

Increasing Relevance of Smoking Cessation Messages in an Online Software Agent Environment

Todd Shimoda, Linda Stapel
Colorado State University
todd.shimoda@colostate.edu

Abstract

An online software agent that helps smokers quit was designed and tested. We created a library of categorized smoking cessation messages using meta-data corresponding to the Stages of Change Theory. A feedback process was developed that used individual participant's relevance ratings and a message similarity search algorithm.

A pilot study of university students who smoke or had recently quit was performed. Participants were randomly assigned to one of three groups: one received generic, non-tailored messages; another received tailored messages based on their answers to questions about their smoking and quitting behavior; and another received messages selected through tailoring and feedback. In the feedback-driven group, participants reported relevance of the messages received averaged higher than the other two groups. There was also a highly significant correlation in this group between relevance and social presence, which indicates the "feeling" of interacting in an interpersonal manner.

1. Behavioral Models and Message Tailoring

According to the 2003 Pew Internet and American Life Project survey (<http://www.pewinternet.org>), 80% of North American Internet users have accessed the Internet to search for health information. Most health websites deliver generic messages, that is, the same information for all visitors. Some websites use programs to gather user data and tailor information. Health communication researchers (e.g. [7, 4]) have shown that tailored health communication messages outperform non-tailored materials. Non-tailored materials are typically generic, "one-size-fits-all" messages designed to reach as much of the total audience as possible. Tailored materials are designed to match the needs and other factors of individuals. Health information technology designers can use complex human behavior models to develop computer-mediated health communication with more

effective message delivery. The behavioral theory used in the development of the system reported here is the Stages of Change.

1.1 Stages of Change Theory

Psychologists use the Stages of Change Theory (also known as the Transtheoretical Model) to compare smokers in therapy and self-changers along a behavior change continuum. The rationale behind the theory is to tailor therapy to individual's needs at their stage in the change process. Six stages were identified and presented as a linear process of change.

A description of each stage are [10, 11]: (a) pre-contemplation—an individual has the problem, recognized or not, and has no intention of changing, (b) contemplation—the individual recognizes the problem and is seriously considering changing, (c) preparation for action—the individual recognizes the problem and intends to change the behavior within the next month, (d) action—the individual has enacted consistent behavior change for less than six months, (e) maintenance—the individual maintains new behavior for six months or more, and (f) termination—the behavior change has been permanently adopted. Stages of Change Theory indicates messages should be tailored to an individual's current stage to move them toward the next. However, the stages are not necessarily linear; rather, they tend to be components that vary according to an individual's cyclical process of change.

In addition to the stages, psychologists identified nine processes that help predict and motivate individual movement across stages [8]. The processes and the stage in which they are typically used are shown below:

Pre-contemplation:

- Consciousness raising (information and knowledge)
- Dramatic relief (role playing)
- Environmental reevaluation (how problem affects physical environment)

Contemplation:

- Self-reevaluation (assessing one’s feelings regarding behavior)

Preparation:

- Self-liberation (commitment or belief in ability to change)

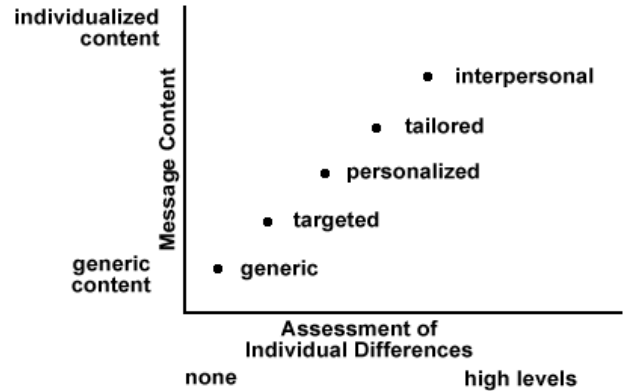
Action:

- Reinforcement management (overt and covert rewards)
- Helping relationships (social support, self-help groups)
- Counter-conditioning (alternatives for behavior)
- Stimulus control (avoid high-risk cues)

1.2 Message Tailoring

The key to using behavior change theory in smoking cessation is to deliver messages that match the factors of individual smokers identified as important in the theory. Some of these factors include readiness to quit, addiction to nicotine, barriers to quitting, motives for quitting, self-efficacy, quitting history, social support, demographics, use of other substances, quitting strategies preferred, physical environment, and medical conditions. The level of individualization of the messages depends on the effort in assessing these factors. Figure 1 shows the continuum of message content ranging from generic to individualized as a function of the assessment of individual differences.

