles of learning. While it is true that the lecture format of courses is still the most commonly used method, it is not the most effective according to many researchers. There have been many classroom approaches suggested by Kolb (1984), Svinicki and Dixon (1987), Vince (1998), and Wynd and Bozman (1996) to enhance student performance by accommodating individual learning styles. In addition to traditional lectures they suggest adding examples during lecture, discussion sections, and text readings to enhance the learning experience for students using any of the four learning processes. Buch and Bartley (2002) recruited individuals who were employees in a large financial institution and enrolled in training courses. Only 167 of the 377 employees completed the learning styles inventory questionnaire. This low response rate provides an opportunity for differentially selecting individuals into the study. However, the learning styles of the participants were relatively evenly distributed (about a quarter of individuals using each learning style) and, based on Kolb's expectations (Kolb, 1984), this sample is representative of the expected distribution of learning styles among the general population. They found that accommodators tended to prefer computer-based learning to print and audio-based learning but that they also

preferred classroom learning to all other formats. Diverging learners tended to prefer classroom-based learning to all other delivery modes and their preference for this method was stronger than the preference of the other three learning styles for classroom-based learning. They also found that both converging learners and assimilators preferred classroom-based learning, but that converging learners second choice was computer-based learning while assimilators second choice was print-based learning.

Several studies, specifically in higher education, have determined that students perform better when materials are aligned with their learning styles (Young, 2003; Gurpinar, 2010). Young (2003) found that students who used their preferred learning style, compared to those who did not, saw an improvement in self-assessed gains in knowledge as well as improvements in course grades. Specifically, he found that lectures and exams were rated lowest by accommodators while writing assignments were rated highest by assimilators. Gurpinar (2010) found that, among a cohort of medical students, the assimilating learning style was predictive of success in the theoretical block exams and satisfaction with traditional training among medical students. However, he also found that all learning style groups preferred problem-based learning to traditional (lecture) based learning but that exam scores did not differ for problem-based learning and traditional lecture among the four learning styles. Given this information it would seem that students have individual preferences for how they like to have information presented to them and that when they are allowed to learn through these preferred modes they are more satisfied and can potentially see improvements in course grades.

These studies suggests that while the current lecture format of classrooms may not be the least preferred method of learning, it is important to use supplemental methods,

like those suggested above, to enhance learning. Although it is not possible to cater to every individual, it is important to understand that individuals operating with different learning styles will have different preferences for information presentation and several techniques may be utilized to make the material more accessible and enhance student performance.

Application to Health Education:

The concept of learning styles affecting preference for educational materials or information presentation has also been applied in healthcare settings. Educating patients about their illnesses and health behaviors that can increase or decrease health risk is extremely important. Quintiliani (2005) looked at the impact of diet-related cancer prevention messages when matched or mismatched with the participants' preference for information presentation. This study examined individuals' preference for information presentation prior to the study and determined whether or not individuals preferred to have fact-based information or emotional, story-based information. After this assessment, individuals were assigned to groups where they were either matched with information presented their preferred way or with information presented not in their preferred way. They found that individuals who were presented with information in their preferred way rated the messages higher than those who preferred factual information but received emotion-based information. However, they also found that those who preferred emotion-based information and were assigned factual information ranked the materials higher than those in the matched groups. This finding is consistent with other findings, which show that health information tailored to personally relevant experiences is read more and more

often remembered (Skinner, 1994). In terms of health information it may be more important to focus information to personally relevant concerns and couple this with preferred mechanisms of learning, as seen below.

It has been shown that formatting educational materials to individual learning styles can improve understanding of health materials. Giuse (2012) formed three experimental groups where the control group received routine discharge instructions, the first treatment group received materials tailored only to their health literacy level and the second treatment group received health education materials that were tailored to their health literacy level and their learning style preference. He found that individuals who received information tailored to both their health literacy level and their learning style showed greater gains in knowledge than those who received materials only tailored to their health literacy. The researchers saw an improvement in test scores for those who were given education materials tailored to the individual's learning style and level of health literacy when compared to those who were not given tailored health education materials.

It can be seen that research has shown increased comprehension and retention of information and increased alteration in behavior when presented with information that aligns with individuals' learning style. This is important because if there is a preference for certain types of education materials based on learning style, then researchers would need to tailor their education materials to reach all types of learners. If the materials are not tailored to reach all modes of learning, then the researchers run the risk of differentially selecting for particular learners to utilize the materials more and to select for certain individuals to perform better in the study. Based on this information, it should

be important for research studies with health education materials presented as part of a treatment group to consider differences in learning styles and format the education materials appropriately.

The Physical Activities and Lifestyles Study (PALS) was implemented at Emory University to assess whether or not there was an increase in physical activity differentially among four separate treatment groups. Two of these treatment groups involved health education materials as part of their intervention to promote increased physical activity. This study aims to determine if, based on feedback focusing on the educational materials, individuals of a certain learning style– Diverging, Assimilating, Converging or Accommodating – report use of educational materials differently.

Methods:

Subjects and Setting

Design and Recruitment

The PALS study was a cluster randomized, prospective cohort study involving 60 departments on the main campus of Emory University in Atlanta, Georgia. Departments were recruited through an invitation that explained the PALS study and encouraged the department to participate. These invitations were sent to the heads of the departments and those that did not respond were then sent an e-mail, called on the phone, and finally received an in-person visit from the project manager. After a department agreed to participate in the study, individual employees in that department were contacted to participate in the study. Individuals were recruited by first sending an invitation postcard through the campus mail. Then individuals received an initial e-mail and two follow-up emails asking the potential participants to complete a six-question eligibility survey. Additional details are provided elsewhere (Gazmararian, et al 2013).

Eligibility

The study had eligibility requirements for both the departments and the individuals. A department was considered to be ineligible for the study if they had fewer than six clock-in/clock-out (non-exempt) employees, had a majority of staff members employed by Emory University Hospital system, or were at a satellite location of Emory's main campus. Individuals were considered ineligible if they reported meeting CDC guidelines for physical activity (a minimum of 30 minutes of moderate activity 5 days a week or a minimum of 20 minutes of vigorous activity 3 days a week), worked

nights, worked off campus, would be missing work for more than a month within the next year (e.g., maternity leave), or if they worked less than 20 hours per week. Also, employees that did not have to clock in and out of work were considered exempt and excluded from the study due to the flexibility of their work schedules. Individuals were excluded for the reasons listed above because these factors ruled out the need for an intervention, interfered with receiving the intervention, or interfered with the follow-up in-person interviews.

