Human-centered Design of Persuasive Appointment Reminders

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Abstract

In this research we describe the use of human-centered design principles to engineer persuasive appointment reminder messages to encourage patients to attend their appointments. Patients' failure to attend clinic appointments often leads to poorer health outcomes and increased healthcare costs. Based on a model of persuasive messaging, we develop appointment reminder messages using a human-centered design approach. We demonstrate the value of a human-centered design methodology in the iterative design and refinement of prototype messages through the use of paper mockups, surveys, interviews of different users, and focus groups. In future work, the persuasive appointment reminders developed using the approach will be evaluated in a randomized controlled trial to test their effectiveness in reducing appointment non-attendance.

1. Introduction

To improve health and reduce costs, we need to encourage patients to make better healthcare decisions. Many informatics interventions are aimed at improving health outcomes by influencing patient behavior.[1] These interventions share the need to appropriately deliver a message to influence decision making. For example, patients are alerted with prompts to take their medications, attend appointments, or schedule recommended screenings. [2] Currently, there is little understanding as to how the message of an intervention can play a role in influencing a decision. Specifically, little research exists to explain how patients process such messages in a healthcare context. A better understanding of message processing and an exploration of the factors that affect acceptance of such requests may help improve adherence of interventions aimed at patients.

1.1 Need to Enhance Patient Appointment Adherence

In this research we focus on enhancing adherence to appointments. Appointment adherence is estimated to range from 8% to 94%.[3] Although appointment reminders are widely used in practice to reduce missed appointments, there has been little research to determine if the content of a reminder message may influence appointment adherence. If the content of the message is important, existing appointment reminder systems may be further improved.

1.2 Persuasive Messaging Model

In preliminary work we have proposed a conceptual model for designing communications that are intended to influence in a specific way.[4] We refer to these communications as persuasive messages. Our conceptual model incorporates Chaiken's Heuristic-Systematic Processing theory to explain how individuals make decisions.[5] Chaiken suggests that there are two primary decision-making strategies. Individuals either use rules of thumb and shortcuts (heuristic approach), or they use more rational, careful or effortful thinking (systematic approach) to make decisions.

Heuristic Technique	Definition
1. Commitment and consistency	Individuals who take a stand are more likely to be consistent with that commitment
2. Liking	As individuals, we are more likely to respond favorably to requests from people we like than those we dislike
3. Authority	As individuals we are frequently influenced and accept requests by those perceived to be in more authoritative positions
4. Scarcity	When a resource is in short supply, our desire for the item, service or opportunity increases

Table 1: Persuasive Heuristic Techniques to influence and change behavior

In the systematic approach individuals rely on arguments such as facts, evidence, reasoning and logic. Therefore this approach is more cognitively taxing, and is thought to occur in situations where there is strong personal relevance to the issue at hand.

Contrastingly the heuristic approach is mainly based on peripheral cues such as expertise of the source, attractiveness, or friendliness. In this approach individuals think just enough to be aware of the situation and use other measures. Cialdini has defined numerous types of persuasion heuristics.[6] We describe four heuristics employed in this study in Table 1.

In this research we propose to create appointment reminders that use either heuristic or systematic approaches.

1.3 Human-Centered Design

In this paper we describe the theory and methodology used to iteratively design a series of persuasive appointment reminders. Our focus is on iteratively creating the message itself and not the underlying technology that drives the reminder system. Human-centered (or user-centered) design is the field in which end users and other stakeholders are intricately involved in the design of an information system. Such a design paradigm is thought to be effective in creating useable systems that actually meet the needs of users [7, 8]. In the field of medical informatics, human-centered design is increasingly being used as part of creating software for clinicians. Large-scale failures of clinical systems have also starkly highlighted the need for such a participatory approach [9, 10]. Therefore, in the creation of human-centered reminder messages we demonstrate the use of a variety of techniques used to conceptualize, build prototypes, redesign, and finally, to evaluate their effectiveness in reducing missed appointments.

2. Methods

2.1 Project Lifecycle

Figure 1 shows the project lifecycle that guided all aspects of the design, implementation, and proposed evaluation of the persuasive appointment reminder messages. A similar perspective was adopted by Rinkus, et al, in their evaluation of distributed knowledge management systems.[11]

In stage 1, we were concerned with formulating the problem. As part of problem formulation, we used existing theoretical frameworks to help understand the problem domain and postulate solutions.

In stage 2 we use the theoretical framework to guide the design of an early prototype. The prototype is then tested using appropriate usability evaluation methodologies. Results from the user-centered design provide input to stage 3 where the prototype is modified.

After modification of the prototype, numerous iterations occur between stage 2 and stage 3. The refined prototypes are then re-tested. Information from each stage may contribute to the redefining of the problem and its subsequent solution.

