AN ANALYSIS OF TELEPHONE MESSAGES: MINIMIZING UNPRODUCTIVE REPLAY TIME

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This paper reports the results of a research project to study the nature and structure of phone messages and the design characteristics of phone messaging systems that would optimize the retrieval of relevant message information. Of particular concern with respect to the structure of a phone message was the location of a phone number left in the message. In order to replay any portion of a message, most messaging systems require the user to listen to the message from its beginning. Because it was found that phone numbers are typically left towards the end of a message, such a system is quite inefficient. One proposed solution is the implementation of a "back" button. A simple equation is employed to optimize the length of time encompassed by the back button, which would result in substantial time savings to users at least 17 seconds per message in which it was used. The ramifications of such time savings are discussed.

INTRODUCTION

This paper reports the results of a research project to study the nature and structure of phone messages and the design characteristics of phone answering machines that would optimize the retrieval of relevant message information. We have noticed that in a typical phone message, caller identification information is provided early, and the caller's phone number is at, or near, the end of the message. Further, a 10-digit phone number is often spoken at a rate faster than the receiver is able to record it, and the ten digits exceed the receiver's short term memory capacity (Miller, 1956). This set of circumstances results in the receiver having to replay the message in order to obtain the phone number of the caller. If the system is designed to require the message to be replayed in its entirety, and the number is at or near the end of the message, the retrieval is obviously not optimal with regard to the receiver's time; that is, the receiver will have to listen to the entire message just to obtain the information near the end of the message.

If one considers the very large number of phone messages that are recorded and retrieved in the United States each day, this scenario represents a significant human factors problem. If the receiver could replay only that part of the message containing the number, or a limited portion of the message that includes the number, considerable time could potentially be saved.

The purpose of the research reported here is twofold. First, it was our intent to analyze a sample of recorded phone messages to determine various structural and time characteristics of the messages. A primary focus was the caller's phone number: when in the message the phone number information is provided and how quickly/slowly it is given. Secondly, if, as suspected, the caller's phone number is typically given at or near the end of the message, and the machine design requires the entire message to be replayed in order to retrieve the phone number, the issue of system efficiency is a valid concern. Could the message retrieval procedure be made more efficient by employing a "back-up button" that allows the receiver to retrieve only the most recent portion of the message? If so, what is the optimal value of the time parameter that defines how much of the message will be replayed?

METHOD

Over 100 voice mail messages were collected from faculty members in the Psychology Department at Rice University. Of the messages collected, 82 were intelligible, included telephone numbers, and thus were included in subsequent analyses.

While the messages were playing over speakerphone they were recorded using a Radio Shack ¤ 160-Minute Digital Recorder. The messages were then transformed into *wav* files and the locations of various elements of the message were coded. A representation of the time coding scheme used is shown in Figure 1.

Each message was divided into seven points of interest (see Figure 1), and time measures were recorded for each point. T_1 - T_3 and T_6 - T_7 are unique features of this voice messaging system, wherein an automated message number and incoming phone number are given, and will not be discussed here (neither will T_6 - T_7, an "end of message," remark). Also, the outgoing message heard by callers will not be addressed as it is not a factor in playback. This study focuses on T_3 - T_6, which represents the spoken message left by the caller and T_4 - T_5, the length of the telephone number.

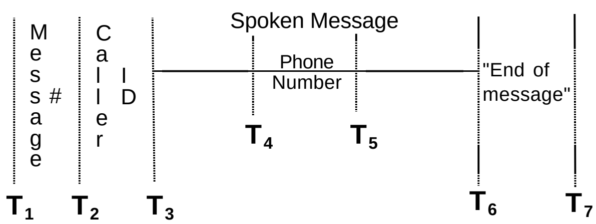

Figure 1: Elements of the messages coded for analysis.

RESULTS: MESSAGE STRUCTURE

Of the 82 messages in the sample, three were considered outliers and removed from the analysis due to their extreme length, which was greater than 100 seconds.