A computerized message tailoring program is an expert system that takes into account several different types of data to select messages. Each of these data types can have a few to several values, making the number of possible combinations of messages in the many thousands. Expert tailoring systems have been shown to be successful in nutrition, breast cancer, smoking cessation, and other health areas. For example, Brug and colleagues [4] showed higher satisfaction with tailored nutritional materials as measured by: (a) reading the material completely, (b) saving the material, (c) discussing the material with others, (d) rating the material as personally relevant, (e) rating the recentness of the information, (f) judging that the material was written for them, and (g) rating the materials as interesting. The message tailoring process can be further refined by interacting with system users to obtain a higher level using individual factors, reactions, and preferences. This further refinement should lead to higher levels of message relevance, user/system interactivity, and social presence of the environment as described in the next section.



(adopted from Kreuter et al. 2000)

Figure 1: Message types as a function of assessment of individual differences

2. Relevance, Interactivity, and Social Presence

Relevance is a concept or construct used in studies of human communication and information systems. In communication, Wilson and Sperber [19] start with Grice’s view of relevance as a maxim during co-operative communication in which there is an expectation that something spoken will guide the hearer toward the speaker’s meaning. Wilson and Sperber use this maxim in developing a theory of relevance which posits that an input (a sight, a sound, an utterance, a memory) is relevant to an individual when it connects with background information he or she has available to yield conclusions that matter to him or her. The conclusion might be an answer to a question or new knowledge on a certain topic. The conclusion might settle a doubt, confirm a suspicion, or correct a mistaken impression. In relevance-theoretic terms, an input is relevant to an individual when its processing in a context of available assumptions yields a positive cognitive effect, that is, it satisfies some need. Relevance theory claims that what makes an input worth picking out from the mass of competing inputs is not just that it is relevant, but that it is more relevant than any alternative input available at that time. This view of relevance implies a highly active, goal-oriented process of inferring, evaluating, and selecting which inputs to pay attention to.

In the context of information science, Schamber [14] states that, explicitly or implicitly, relevance is the fundamental criterion for evaluating the effectiveness of information retrieval and use. Unfortunately, rather than a single concept, relevancy is a bundle of many types of cognitive judgments and other evaluative criteria such as content, importance, credibility, comprehensiveness, and

specificity to mention a few. Research [14] has shown that relevance is highly individual and situational. This complexity has limited widespread use of relevance as a factor in information research.

Brouard, C. & Nie [2] have adapted a neural cognitive model of how our brains select information from the environment. Adaptive resonance theory was thus proposed to be a “natural” process of information retrieval using two-layer neural networks. To simplify here, inputs into the network attempt to associate and reinforce stimulus representations and internal representations. The computation is measure of strength of the assertion “if Node A is activated then Node B is also activated.” With high strength, the network locks into a resonant state. For example, resonance helps us keep track of a single conversation at a loud cocktail party. This approach allows a search and retrieve process to be updated and improved in successive iterations through user feedback.

Similarly, in computer-mediated communication, user feedback can increase relevance of messages delivered. Feedback allows for increased user interaction with a system, and more information is gained on which to select relevant messages. Interactivity has been defined many ways. Rogers & Albritton [13] define it as the degree to which participants in a communication process have control over and can exchange roles in their mutual discourse. Rogers [12] defines interactivity as the capability of computer communication systems to “talk back” to the user as individuals participating in a conversation. The components of a conversation include (a) mutual discourse—the degree to which a particular communication act is based on a prior series of communication acts, (b) exchange of roles—the ability of individual A to take the position of individual B and thus to perform B’s communication acts, and vice versa, and (c) control—the degree to which an individual can choose the timing, content, and sequence of a communication act, search for alternatives, enter message content into storage, and other actions. According to Heeter [6], interactivity consists of six main dimensions: (a) complexity of choices available, (b) effort required of users, (c) responsiveness to user, (d) monitoring information for the user, (e) ease of adding information, and (f) facilitation of interpersonal communication.

