ABSTRACT

Title of Document: Reducing Electronic Information Overload.

Colin Adamson, Chris Gennaro, George Kinchen, Joshua Koehler, Peter Liu, Derek May-West, Jason Zhang

Directed by: Dr. Aravind Srinivasan,
Department of Computer Science

College students receive a wealth of information through electronic communications that they are unable to process efficiently. This information overload negatively impacts their affect, which is officially defined in the field of psychology as the experience of feeling or emotion. To address this problem, we postulated that we could create an application that organizes and presents incoming content in a manner that optimizes users' ability to process information. First, we conducted surveys that quantitatively measured each participant's psychological affect while handling electronic communications, which was used to tailor the features of the application to what the user's desire. After designing and implementing the application, we again measured the user's affect using this product. Our goal was to find that the program promoted a positive change in affect. Our application, Brevitus, was able to match Gmail on affect reduction profiles, while succeeding in implementing certain user interface specifications.

REDUCING ELECTRONIC INFORMATION OVERLOAD

Colin Adamson
Chris Gennaro
George Kinchen
Joshua Koehler
Peter Liu
Derek May-West
Jason Zhang

Thesis submitted in partial fulfillment of the requirements of the Gemstone Program
University of Maryland, College Park
2014

Advisory Committee:
Dr. Aravind Srinivasan, University of Maryland, Mentor
Dr. William Gasarch, University of Maryland
Dr. Evan Golub, University of Maryland
Dr. Kent Norman, University of Maryland
Dr. James Purtilo, University of Maryland
Dr. Jessica Vitak, University of Maryland

Acknowledgements

Team RIO would like to thank everyone that has supported us over the previous years in developing our research and application. We would like to especially thank our mentor Dr. Srinivasan, our current librarian Mr. Karl Nilsen, our previous librarian Ms. Lara Otis, and the entire GEMSTONE staff. Without their leadership, guidance, and assistance, our project would not have reached the level that it did. We would also like to thank Dr. Norman, who graciously provided us with facilities for our testing. We would also like to thank our previous team members - Natalie Barnes, So Kim, Nathan Fernando, and Alex Hughes for their hard work in helping us complete this project. Finally, we would like to thank the people that encouraged and propelled us to complete our thesis - our family, friends, and cohort.

Table of Contents

List of Figures

1. Chapter One: Introduction

1.1. Research Problem

People presented with large, diverse sets of information from multifarious sources face what is known as information overload (Eppler & Mengis, 2004). Given that there is a limit to the amount of information that can be processed at a given time, approaching that limit would cause the cognitive function of the brain to degrade (Miller, 1956). Though there are many different activities that may cause information overload, we have decided to focus specifically on the contribution of email, online calendars, and contacts to information overload.

Electronic Communication has become a growing part of a college student's life, both personally and professionally. Colleges (such as the University of Maryland) have made the switch to email as their primary method for contacting the typical college student. College students have responded by checking their email frequently, with the average University of Maryland student checking it over 20 times a day, from our testing.

The phenomenon of information overload merits further study because it can have negative repercussions on one's psyche. As a person approaches the information-processing limit, that person becomes unable to properly handle any new information. As a result, information overload promotes negative affect. For the purposes of this proposal, affect is defined as a psychological state of mind. Positive affect encompasses feelings perceived as pleasant, while negative affect encompasses feelings perceived as unpleasant. Negative affect contributes to stress and agitation, which can lead to health problems (Hurst, 2007).

Previous research has supported the conclusion that one of the biggest contributors to information overload is an excessive amount of email (Gleick, 2011). The distinction often drawn between email and other forms of Internet communication is one of voluntary participation; email, like postal mail, is often delivered without solicitation. Also, recipients of email are often forced by social or professional obligations to respond quickly and thoughtfully to the sender (Renaud, Ramsay & Hair, 2006). It is for this reason that information overload due to email has been a more pressing concern than other forms of online communications. However, because of the growing use of other forms of Internet communication, we also attempted to analyze the effects of information overload due not only to email, but also due to search engines, blogs, news feeds, social networks, and social media.