Finally, once the prototype has been extensively tested, it will undergo a randomized controlled trial to test its effectiveness in a real patient population. In this paper we report on prototype development, user testing and prototype modification. The outputs of this process will be used in the randomized controlled study.

2.2 Initial Message Creation

In this section we describe how we initially created and evaluated mockup persuasive appointment reminder messages. Guided by the conceptual framework and
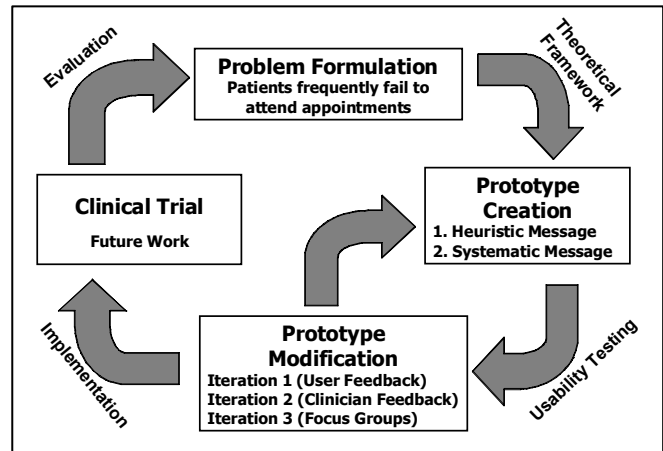

Figure 1: Project Design Lifecycle

especially by Chaiken's Heuristic Systematic Processing Model, it was determined that an appointment reminder message should contain the following elements:

i. Necessary Information to carry out the desired action (example: the date and time of the appointment)
ii. Explanatory information explaining why the desired action is beneficial (support systematic processing)
iii. Peripheral information to guide the adoption of the desired action (support heuristic processing)

Based on our research goals we created three persuasive reminder messages. In the example below the message was aimed at diabetics. The elements manipulated are also listed below:

i. Necessary Information:
Your next appointment with Dr. Smith is on Monday July 30, 2005, at 12:00 a.m.
If you have any questions, please call 409-123-4567

ii. Peripheral Information (Heuristic Message)
Just a reminder that you have scheduled your next appointment with me on Monday July 30, 2005, at 10:00 a.m. **[Commitment Heuristic]**

I very much enjoyed your last visit, and look forward to seeing you on the date you scheduled above. **[Liking Heuristic]**

If you need to reschedule your appointment please let us know as soon as possible, as we are usually fully booked. **[Scarcity Heuristic]**
Sincerely

Jane Smith M.D., F.A.C.E. **[Authority Heuristic]**
Associate Professor,
Stark Diabetes Center
American Diabetes Association Certified Physician

iii. Explanatory Information (Systematic Message)

Based on a literature review of appointment adherence for diabetes and general information about the condition the following statements were developed:

As you know it is very important to keep your appointment.

People who fail to keep their appointments have:
- Poorer control of their diabetes
- More side effects and complications (such as going blind)
- Poorer quality of life (more reliance on others to carry out everyday tasks)

When you do not show up for your appointment at the clinic you also prevent doctors from seeing other patients who need attention. It also results in wasted resources.

2.3 Evaluation of Persuasive Messages (Iteration 1)

Paper prototyping is an inexpensive and highly effective technique to gather user feedback. Paper mockups are often used early in a products lifecycle. Paper prototyping was particularly suited to our tasks. In order to evaluate the initial message elements we created a paper mockup of an appointment reminder. Three types of messages were created. All the messages were presented in the form of an email reminder. Message 1 used heuristic elements, message 2 used systematic elements and message 3 was a combination of both heuristic and systematic elements (mixed reminder). We also created a scenario and a set of questions to assess the degree to which subjects agreed to statements that related to heuristic and systematic processing. In order to help evaluate the perceived effectiveness of these messages subjects were randomly assigned to one of the following groups: 1) control (did not receive a reminder), 2) heuristic reminder, 3) systematic reminder, or 4) mixed reminder.

2.3.1 Methods
After random assignment, subjects received a paper packet that contained the following scenario:
- Forty-one year old technology worker, works very hard
- Diagnosed with Type 2 diabetes recently
- Required to take meds, exercise frequently, and watch diet
- Last clinic visit showed need to better control diabetes
- Last visit to doctor was on April 12, 2005. Next visit is scheduled on July 30
- Doctor's office is about a 25-minute drive in Houston traffic

After reading the scenario, all subjects apart from those assigned to the control group were told that a few days before the appointment they received an email message. All the emails were provided as a paper-based mockup. Each packet contained the appropriate reminder message. For example, subjects assigned to the heuristic group would receive the heuristic reminder. After reading the messages,

subjects were asked a series of questions and asked to rate their agreement on a 5-point Likert scale. Subjects were provided the following statements relating to heuristic processing:

1. I should do what my doctor recommends as she is experienced and knowledgeable in treating diabetes.
2. I look forward to seeing my doctor.
3. I made the appointment; therefore, it is important for me to attend.
4. If I don't go to the appointment it will be difficult for me to make another appointment.

