The Effect of Tailored E-mails in the Workplace

Part II. Increasing Overall Physical Activity

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RESEARCH ABSTRACT

The purpose of this study was to evaluate the impact tailored e-mail messages, based on participants' identified needs, have on intentional physical activity. A quasi-experimental design (two groups, repeated measures) in a population of manufacturing workers (73 employees from two distribution plants of a multi-national manufacturer) was used. Significant differences were found between contemplation-staged participants in the intervention and the comparison groups. In the intervention group, 53.3% of the workers moved forward, as opposed to 19.2% in the comparison group (medium effect size = 0.353). Although both the intervention group and the comparison group increased their number of steps, the comparison group's improvement was most likely attributed to a Hawthorne effect. These results are highly promising given the small sample size and limited "dose." The intervention is one most industries could feasibly implement. Such efforts have the potential to significantly impact public health.

This article continues a discussion started last issue (Yap, Davis, Gates, Hemmings, & Pan, 2009) and focuses on the second hypothesis from the quasi-experimental study of 73 participants, aged 23 to 59, who were recruited from two manufacturing distribution plants (N = 393, N = 225). These plants were part of the same multi-national corporation but in different locations in the same state. One plant served as the intervention group, and the other plant served as the comparison group. In a preliminary study, using health care experts and focus groups, Yap, Hemmings, and Davis (2009) developed a series of theory-based tailored e-mail messages designed to increase intentional physical activity. Using these developed messages for those workers in the contemplation and preparation stages, the objective of this study was to evaluate an innovative method of delivering tailored messages—the occupational health nurse delivering them by e-mail—and the effect they had on stage progression (discussed last issue) and overall movement.

The following hypothesis was tested: Individuals who receive tailored e-mail messages will have a greater increase in overall physical activity than those who do not receive tailored e-mail messages.

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INSTRUMENTS

The Stanford Brief Activity Survey

The Stanford Brief Activity Survey (SBAS), a self-administered two-item activity tool that classifies partici-

Applying Research to Practice

Occupational health nurses can increase intentional physical activity within their organizations just by providing pedometers to workers. Pedometers help quantify activity level and make workers aware of their need to increase physical activity.

pants into five distinct physical activity levels, was used to measure physical activity behavior. This tool does not provide information on specific activity patterns; rather, it provides a global index of activity (Taylor-Piliae et al., 2006). The SBAS requests that participants identify one statement of five in each category (on-the-job activity and leisure-time activity) that best represents their activity during the past 2 weeks. At moderate physical intensity, the SBAS had a sensitivity of 0.73 and a specificity of 0.61 (Taylor-Piliae et al.).

Accelerometer

A piezo-electric accelerometer was worn by the participants to determine the number of steps taken in a 24-hour period. The accelerometers were capable of measuring and storing the participants' frequency, intensity, duration, and patterns of activity. These accelerometers store up to 7 days of data and are accurate for the slower walking speeds of overweight and obese individuals (Calfas, Sallis, Oldenburg, & Ffrench, 1997; Coleman et al., 1999; Crouter, Schneider, & Bassett, 2005; Sallis & Owen, 1999). In addition, the tilt of the accelerometer does not appear to affect the accuracy, thus providing more reliable data collected from overweight or obese participants.

The use of an accelerometer avoids the potential bias when workers record or report their own data by providing quantitative data—the number of steps taken in a 24-hour period. Accelerometers are not sensitive to additional energy expenditure due to carrying loads or moving up an incline, and they usually do not detect stationary activities such as leg and arm movements.

STATISTICAL ANALYSIS

The researchers used SPSS software, version 15. A two-way within-subjects analysis of variance was used to evaluate the hypothesis that participants who received the tailored e-mail messages would have a greater increase in activity level than those who received a general health information message. Additionally, the participants' perception of activity was examined and compared with the number of steps taken using a Mann-Whitney U test to evaluate the difference in mean steps between the contemplation and the preparation groups. Finally, the Kruskal-Wallis test was used to examine the last data point (now consisting of three stages-of-change: contemplation, preparation, and action)—level of activity identified and the mean rank for number of steps taken.