The length of time in which the caller gave a phone number (T_4 - T_5), is crucial for two reasons. This measure permitted the calculation of an optimal back up time, and it provided the rate at which the phone number was spoken. The distribution of the phone number times is shown in Figure 2. The mean length of the phone number was 3.5 seconds with a standard deviation of 1.38 seconds. Over 80% of the phone numbers were spoken in less than 5 seconds. The majority of the numbers included area codes, making them 10 digits. The average rate of presentation was 2.9 digits per second.

In addition to the phone number, we also determined the length of the entire message, and where in each message the phone number was located. The distribution of the recorded message lengths is shown in Figure 3. The mean message length was 32 seconds and the standard deviation of the message lengths was 15.48 seconds. Approximately 80% of the messages in the sample were between 15 and 45 seconds long.

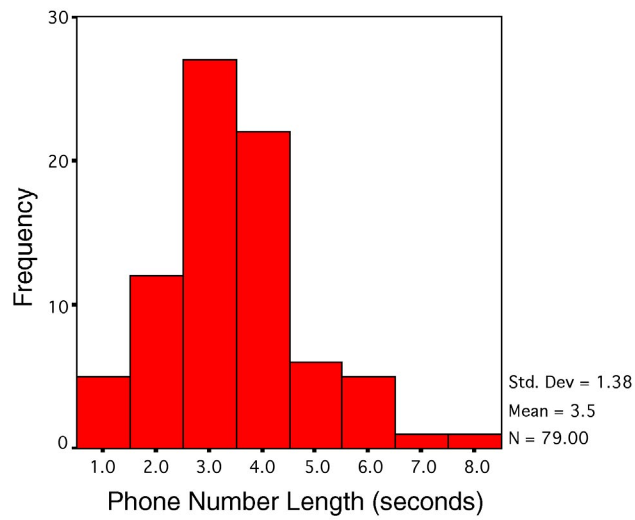

Figure 2. Distribution of times of spoken phone numbers.

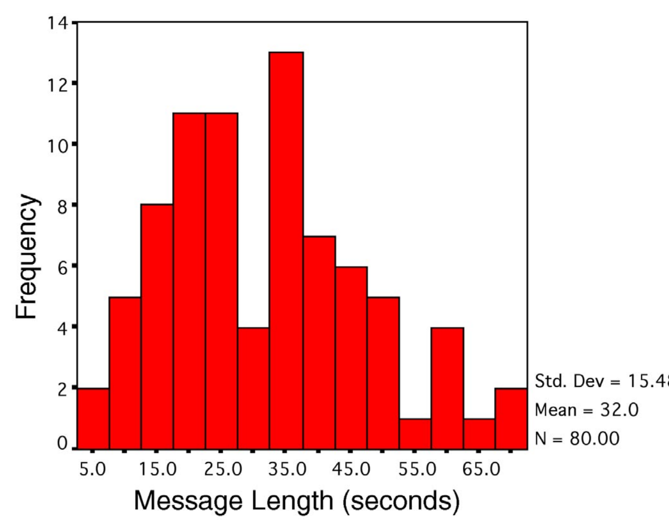

Figure 3. Distribution of total message length.

To determine how much time is wasted when listeners must start from the beginning of the message in order to hear the phone number repeated, we calculated the time from the start of the message to the end of the phone number (T_3 - T_5). This distribution is shown in Figure 4. The mean length of time from the start of the message to the end of the phone number left by the caller was 24.7 seconds and the standard deviation was 13.9 seconds.

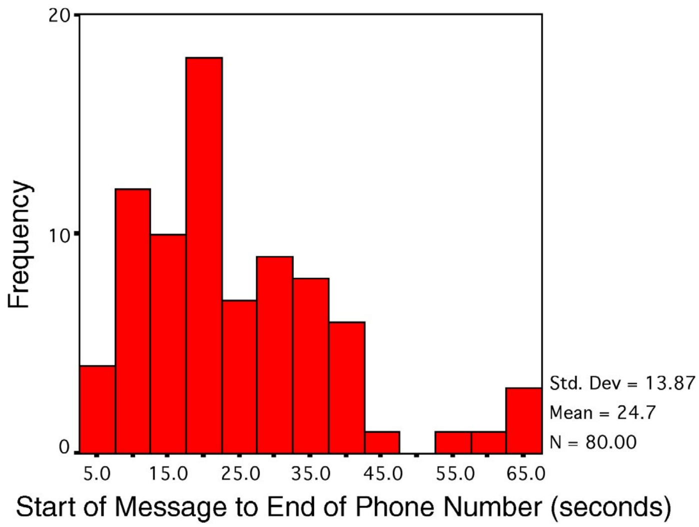

Figure 4. Distribution of time from the start of the message to the end of the phone number.