The last 4 statements related to systematic reasoning.
1. If I miss my appointment it will increase the likelihood that I will experience a side effect of diabetes such as vision loss.
2. If I miss my appointment it will make my health worse in the long run.
3. If I do not show up for my appointment it prevents other patients who need attention from being seen.
4. If I do not show up to my appointment it causes financial problems for the clinic.

In order to minimize any order effect, questions were presented in random order. Subjects were also asked to provide reasons for their decision. After completing the evaluation, subjects were asked to provide additional oral feedback regarding the messages.

Sample
A convenience sample of 38 staff and students at the University of Texas Health Science Center at Houston participated in this evaluation. This study was approved by the UT Houston Institutional; Review Board (IRB). Each subject signed an informed consent form.

Statistical Analysis
Due to the small sample size, only descriptive statistics are provided. All analyses were performed using SPSS 14.0 statistical software (SPSS, Inc., Chicago, IL).

2.3.2 Results
Figure 2 shows subject responses to questions relating to heuristic processing. Figure 3 shows subject responses to systematic processing. The results suggest that regardless of the group, most subjects agreed to statements relating to authority, liking, and commitment heuristics, even when these elements were not specifically mentioned or manipulated. Similarly, most questions associated with systematic processing also had similar levels of agreement among the message groups. However, subjects in the heuristic group appeared to agree at a higher degree to the scarcity-related statement that "If I don't go to the appointment it will be difficult for me to make another appointment."
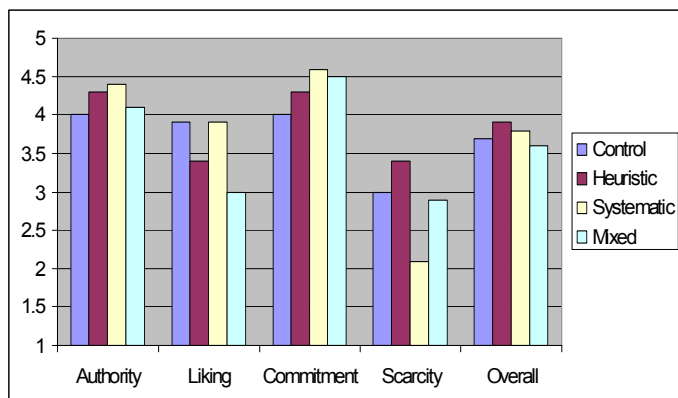
Figure 2: Subject responses to questions associated with heuristic reasoning
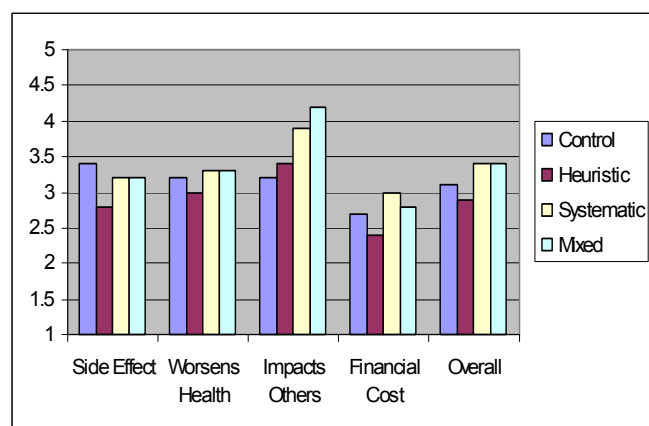
Figure 3: Subject responses to questions associated with systematic reasoning

Those subjects assigned to the systematic group also had higher agreement to the statement that "If I do not show up for my appointment it prevents other patients who need attention from being seen."

The results also indicated a trend in which subjects who viewed the mixed reminder were more likely to go to the doctor's appointment. Conversely, those who received the heuristic reminder were more likely to go to their business meeting. It is important to note that the differences were not significant.

Reasons for Confirming Client Meeting
Subjects who elected to attend their client meeting provided the following reasons:
- Easy to reschedule doctor
- Diabetes is a long-term condition, missing one appointment probably not a big deal
- Job important, no job = no health insurance (cannot then go to doctor)
- Company depends on me
- New client important, especially in tech industry

Reasons for Attending Doctor's Appointment
Subjects who elected to attend the doctors' appointment provided the following reasons:
- Commitment to keeping appointments, keep promise
- Difficult to reschedule appointment with doctor
- Diabetes is a serious condition
- Take health seriously
- Health is first priority and more important than client.

Feedback from Subjects
The following is a summary of the comments provided by a small number of subjects who elected to provide further feedback:
- Heuristic Message
    - Sounds too "commercial"
    - Why did the doctor "enjoy" last visit
    - Sounds as if I am being lectured (*you, your…*)
    - Get to the point!