FINDINGS

The Hypothesis

A two-way within-subjects analysis of variance was conducted to evaluate the hypothesis that participants who received the tailored e-mail messages would increase their overall activity level. The dependent variable was the number of steps taken. The within-subjects factors were time with four levels (baseline, week 2, week 4, and week 6) and group (intervention and comparison). The steps main effect [$\Delta = 0.89$, $F\ (3, 63) = 2.37$, $p = .039$] and the steps by group interaction effect [$\Delta = 0.87$, $F\ (3, 63) = 2.95$, $p = .019$] were significant. The number of steps increased overall.

The mean number of steps per day was greater for the intervention group than for the comparison group at the final measurement period, with a 300-step per day difference between the two groups at the end of the study. Although both groups increased their number of steps, the comparison group's improvement was most likely attributed to the Hawthorne effect (a short-lived increase in productivity in response to a change in the environmental conditions) of having the accelerometer tracking movement. Another possible explanation for the Hawthorne effect could be workers comparing their steps to those of other workers.

Perception of Physical Activity

Participants' perception of activity was examined and compared with the number of steps per day recorded by the accelerometer. A Mann-Whitney U test was used to examine the first data points (two stages-of-change) to evaluate the difference between the contemplation and the preparation groups' mean steps. In other words, did those in the contemplation stage-of-change group move less than those in the preparation stage-of-change group? Those in the contemplation stage did, in fact, move less than those in the preparation stage ($z = -1.94$, $p = .05$). Additionally, the groups are appropriately ranked (contemplation ranked 30.92, preparation ranked 41.06), indicating a statistically significant perception difference between those in the contemplation stage-of-change (less active) and those in the preparation stage-of-change (more active).

The Kruskal-Wallis test was used to examine the last data points (three stages-of-change: contemplation, preparation, and action). This test is a non-parametric alternative to a one-way between-groups analysis of variance; however, the results were not significant ($p = .227$). Although the results were not statistically significant, an appropriate ranking in groups indicated a progression in perception of movement as stage-of-change increased.

Next, how participants' perceptions of either on-the-job or leisure-time activity compared to the number of steps taken in a day provided by the accelerometer was examined (Table). The SBAS (Taylor-Piliae et al., 2006) was used to obtain a quick assessment of the participants' perceptions of their usual amount and intensity of physical activity on-the-job and during leisure-time. Each of the survey sections provided a global statement about the

Table

Participants' Perceptions of Their Physical Activity Using the Stanford Brief Activity Survey

	Intervention Group (n = 37)		*Comparison Group (n = 36)*	
	%	n	%	n
On-the-job baseline category				
A	2.7	1	0	0
B	67.6	25	69.4	25
C	21.6	8	27.8	10
D	8.1	3	2.8	1
E	0	0	0	0
On-the-job final category				
A	0	0	0	0
B	51.4	19	50.0	18
C	40.5	15	27.8	10
D	5.4	2	11.1	4
Missing	2.7	1	11.1	4
Leisure-time category				
F	24.3	9	30.6	11
G	54.1	20	50.0	18
H	21.6	8	19.4	7
I	0	0	0	0
J	0	0	0	0
Leisure-time final category				
F	18.9	7	25.0	9
G	43.2	16	44.4	16
H	35.1	13	19.4	7
Missing	2.7	1	11.1	4

overall type of activity, classifying the participants into one of five distinct activity levels according to the dimensions of frequency, intensity, and time. Each global statement was represented by a letter (Table).

A Kruskal-Wallis test was conducted to evaluate differences among the levels of activity identified for the on-the-job activity category and the mean rank for number of steps taken. The test was significant [χ^2 (3, N = 73) = 7.58, p = .05] for the baseline measurement; however, the final measurement did not show a significant difference [χ^2 (2, N = 68) = 3.79, p = .15]. Similarly, leisure-time activity was examined and was significant at baseline [χ^2 (2, N = 73) = 6.20, p = .04]; however, the final measurement did not show a significant difference [χ^2 (3, N = 68) = 1.34, p = .71]. Initially, each of the participants' categories ranked appropriately with the steps taken; however, the final measurement period did not rank appropriately. Again, because this study ended with participants in three stages-of-change rather than two, perhaps the final measurement period was not significant due to sample size.

DISCUSSION

This was a theory-driven, worksite physical activity intervention study that used principles of cognitive behavior modification and tailored e-mail messages based on participants' identified needs. The study's goal was to modify behavior through tailored e-mail messages that addressed individual participants' needs and tapped into their epistemology, expanding their knowledge, thus influencing their perception of the importance of physical activity.