Randomization

A pseudo-random number generator (SAS 9.227) was used to distribute departments into one of two study blocks, accounting for seasonality, and then the departments were randomized into one of the five intervention groups. Study administrators, interviewers and participants were not blinded to the intervention assignments due to the nature of implementing the interventions.

Participants

There were a total of 60 departments that agreed to participate and these departments were randomized as described above. From these departments, non-exempt employees (n=1,107) were sent an invitation to participate and an eligibility survey. Of these, 457 individuals (45%) were ineligible and 27 (2%) were unable to be contacted. A total of 410 individuals completed the baseline interview, and 381 (93%) of these individuals completed the nine-month follow-up interview.

Interventions

The five treatment groups were made up of three main components involving time, gym membership, and education. These components and the five treatment groups are described in more detail below. This study focuses on the two physical activity (PA) treatment groups in which education materials were provided.

Time.

Time during the workday was offered to individuals, with the consent of the administration and chairs of each department, for thirty minutes of "on the clock" exercise. This allowed the employees of the departments randomly assigned to the "time + gym" and "time + education + gym" treatment groups to be compensated for thirty minutes of exercise during the workday as though it was regular work time.

Gym.

Gym membership was provided to all study participants using a paper certificate for a 1-year membership redeemable at Emory's centrally located main exercise facility. The facility provides access to athletic courts, tracks, a swimming pool, free weights and other weight machines, and cardiovascular exercise equipment. All participants, except those in the control group, received the certificate at the first in-person interview and were required to redeem it within 6 weeks.

Education.

Educational materials on physical activity were provided to the employees in the treatment groups "gym + education" and "gym + education + time". All education materials were created after a thorough review of the literature on already existing materials and consultations with experts in the field of physical activity education. These educational materials were based on the social cognitive theory and approval was received to adapt PA education materials that had been previously used and tested by the Cooper Institute (information at http://www.cooperinstitute.org/). The PALS team also edited these existing materials in order to insure that they were clearly worded. These education materials were designed to address the barriers to physical activity, the benefits to becoming more physically active, and to provide social support for physical activity (for example, other employees success stories on including more physical activity in their lives). The researchers also made available the current PA recommendations, including the definitions of moderate and vigorous physical activity in order to target all education materials to information based on what participants should know and do.

The educational materials for PALS were transmitted through several forms of communication: (1) Post cards and e-mail were used to send weekly reminders and tips on becoming more physically active; (2) a Web site was also created that included all the printed education materials and physical activity resources; (3) a campus walking map with 18 planned routes ranging from a quarter mile to one and a half miles; (4) a PA log-book was given to the participants to track weekly and monthly personal behavior and goals; and (5) peer-led walking groups were organized to meet on campus around noon and after five pm on different days of the week.

Treatment Group Formation

Each of these three components were arranged to give five treatment groups: 1) Control, 2) Gym, 3) Education + Gym, 4) Time + Gym, 5) Time + Education + Gym. This study will focus specifically on the two groups which included educational materials as part of their intervention, Education + Gym and Education + Gym + Time groups.

Data Collection Instruments

The data for the PALS study was collected using several in-person interviews, online or paper surveys and telephone interviews. There were a total of five data collection points over the nine-month study period (Appendix A). This study will focus on specific interview tools and questions for the treatment groups in which educational materials were provided to the participants. Surveys entitled Baseline Part A and Baseline Part B gathered information for demographics, height and weight (used to calculate BMI) and health literacy. The 3-month telephone follow-up and 6-month telephone follow-up gathered the information on participant's assessment of the educational materials. Only those participants who did not answer the questions about the educational materials at three months were asked these questions at six months. The Final Survey part A (9-month survey) gathered the information about individuals learning styles. Learning style was not expected to change over the study period and was only assessed at one time-point. These four surveys/interviews provided data on all of the variables of interest for this study.

Participant Incentives

Cash and gift (T-shirt, water bottle, or gym bag) incentives were used to promote employees continued participation in the study. For those participants who completed all five surveys, they received a total cash incentive of $100 and the gym membership (which was valued at over $200). Consent forms were signed at the initial in-person interview. The Emory Institutional Review Board approved the PALS study protocol.

Measurement of Outcome, Exposure, and Covariates

Primary Outcome

The outcome variable, whether or not participants used the educational materials, was measured using data from the 3- and 6-month surveys (Appendix B) where participants were asked to rank the usefulness and quality of the educational materials. There were eight educational materials provided to participants: an activity log-book, an education booklet, emailed tips, a gym brochure, mailed tips, walking groups, a walking map, and the PALS website. These questions asked participants to rank each material Very Useful, Somewhat Useful, Not at all Useful, Never Used/Don't Know, and Refused (Appendix B, H1). The rankings were collapsed to form dichotomous variables to examine if the participants used (ranked the materials as Very Useful, Somewhat Useful, Not at all Useful) or did not use the materials (ranked the materials as Never Used/Don't Know). Those participants who refused to answer the questions regarding the educational materials were set to missing.

Participants were also asked to rank the overall quality of the PALS education materials as Excellent, Very Good, Good, Fair, Poor, Never Used/Don't Know, or

Refused (Appendix B, H2). The rankings were collapsed to form dichotomous variables to examine if the participants used (ranked the materials as Excellent, Very Good, Good, Fair, or Poor) or did not use the materials (ranked the materials as Never Used/Don't Know). There were no participants who ranked the overall quality of the materials as poor or who refused to answer this question. Although the original question regarding the overall opinion of the PALS materials asked about the quality of the materials, it was assumed that participants who answered Excellent, Very Good, Good, Fair or Poor must have used at least one of the educational materials. Therefore, these assessments of quality could provide information about whether or not participants used at least one of the provided education materials. These dichotomous variables were created as a first step to assess whether or not participants used the materials differently by learning style. If there was a difference in use, the next step would have been to assess if there was a difference in how useful participants thought each material was, using the original categories rather than the dichotomous categories, by learning style.