- Systematic Message:
    - Personalize
        - Use language such as "You will…"
        - Provide patient specific reasons

2.3.3 Discussion and Implications for Design
Due to the small sample size it was difficult to draw definitive conclusions from the subject survey responses. The user feedback suggested that the commercial aspects of the heuristic reminder were least effective. However, the scarcity heuristic appeared to resonate with some of the subjects. Participants reported that they were generally satisfied with the systematic message. Suggestions to improve the message included trying to personalize the reasons given to an individual patient.

2.4 Evaluation by Clinicians and Staff (Iteration 2)

Based on feedback from the initial evaluation, the appointment reminder messages were refined. Figures 4A and 4B reflect the improved messages. Much of the language that was perceived to be of a commercial nature in the heuristic message was removed. The messages were also shortened and changed based on user comments. In the second stage of evaluation, we asked clinicians and staff who see patients to evaluate the appointment reminders.

2.4.1 Methods
Subject recruitment and procedures
The study population consisted of clinic staff at a specialist diabetes clinic. Fourteen staff members were approached to participate in the study. One person declined. Two subjects agreed to participate but failed to complete the questionnaire and were excluded from the analysis.

Therefore, 11 subjects were enrolled in the study. All subjects signed an informed consent form. The subjects included 5 physicians, a physician assistant, a nurse, a diabetes educator, a dietician, a social worker, and a scheduler.

Subjects were provided with a 7-page paper questionnaire that included the systematic and heuristic reminders. Subjects received either Form A or Form B of the paper questionnaire. Both forms were identical with the exception of the ordering of the reminder messages. Subjects who received Form A were presented with the heuristic message first, followed by the systematic message. Subjects who received Form B were presented with the systematic message followed by the heuristic message. Subjects were randomly assigned to either Form A or Form B. An equal number of forms were prepared so both orders would be shown in approximately equal numbers. Of the 11 subjects, 6 participants received Form A, and 5 participants received Form B.

Subjects were asked about their current perception of appointment adherence at the clinic, and reasons why they thought patients missed appointments. Subsequently, subjects were asked to read both reminders and then complete a set of questions relating to the accuracy, credibility, perceived effectiveness, and rationale of the reminder message. Subjects were also asked to rate the appropriateness of the sender field and informativeness of the email subject line. Each question was posed as a statement and subjects were instructed to rate their agreement on a 5-point Likert scale. The two extremes of the Likert scale were "strongly disagree" to "strongly agree". Subjects were then asked to respond in free text format to aspects of the reminder they liked the most, aspects they liked the least, and how they felt the message might be improved.

Statistical Analysis

Paired sample T-Tests were used to detect differences among survey responses relating to subjects' perceptions of the systematic and heuristic appointment reminders. Significance was set at $p < 0.05$. All analyses were performed using SPSS 14.0 statistical software (SPSS, Inc., Chicago, IL).

2.4.2 Results
Result 1: Predictions of missed appointments at the clinic

Clinic staff predicted on average that 19% (± 11.3) of clinic appointments were missed (defined as no-shows or cancellations). Responses ranged from 50% missed appointments to only 7%. An analysis of data showed that over a one year period 24.9% of all appointments scheduled at the clinic were actually missed.

Result 2: Reasons for missed appointments

In total, 11 subjects suggested 56 reasons why patients' may miss appointments. These reasons were characterized into 9 themes (in descending order of frequency):
1. Patient has appointment conflict -10
2. Patient forgot - 9
3. Transportation problems- 8
4. No reminder to patient - 8
5. Lack of money – 7
6. Other patient characteristics – 7
7. Misunderstanding about appt - 4
8. Bad weather - 2
9. Doctor cancelled appointment - 1

(Numbers represent frequency of occurrence)

Result 2: Perceptions about the persuasive appointment reminders

Table 2 shows subjects' perceptions about the systematic and heuristic appointment reminders. Both reminders were perceived to be highly accurate and credible. There was general agreement to the statement that the reminder may help patients better attend their appointment. The sender and subject lines of both messages were also highly rated by the subjects. There were no significant differences between the two reminders.

Result 3: Most liked and disliked aspects of the reminders

Subjects provided valuable feedback about the reminder messages. The reasons provided in the systematic reminder why patients should attend the appointment was the most commonly liked item. Similarly the message sender (physician) in the heuristic message was the most liked item.

However, the item that stated "patients should attend appointments as it may help others", was the most disliked item in the systematic reminder. Subjects commented that patients may feel that other people are more important than themselves. The paragraph describing the diabetes clinic was listed as the most disliked item of the heuristic reminder.