Movement

Although the results for the first hypothesis were encouraging—38% of intervention group participants moved to a higher stage compared to 27% of the comparison group and the increase in steps was statistically significant—the patterns within the comparison and in-

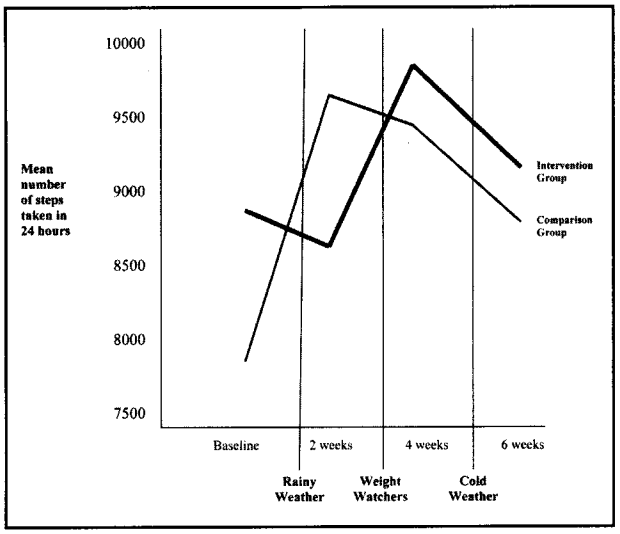

Figure. Confounding variables on steps taken.

tervention groups are difficult to interpret (Figure). That is, the intervention group had less gain in steps from baseline but had completed the greatest number of steps at the end of the trial. The comparison group had a greater gain in steps overall from baseline with only a brief, temporary change in performance, spiking from 7,794 steps to 9,643 steps in the second measurement period (Figure). As the study continued, the comparison group's mean number of steps declined each week. This pattern is a prime example of the Hawthorne effect; participants improved their behavior because of research attention. Consequently, the spike could have resulted from the accelerometer providing quantification and immediate feedback of steps taken (also known as the pedometer effect). Because of this, blinding participants to the accelerometer data is essential for future research.

Although the intervention group had a slight decline of 300 mean steps taken in the second measurement period, this can likely be attributed to increased precipitation during this time—a total of 4.44 inches of rain fell (National Weather Service, 2006). This precipitation fell across the region, including both study worksites. However, when on the job, the intervention group's work area was more out-of-doors than the comparison group's work area. The means of both groups dropped for the final measurement period, which could be attributed to the sudden change in temperature, dropping from the upper 50s to the lower 40s (degrees Fahrenheit), that started the day the final e-mail was sent. Additionally, both workplaces began a Weight Watchers program midway through the research study, which may have affected study outcomes (Figure). However, the degree of effect is unknown.

This health promotion campaign, in addition to the tailored e-mail messages, could have influenced the number of steps taken. Although most participants were cognizant of the importance of both a balanced diet and regular exercise to maintaining physical fitness and health, they may have felt a burden from two simultaneous health initiatives, resulting in their choosing to focus only on the one that appeared to provide more return on effort invested. For example, if participants of this study wanted to lose weight and thought they could receive the same, if not better, results from the Weight Watchers program with possibly less effort required, their focus may have been diverted from engaging in intentional physical activity to diet change and weight loss. Hence, the Weight Watchers program may have been more enticing than increasing their physical activity. Conversely, the Weight Watchers program may have had a positive effect on increasing steps. Although pedometer-based walking programs without a dietary intervention component can result in modest weight loss (Richardson et al., 2008), the combination of exercise and diet is usually emphasized in weight loss programs such as Weight Watchers. Ideally, it would have been best to have only one intervention at a time. Because this was a test of tailored messages, the intervention could have been combined with the corporate-wide Weight Watchers program if this had been known from the outset. Planned corporate health initiatives will need to be identified prior to designing and implementing future studies. Finally, the intervention group had a large number of commuters who traveled long distances to work. This travel time could have negatively impacted the physical activity in which these participants were able to engage.