Another gap in the existing literature is the effect of information overload on college students. While studies have examined these effects in the corporate setting (Spira, 2011) and among academic researchers and professors (Renaud et al.), studies have not yet been conducted that specifically focus on how information overload affects college students. We believe that it is important to study how college students respond to electronic information overload based on the lack of previous research for this target audience, as well as the perceived large amount of electronic information that these students receive.

1.2. Research Questions

We posed two research questions throughout our study:

1. To what extent are college students influenced by information overload?

2. Will the use of our information management system promote positive affect, as measured by the PANAS-X scale, as well as reduce stress, through the Stress Overload Scale (SOS) test?

1.3. Product Planning

Information overload's influence on students continues to increase due to the perpetual expansion of Internet communication as a medium of academic and social communication. We hypothesized that information overload increases college students' negative affect while at the same time decreases their positive affect. We measured this influence through a survey, which we have designed, as well as the PANAS-X affect test and SOS-QUIS stress test, which we utilized during email-based lab testing in the later phases of our research. We developed a prototype product that interfaces between students and their email accounts with the goal of reducing the negative psychological consequences of information overload. We have measured the success of this program by the change in affect of each user throughout the phases of research.

With these lab tests, we have found that electronic information overload does perturb the affect of the user, and that college students do experience the effects of electronic information overload from the overwhelming amount of emails they receive on a daily basis. We created an email platform named Brevitus in an attempt to reduce the drop in positive affect and rise in negative affect. Through multiple design iterations, the team was able to have the affect differences experienced during email use nearly match

that of Gmail, an established “baseline” email platform used by most college students today.

2. Chapter 2: Literature Review

2.1. Background

This literature review examines the constructs and past studies regarding electronic information overload. First, we examine information overload in a general sense, and how it impacts the population. We then discuss affect and stress, the psychological measures we used to quantify information overload. We describe how the three factors are intertwined—information overload undeniably promotes negative affect and stress, both of which can lead to serious health issues. Next, we acknowledge existing work to mitigate information overload, leading to a discussion of user interface design and machine learning, both of which were vital in the creation of our own product to effectively combat information overload. We also address the limitations in current research and suggest a unique solution for the problem of information overload.

2.2. Information Overload

As background on our topic, information is "knowledge communicated concerning some particular fact, subject, or event" (Information Fatigue, 2013) and can be parameterized by the characteristics of volume, complexity, uncertainty and turbulence. Volume refers to the amount of information available to the user. Complexity measures how difficult the information is to process. Uncertainty describes a measure of the adequacy of the provided information. Turbulence measures

the similarity of this information; highly similar content has low turbulence while dissimilar information has high turbulence (Evaristo, Adams, & Curley, 1995).

Of these four characteristics, complexity is the most important when categorizing information. Complexity is comprised of the differences among the information units, diversity; the specialization of the information, interdependence; and the number or components in the environment, numerosity (Huber & Daft, 1987). If all three attributes of complexity are high, then an information unit is distinct, meaning it is unique and separate from other less complex information. Experts are in consensus that humans are limited in their capability to process distinct information units (Klausegger, 2007). In fact, functional magnetic resonance imaging (fMRI) scans of the brain indicate that the information processing portions of the brain are stimulated by a maximum of nine units of information at any specific instant of time (Marois & Ivanhoff, 2005). Moreover, Miller's research has shown that techniques to increase processing capacity have only temporary effects (1956).

In recent years, the term information load and its four dimensions of volume, intensity, diversity, and patterning has come into prominence; these terms are critical in the descriptions of how this information is received and processed. As previously described, volume is the amount of information incurred, but intensity refers to the amount of information within that volume that one can utilize. Together, volume and intensity represent the total quantity of information given to an individual. Much like turbulence, diversity refers to the similarity or dissimilarity of the information. The final characteristic, patterning, is how assignments are given to the units of information. Diversity and patterning, together, represent the degree to which the

information is different and how repeatable the information is (Milord & Perry, 1977; Spier, Valacich & Vessey, 1999).

Recently, Spier et al. proposed that an additional variable, the time required to process information, be introduced to the concept of information load (1999). Hwang and Lin (1999) conclude that the best representation of the relationship between information load and information processing is that of an inverted U-curve (See Appendix F, Figure 1). Up to a critical point, additional information aids in decision-making, but after the critical point, information acts as a hindrance (Karr-Wisniewski & Lu, 2010). The exact location of this critical point differs from person to person, but cutting down on the amount of irrelevant data should help all users.