By increasing interactivity, the user’s perceived social presence (the feeling of interacting with a person) should increase. A high degree of social presence has shown to increase desirable outcomes such as recall, satisfaction, and behavioral change intentions [17]. Social presence is the degree of salience of the other person in the interaction and consequent salience of the interpersonal relationships. Biocca [1] further defines the amount of social presence as the degree to which a user feels access to intelligence, intentions, and sensory impressions of another. In other words, a face-to-face

conversation will have a higher degree of social presence than reading a printed document for a mass audience.

The computer-mediated system designed in this project to deliver smoking cessation messages is based on the premise that through increasing user interactivity and perceived social presence using feedback, messages will be judged more relevant than generic or tailored messages. The system design is described in the following section.

3. Software Agent Environment

Software agents are an implementation of artificial intelligence programming. Software agents are programmed with knowledge and the ability to reason and act [15, 16, 18]. They can receive information available in their software environment, such as answers that users provide in response to questions, the preferences users express, and other actions users perform while interacting with the software. Software agents use this information and their knowledge and reasoning abilities to display context-specific messages, ask for clarification or more information, request feedback, and other communication acts. This ability allows software agents to further refine the tailoring process to deliver more relevant messages for individual users of the system.

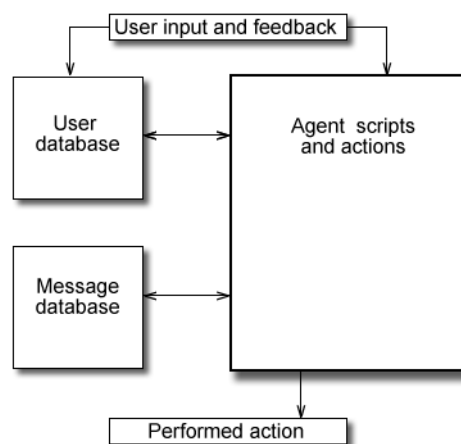


Figure 2. Software agent modules.

This project’s software agent environment consists of user input, a user database, a message database, the agent reasoning scripts and actions, and the display of actions performed. The system is implemented in a website. The databases are implemented in SQL Server 2000. The scripts and actions are coded in a series of if-then rules

and search algorithms. ColdFusion markup language is used with the scripts to display HTML pages. Figure 2 shows the modules and the flow of information.

3.1 User database

Online questionnaires are used to collect information about users' smoking history (including the Fagerstrom Test for Nicotine Dependence, discussed later), previous quitting attempts, quitting stage (i.e., stage of change), perceived difficulty of overcoming quitting obstacles, and demographics. If users are currently quitting or previously attempted to quit they are asked to rate the helpfulness of the types of smoking cessation advice, nicotine replacement therapy, or other techniques they used. A more detailed list of the information collected is found in Section 4, which describes the pilot study. If users are quitting they were asked to report their confidence in staying quit. If they are not currently quitting or considering quitting they were asked when they believed they would eventually quit.

The Fagerstrom Test for Nicotine Dependence [5] is a scale measure that provides an approximation of a smoker's relative addiction to nicotine. The questions, answers, and scores (in parentheses) are:

1. How soon after you wake up do you smoke your first cigarette?

0-5 minutes (3), 6-30 (2), 31-60 (1), after 60 (0)

2. Do you find it difficult to refrain from smoking in places where it is forbidden (e.g. church, library, cinema)?

Yes (1), No (0)

3. Which cigarette would you be the most unwilling to give up?

First in the morning (1), Any of the others (0)

4. How many cigarettes per day do you smoke?

10 or fewer (0), 11 to 20 (1), 21 to 30 (2), 31 or more (3)

5. Do you smoke more frequently during the first hours after waking than during the rest of the day?

Yes (1), No (0)

6. Do you smoke when you are so ill that you are in bed most of the day?

Yes (1), No (0)

The summed scale scores and qualitative categories of dependence are:

0-2 Very low dependence

3-4 Low

5 Medium

6-7 High

8-10 Very high

The user database also includes the identification number of the messages that users received in a session. Other session information collected in the database includes variables in the evaluative study, such as user-rated relevance of messages. Section 4 describes these variables.