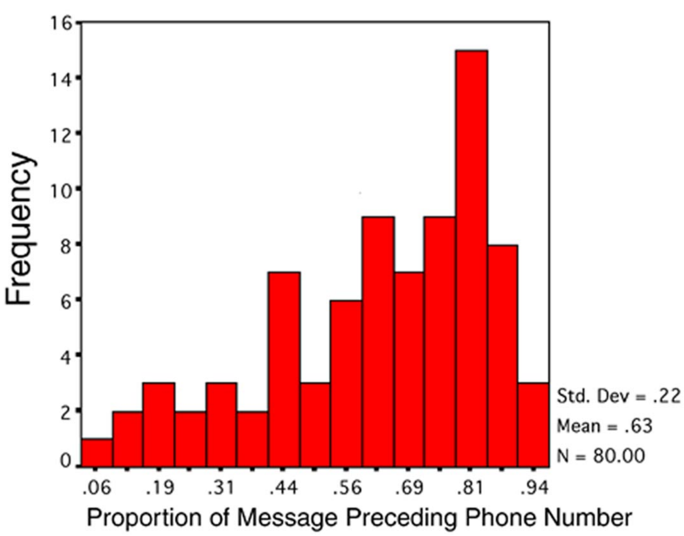

Figure 5. Distribution of the proportion of each message that preceded the phone number.

It is also interesting to note where in each individual message the phone number was given. To calculate this we divided the time before the message by the total message length (See Figure 5). The mean percentage of each message that occurred before the phone number was 63% with a standard deviation of 22%. Although the majority of callers did leave a phone number near the end of the message, most followed the number with a few sentences in parting. The distribution is negatively skewed as some callers left the number after they introduced themselves at the beginning of their message. However, the placement of the phone number generally was near the end of the message.

RESULTS: BACK BUTTON ANALYSIS

As mentioned, users of phone message systems often are not able to commit a phone number to memory the first time it is heard over a message system. The user may want to replay only that portion of the message containing the phone number. However, given most phone message systems currently in use and the tendency for the phone number to typically be left near the end of the message, the entire message must be replayed to access the phone number. One obvious solution to this problem is to equip the messaging system with a feature that would allow the user to replay only that portion of the message containing the phone number. One option that we suggest and use as the basis of an analysis is a "back" button, which would replay some portion of the message that was heard immediately before the button was pressed. One question into which our data provides some insight, is the amount of time that the button should "back-up," i.e. when the button is pressed, how much of the message should the system replay?

One piece of information helpful in this analysis is the proportion of messages where the phone number is fully recovered given a specific back-up time. For example, if the back button is pressed immediately following the phone number and is set to replay the previous three seconds of the message, what proportion of phone numbers are fully replayed? This information is presented in Table 1.

Given these proportions, we can estimate an "optimal" back-up parameter. In this sense, "optimal" refers to minimizing the amount of time spent listening to the message in order to replay the phone number. In order to calculate this value, one other parameter needs to be estimated. We can assume that there is some time cost in pressing the back-up button, some time to make the decision to press the button and some time to complete the action. This decision/action time is likely to vary depending on the specific messaging and phone system examined. We have estimated the optimal back-up parameter using a range of values for the estimated decision/action time; 1, 2, and 3 seconds (See Figure 6).