Although this study did not have a substantial impact on physical activity levels, one may infer from the increase in steps that further development of the intervention and program design should be pursued. For example, the intervention group had an increase of 300 steps per day—109,500 extra steps per year or 54.75 extra miles per year. Assuming workers weigh 155 pounds, they will burn approximately 100 calories for every mile they walk. Therefore, if 100 calories were burned for every mile walked, this participant population would burn an extra 5,475 calories each year. Because 3,500 calories must be expended to lose 1 pound of fat (University of Illinois Medical Center, 2006), each employee would have lost approximately 1.6 pounds per year. During a 5-year period, 8 pounds would have been lost. This is sufficient to impact blood pressure and insulin control (University of Illinois Medical Center) and contribute to reversing the current trend toward obesity that plagues Americans. To reverse unhealthy trends, physical activity interventions should be seen as long-term and as part of workplace culture. Efforts to change organizational culture must align with culturally expected behavior, incorporating the norms and values or "the way we do things around here."

Perception

To be stakeholders in behavior change, workers should perceive that change is possible and that they are capable of changing. Workers' perception that change is possible is important to the motivational process. Through tailored e-mail messages, an individual's perception can be altered, leading to behavior change. The cognitive aspects of change in physical activity (contemplation vs. preparation; on-the-job vs. leisure-time activity) occurred before the actual behavior change itself.

Although the results were not statistically significant

for the stage-of-change and mean steps taken, appropriate ranking in groups indicated a progression of stage-of-change as movement increased. Likewise, participants' perceptions of either on-the-job or leisure-time activity did not adequately demonstrate where they were most active. This discrepancy was probably due to an inadequate sample size. Moreover, this study was based on a theoretical framework that assumes individuals are capable of identifying their current stage-of-change.

Theory

When considering the efficacy of theories, researchers can only disprove them. Because all measurement is theory-laden, objective knowledge or "proof" is not possible; theories are supported or not supported through testing of hypotheses. The results of this investigation are encouraging, in that the theoretical framework provides some description of behavior change.

This study used a synthesized model (Yap & Davis, 2007) of Maslow's Hierarchy of Needs and the Transtheoretical Model (TTM). Maslow's theory is intuitive; individuals must meet certain needs to engage in a particular behavior. The TTM is a continuum of behavioral change in which a decisional balance construct must include more support for behavior change than barriers for change to occur. In this study, arousal about intentional physical activity was created when information was given via an e-mail tailored to the need level identified by the participant. The theory posits that by addressing the most pressing need and explaining how engaging in intentional physical activity could help participants meet their identified need, an increase in support for behavior change would occur and that support would encourage participants to engage in physical activity.

Resnicow and Vaughan (2006) provide a possible explanation for why the stage change hypothesis was not rejected. These authors viewed behavior change as a quantum event best understood through Chaos Theory and Complex Dynamic Systems. They postulated that behavior changes include both chaotic and cognitive processes, and this synthesized model certainly meets their premise. When considering the introduction of needs to the concept of decisional balance, an element of "chaos" is introduced. For example, consider the individual who sits in the lunch room during all breaks (an unhealthy behavior) to meet the need of belonging at work. No number of pros will deter this individual from sitting in the breakroom if this need to belong (chaos) is pressing. But, if individuals were to receive tailored e-mails encouraging them to substitute intentional physical activity via a walking club during breaks to meet this need of belonging, then the occupational health nurse might expect to see change because the pros outweigh the cons of the activity behavior.

When considering the merging of Maslow's theory and the TTM, an element of chaos is not included. Individual perceptions and experiences contribute to a reality that is unique to each person. These individualities form chaotic systems that can be mathematically modeled but are impossible to predict on an individual basis—and which in predictive systems are called errors. This is certainly true in this study whereby movement toward intentional physical activity (behavior change) occurred for the intervention group, but an individual's behavior was not predictable. Therefore, the group as a whole can be predicted to move, but an individual's behavior within the group cannot be predicted. Second, chaotic systems are sensitive to baseline conditions. In this study, each participant lived within a unique set of circumstances (baseline condition) each day of the study period and circumstances that came before the study could also affect participants.

Finally, systems have multiple component parts that do not interact in a linear manner. In this study, components of the individual plants and overall corporate culture, seasonality, and study influences were uncontrolled. First, the cultures of manufacturing plants are anything but linear. The comparison group plant was unionized, but the intervention group plant was not. Therefore, one culture has external employee support (union) for defined behavior patterns, but the other does not. Unlike the comparison group, the intervention group had numerous long-distance commuters. These individuals had less time for physical activity and social bonding activities with coworkers. The two plants had a corporate link that supported a voiced need for competition between the plants (although this link was not used in this study). Seasonality and the weather also may have impacted study outcomes. Finally, feedback from the accelerometer or the presence of the researcher could have motivated behavior change.