3.2 Message database

A "message" in this project consists of short paragraph of related information. The messages were primarily from the US National Institutes of Health (NIH) online advice for quitting smoking [6]. Other sources were from the American Cancer Society, American Lung Association, and some written by project staff. Some messages were revised for consistency in length, tone, and other factors.

The content of each message was entered into the database, along with administrative data and meta-data. Administrative data include: title, source, created date, and revised date. Meta-data include: general category (concept, strategy, fact, example), stage (from Stage of Change Theory), process (e.g., consciousness raising, see Section 1.1), age, gender, race (broad, physiological distinction), ethnicity (political distinction), culture (lifestyle distinction), and keywords. For example:

Title: Be prepared for relapse or difficult situations

Source: National Cancer Institute

Category: Strategy

Stage: Pre-contemplation

Process: Consciousness raising

Age: Adult

Race/Ethnicity/Culture: neutral

Keywords: relapse, alcohol, smokers, weight, mood

Message:

Most relapses occur within the first 3 months after quitting. Don't be discouraged if you start smoking

again. Avoid drinking alcohol. Drinking lowers your chances of success. Being around smoking can make you want to smoke. Many smokers will gain weight when they quit, but usually less than 10 pounds. There are a lot of ways to improve your mood other than smoking.

3.3 Agent scripts and actions

Scripts are the programming code used to determine which messages to display. They are called scripts because they are similar (at least in spirit) to the scripts used by smoking cessation counselors (e.g., [3, 9]). Actions refer to what the agent does at a particular point in time such as display messages or request the user to input information. Three main types of scripts were developed for this project based on the message selection process: generic, tailored, and feedback-driven. In this project, a total of ten messages are selected to be displayed.

Generic. The generic script selects the same ten messages regardless of user profile. The messages consist of five reasons to quit: health, cost, social, professional, or personal; and five key strategies to quitting: get ready, get support, learn new skills and behaviors, get medication and use it correctly, be prepared for relapse or difficult situations. The selection script uses a match of meta-data to select the messages.

Tailored. The tailored script selects ten messages based on user profiles determined from user data and through matching meta-data. Factors in how messages are selected include: the user's stage of change, rated importance of reasons given for quitting, the level of nicotine addiction (Fagerstrom index), obstacles to quitting rated as most difficult, and rated helpfulness of techniques used in previous quit attempts.

For example, a user is determined to be in the contemplation stage. The script first selects three messages based on the ratings of importance given by the user for reasons for quitting. Next, a message is given related to setting a target date for quitting. Next, one or two messages dealing with nicotine replacement and counseling are selected based on the user's Fagerstrom index. Next, two or three messages are selected based on the user's perceived difficulty in overcoming obstacles to quitting. Next, two or three messages are selected based on rated helpfulness of support used in previous quitting attempts. If ten messages have been selected, the process ends. If not, the remaining messages selected are effective strategies for the contemplation stage.

Feedback-driven. The script in the feedback-driven group first selects messages determined using the tailoring procedures as described above. Messages are presented to a user one at a time and the user rates the relevance of the message. The users are then asked if they are satisfied with that message or if they would like to see

other messages. If they are satisfied, the next message from the tailored set is displayed. If they would like to see new messages, they are shown three messages not in the original set. These three messages are selected using a similarity algorithm.

This similarity search procedure begins with the user's relevancy rating of the tailored message. Essentially, if the message is rated high, substitute messages that are similar are chosen. If the message is rated low, messages that are dissimilar are chosen. The similarity is calculated based on number of matches and non-matches to meta-data. At the end of the feedback process, users in this group end up with ten messages that vary from the original ten tailored messages depending on the feedback.