Primary Exposure

Learning styles were examined as the main exposure variable for why individuals found certain educational materials more useful than others. Individuals learning styles (Accommodating, Assimilating, Converging and Diverging) were assessed using Kolb's Learning Style Inventory (Kolb, 2005), which contained 12 questions (Appendix C) and was measured in the 9-month survey (part A). It was noted during analysis that there were a small number of people in the converging and assimilating learning style groups. Due to the sparse data in these groups, they were combined to form one "assimilating +

converging" learning style group. This created three learning style groups (Diverging, Accommodating, and Assimilating + Converging), which were used for the analysis.

Covariates

The demographic variables for this study measured at baseline that were not considered as covariates were: Marital status (Married, Never married, Other), current cigarette smoker (Yes/No)[32], health literacy (Adequate or Not Adequate)[31], and BMI (classified as Underweight (<25), Normal (25-30), Overweight (>=30))[33]. Health literacy was measured using the Newest Vital Sign questionnaire, which asks participants to review a nutrition label on a food item and then asks six follow up questions about on the information in the nutrition label. Participants who answer at least four of the six questions correctly were considered to have adequate health literacy skills, those who answered less than four of the questions correctly were to have an inadequate health literacy. Other demographic variables that were considered as covariates of interest were: Gender (Female vs. Male), Race (Other, Black and White; referent was White), Education (High School or Less, Some College, Completed College, or Masters or Greater; referent was Masters or Greater), Age (Years), and self- reported Income group (<$50,000 vs >$50,0000). Other variables of interest were treatment group (Gym + Education and Gym + Education + Time) and seasonal block. Treatment group was controlled for because the lack of added time in the Gym + Education group could have influenced whether or not they felt that they had time during the day to utilize the education materials. Block (or season) of participation was controlled for because use of

some of the materials, particularly the walking group and walking map, could have been influenced by the weather.

Analysis

Descriptive Statistics

Baseline descriptive statistics were calculated using simple univariate procedures for both of the education treatment groups. The mean and standard deviation were calculated for continuous variables and the proportion of individuals reporting a given characteristic was calculated for categorical variables. Analyses were performed at all time-points to ensure that the individuals present at each time-point were similar and that the data from each time-point would be comparable.

Crude Distribution Estimates

The distribution of learning styles among the education treatment groups was assessed as the proportion of individuals reporting each learning style. The crude use for each type of educational material was examined using the dichotomous variables that were created for each outcome (used/did not use). The use for the outcome variables in this study was then stratified by treatment group and reexamined to look for differences in use between the two treatment groups. Differences in use were then examined by learning style for each outcome variable. Still using simple univariate procedures the number of individuals of each learning style who used, or did not use, each of the educational materials was examined.

Covariate Adjusted Analysis

To account for clustering of the data Proc Genmod was used. This procedure fits a generalized linear model to the data using generalized estimating equations that allow for the data to be discrete and correlated. Odds ratios and 95% confidence intervals for these associations were reported using binomial logistic regression accounting for clustering by department. Crude logistic regression analyses were conducted to examine the association between each individual variable of interest and outcome variable.

After examining the independent association between each covariate and the outcome, collinearity was examined to determine if any of the covariates were associated with one another. All variables that were categorical had dummy variables created to allow them to behave numerically. Using Proc Reg, it was determined that there were no collinearity issues (assessed by variance inflation factors) and all potential variables of interest could be included in the analysis.

Each outcome was then modeled to examine the association between learning styles and their effect on use of the education materials controlling for all covariates (block, treatment group, income, age, gender, race, and education). The odds ratios and 95% confidence intervals were reported. It was noted that there were 41 individuals missing from the final model when compared to those who were present at baseline. Individuals would have been excluded from the model if they were missing any of the variables of interest or the outcome. The primary reasons for missingness were a lack of learning style assessment and income information. These missing individuals were assessed on their demographics and compared to the demographics of those who were

included in the final model to determine if those who excluded from the model were demographically different from those included in the model.

All analyses were performed using SAS version 9.3 (SAS Institute, Cary, NC).

Results:

Descriptive Statistics at Baseline

At baseline there were 12 departments assigned to each group. Of the 195 participants present at baseline, 106 were in the Gym + Education group and 89 were in the Gym + Education + Time group (Table 1). Among those in both the Gym + Education group and the Gym + Education + Time group the majority were female and Black. The median age was 44.8 for those in the Gym + Education group and 40.8 for those in the Gym + Education + Time group. Among those in both the Gym + Education group and the Gym + Education + Time group the majority were married, had some college or had completed college, had an income less than $50,000, and had a BMI greater than or equal to 30. The majority of individuals in the Gym + Education group did not have adequate health literacy skills and were not current smokers; while the majority of individuals in the Gym + Education + Time group did have adequate health literacy skills and were not current smokers.

In addition to the descriptive statistics calculated at baseline, descriptive statistics from 3-, 6-, and 9-months were also calculated. Appendix D tables A, B, and C show the descriptive statistics for participants present at 3, 6 and 9 months, respectively. At 3-months (Appendix D, table A) there were 8 participants lost from the Gym + Education group and 4 participants lost from the Gym + Education + Time group compared to baseline. The individuals with data at this time-point were similar to those at baseline in that the majority were female, Black, had an income less than $50,000, and the majority had some college or had completed college for both treatment groups. At 6-months (Appendix D, table B) there were 10 participants lost from the Gym + Education group

and 7 participants lost from the Gym + Education + Time group compared to baseline. All the participants who were not present in the Gym + Education group at this time-point were female. The individuals with data at this time-point were similar to those at baseline in that the majority were Black, had an income less than $50,000, and had some college or had completed college. At 9-months (Appendix D, table C) there were 5 participants lost from the Gym + Education group and 8 participants lost from the Gym + Education + Time group compared baseline. All of the participants that dropped out of the Gym + Education group were female. The individuals with data at this time-point were similar to those at baseline in that the majority were female, Black, had an income less than $50,000, and the majority had some college or had completed college in both groups.

Distribution of Exposure and Outcome

After ensuring that the data at all time-points would be comparable to one another, the distribution of learning styles was examined among the two treatment groups (Table 2). In both of the treatment groups, there was a larger percentage of individuals with a diverging learning style than with any other type of learning style, 69% in the Gym + Education group and 72% in the Gym + Education + Time group. The least prevalent learning style was for individuals with a converging learning style, 2% in the Gym + Education group and 1% in the Gym + Education + Time group. Those with accommodating learning styles were the second most prevalent and those with assimilating learning styles were the second least prevalent.

