# Poster: A Preliminary Study of Users' Experiences and Beliefs about Software Update Messages

Michael Fagan
University of Connecticut
371 Fairfield Way
Storrs, CT 06269-4155
michael.fagan@uconn.edu

Mohammad Khan
University of Connecticut
371 Fairfield Way
Storrs, CT 06269-4155
maifi.khan@engr.uconn.edu

Ross Buck
University of Connecticut
337 Mansfield Road
Storrs, CT 06269-1259
ross.buck@uconn.edu

## 1. INTRODUCTION

Today, cyber criminals often exploit known software vulnerabilities to breach a computer's security [1]. These attacks are often preventable by keeping the system up-to-date via installing the latest software and security updates. Old buggy software often leads to poor system performance and inefficient resource utilization as well. Unfortunately, users often consistently ignore recommended updates. To understand the underlying reasons behind such behavior, this study investigates the current designs for delivering software update messages, and leverages the Communication-Human Information Processing (C-HIP) framework [2] as an investigative tool to identify their limitations from an affective-cognitive perspective. More specifically, we use the aforementioned framework to design a multi-phase study which asked participants about their experiences with and opinions of computer update messages. Through analysis of our survey data, we identified that, for the most part, current update messages lack proper affective-cognitive appeals and do not work to build the trust of the user in the software or company. The details of our study are below.

## 2. ANALYZING THE EFFECTIVENESS OF UPDATE MESSAGES

The Communication-Human Information Processing (C-HIP) protocol [2] is widely used by the marketing research community to determine, where, if at all, the failure in persuasion happens when trying to warn a user and convince them to perform a behavior. A visual representation of the C-HIP framework can be found in Figure 1. Specifically, C-HIP models the multiple information processing steps that are often involved in the decision making process. In our work, we leverage the C-HIP model as an investigative tool to identify the stage(s) where the current software update messages fail. In the C-HIP model, the source is the entity that attempts to communicate the message through one or more communication channels (e.g., visual, auditory) to one or more receivers (i.e., human). In our work, the source is the software company, the channel is the software update message, the receiver is the computer user, and the expected behavior is the user applying the update. To phrase our findings in terms of affective-cognitive design, we map the various aspects of a software update messages to different stages of the C-HIP model as follows.

1. Attention Switch and Maintenance - Is the update message noticeable and do people take the time to look at the message?

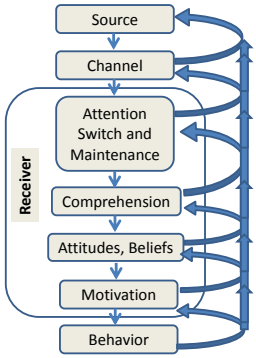


Figure 1: A visual representation of the C-HIP model [2].

2. Comprehension - Can the receiver of the message understand what they are being instructed to do?

3. Attitudes/Beliefs - Is the message in line with the existing attitudes and/or beliefs about the software, company, or in general?

4. Motivation - Does the message appropriately motivate the receiver to apply the update?

According to the model and our mapping, a failure to convince the user at any of these stages can result in the user not acting out the desired behavior. The goal of our study is to identify the stage(s) where update messages fail.

## 3. EVALUATION

For preliminary investigation, a two phased web survey was conducted to collect data from a total of 226 people. Seventy-one (71) of those responses were from the first run in the Fall of 2013, the remaining 155 were gathered in the Winter of 2014. The first run survey asked participants to consider their experiences with update messages overall. Respondents were asked about their opinion of update messages, how often they see update messages, how long they wait to apply updates, as well as other questions. The second run survey started by asking participants the same set of questions as in the first run. After this portion of the survey, respondents were shown 14 images of real update messages and asked to rate numerically their opinion of the message. Our phase 1 sample tended towards 20 to 30 year olds with an average age of 33 and a standard deviation of 14 years. The sample has a slight male bias. Overall, 58% of our sample was male, and 42% was female. The phase

| | Fall 2013 (n=71) | | | Winter 2013 (n=155) | | |
|---|---|---|---|---|---|---|
| Question | Yes | No | DK/NA | Yes | No | DK/NA |
| Annoying | 0.90 | 0.09 | 0.01 | 0.92 | 0.06 | 0.02 |
| Confusing | 0.63 | 0.31 | 0.06 | 0.62 | 0.35 | 0.03 |
| Hesitant | 0.70 | 0.23 | 0.07 | 0.66 | 0.28 | 0.06 |

Table 1: Normalized response frequencies for select questions.

2 population was younger with an average age of 22 and a standard deviation of 5.4 years. In our second sample, we had 60% female and 40% male respondents. The key findings are summarized below.