Although the e-mail messages were a small part of the participants' lives, they resulted in a stage change movement toward more physical activity. In a complex system, the results are often greater than the sum of their parts. This is certainly true in this study. Although the e-mail messages were a small part of each participant's life, considering that each message took less than 1 minute to read, an overall positive behavior change resulted.

SUMMARY

The United States is a safety-conscious society, and this focus on safety has come about in part because of occupational safety programs that have impacted the entire culture. Because workplaces are not isolated systems, using the workplace as a base for changing perceptions toward physical activity can have an impact on the entire U.S. culture. In keeping with chaos theory, a small impact on physical activity perception at work can have a greater effect downstream. For example, workers model behavior for their children and these children both are impacted by parents' behavior and influence their friends. Health promotion interventions have many of the same principles as safety programs at work. Therefore, management support, defined strategies, meaningful behavior prompts, and internal and external benchmarking are also essential to successful health promotion programs. In this research on intentional physical activity, management supported the research, strategies and prompts were provided, and participants received feedback from the accelerometer.

Improving the physical health of a work force may

ultimately reduce the manufacturing sector's economic burden associated with worker illness and injury as identified by the National Institute for Occupational Safety and Health research, which aims to diminish occupational diseases, injuries, and fatalities among manufacturing workers through focused programs of research and prevention. Because it has been well established that physically fit individuals are less prone to illness and injury, this study begins a line of research ultimately aimed at improving physical health within a working population—striving to fulfill the National Institute for Occupational Safety and Health mission through increased intentional physical activity leading to reductions in occupational injuries and illnesses among workers in manufacturing industries.

An inverse linear relationship exists between the volume of physical activity behavior and all-cause mortality (Lee & Skerrett, 2001). Additionally, physical activity reduces the risks of cardiovascular disease, type 2 diabetes mellitus, osteoporosis, depression, cancer, and obesity (Centers for Disease Control and Prevention, 1999). Although the health benefits of intentional physical activity are many, Americans remain sedentary. It is imperative that interventions be designed to effectively promote the adoption and maintenance of an active lifestyle for large numbers of Americans. The workplace is a logical setting in which to begin intentional physical activity promotion programs. Furthermore, business and industry bear a sizeable portion of the cost of obesity through health care and disability costs and lost productivity (Bungum, Satterwhite, Jackson, & Morrow, 2003). Consequently, from the business perspective, workplaces are ideal settings for health promotion programs.

The first goal of this study was to determine whether individuals who received tailored e-mail messages were significantly more likely to progress in stage-of-change movement than those participants who did not receive tailored messages. Thirty-eight percent of intervention group participants moved up in stage, compared to only 27% of comparison group participants. Also, 18.9% of intervention group participants actually moved forward two stages, engaging in physical activity on a regular basis (action stage-of-change). No participants in the comparison group moved through two stages of change. Additionally, parameter estimates show a small-to-medium effect size with a positive direction. By increasing the sample size, it is very likely a significant change may have been found in the direction of the original hypothesis, progression in stage movement for those who received the tailored e-mail messages. Therefore, future research studies should include larger samples.

The second goal of this study was to determine if an increase in overall activity level (steps taken) among participants who received the tailored e-mail messages would occur. The results are encouraging as the overall pattern appears to be positive and is worth investigating, again with more participants.

Furthermore, a tailored e-mail program of longer duration may encourage more understanding of this phenomenon and result in more steps taken and greater overall physical activity. Also worth considering is the "small dose" and limited exposure (time) to the intervention that may have limited the intervention's potential for impacting health behavior change. Similarly, an exploration of specific pro and con items is needed, as well as any environmental, psychological, and social mediators that may have an impact on those items. This assessment will enhance the researchers' and clinicians' abilities to design effective physical activity promotion programs using tailored e-mail messages.

Future research should focus on the development and implementation of expert systems (knowledge-based computer systems that would contain analytical skills of human counselors) that can be used by the occupational health nurse. Similarly, the development of an interactive site has the potential to influence worksite physical activity by allowing workers to monitor their level of physical activity over a period of time and possibly benchmark against other workers. At the very least, the use of a pedometer-based program in combination with a corporate competitive spirit may increase activity. Finally, high-quality measurement built into the evaluation of such programs can critique theory and produce guidelines and recommendations for best practices.

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