When examining the crude use of each type of education material, more people tended to utilize the PALS education materials than not (Table 3). Greater than 50% of individuals reported having used the activity logbook, education booklet, e-mailed tips, gym brochure, mailed tips, and walking maps. The two most used items were the emailed tips (84%) and the mailed tips (78%). For the walking groups it was reported that only 47% of participants used or attended these walking groups and only 41% of individuals reported having used the PALS website. The overall measurement showed that 92% of individuals reported having used at least one of the education materials provided. When looking at the outcome variables stratified by treatment group, the use of the materials is comparable among the two treatment groups (Table 3). The majority in each group reported having used at least one of the education materials, although a higher percent of individuals reported having used at least one of the education materials in the Gym + Education compared to the Gym + Education + Time group (95% vs. 89%).

When looking at use regardless of learning style, the majority of individuals reported using the education booklet, the gym brochure, the walking map and having used at least one of the educational materials (Table 4). For the website, less than half of the individuals reported use, except for those with converging learning styles, where 67% of individuals reported use. After collapsing to form the three exposure groups (Diverging, Accommodating, and Assimilating + Converging) there were three instances in which all individuals in a group reported having used the educational materials. The materials for which 100% of individuals reported use in the Assimilating + Converging were the emailed tips, the mailed tips and the overall use. The emailed tips also had the highest reported use of any individual educational material in the diverging and

accommodating groups with 90% having used them in each group. It should also be noted that 80% of individuals in the diverging group and 90% of individuals in the accommodating group reported using the mailed tips. The accommodating group also reported the highest use of the gym brochure, with 83% of individuals reporting use. Only the individuals in the assimilating and converging groups reported greater than 50% use of the walking groups (63% and 67%, respectively, 63% combined).

Covariate Adjusted Analysis

This study first looked at the crude association for use of educational materials with each covariate (Table 5A and 5B). For learning styles (Table 5A), the odds of those with an assimilating or converging learning style using the mailed tips was 1.2 times the odds of those with a diverging learning style using the mailed tips (95% CI 1.1, 1.4). In all other instances, the association of learning styles with the use of any of the educational materials was not significant. For gender (Table 5B), the odds of females using the emailed tips (OR 3.3; 95% 1.3, 8.1), gym brochure (OR: 2.5; 95% CI 1.2, 5.2), mailed tips (OR: 2.2; 95% CI 1.1, 4.4), walking group (OR: 3.2; 95%% CI 1.7, 6.0), and website (OR: 2.8; 95% CI 1.4, 5.4) were at least 2 times the odds of males using each of these materials. The odds of females using the activity log-book (OR: 2.0; 95% CI 1.0, 4.1), the education booklet (OR: 2.0; 95% CI 1.0, 4.1), the walking map (OR: 1.8; 95% CI 1.0, 6.1), and overall use (OR: 2.5; 95% CI 1.0, 3.0) were at least 1.8 times the odds of males using these materials, however, these associations were not significant. For education, the odds of those with an education of high school or less using the emailed tips or the website were 0.1 times the odds of those with a masters or greater using the

emailed tips or the website (95% CI 0.01, 0.9 and 0.03, 0.6, respectively). The odds of those with an education of some college using the education booklet or walking maps were 0.2 times the odds of those with a masters or greater using the education booklet or walking maps (95% CI 0.1, 0.8 for both). All other associations for these educational groups were not significant. There were no significant associations between those who completed college and any of the educational materials when compared to those with an education of masters or greater. The associations for race, income, block, treatment group, and age were not significant for any of the educational materials provided.

After assessing the relationship of the exposure and each secondary variable of interest with the outcome this study examined the association between learning styles and the use of each educational material controlling for gender, race, education, income, age, block, and treatment group (Table 6). The data was too sparse to model the association of learning styles with the overall, gym brochure, mailed tips, and emailed tip use when controlling for all of the secondary variables of interest. For the full model, the odds of those with an accommodating learning style using the activity log-book was 0.4 times the odds of those with a diverging learning style using the activity log-book (95% CI 0.2, 0.7). All other associations were not significant.

Table 7 displays the demographics for those individuals who were excluded from the final model and those individuals who were included in the final model. These two groups appear to have several differences in the distribution of demographics. Those who were excluded were more likely to be black, married, with an education of high school or less, a BMI ≥30, current smokers, have an inadequate health literacy, and an income >$50,000.

Discussion:

Overall this study found that, generally, more participants used the materials than not. In particular, the most used materials appeared to be the emailed and mailed tips while the least used materials were the walking groups and the website. Only the association between accommodating learning styles versus diverging learning styles and use of the activity log-book was significant. This association showed that the odds of those with an accommodating learning style using the activity logbook were significantly less compared to those with a diverging learning style. This result was not necessarily expected as divergers tend to prefer activities and accommodators tend to be hands-on learners, so it was expected that they would both use the activity log-book. However, because accommodators are more likely to use materials that are hands on it could have been that this material was not as appealing to them because it did not involve them learning through action. No other associations between learning styles and the use of educational materials were found to be significant when controlling for gender, age, race, income, education, treatment group, and block.

For learning styles, the only significant, independent association showed that the odds of those with an assimilating or converging learning style using the mailed tips were greater than the odds of those with a diverging learning style. This was an expected result because those with a diverging learning style prefer activities and discussion while those with assimilating or converging learning styles prefer factual information that can be applied practically. Thus, it was expected that diverging learners would be least likely to use the written materials such as the education booklet, mailed tips, emailed tips, and website. It was also expected that there would be some variation in the preference for use

of materials by gender. The significant associations showed that the odds of women using the emailed tips, gym brochure, mailed tips, walking group and website were greater than the odds of men using these materials. This difference is important to note because it could have implications in health research. If the target population is mostly women then using short tips and factual guides along with group activities may be more helpful in educating them than if the target population was mostly men.