4. Evaluative Study Methods and Results

The pilot study's primary research question is: Does a feedback-driven message selection process produce higher message relevance than a generic or tailored message selection process? It also investigates the effect of feedback-driven message selection on message recall, perceived social presence, and intention or confidence in quitting. The study's hypotheses are that the feedback-driven message delivery system will produce higher message relevance, message recall, social presence, and intention to quit. The study is a small, preliminary evaluation of the agent-based system prior to further development.

4.1 Methods

Participants: Participants were 51 university students aged 18 to 29 who had smoked within the six months prior to the study. Minors were excluded from the study because of the illegality of purchasing cigarettes and the need for parental permission to participate in the study. Those older than 29 were excluded because of their lifestyle that tends to differ from younger students (e.g., having a spouse or partner, children, careers). Participants were recruited using flyers posted around campus, an ad placed in the student newspaper, and a health promotion specialist at the campus student health center. Participants were randomly assigned to one of the three groups. Participants were paid \$40 for completing the study. The study took place in a university computer lab.

Pre-test questionnaires: Online questionnaires were given to participants. The questionnaires corresponded to the information collected for the user database as described in Section 3.1.

Smoking cessation messages: After answering the pre-test questionnaires, each participant received ten messages. Group 1 participants received generic messages, Group 2 tailored messages, Group 3 feedback-

driven messages. The message-selection process for each was described in Section 3.3.

Message relevance: Each of the final ten messages received in the three groups was rated by the participants for personal relevance. Relevance was measured using a four-point Likert scale. The instructions read: "Please rate each paragraph of information according to how relevant it is to you. 'Relevant' means personally meaningful and helpful." The scale items (score) were: not relevant (1), a little relevant (2), moderately relevant (3), very relevant (4).

Social presence: Perceived social presence of the experience using the online message delivery system was measured using a series of six-point semantic scales. The scales were: impersonal-personal, insensitive-sensitive, unsociable-sociable, cold-warm, passive-active. An example of the response format is:

Using the scale below rate the program you just used. Click on the box closest to how you feel:

Impersonal Personal

Message recall: One week later the participants returned to the computer lab. They were asked to recall as much as they could about the messages they received. The instructions were: "You rated several pieces of information and advice last week. In the box below, please type as much as you can recall about that information and advice."

Post-test questionnaire: After the free recall task, the participants were again asked to rate their stage of quitting. As in the pre-test, depending on their stage, they were asked for their quit confidence or when they believed they would eventually quit.

4.2 Results

Demographics: A total of 51 university students, 17 in each group, participated in the study. Of the total, 22 were female and 29 were male. The mean age was 19.6 ($SD = 1.5$, range = 18-25). Of the 51 participants, 40 were white/Caucasian (non-Hispanic), 6 Latino/Hispanic, 4 Asian/Pacific Islander, 1 black/African American.

Smoking behavior: The participants were generally light smokers: 36 (71%) indicated they smoke less than half pack per day, 13 (25%) one-half to one pack, 2 (4%), one pack to one-and-a-half packs. About 40% of the participants first started smoking regularly in the past two years, 50% between 2 and 5 years, and 10% over five years. The mean rating of nicotine addiction on the Fagerstrom index (0-10) was 2.0 ($SD = 1.9$, range = 0-7). Table 1 gives the frequencies of the index.

Table 1. Frequency table results for Fagerstrom (0-10 index nicotine addiction)

Fagerstrom	frequency	relative frequency
0	14	0.27
1	12	0.24
2	9	0.18
3	6	0.12
4	2	0.04
5	5	0.10
6	2	0.04
7	1	0.02

Stage of change: The majority of the participants (92%) indicated they were in the pre-contemplation, contemplation, or preparation for action stage for quitting smoking. Table 2 shows the frequencies of reported stages.

Table 2. Frequency table results for pretest stage of change

pretest stage	n	relative frequency
pre-contemplation	18	0.35
contemplation	15	0.29
preparation	14	0.27
action	3	0.06
maintenance	1	0.02

Obstacles to quitting smoking: The participants were asked the difficulty they had (or perceived they would have) in overcoming obstacles to quitting smoking. The five-point scale was: (0) don't know, (1) not important, (2) a little important, (3) moderately important, and (4) very important. Table 3 gives the mean ratings for all participants.

