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Mapping Use of a Self-directed On-line Heart Disease Education Program onto Health Learning Outcomes: A Study of Post-Heart Attack Learners

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Abstract: *We correlated 25 heart patients' changes in four behaviors to usage of behavior themes and three on-line learning activities. Information correlated negatively; communications correlated positively; and interactive planning showed a positive trend with changing behaviors. These findings challenge on-line educators to transcend information provision and offer more opportunities that integrate social interaction and planning.*

Background

About one-half million people in the U.S. die from heart attack or subsequent complications of coronary artery disease, each year, making it the nation's leading killer of both men and women (American Heart Association, 1999). Thousands of research studies over several decades have found that a healthy lifestyle (diet, exercise, not smoking and reducing stress) reduces symptoms and extends survival time. Lifestyle changes are complex learning endeavors involving emotional, existential, cognitive and behavioral learning – as such most post-heart attack patients do not succeed with maintaining a heart healthy lifestyle (AHCPR, 1995; Ornish, 1998). Cardiac rehabilitation provides behavioral and cognitive education, and improves health and behavior outcomes for about half of participants. However, only 38% of post-heart attack patients participate, due to time, geographic, economic and cultural constraints. Many health care organizations provide access to on-line programs to compensate for these barriers. It is well known that access to computers is skewed toward people with higher incomes and educational levels. However, little is known about *how* individuals with advanced heart disease use and benefit from on-line lifestyle education programs, when computers and training are provided.

CHES: *Living With Heart Disease*, a self-directed computerized heart disease education program, was developed and evaluated by a multi-disciplinary team of university researchers and clinicians. CHES (Comprehensive Health Enhancement Support System) provided three learning activities to facilitate lifestyle changes – information, interactive planning tools, and on-line com-

munication with peers and experts (Johnson, et. al., 2000). Fifty-two post-heart attack or post-heart surgery patients completed a six-month randomized pilot test that evaluated a prototype version of CHES' effects on behavior change learning outcomes. Computers and home training were provided to the CHES group (N=25). CHES had positive effects on learning processes and efforts to change diet, exercise and stress management. This finding raises several questions about how on-line systems might facilitate health behavior change. This paper addressed the question of *how individuals' use of CHES' behavioral content themes and learning activities related to behavior change learning outcomes*. That is, how did users' engagement with diet content relate to their diet change? Smaglik (1996) addressed the relationship between on-line learning activities and quality of life, but there are no reports about how on-line thematic usage relates to behavioral outcomes (Eng & Gustafson, 1999, chapter 4).

Methodology

Sample

The sample included the 25 individuals who had been randomized to use CHES in the pilot evaluation study. Characteristics included: 63% male, 93% Caucasian, mean age 57 (s.d. 10); 88% high school education or more; 60% were comfortable using a computer and 84% had participated in cardiac rehabilitation (Johnson, et. al., 2000).

Methods

We conducted Pearson correlation tests between individuals' use of CHES content and learning activities for each of four behavioral categories (e.g.,

diet, exercise, stress reduction and smoking cessation), and their change in corresponding behaviors during the six-month study. This involved two prior steps. For each behavioral category, we calculated individuals' saturation of available CHESS information and interactive planning activities, and the level of communication about those behaviors. Then, we calculated the differences between individuals' six-month post-test and pre-test survey scores for self-reported changes in diet, exercise, stress management and smoking. The survey measured several behavior change learning processes – including commitment, planning, reflection-in-action, seeking resources and social support, building self confidence, and resilience in the face of relapse (Prochaska, 1994).

Saturation of CHESS content. Saturation is the proportion of available content used by individuals for each behavioral category. The continuous proportional variable allowed us to compare levels of a category's use across individuals. Calculating saturation levels involved, first, developing a thematic inventory of CHESS content, and then using CHESS' automatically collected usage data to identify individuals' thematic content choices.

The thematic inventory was developed by coding all content in CHESS' information and interactive problem solving tools. The 667 information documents were automatically coded by grouping their tagged keywords into nine categories, including the four studied here—diet, exercise, stress management and smoking cessation. For example, the keyword Recipes fit into the Diet category, and

the keyword Relaxation Techniques fit into the Stress category. The four behavioral categories accounted for a total of 192 information items or about 29% of the total information content in CHESS. The diet code was manually assigned to the diet action plan, which also included food assessments (at the time there were no in-depth interactive planning tools for other behaviors). Although not technically part of the CHESS inventory, we also coded and calculated the number of times individuals addressed the behaviors in communicating with peers and the expert. Messages addressing more than one category were multiply coded.