Strengths

This study had at least six strengths. First, this study had a high retention rate with only 6 (3%) of the individuals enrolled at baseline (n=195) dropping out of the final study population (n=189). Second, this study had a high response rate. Of the 195 individuals enrolled in the two treatment groups at baseline, there were only 9 individuals (5%) who did not have responses for the outcome variables at the 3- and 6-month follow ups. Third, this study also used in-person interviews, which can be more accurate than online surveys or over the phone interviews. Fourth, the questions for these interviews were standardized and all interviewers were told what to say, which provided a level of consistency. Fifth, the Learning Style Inventory is a validated tool (Felder, 2005) and so it can be assumed with reasonable certainty that it provided a valid assessment of individuals learning styles. Finally, even though the sample size was small, this study fulfills a need for pilot information that can be used to inform future, more in depth studies looking at learning styles in the health field.

Limitations

Despite the strengths of this study, there were at least five limitations. The first limitation of this study was the rather small sample size. The small sample size led to sparse data and made some of the analyses impossible to perform. Second, the particularly small numbers of participants operating with converging and assimilating learning styles forced this study to combine these two groups into one, making interpretation of these results difficult. Third, Kolb (1984) asserts that these four learning styles should be relatively evenly distributed in a population. Because these learning styles were not evenly distributed in this study population, it is possible that this group was not truly representative of the general population and that influenced the results that were found. By having the majority of participants representing one learning style this will skew the results and make detecting differences in use between the various learning styles difficult. Fourth, having to collapse the outcome variables into dichotomous (used and not used) groups did not allow for the study to look at more nuanced relationships. This introduces the potential for misclassification bias by lumping together individuals as though the values of their responses were the same, even when they were not.

Fifth, there was a lack of similarity in the distribution of the demographic variables between those who were included in the final model and those who excluded. This may imply that there was something about those individuals who were excluded for missing responses that was different on learning style from those who were not missing these responses. For example, most individuals who were excluded from the final model had inadequate health literacy while those who were included had adequate health literacy skills. This may have contributed to the high percentage of use that was found

among the study population, with close to 100% of individuals reporting to have used at least one of the educational materials. If there was some unique reason for why these individuals were lacking these responses then it should not be assumed that this study was internally valid.

Public Health Implications

The small number of significant findings found in this study corresponds with other studies in the field that have also found non-significant results when looking for associations between preference of educational materials and learning styles. Bolliger (2010) reported that there was no association between individuals learning styles and how they reported usefulness of provided education materials for learning how to use software programs. Massa and Mayer (2006) found that even when they formatted materials specifically to align with verbal or visual learning styles, there was no evidence that individuals performed better. While there may be several studies showing that there is no association between learning styles and use of educational materials, there are also many studies that show this association does exist (Ellsworth, 1991; Carrier, 1988; Guise, 2012). Ellsworth (1991) showed that concrete experience and active experimentation learners were more likely to select electronically mediated learning strategies than other individuals. Carrier et al. (1988) discovered that students who were accommodating or diverging learners did not take notes, while those who were assimilators or convergers preferred to copy information from the lecturer exactly. Giuse (2012) indicated that individuals who received information tailored to both their health literacy level and their

learning style showed greater gains in knowledge than those who received materials only tailored to their health literacy.

While this study did not find many significant associations for preference of use of materials based on learning style, the tools used in health care settings should still be mindful of individual preferences. The results of this study show that in this small population of Emory University employees, there is not a significant preference for material use based on learning style. However, that does not mean that all individuals prefer to use the same materials. In order to appeal to all learning styles, it is important to provide factual materials in written form for convergers and assimilators and something more interactive for divergers and accommodators. With the advent of technology, email and other web formats have become increasingly accessible and convenient for all individuals, regardless of learning style.

Thus, moving forward, it will be important for researchers to consider utilizing these options, particularly in future studies on the impacts of learning styles in health settings. It will be particularly important for future studies to focus on enrolling larger populations so that all learning styles are appropriately represented. It would be interesting for future studies to present similar educational materials online and on paper to see if there is a difference in use by learning style. This comparison could be useful in promoting policy and practice updates in all health care settings. There may be no significant difference in use and the move to technological formats may not affect patient use of education materials. However, there may be a significant difference in use and the move to technological formats will decrease the use of educational materials by learning style. This difference would be important for physicians' offices and other health care

organizations to recognize when designing and providing materials to educate their patients and the population at large about diseases and methods to decrease disease risk. The lack of research in this area leaves a large gap in the literature that should be explored in order to ensure that, regardless of learning style, comprehensive and easily understood educational materials are being provided to all patients.

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Tables

Table 1. Baseline Demographics and Health Characteristics of Participants in the Intervention Groups Containing Education Components, PALS Study (n = 195)

	Intervention	
Characteristic	**Gym + Education**	**Gym + Education + Time**
No. of Departments	12	12
No. of Participants	106	89
Gender, n (%)Female	77 (73%)	59 (66%)
Race, n (%)		
White	36 (34%)	40 (45%)
Black	64 (61%)	46 (52%)
Other	5 (5%)	3 (4%)
Age (years), Mean (range)	44.8 (22- 68)	40.8 (22- 69)
Marital Status, n (%)		
Married	44 (42%)	38 (45%)
Single, never married	27 (26%)	28 (33%)
Other	33 (32%)	18 (22%)
Education, n (%)		
High School or Less	21 (20%)	14 (16%)
Some College	40 (38%)	31 (36%)
Completed College	33 (32)	35 (41%)
Masters Degree or More	10 (10%)	5 (6%)
Income, n (%) <$50,000	73 (72%)	52 (63.42)
Initial BMI, n (%)		
<25	27 (25%)	20 (22%)
25-30	28 (26%)	26 (29%)
≥30	51 (48%)	43 (48%)
Health Literacy Adequate, n (%)	49 (46%)	46 (52%)
Current Smoker, n (%)	15 (15%)	8 (9%)

Table 2. Distribution of Learning Styles by Treatment Group, PALS study (n=195)*

	Intervention	
Learning Style	**Gym + Education**	**Gym + Education + Time**
Accomodating, n (%)	17 (20%)	12 (16%)
Assimilating, n (%)	8 (9%)	8 (11%)
Converging, n (%)	2 (2%)	1 (1%)
Diverging, n (%)	59 (69%)	54 (72%)

*There were 21 individuals with missing observations for learning styles

Table 3. Use of Educational Materials, by Treatment Group, PALS study (n=195)