Result 4: Suggestions for improvement

Subjects provided thoughtful suggestions as to how the reminders may be improved. They recommended that both messages could be made more concise. In particular, subjects suggested removing the information about the clinic that was included in the third paragraph of the heuristic message. However, subjects suggested adding more patient-specific information to both reminders. For example, they felt it would be helpful to state the nature of the appointment and to remind patients to bring their medicines and glucose meter.
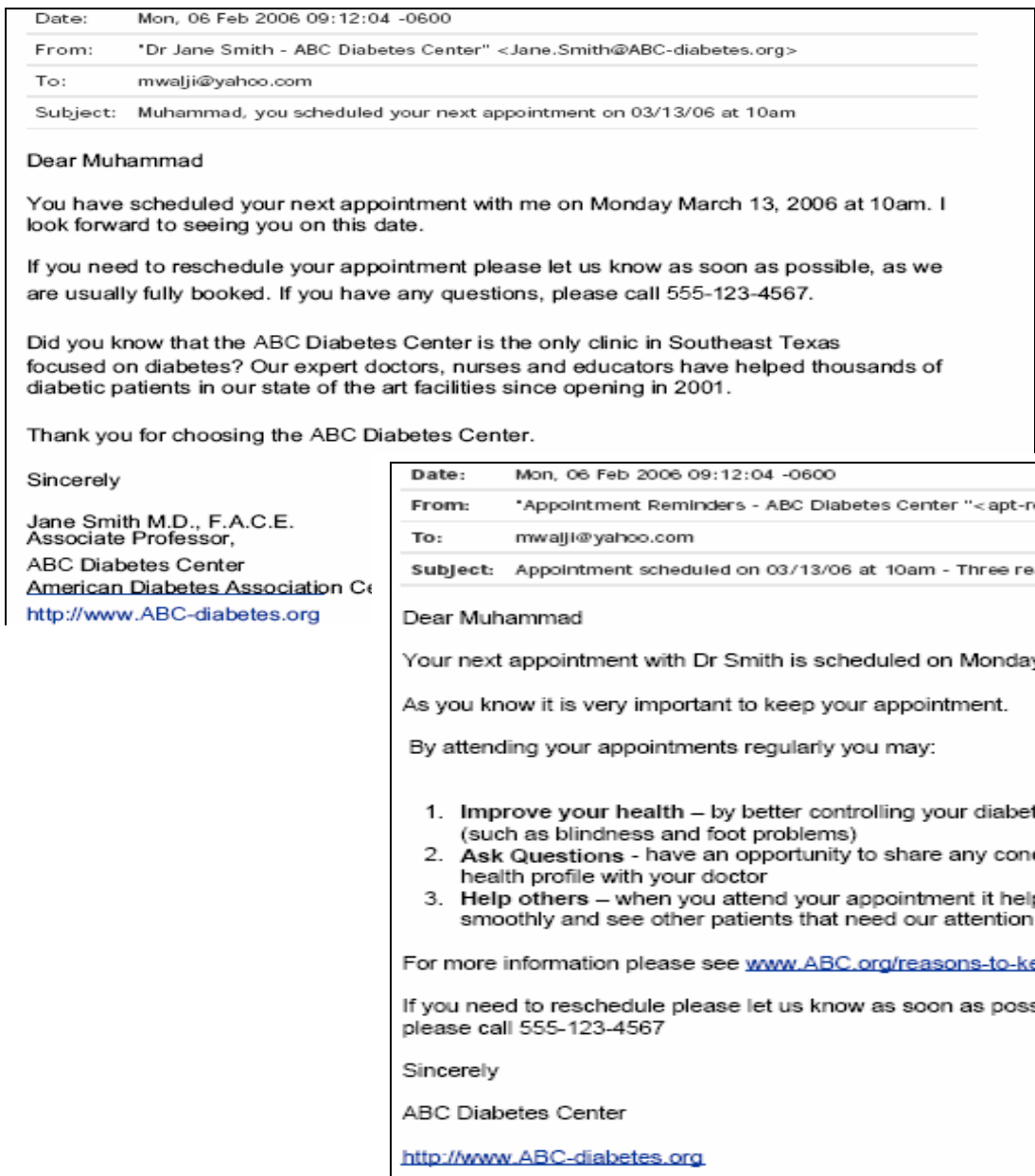
Figure 4: A) Systematic Reminder Mockup (top) and B) Heuristic Reminder Mockup (bottom)

	Systematic Reminder	Heuristic Reminder
Reminder is accurate	4.73 (0.47)	4.18 (0.98)
Reminder is credible	4.64 (0.50)	4.36 (0.67)
Reminder will help patients better attend appointments	3.73 (1.10)	3.82 (1.17)
Reminder provides good reasons to attend appointments	4.45 (0.52)	3.73 (1.49)
Sender address appropriate	4.20 (0.92)	4.4 (0.84)
Subject line informative	4.64 (0.50)	4.55 (0.69)

Table 2: Mean scores (st dev) of agreements to statements. Scores were rated on a 5-point Likert scale. (1=low agreement, 5=high agreement).