Those who were in the Pre-contemplation stage in the pretest ($n = 18$) were asked when they believed they would quit in the future. Five indicated they would quit within 1 year, 7 within 1-5 years, 4 within 5-10 years, 1 in more than 10 years, 1 never.

Table 3. Mean rated obstacles in quitting smoking cessation (1-4)

obstacle	mean	SD
being around other smokers	3.5	0.8
missing the smoking ritual	3.1	0.8
craving cigarettes	3.0	1.0
feeling anxious	2.5	1.1
feeling peer pressure	2.3	1.1
feeling hungry	2.0	1.1
feeling depressed	2.0	1.2
seeing actors smoke	2.0	1.1
having trouble concentrating	1.9	1.0
gaining weight	1.6	1.4
feeling fatigued	1.5	0.8
feeling light-headed	1.1	0.8

Quitting behavior: Most of the participants (84%) had tried to quit smoking one or more times. Of those who had tried to quit before, most had tried to quit more than one time, and about a the third of the participants three or more times. Of those who had tried to quit, about two-thirds quit for less than a month at the longest.

Participants who had tried to quit were asked to rate the helpfulness of types of smoking cessation techniques and sources. The four-point scale was: (1) not helpful, (2) a little helpful, (3) moderately helpful, and (4) very helpful. Table 4 gives the rated helpfulness in order of most helpful for those with greater than 5 responses. NRT refers to nicotine replacement therapy.

Reasons for quitting: The participants ($n = 33$) who said they quitting or planning to quit in the next three months, or had tried to quit before, were asked to rate the importance of several reasons for quitting (Table 5). The four-point scale was: (1) not important, (2) a little important, (3) moderately important, and (4) very important. "Other personal" refers to reasons such as self-confidence, smoke smell.

Message relevancy ratings: To test the relevance hypothesis, an analysis of variance (ANOVA, one-tailed) was performed on the total reported message relevance (total possible 10-40). The mean for Group 1 (generic) was 27 ($SD = 4.1$), Group 2 (tailored) was 26 ($SD = 5.8$), and Group 3 (feedback-driven) was 30 ($SD = 4.0$). The ANOVA indicated that the difference in means between Group 1 and Group 2 was not significant ($F < 1$), significant between Group 1 and Group 3 (10%): $F(1, 32)$

= 3.6, $p = .03$, and significant between Group 2 and Group 3 (11%): $F(1, 32) = 3.2, p = .04$.

Table 4. Mean rated helpfulness of smoking cessation techniques and sources (1-4)

technique	n	mean	SD
NRT	8	3.0	1.5
exercise	34	2.6	0.7
friends	34	2.4	0.9
substitute activity	36	2.2	0.8
doctor	22	2.0	0.6
brochures	22	1.7	0.7
websites	12	1.6	0.8

Table 5. Mean rated importance of reasons for quitting smoking (1-4)

reason	mean	SD
health	2.8	0.4
other personal	2.1	0.9
cost	2.0	1.0
social	1.1	0.9
professional	0.5	0.8

Social presence: Each participant's responses to the five social presence items was summed (total possible 5-30). The mean for Group 1 (generic) was 19 ($SD = 4.5$), Group 2 (tailored) was 19 ($SD = 4.4$), and Group 3 (feedback-driven) was 20 ($SD = 4.1$). No significance was found between groups ($F < 1$). An analysis indicated differences between groups in the correlation between social presence and relevance ratings: Group 1 was moderately correlated, $r(15) = .53, p < .05$, Group 2 had a low correlation, $r(15) = .19, p > .05$, and Group 3 was highly correlated, $r(15) = .90, p < .001$.

Message recall: A recall score was calculated by counting the number of matches between the participant's free recall and the messages given that participant. Scores for each message ranged from 0 to 3. The range of possible summed scores was 0 to 30. Overall, scores were low, the mean for all participants was 2.2 ($SD = 2.1$). The mean for Group 1 (generic) was 2.9 ($SD = 3.0$), Group 2 (tailored) was 2.0 ($SD = 1.5$), and Group 3 (feedback-driven) was 1.6 ($SD = 1.1$). An ANOVA for the groups

found a marginally significant difference for Groups 1 and 3 $F(1,32) = 2.6, p = .11$. No significant difference was found for the other group comparisons ($F < 1$). All group correlations between social presence and recall were low, $r(15) < .20, p > .10$.