## 3.1 Prevalence of Annoyance and Confusion

The survey included two questions that asked about annoyance ("Have you ever been annoyed by an update message?") and confusion ("Have you ever been confused by an update message?"). The proportions of the responses for these two questions for both samples is shown in Table 1. One strong trend that was common among a large group of respondents is the tendency for users to be annoyed by update messages. They also indicated that they have commonly been confused by update messages. As we can see from Table 1, the results for these questions from both our phases had similar response proportions. For example, about 90% of all respondents from the first phase and 92% from the second phase of our study reported having been annoyed by an update message. This reflects a general negative sentiment in users' minds regarding update messages. Having been annoyed in the past will make a person less likely to adhere in the future, as predicted by the C-HIP model. Also, over 63% of survey respondents in the Fall of 2013 and 62% in the Winter of 2014 report having been confused by an update message in the past. Like annoyance, confusion not only hurts the understandability of the current message being viewed, but may also affect future update messages due to the influence of past experiences, as explained in the C-HIP model. It is important for users to understand the messages they read so that they can make informed decisions. If users are confused, they are more likely to reject the recommended updates.

The message-specific data from phase 2 indicated a correlation between respondent's rating of how confusing a message is and how annoying it is. Pearson's r value for responses to the questions "How annoying is the message?" and "How confusing is the message?" is 0.50. This relationship can work both ways. A confusing message could be frustrating, and thus annoying, and an annoying message may be hard to focus on and understand, thus making it confusing. Being annoyed or confused by a message are both undesirable responses in the context of the C-HIP model.

## 3.2 Prevalence of Hesitation

Both samples highlight a feeling of hesitation towards applying software updates. Figure 2 shows the proportion of respondents from phase 2 who responded that they felt hesitant in applying an update in the past. Table 1 shows the proportional responses to the question "Have you ever been hesitant to apply an update?" for both phases of the study. If a user indicated that they felt hesitant, we also asked them to identify why they had felt hesitant. In the first phase, of the 50 who responded yes, 45 left an explanation. The biggest concern for users were the possibility of the update being malicious or the update causing a negative impact on system performance, accounting for 58% of reasons offered. A majority of users felt hesitant because of possible negative consequences, either from an inferior update or malicious code. Hence, convincing users that an update is safe and will help their system is important. In the context of the C-HIP model, hesitation may cause failure at the Attitudes-Beliefs stage as these users aren't applying the update because they believe it will hurt their system.

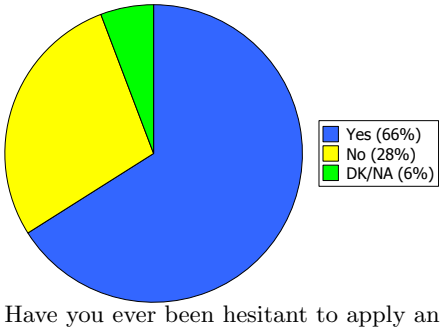


Figure 2: Have you ever been hesitant to apply an update? DK = Don't Know, NA = No Answer

## 3.3 Noticeability and Perceived Importance

In the message-specific data, noticeability and importance were found to be correlated. Pearson's r value for the responses to the questions "How important is the message?" and "How noticeable is the message?" is 0.42. The noticeability of a message has been shown to be very important to the ability of that message to transmit information to a reader. Our findings indicate that it is also tied into the perceived importance of a message. This relationship can work in either direction. A more noticeable message may look more important and a message that is more important may be more easily noticed by the user.

# 4. CONCLUSION

Our results show that users are commonly annoyed and sometimes confused by update messages. More importantly, our study identifies a general negative attitude associated with software update messages. We strongly believe that our results will foster future research in this critically important direction and will lead towards the design of better, more effective software update messages and delivery mechanisms.

**Acknowledgments**

This work is supported by the National Science Foundation under Grant No. CNS-1343766 and by the U.S. Department of Education via the GAANN Fellowship No. P200A100141. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the funding agencies.

# 5. REFERENCES

[1] C. Grier, L. Ballard, J. Caballero, N. Chachra, C. J. Dietrich, K. Levchenko, P. Mavrommatis, D. McCoy, A. Nappa, A. Pitsillidis, et al. Manufacturing compromise: the emergence of exploit-as-a-service. In *Proceedings of the 2012 ACM conference on Computer and communications security*, pages 821–832. ACM, 2012.

[2] M. S. Wogalter, D. DeJoy, and K. R. Laughery. *Warnings and risk communication*. CRC Press, 1999.