2.4.3 Discussion and Design Implications

Clinic staff appeared to have a good approximation of the number of missed visits at the clinic. About 1 in every 4 appointments was either missed or canceled. When queried, clinic staff, on average predicted that 1 in 5 appointments were missed or cancelled. In this study we defined missed appointments as no-shows or cancellations. Rescheduled appointments were not included. However, it should be noted that late rescheduled appointments may also have a detrimental impact on clinic operations.

Nine recurring themes were identified as to why a patient may miss an appointment. Ten of the eleven subjects suggested that a patient may not attend an appointment because they have conflicting activities such as work conflicts, unexpected schedule changes, emergencies, illness, or hospitalization. Subjects also noted that patients forgot, failed to receive a reminder, or had a misunderstanding about their appointment. These three themes suggest opportunities for improving how appointments are communicated. Subjects also identified very practical barriers to compliance including lack of transportation, lack of money, and bad weather. Patient characteristics were also suggested as important factors. For example, some subjects felt that patients were "not responsible enough to reschedule", did not want to come, denied their disease state, or were simply "afraid that they will be fussed at for not caring for themselves appropriately". These reasons for non-adherence suggest that reminders that attempt to persuade, rather than merely inform, may be beneficial.

After viewing the proposed reminder messages, subjects gave high ratings regarding the accuracy and credibility of the messages. The sender address and subject line of both reminder messages were also rated highly by the clinic staff. Email marketing professionals have suggested that sender address and the subject line of an email are critical elements for successful email campaigns [12]. These ratings suggest that staff were comfortable with most aspects of the messages.

Feedback from the subjects regarding the most liked and disliked aspects of the reminders were also constructive. Many staff liked the bulleted list of reasons why patients should attend appointments in the systematic reminder. In the heuristic message, three subjects liked the fact that the physician was the sender of the message. Therefore, the authority heuristic seemed to resonate with some of the subjects although one subject noted that the message sender was the least liked element.

We had purposefully created the systematic message to remain neutral in tone and present the reasons why it may be beneficial to attend. Some subjects suggested that this email sounded paternalistic and overly formal. Conversely, the heuristic message was designed to have a lighter tone. It seemed most subjects appreciated the lighter tone, although one noted that she usually addressed her patients as Mr. or Mrs. as opposed to using their first name. Therefore, a reminder that merges favorable qualities of both the systematic and heuristic message may be optimal. These results also suggest the possibility that patients who prioritize other commitments over and above their appointment may be persuaded otherwise by the reasons provided in the systematic reminder relating to the importance of attendance.

2.5 Focus Group Evaluation (Iteration 3)

Based on results and feedback from clinicians and staff, the reminder messages were further refined. The messages were also converted into a script suitable for delivery as an audio message over the telephone. In addition, they were redesigned to serve as an appointment reminder for any other type of clinic visit.. The messages were generalized so that a randomized controlled trial could be conducted in a general medicine clinic (future work). Two focus groups were conducted to gather feedback from 1) a convenience sample of students at University of Texas Houston and 2) clinicians at the Baytown Health Center, which would serve as the clinical site where the refined reminders would be tested in a randomized controlled trial in future work.

2.5.1 Focus Group of non-clinicians

Six individuals participated in a focus group to assess their opinions of pre-recorded audio messages. Focus groups are similar to individual interviews, but have multiple concurrent participants. Participants respond to questions from a facilitator. Focus groups are thought to generate a lot of information due to their interactive nature. Participants in this study were graduate students at the UT Houston School of Health Information Sciences. The focus group was conducted as part of the class lecture. The racial demographics of the participants were as follows: Caucasian – 3; Asian – 2, and African American – 1. The overall goal of the focus group was to receive feedback from them related to the pre-recoded audio messages.

Scenario and Context

Participants were provided with the following scenario:
- A clinic wants to improve the show rate of appointments
- They want to determine if a reminder system will help
- They want feedback on voice reminder messages

Then participants were told that missed appointments are detrimental to patients, the clinic, and other patients.

Past Experience with Appointment Visits

Participants were then asked what they liked about visiting their doctor's office.

Although the question asked about the positives, the first comment from a participant was that they would like it if their doctor had shorter waiting times. The participant expressed frustration at a recent clinic visit in which she had to wait for an unacceptable for a very long time to see the doctor. Another participant said that she liked it when her pediatrician's office called to remind her of an appointment.

She also liked the fact that when she had a question, she would be promptly called back by a knowledgeable staff member, usually on the same day. The ability to read the latest magazines without paying for them was also mentioned as an advantage of attending an appointment visit.

When asked about negative aspects when keeping an appointment, waiting time was identified as the main problem by most participants. One participant who worked in a health clinic suggested that new electronic systems are responsible, in part, for clinic problems ". . . especially when the clinician who installs and maintains the system is away from the office."