Intention to quit: Intention to quit was measured by comparing reported stage of quitting in the first session to reported stage in the second session. Overall, there was a migration trend from the pre-contemplation stage to the contemplation stage. A total of 11 participants (22%) moved to a higher stage, 7 (14%) went to a lower stage. Data were too sparse to perform statistical analyses by group: Group 1 net = +2, Group 2 net = -1, Group 3 = net +3.

For those in the pre-contemplation stage in the pretest ($n = 18$), 4 reduced the time they believed they would quit in the future, and 7 went to a higher stage of quitting. Data were too sparse to perform group analyses.

Number of feedback-driven message changes: For the participants in Group 3 (feedback-driven), the 10 messages that the participants ultimately settled on was recorded. The number of messages that were different from the initial set of tailored messages was summed. The mean number of different messages was 1.3 ($SD = 1.7$, range = 0-5). The correlation between social presence and number of differences was low, $r(15) = .30, p > .10$.

5. Conclusions

An online software agent system was designed to deliver smoking cessation messages. Several hundred messages were categorized with meta-data based on the Stages of Change Theory and other meta-information. Three types of software agent scripts were developed to deliver messages using different search algorithms. The intention was to match three types of message selection processes typically used in health communication: generic (mass media), tailored (matching individual factors to messages), and interpersonal (highly interactive). The latter used a combination of a tailoring system and a feedback-driven process to select messages.

A pilot study was conducted to evaluate the messages and delivery process. For our sample of university students aged 18 to 25, the evaluative study confirmed the main hypothesis that the feedback-driven process increased by 10 to 11 percent the reported relevance of the messages over generic or tailored messages. Other studies have shown an increase in reported relevance in tailored messages over generic messages; our study did not show this increase. Relevance has typically been a measure of likelihood to remember and implement the advice contained in a message.

In our study, message type, that is, generic, tailored, or feedback-driven, was not a significant factor in participant recall of messages. Overall, recall of the

specific propositions contained in the messages was low. Given the number of message propositions received (about 30), the separation of one week might have been too long for much recall. Also, no reinforcement was given, such as providing the participants with a printed version of their messages to review.

Changing intention to quit was measured by stage of change. Overall, a net movement from the pre-contemplation stage to the contemplation stage occurred. The feedback-driven process had the largest net increase although there was insufficient data to provide significance tests. A short, one-shot session of smoking cessation messages will not likely change many of the participants' smoking behavior. Future studies will increase the number of interactions with the system.

Giving and using feedback is one dimension of interpersonal communication. The higher the quality and the greater the amount of feedback used and given, the more likely the process is perceived as interpersonal. Interpersonal communication is also characterized by high levels of perceived social presence. In our study, no significant differences between message types occurred, that is, perceived social presence was more an individual factor than a group factor. However, in the feedback-driven group only, a highly significant correlation between social presence and relevance ratings was found. The higher the perceived social presence, the higher the ratings.

In sum, the effects of the feedback-driven process did change the experience for the study's participants, even though the study was limited in time and exposure to the messages. Messages were only given once and the participants did not have access to them between times. In a real smoking cessation program, participants will be given access to the messages either by printing them or allowing access to the website through a login process. Also, a real smoking cessation program would be conducted over several weeks. The intention of this study was strictly to measure specific variables to evaluate the relevance hypothesis.

Measuring relevance in a real-time system might have to take some other form. Users of such a system would grow weary of continually evaluating relevance, among other possible factors. A more refined algorithm and more graphical display might be possible solutions. A more refined algorithm could use data from several users to find patterns of relevance with user characteristics, for example.

The study was not intended to duplicate the full process of helping smokers quit. Based on the results, the feedback-driven process can be implemented in a more sophisticated system that moves even closer to interpersonal communication. Such a system could, for example, use natural language processing to provide more refined feedback.

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