	Use of Materials n (%)		
Characteristic	Overall	Gym + Education	Gym + Education + Time
Activity Log-Book	108 (58%)	62 (61%)	46 (54%)
Education Booklet	127 (68%)	70 (69%)	57 (67%)
Emailed Tips	157 (84%)	82 (81%)	75 (88%)
Gym Brochure	134 (72%)	75 (74%)	59 (69%)
Mailed Tips	145 (78%)	78 (77%)	67 (79%)
Walking Group	84 (45%)	45 (45%)	39 (46%)
Walking Map	104 (56%)	58 (57%)	46 (54%)
Website	76 (41%)	40 (34%)	36 (42%)
Overall Rating	172 (92%)	96 (95%)	76 (89%)

Table 4. The Distribution of Usage For Each Educational Material by Learning Style, PALS study (n=195)[A]

	Learning Style (Main Exposure Variable)				
Education Material	Diverging (n=110)	Accomodating (n=29)	Converging (n=3)	Assimilating (n=16)	Converging (n=3) + Assimilating (n=16)
Activity Log-Book	63 (57%)	13 (45%)	3 (100%)	13 (81%)	16 (84%)
Education Booklet	77 (70%)	18 (62%)	3 (100%)	12 (75%)	15 (79%)
Emailed Tips	100 (90%)	26 (90%)	3 (100%)	16 (100%)	19 (100%)
Gym Brochure	77 (70%)	24 (83%)	2 (67%)	12 (75%)	14 (74%)
Mailed Tips	88 (80%)	26 (90%)	3 (100%)	16 (100%)	19 (100%)
Walking Group	50 (45%)	14 (48%)	2 (67%)	10 (63%)	12 (63%)
Walking Map	64 (58%)	15 (52%)	2 (67%)	8 (50%)	10 (53%)
Website	49 (45%)	13 (45%)	2 (67%)	6 (38%)	8 (42%)
Overall Rating	102 (93%)	28 (97%)	3 (100%)	16 (100%)	19 (100%)

[A.]Data displayed as number and percent of individuals with each learning style who used the material

Table 5A: Crude Association Between the Use of Educational Materials and Each Covariate, PALS study (n=195)[A]

	Learning Styles		Block	Treatment Group	Age
Education Material	Assimilating + Converging vs. Diverging	Accommodating vs. Diverging	Block	Treatment Group	Age
Activity Log-Book	3.9 (0.8,17.9)	0.6 (0.3, 1.2)	1.0 (0.5, 2.0)	0.8 (0.4, 1.5)	1.0 (1.0, 1.0)
Education Booklet	1.6 (0.4, 6.5)	0.7 (0.3, 1.8)	0.8 (0.4, 1.4)	0.9 (0.5, 1.6)	1.0 (1.0, 1.0)
Emailed Tips	1.1 (1.0, 1.2)	1.0 (0.9, 1.1)	1.0 (0.2, 5.3)	1.6 (0.3, 8.1)	1.0 (0.9, 1.0)
Gym Brochure	1.0 (0.9, 1.2)	1.1 (1.0, 1.3)	1.5 (0.6, 3.4)	0.8 (0.4, 1.9)	1.0 (0.9, 1.0)
Mailed Tips	**1.2 (1.1, 1.4)**	1.1 (1.0, 1.3)	1.2 (0.3, 4.8)	1.1 (0.3, 4.3)	1.0 (1.0, 1.0)
Walking Group	1.2 (1.0, 1.4)	1.0 (0.8, 1.2)	0.6 (0.3, 1.2)	1.1 (0.4, 2.6)	1.0 (1.0, 1.0)
Walking Map	0.9 (0.8, 1.1)	0.8 (0.8, 1.1)	0.9 (0.4, 1.9)	0.9 (0.4, 1.9)	1.0 (1.0, 1.0)
Website	0.9 (0.3, 3.1)	1.0 (0.5, 1.9)	1.4 (0.7, 3.0)	1.1 (0.5, 2.5)	1.0 (1.0, 1.0)
Overall Rating	NA	NA	1.4 (0.2, 7.8)	0.4 (0.1, 2.4)	1.0 (0.9, 1.0)

[A.]Data presented as OR (95% CI)

Table 5B: The Crude Association Between the Use of Educational Materials and Each Covariate, PALS study (n=195)

	Income	Age	Gender	Race		Education		
Education Material	<$50,000 VS. >$50,000	Age	Female Vs. Male	Black vs. White	Other vs. White	High School or Less vs Masters or Greater	Some College vs. Masters or Greater	Completed College vs. Masters or Greater
Activity Log-Book	0.7 (0.4, 1.4)	1.0 (1.0, 1.0)	2.0 (1.0, 4.1)	1.4 (0.9, 2.2)	2.2 (0.4, 11.2)	0.6 (0.2, 1.9)	0.6 (0.2, 1.5)	0.5 (0.2, 1.4)
Education Booklet	1.1 (0.5, 2.2)	1.0 (1.0, 1.0)	2.0 (1.0, 4.1)	1.1 (0.6, 2.0)	1.3 (0.3, 6.2)	0.4 (0.1, 1.3)	**0.2 (0.1, 0.8)**	0.4 (0.1, 1.4)
Emailed Tips	0.7 (0.2, 2.2)	1.0 (0.9, 1.0)	**3.3 (1.3, 8.1)**	NA	NA	**0.1(0.01,0.9)**	0.5 (0.1, 4.3)	2.5 (0.2, 28.5)
Gym Brochure	0.8 (0.4, 1.7)	1.0 (0.9, 1.0)	**2.5 (1.2, 5.2)**	NA	NA	0.9 (0.6, 1.3)	1.1 (0.8, 1.5)	1.2 (0.8, 1.6)
Mailed Tips	1.0 (0.4, 2.2)	1.0 (1.0, 1.0)	**2.2 (1.1, 4.4)**	0.6 (0.2, 1.8)	1.70 (0.17, 9.25)	0.1 (0.0, 1.0)	0.7 (0.1, 3.2)	1.2 (0.2, 7.1)
Walking Group	1.5 (0.9, 2.4)	1.0 (1.0, 1.0)	**3.2 (1.7, 6.0)**	1.1 (0.5, 2.4)	1.0 (0.3, 3.5)	0.2 (0.0, 1.3)	0.7 (0.2, 2.9)	0.8 (0.1, 4.2)
Walking Map	0.8 (0.4, 1.6)	1.0 (1.0, 1.0)	1.8 (1.0, 3.0)	0.6 (0.2, 1.2)	1.4 (0.3, 7.7)	0.3 (0.1, 1.4)	**0.2 (0.1, 0.8)**	0.4 (0.1, 1.6)
Website	0.9 (0.5, 1.6)	1.0 (1.0, 1.0)	**2.8 (1.4, 5.4)**	1.2 (0.6, 2.4)	0.6 (0.2, 2.0)	**0.1(0.03,0.6)**	1.3 (0.5, 3.4)	1.3 (0.4, 3.7)
Overall Rating	0.9 (0.2, 3.2)	1.0 (0.9, 1.0)	2.5 (1.0, 6.1)	NA	NA	0.3 (0.0, 3.7)	0.8 (0.1, 7.1)	5.0 (0.3, 74.8)