Participants were then asked what solutions they might have to offer to reduce no-shows. A clinic requiring patients to call 24 hours before the appointment to cancel, or face a monetary fee was seen as one way to reduce failure to keep an appointment and not notifying the doctor's office in advance. . A participant mentioned that they would pay the fee out of fear it would reflect on her credit report.

When asked why patients failed to keep appointments, the participants suggested that there may be other important issues or events to attend to. One participant said that perhaps the patient did not feel very sick that day, therefore feeling it was unnecessary to attend. Another reason provided was lack of money. One participant also said that by not attending appointments, he was "being lazy". He also that he would delay a preventative care visit preferring to wait until he felt he had a medical need to attend. One participant mentioned that patients may simply forget to keep an appointment. A participant who worked in a health clinic noted that they had observed that on a nice day, few patients would attend; and that busiest days were those with bad weather.

Participants were then told that they would be presented with a series of audio reminder messages. They were told that after hearing each message, they would be asked their opinions.

Generic Reminder Message

The audio of the generic reminder message was played. This message contained only the date and time of the appointment.

After hearing the audio message, a participant noted that it sounded like a telemarketing call. Another mentioned that it was easy to forget the date/time of the appointment, particularly if it came at the beginning of the message; and that it should be repeated later. One participant mentioned that there was no information about name of the recipient (patient). Nor was there any mention about their particular doctor. Participants stated that they do not go to a clinic, but rather to see a particular doctor. Another participant asked if Health Insurance Portability and Accountability Act (HIPAA) laws were invoked, especially since he would not like a reminder message about a sensitive lab test delivered by this method.

Participants also noted that it was not a real person calling. She preferred a message from her doctor in the form of "Hi, this is Mary from Dr Smith's office…". This type of message would have less chance of being immediately deleted from an answering machine.

Heuristic Reminder Message

Participants were then asked to listen to the heuristic reminder message. This reminder contained the authority, commitment, scarcity and liking heuristics.

After hearing the audio message, the first response was that this message was better than the generic message. When asked why, the participants responded that the doctor's name was mentioned. (The message was phrased as if it was on behalf of the Medical Director, Dr Smith, rather than an appointment with a particular doctor on staff). Participants also felt that this message was more personal due to phrasing such as "You have an appointment…". One participant mentioned that she did not like the phrase "We look forward to …." Another participant also pointed out that a call-back number needs to be added to the message, especially if left on an answering machine.

When asked about the language referring to the fact that clinic is normally full, one participant commented that they thought they were being "sent on a guilt trip". The voice of the message was also seen to be monotonous. When asked what they considered the best time to call with a reminder, there was disagreement among the participants. One participant wanted to have the call one day before the appointment; another suggested a call 2 days in advance of the appointment in order to adequately prepare and change schedule if necessary. Another participants suggested being called twice, the first time a week before the appointment; the second on the morning of the appointment. Participants also disliked the option presented at the end of the message to "press 1 to confirm the appointment". Instead they wanted the clinic to assume they would attend unless otherwise notified. The option to press 2 to speak with a customer representative was considered appropriate. However, one person suggested that the term "customer representative" sounded like a marketing call, and thought the word "receptionist" should be used instead.

Systematic Reminder Message

The participants were then asked to listen to the systematic message. The systematic message contained reasons or benefits of appointment attendance. The first response was that the message was too long. Another commented that it sounded as if they were being lectured, while another said that no machine has any idea about her health status. The latter comment sparked a discussion about how very impersonal message seemed to come across and that most of them felt that the message delivered this way was too cold. Participants were further asked their opinions of the voice of the reminder messages, and whether there was a preference for a male or a female voice. (A similar message was recorded by a male actor and played back for

the participants' comparison.) Opinions were inclusive although one participant suggested that she preferred the female voice as she expected that 90% of receptionists were female and another commented that she thought greater than 50% of telemarketers were male.

Participants were then asked to summarize and provide suggestions for improving the messages. The group consensus was to create short, concise messages with important information including the name of the message recipient as well as that of their treating doctor. The group also suggested minimal options at the culmination of the message. One participant suggested having a message that began with the voice of a receptionist which was personal to be followed by an automated voice which then states the time of the appointment and the doctor's name. Another participant suggested that a sentence be added prompting patients to retrieve a paper and pencil in order to write down the important information. Lastly, a participant suggested that what they found appealing about the recorded male voice was the inflection, emphasis, and feeling. These elements should be incorporated into the voice of the reminder message whether it be delivered and/or recorded by either a male or a female.