Table 1 shows how the CHESS content inventory varied across categories, learning activities and keyword concepts. The diet and stress categories had much more content than did exercise and smoking. Thus saturating 100% of 24 exercise items may not be comparable to saturating 50% of 112 stress items. This variance, in part, reflects the different nature of the behavior changes, and in part, the level of CHESS development at the time of the study. For instance, adopting a regular exercise regimen may require less information than changing a diet, where recipes or tips on dealing with food cravings can be helpful. Stress was conceptualized as a theoretically comprehensive category, and included stress symptoms; common stressors; and several emotional, cognitive, physiological and behavioral stress management strategies (Lazarus & Folkman, 1984; Seligman, 1990). Smoking cessation, an immensely complex activity, but content was not developed.

Table 1. Inventory of CHESS Information and Interactive tools by Behavioral Category

	Diet	Exercise	Stress	Smoking
Information	54	24	112	16
Interactive Tools	1	0	0	0
Communications (to peers and expert)	62	58	56	16

The second step in developing the behavioral saturation scores was comparing individuals' CHESS use data to the thematic inventory. For each user code name, CHESS automatically recorded information selections, responses in the interactive tools, and message texts to the peer chat-line and the CHESS Expert. Saturation of CHESS informa-

tion was calculated by dividing the number of documents accessed for each behavior by its inventory number, as shown in Table 1 – thus yielding a continuous proportional score. Saturation levels for the interactive diet action plan were represented by a five point saturation score, using criteria based on the plan's systematic learning goals

(Wise, 2000b). Communications were not calculated as a saturation score, because they were generated by the learners, rather than by CHES. Instead, we used individuals' number of messages that addressed each behavior.

Behavior change learning outcomes. Learning outcomes were represented as self-reported efforts to change, as the difference between six-month and pre-test survey scores. We used a previously validated scale of nineteen variables based on Prochaska's (1994) stages of change model. The scale measured several learning activities involved in the process of implementing and maintaining change for each of the four behaviors. These included knowledge about the benefits of changing and how to do it; attitudes toward changing, willingness to seek support and resources; self-efficacy (confidence in one's ability to change); specific actions toward changing; and resilience in the face of relapse.

Correlation tests. For each of the four behaviors, we conducted *Pearson r* correlation tests between individuals' survey scores for the 19 behavior change variables and their saturation of the corresponding information about the behavior. For the communication activity, we used the number of times individuals addressed each code, rather than a saturation score. We also ran the test between the diet survey change scores and the level of engagement with the interactive diet action plan.

Findings

In general, communication activities correlated positively with diet and smoking cessation change processes, while information gathering correlated negatively with change processes for diet, exercise, and stress reduction. An early prototype diet action plan showed a possible trend toward positive diet change. Table 2 shows, for each behavior and learning activity, the range of content usage and the total number of users; how many of the 19 learning variables with significant, marginally significant or trend *Pearson r* correlation score with CHES usage; and the direction and range of the coefficient scores.

Although more individuals (84%) engaged in information seeking than other learning activities, the information saturation scores across all behaviors was low – with the highest individual saturation level being 40% of diet content. Fewer individuals engaged in communication (11) about lifestyle be-

haviors, or used the interactive diet action plan (7). Information seeking correlated with a greater number of behavioral learning variables and behaviors than did the communications or interactive problem solving activities. However, except for one diet variable, all correlations between information seeking and behavior change were negative – meaning that greater saturation of CHES diet, exercise and stress information correlated negatively with diet, exercise and stress learning outcomes. No significant correlation was found between saturation of smoking information and smoking behavior. Although fewer individuals used the peer discussion groups, those who did had significant positive correlations with diet change and much more so for smoking cessation outcomes. There were no significant correlations between communication about exercise or stress and outcomes for those behaviors. At the time of the study, only diet had an interactive planning tool. The degree of usage had no significant correlation with behavioral outcomes, but there was a possible trend for improving self-confidence in maintaining diet changes—a specific goal of the prototype program.

Discussion

This exploratory study used simple bivariate correlation tests with a small sample size to address how using a prototype computerized learning system related to the enormously complex learning endeavor of transforming the way ones lives after a heart attack. As such, any significant findings must be seen as preliminary. Nonetheless, the data suggest several intriguing questions that challenge on-line educators to integrate transformative, experiential and contextual adult education principles into on-line learning environments. Furthermore, they suggest several possible research directions using more sophisticated multivariate analyses with larger and more varied samples, and in-depth interpretive research to discover how adults' prior life experience and their social environments influence post-heart event learning – on-line and otherwise. Given the limited space, we focus this discussion to the relative roles and underlying assumptions of the different learning activities in transformative learning, and conclude with suggestions for next-generation development of on-line learning systems and further research.