[A.] Data presented as OR (95% CI)

Table 6. The Association Between Learning Style and the Use of Educational Materials, PALS study (n=195) [A]

Data displayed as OR (95% CI)

Education Material	Assimilating + Converging vs. Diverging	Accommodating vs. Diverging
Activity Log-Book	3.3 (0.7, 16.1)	**0.4 (0.2, 0.7)**
Education Booklet	1.3 (0.3, 5.1)	0.5 (0.2, 1.2)
Website	0.6 (0.1, 2.9)	0.6 (0.2, 1.4)
Walking Group	1.9 (0.6, 5.8)	1.0 (0.3, 2.7)
Walking Map	0.7 (0.3, 1.8)	0.6 (0.2, 1.4)

[A]All models control for gender, ethnicity, income, education, age, block and treatment group

Table 7. Demographics of Those Included in the Final Analysis Model Compared to Those Not in the Final Analysis Model, PALS study (n=195)

VARIABLES	Included in Final Model (n=148)	Excluded from Final Model (n=41)
Gender, n (%)Female	104 (70%)	32 (68%)
Race, n (%)		
White	70 (47%)	6 (13%)
Black	72 (49%)	38 (81%)
Other	6 (4%)	2 (4%)
Age (years), Mean (range)	42.3 (22-68)	45.3 (26-69)
Marital Status, n (%)[A]		
Married	58 (39%)	24 (51%)
Single	45 (30%)	10 (21%)
Other	44 (30%)	7 (15%)
Education, n (%)[A]		
High School or Less	15 (10%)	20 (43%)
Some College	59 (40%)	12 (26%)
Completed College	61 (41%)	7 (15%)
Masters Degree or More	13 (9%)	2 (4%)
Income, n (%) <$50,000 [A]	103 (70%)	23 (49%)
Initial BMI, n (%)		
<25	42 (28%)	5 (11%)
25-30	40 (27%)	14 (30%)
≥30	66 (45%)	28 (60%)
Health Literacy Adequate, n (%)	84 (57%)	11 (23%)
Current Smoker, n (%)[A]	13 (9%)	10 (21%)

[A] Marital status was missing 7 individuals, Education was missing 6 individuals, Income was missing 12 individuals, Smoking was missing 7 individuals

Appendix A*

Data Collection Time-points, Tools, Modalities, and Key Information Gathered		
Data Collection Time-point	**Data Collection Tool Title (modality)**	**Variables Collected**
Time-point = 0[A]	*Baseline Part A (online or on paper)*	Gym membership Attitudes Toward Exercise Exercise Knowledge Plans To Exercise *Demographics* Helath Behaviors Health Status Work Environment
Time-point = 0[A]	*Baseline Part B (in person)*	PA Variables *Height* *Weight* *Waist Measurement* *Health Literacy – Newest Vital Sign*
Time-point = 6-weeks	6-week follow-up (telephone/in person)	7 Day PA Recall Gym Membership and Use Walking Groups Exercise Attitudes
Time-point = 3-months	*3-Month Follow Up (telephone)*	*Feedback on Education Materials* Exercise Knowledge 7 day PA Recall Exercise Attitudes Health Status Work Environment Gym Membership
Time-point = 6-months	*6-Month Follow Up (telephone)*	*Feedback on Education Materials (if not answered at 3-months)* Exercise Knowledge 7 day PA recall Attitudes about Exercise Health Status Work Environment

Time-point = 9-months[B]	*The Final Survey Part A (online/on paper)*	*Learning Styles* Attitudes Toward Exercise Health Status Health Attitudes Health Behaviors Work Environments
Time-point = 9-months[B]	The Final Survey Part B (in person)	7 day PA recall Exercise Knowledge Assessment of Interventions Height, Weight and Waist Measurements Gym Use

A Baseline interviews were conducted between July 2006 and March 2007.
B Final interviews were conducted between April and November 2007.
*Italicized values were used in the analysis

Appendix B

Feedback on Educational Materials – 3 and 6 months

H1. As part of the study, we have provided different sources of information about physical activity. For each of these different sources of information that you have used, please tell me how useful these have been to you? Or if you haven't used the material, please tell me this as well.

*[Read each response followed with "**would you say… very useful, somewhat useful, or not at all useful?**" until the participant is familiar with the responses. Do not read never used or refused]*

	Very Useful	Somewhat Useful	Not at all	Never Used / Don't	Refused
a. PALS education booklet- the orange booklet	1	2	3	8	9
b. PALS walking map of campus walks	1	2	3	8	9
c. PALS activity log-book	1	2	3	8	9
d. PALS website	1	2	3	8	9
e. PALS mailed tips of the week	1	2	3	8	9
f. PALS tip of the week e-mails	1	2	3	8	9
g. Brochure about Emory gyms	1	2	3	8	9
h. Walking Groups held on campus	1	2	3	8	9

H2. Overall, how would you rate the educational materials for PALS? Would you say excellent, very good, good, fair, or poor? *[Do not read don't know or refused]*

- ☐ Excellent
- ☐ Very Good
- ☐ Good
- ☐ Fair
- ☐ Poor
- ☐ Don't know
- ☐ Refused

Appendix C

Learning Styles – 9 month Survey Part A

In this section, there are statements that describe learning. Each sentence has four possible endings, and we want you to choose the endings that are the MOST like you and the LEAST like you.

Using the numbers 1 through 4, rank the endings for each sentence according to how well you think each ending describes the way you learn. To help you pick your answers: First, decide which phrase is MOST like you, and write the #1 on the line above it.