2.5.2 Focus Group: Clinicians

Six medical doctors participated in the clinician focus group. The participants were the medical doctors whose patients would undergo the persuasive appointment reminder system intervention in future work. Therefore, the focus group was used as an opportunity to introduce the aims and goals of the study and allow them to participate in the design of the messages. The focus group was conducted during the lunch break at the clinic. All the participants were in one room; but due to various needs, the participants were often eating lunch, completing medical charts, or consulting on patient cases while they were providing their feedback. Although this was not the ideal setting in which to conduct such an evaluation, it was the optimum possible in this real world setting and it had been felt that it was very important to get feedback from the treating physicians.

After introducing the aims and goals of the study, participants were asked to listen to a reminder message and provide feedback. First, the generic message was played.

Participants thought the message was appropriate. Participants were asked what they thought about the response options. Participants indicated that they "seemed ok". When told that in a previous focus group, many participants felt that the response option to press 2 to confirm the appointment was unnecessary, the participants agreed with this sentiment.

Next the heuristic message was played. One individual did not like the use of "Dr Smith, Medical Director". She thought her patients might not recognize the name of the medical director as opposed to their own particular doctor. Another commented that the message was long. One participant also suggested adding personal language such as ". . . important to take care of your needs".

Next, the systematic message was played. Participants also thought that this message was long. One participant commented that she did not like the statement ". . . it helps us keep the clinic running smoothly and see other patients on time". They felt that this was too impersonal. A conversation arose among the participants about advising patients to come 30 minutes prior to their appointment which produced disagreement among the participants about this suggestion.

One participant also did not like the beginning of the message. It was suggested that "Baytown Health Center" be mentioned at the very beginning of the message.

Participants were also asked about how to deal with answering machines and language. The participants responded that the message should be left in English first, followed by Spanish.

Participants were then played the mixed message. Due to participant time constraints, they were told that this message was a combination of the heuristic and systematic message. Participants indicated that the message was too long.

In summary, the participants liked the generic and systematic message. However, they thought all the messages, apart from the generic one, were too long. They suggested using the name of each treating physician instead of the medical director. They also suggested using more personal and encouraging language.

2.6 Creation of Final Refined Messages

Figures 5 and 6 show the final version of the heuristic and systematic reminder messages to be used in the randomized controlled trial in future work.

Hello, this is an appointment reminder from the Health Center for [First Name, Last Name]. Dr Smith, Medical Director at the Health Center, asked me to remind you that your next appointment is on [day of week] [day] [month] at [time]. In case you can't attend, please let us know as soon as possible, as we are normally fully booked. We look forward to seeing you on the date you scheduled your appointment. If you need to reschedule the appointment, please call 713-000-0000. Thank you.

Figure 5: Final Script of the Heuristic Message

Hello, this is an appointment reminder from the Health Center for [First Name, Last Name]. Your next appointment is on [day of week] [day] [month] at [time]. As you know it is very important to keep your appointment. By attending your appointments regularly you may improve your health. You can also ask questions, and share any changes about your health with your doctor. If you need to reschedule the appointment, please call 713-000-0000. Thank you.

Figure 6: Final Script of the Systematic Message

3. Discussion

Patient appointment reminder systems are often implemented by healthcare practitioners without careful consideration and refinement of the contents of the message. In this research, we use human-computer interaction (HCI) principles to demonstrate how to generate various types of reminders that may appeal to patients and improve adherence to clinic visits. The human-centered design process was valuable in eliciting feedback about the reminder messages and led to numerous improvements. For example, in iteration 1 we discovered that the heuristic message was perceived as commercial in nature. This led to the development of more effective language. In iteration 2 we received feedback from clinicians as to why patients miss appointments. This suggested that persuasive reminders may help convince some patients to attend. The focus groups were effective in receiving feedback regarding the voice and tone of the messages.

A limitation of our work was the absence of actual patients in the evaluating the reminders due to the difficulty in recruiting human subjects. However, the convenience sample of subjects recruited to evaluate the reminders including individuals (staff and students) with diverse backgrounds, who in all likelihood had experience as patients' in managing their health conditions and attending appointments. In iteration 1, an attempt was made to generate empirical results by conducting a randomized controlled experiment. However, in retrospect, additional qualitative methods such as in-depth interviews with a greater sample of users may have generated deeper insight. In order to triangulate results, in future designs, it would be useful to use multiple techniques for each iteration in order to generate diverging and converging viewpoints to provide better evidence for refinement of the prototype at each stage.

Our work demonstrates the value of HCI methodologies, in a consumer healthcare context, to iteratively refine a prototype through the use of paper mockups, surveys, interviews of different users, and focus groups. Although HCI is often used to improve the usability of an interface or system, we demonstrated the value of HCI techniques in optimizing the actual words used to influence user action. The heuristic-systematic processing model may also be beneficial to other HCI researchers as a theoretical framework to create persuasive interfaces.

A human-centered iterative design process is both a valuable and feasible approach in the design of health informatics applications aimed at patients. In future work, the messages developed through this process will be evaluated in a randomized controlled study to determine their effectiveness in improving patient appointment adherence.

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