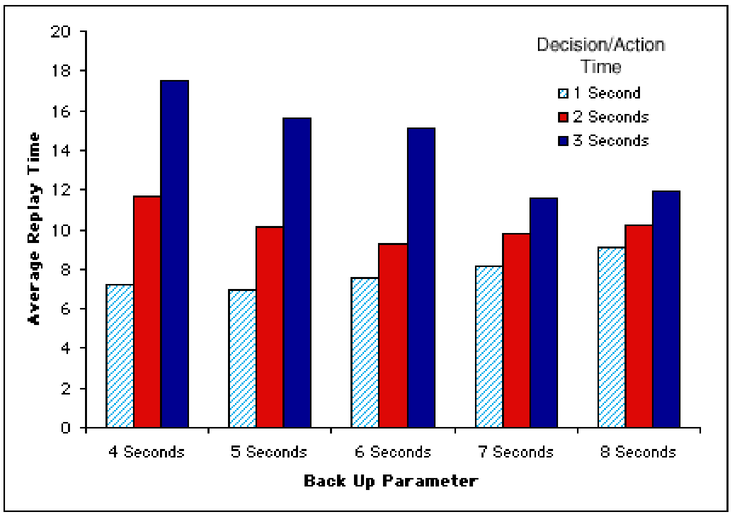

Figure 6. Average time to replay phone number by estimated decision/action times and back-up parameters.

Our average replay times were calculated according to a simple algorithm:

$$N_1 (B + D)P_1 + N_2 (B + D)P_2 + \ldots N_n (B + D)P_n$$

Where:

B is the back-up parameter (4, 5, 6, 7, and 8 seconds were used)

N is a number of button presses

D is the decision/action time estimate (1, 2, or 3 seconds)

P is the proportion of phone numbers completely heard for each time interval. A time interval was calculated as the back-up parameter minus the decision/action time. The proportion of messages completely heard during a particular time interval was taken from Table 1.

It should be noted that for our estimates of the decision/action time, the optimal back-up parameter was one that would replay approximately four seconds of the message. For instance, if the decision/action time were estimated to be 1 second, the optimal back-up parameter would be approximately 5 seconds. By replaying four seconds of the message approximately 84% of all phone numbers would be replayed with a single press of the button. Pressing the button a second time would replay 100% of the phone numbers left in our sample of messages, but would only have to be done for less than 16% of messages. A second button press would cost and additional 6 seconds of time (1 second of decision/action time, and 5 additional seconds of message replay). Of course, a back-up parameter of 8 seconds, which would replay 100% of the phone numbers in the sample, could be implemented, but because it would replay more than just the phone number for the vast majority of messages, it would be a less than optimal parameter value.

Back-up Time (seconds)	Proportion of complete #'s recovered	Cumulative Proportion recovered
1	0.0602	0.0602
2	0.1687	0.2289
3	0.3494	0.5783
4	0.2651	0.8434
5	0.0723	0.9157
6	0.0602	0.9759
7	0.012	0.9879
8	0.012	0.9999

Table 1. Proportion of complete phone numbers recovered for each second replayed from the end of the phone number.

The value of a back-up button would be passed on to phone system users in the form of substantial time savings. Given that the mean time from the start of a message to the end of the phone number (24.7 seconds), the use of a back button would result in an average time savings to users of 13 to 18 seconds per replay of the phone number portion of the message, depending on the decision/action time estimate. As an example, if we assume a decision/action time of 2 seconds, the optimal back-up parameter would be 6 seconds, and the average replay time for all messages in this sample would be 9.25 seconds. Under these circumstances, if the back button were used once per message for each of the 80 messages examined in this study, its use would result in a time savings of nearly 21 minutes.

DISCUSSION

The value of any time savings through such a system goes well beyond the individual user. When one considers the potential time savings to an entire company, a region, or even an entire country, the savings in time rapidly approach very large numbers. In fact, the time savings calculated here likely underestimate the actual time savings of the technology. The button could, and undoubtedly would, be used for replaying any portion of a recorded message that was unclear, such as directions or names of people and places. Additionally, the savings per message presented here assumes that the phone number is entirely understood with only a single replay. The average savings is multiplied with each additional use of the back button.

This research shows that many modern telephone messaging systems are inefficient. Given the structure of a typical message in which a phone number or other important information is recorded, there is an opportunity for substantial time savings to users of messaging systems. A back button is one solution using available technology.

REFERENCES

Miller, G. A. (1956) The magical number seven plus or minus two: Some limits on our capacity for processing information. *Psychological Review*, 63, 81-97.