- *Then, decide which phrase is LEAST like you, and write the #4 on the line above it.*
- *After you've ranked most and least, write the #2 on the line that is NEXT TO MOST like you and the #3 on the line that is NEXT TO LEAST like you.*

1=MOST LIKE YOU
2
3
4=LEAST LIKE YOU

DO NOT USE THE SAME RANKING FOR MORE THAN ONE ENDING.

Example: When I learn:	**__2__**	**__4__**	**__1__**	**__3__**
	I am happy	**I am careful**	**I am fast**	**I am logical**
F1. **When I learn:**	_____	_____	_____	_____
	I like to deal with my feelings	I like to think about ideas	I like to be doing things	I like to watch and listen
F2. **I learn best when:**	_____	_____	_____	_____
	I listen and watch carefully	I rely on logical thinking	I trust my hunches and feelings	I work hard to get things done
F3. **When I am learning:**	_____	_____	_____	_____
	I tend to reason things out	I am responsible about things	I am quiet and reserved	I have strong feelings and reactions

F4. **I learn by:**	_____ Feeling	_____ Doing	_____ Watching	_____ Thinking
F5. **When I learn:**	_____ I am open to new experiences	_____ I look at all sides of all issues	_____ I like to analyze things, break them down into their parts	_____ I like to try things out
F6. **When I am learning:**	_____ I am an observing person	_____ I am an active person	_____ I am an intuitive person	_____ I am a logical person
F7. **I learn best from:**	_____ Observation	_____ Personal relationships	_____ Rational theories	_____ A chance to try out and practice
F8. **When I learn:**	_____ I like to see results from my work	_____ I like ideas and theories	_____ I take my time before acting	_____ I feel personally involved in things
F9. **I learn best when:**	_____ I rely on my observations	_____ I rely on my feelings	_____ I can try things out for myself	_____ I rely on my ideas
F10. **When I am learning:**	_____ I am a reserved person	_____ I am an accepting person	_____ I am a responsible person	_____ I am a rational person
F11. **When I learn:**	_____ I get involved	_____ I like to observe	_____ I evaluate things	_____ I like to be active

F12. **I learn best when:**				
	_____	_____	_____	_____
	I analyze ideas	I am receptive and open-minded	I am careful	I am practical

Appendix D

Table A. Three Month Demographics and Health Characteristics of Participants in the Intervention Groups Containing Education Components, PALS Study (n = 184)

Characteristic	Intervention	
	Gym + Education	**Gym + Education + Time**
No. of Departments	12	12
No. of Participants	98	84
Gender, n (%) Female	71 (72%)	57 (68%)
Race, n (%)		
White	35 (36%)	39 (46%)
Black	58 (59%)	43 (51%)
Other	5 (5%)	2 (2%)
Age (years), Mean (range)	44.8 (22- 68)	40.3 (22- 69)
Marital Status, n (%)		
Married	41 (43%)	31 (43%)
Single, never married	25 (26%)	28 (35%)
Other	30 (31%)	17 (22%)
Income , n (%) <$50,000	67 (72%)	49 (64%)
Initial BMI, n (%)		
<25	26 (27%)	20 (24%)
25-30	27 (28%)	24 (29%)
≥30	45 (46%)	40 (48%)
Health Literacy Adequate, n (%)	48 (49%)	44 (52%)
Current Smoker, n (%)	14 (15%)	6 (8%)
Education, n (%)		
High School or Less	20 (21%)	13 (16%)
Some College	36 (38%)	28 (35%)
Completed College	31 (32%)	34 (43%)
Masters Degree or More	9 (9%)	5 (6%)

Table B. Six Month Demographics and Health Characteristics of Participants in the Intervention Groups Containing Education Components, PALS Study (n = 178)

Characteristic	Intervention	
	Gym + Education	**Gym + Education + Time**
No. of Departments	12	12
No. of Participants	96	82
Gender, n (%) Female	67 (70%)	55 (67%)
Race, n (%)		
White	35 (36%)	40 (49%)
Black	58 (60%)	40 (49%)
Other	3 (3%)	2 (2%)
Age (years), Mean (range)	45.1 (22- 68)	40.4 (22- 69)
Marital Status, n (%)		
Married	39 (41%)	33 (43%)
Single, never married	25 (27%)	27 (35%)
Other	30 (32%)	17 (22%)
Income, n (%) <$50,000	66 (73%)	48 (64%)
Initial BMI, n (%)		
<25	23 (24%)	20 (24%)
25-30	26 (27%)	25 (30%)
≥30	47 (49%)	37 (45%)
Health Literacy Adequate, n (%)	45 (47%)	44 (54%)
Current Smoker, n (%)	13 (14%)	5 (6%)
Education, n (%)		
High School or Less	20 (21%)	12 (15%)
Some College	37 (39%)	27 (35%)
Completed College	29 (31%)	34 (44%)
Masters Degree or More	8 (9%)	5 (6%)

Table C. Nine Month Demographics and Health Characteristics of Participants in the Intervention Groups Containing Education Components, PALS Study (n = 182)

Characteristic	Intervention	
	Gym + Education	**Gym + Education + Time**
No. of Departments	12	12
No. of Participants	101	81
Gender, n (%) Female	72 (71%)	56 (69%)
Race, n (%)		
White	36 (36%)	38 (47%)
Black	61 (60%)	41 (51%)
Other	4 (4%)	2 (2%)
Age (years), Mean (range)	44.8 (22- 68)	40.4 (22- 69)
Marital Status, n (%)		
Married	41 (41%)	33 (43%)
Single, never married	26 (26%)	27 (35%)
Other	32 (32%)	17 (22%)
Income , n (%) <$50,000	71 (74%)	49 (65%)
Initial BMI, n (%)		
<25	25 (25%)	20 (25%)
25-30	27 (27%)	24 (30%)
≥30	49 (49%)	37 (46%)
Health Literacy Adequate, n (%)	47 (47%)	42 (52%)
Current Smoker, n (%)	15 (15%)	5 (6%)
Education, n (%)		
High School or Less	20 (20%)	13 (17%)
Some College	40 (40%)	26 (33%)
Completed College	31 (31%)	34 (44%)
Masters Degree or More	8 (8%)	5 (6%)