Table 2. CHESS Usage and Correlation Coefficient Scores for Each Behavior Change Category

	Diet	Exercise	Stress	Smoking
Information				
Saturation Range	1.85 – 40.74% (n = 22)	4.17 – 33.33% (n = 12)	.89% - 19.64% (n = 19)	6.25 – 31.25% (n = 9)
Variables with Significance	6	1	5	-
Pearson r Correlation Coefficient Direction (and range)	1 positive (r = .453) 5 negative (r = -.673 – -.480)	1 negative (r = -.760)	5 negative (r = -.705 – -.498)	
Communication				
Message Range	1 – 40 (n = 13)	1 - 27 (n = 11)	1 – 39 (n = 8)	1 – 9 (n = 7)
Variables with Significance	5	-	-	5
Pearson r Correlation Coefficient Direction (and range)	4 positive (r = .859 – .480) 1 negative (r = -.455)			4 positive (r = .992 – .684) 1 negative (r = -.795)
Interactive Action Plan				
Saturation Range (5-point)	1 - 5 (n = 8)	-	-	-
Variables with Trend	1			
Pearson r Correlation Coefficient Direction (and range)	1 positive * (r = .122)			

Total N = 25 Total variables = 19 * trend

Information and behavior change. All but one behavior change variable correlated negatively with saturation of CHESS' information. Notably, the one variable with a positive correlation showed marginal significance with increased knowledge about adopting a healthy diet – not with attitude, behavioral or contextual issues associated with behavior change. This supports prior research that generally shows a low correlation between knowledge and lifestyle behavior change. For example, repetitive information about how to change health behaviors is ubiquitous in the mass media. However, the vast public investment in diet books has not stemmed the tide of increasing obesity. In fact, those who *repeatedly* invest in such resources may be the least successful in dieting. Likewise, we wonder whether those who saturated greater amounts of CHESS information were those having the hardest time with diet, exercise and stress, while those who were doing well had no inclination to revisit the informa-

tion. We ask this because patients with advanced heart disease are even more likely to know about lifestyle changes than the lay public, and have high rates of behavioral relapse after six months (AHCPR, 1995). In fact, 84% of the sample had participated in cardiac rehabilitation, which provides lifestyle information, counseling and monitoring; in-hospital education and information packets are standard care. Interviews with a selected sample said that CHESS' lifestyle information was accurate, but largely replicated what they already knew (Wise, 2000a). From an adult learning perspective, Jarvis (1987) and Mezirow (1991) contend that technical information or instrumental knowledge becomes salient *after* a perspective shift and commitment to go onto higher order or transformative learning. In summary, we suggest that to facilitate change, educators must continue to stretch the capacities of on-line learning environments by weaving salient information into application,

meaningful self-reflection and social interaction activities.

Social interaction and behavior change. Fifteen of the total sample of 25 joined the peer discussion and only four posted more than 10 total messages over the six months. Peer communication was low, compared to that in CHESS Breast Cancer and HIV/AIDS. However, those who did write seemed to benefit across the different learning processes for diet, and even more so for smoking. As with all correlations, we cannot tell the direction of the relationship. Were those who chose to communicate more successful to begin with and thus more willing to talk about their experience? Were they more successful because they were generally more inclined to seek and get support in their other social relationships? Alternatively, did the CHESS communication activity provide direct help with lifestyle changes? Only multivariate analyses with larger samples, or in-depth interpretive research can begin to address these questions. However, the quality of the 16 smoking messages among seven individuals may shed light on the high positive correlation coefficients. Several messages addressed the intensity and the meaning of successfully quitting in the face of a heart attack. While supportive social interaction is beneficial to health outcomes (Spiegel, 1989), other research suggests that people with heart disease may be less likely to participate in and benefit from on-line support groups than those with other illnesses. A text analysis of on-line chat-lines across several illnesses found that heart disease attracted the least amount and thinnest interaction (Davison & Pennebaker, 1997). These findings suggest the need to explore other models for learning in social interaction.

Interactive planning. Use of the input-intensive prototype diet action plan showed a possible trend toward improving diet self-efficacy – precisely the goal of the action plan. The prototype action plan used cognitive and behavioral learning theories to provide a systematic planning process. This positive trend suggests the need to explore ways to streamline and tailor interactive feedback. Other research also suggests that behavior change programs should integrate activities that encourage learners to work through the emotional and existential issues associated with having a heart attack (Ornish, 1998; Wise, 2000a).

Summary. We described a methodology to discover basic relationships between thematic use of a

self-directed on-line health education program and health behavior change learning outcomes. Our findings support previous research that social interaction is more effective than information in helping adults address the emotional, existential and technical aspects of lifestyle change; and that information increases knowledge but does not necessarily translate to behavior change. Finally, we emphasized the need to integrate the best of face-to-face and on-line learning, and to broaden our understanding of how use of on-line programs relates the whole learning experience.

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