The digital age enables easy dissemination of information through the Internet. However, this vast collection of readily accessible information comes at a significant cost, as the overabundance of information available overwhelms most users and contributes to information fatigue, which is mental exhaustion resulting from exposure to information (Information fatigue, 2011; Gleick, 2011). Minimizing the harmful effects of electronic user information fatigue has become a critical area in the reduction of information overload.

Although information overload has long been a topic of interest, past research on the subject focused on its consequences. Evaristo et al. showed that prior studies fail to provide sufficient discussion on the information overload construct itself (1995) and thereby fail to address the root issue of information overload. To avoid this common mistake and better understand the source of information overload, an operationalized definition must be established. Milord and Perry posit that information overload is the

condition where the information load placed on a system exceeds that system's ability to process the information (1977). Specific to this research, information overload is defined by Karr-Wisniewski and Lu as the state in which "an individual is presented with more information than the individual has the time or cognitive ability to process or, in other words, when an individual's information processing capabilities are exceeded by the information processing requirements" (2010).

2.3. Affect

Affect is the human experience of feeling emotion, formally defined by Baumeister and Bushman (2011) as the flattening of all emotions onto two axes, with one axis (positive affect) representing the spectrum of good emotions, and the other axis of negative affect representing the bad emotions. Affect is present whenever a human is presented with stimuli and is strongly correlated with the person's response to the stimuli. Thus, the concept of affect is closely tied to everything a person does (Myers, 2010). It is important to note, however, that the term affect does not pertain to the words of emotion. The word "affect" and "emotion" are not interchangeable. Affect specifically refers to the experience of emotion by the conscious whereas emotion refers to all the behavioral and cognitive changes that occur in a human.

Traditionally, affect has been visually represented as a circular ordering of emotions around the two dimensions of valence and arousal (Larsen & Diener, 1992). The horizontal axis, valence represents the hedonistic value of an emotion, ranging from unpleasant to pleasant. On the vertical axis, arousal measures the level of

awareness that an emotion is present, varying from inactivated to activated awareness (Feldman, 1995). The location of emotions on this circumplex corresponds to affect (see Appendix F, Figure 2). Recent studies have argued that the circumplex model is not accurate, stating that the model of affect varies greatly based on an individual's character and circumstances (Remington, Fabrigar, & Visser, 2000; Terracciano, McCrae, Hagemann, & Costa, 2003). Some psychologists claim that no model can be completely representative of affect, but they nevertheless propose an elliptical model that they believe to be the best possible representation (see Appendix F, Figure 3; Watson, Wiese, Vaidya, & Tellegen, 1999).

2.4. Stress

Stress is "any environmental or physical pressure that elicits a response from an organism" (Stress, 2013). Specifically, psychological stress "occurs when an individual perceives that environmental demands tax or exceed his or her adaptive capacity" (Cohen, Janicki-Deverts, & Miller, 2007). In general, psychological studies regarding stress focus on either the occurrence of environmental events that may cause stress or on individual responses to stress, such as negative affect or perceived stress. Psychological stress can be measured by several scales, including the Stress Overload Scale (SOS) (Amirkhan, 2012). The SOS fits our goals by both characterizing stress reliably and diagnosing the reasons for increased stress.

2.5. Affect, Stress, and Information Overload

Roets and Van Hiel (2011) found that negative affect is highly intertwined with stress. Stress is believed to cause negative affective states, which can affect biological processes or behavioral patterns. Whether these events occur over an extended duration or a single brief event that continues to affect the user after it ends, exposure to chronic stress is believed to be the most harmful due to its potential long-term and perhaps permanent changes to emotional, physiological, and behavioral response. Cohen et al. found that stress has the potential to influence depression, infectious, autoimmune, and coronary artery disease, and some cancers (2007). Lightsey, Maxwell, Nash, Rarey, and McKinney (2011) found that, much like stress, affect shapes mental health, physical health, and life satisfaction. Specifically, negative affect is a predictor of lower life satisfaction and contributes heavily to a wide range of mental and physical problems, among them depression, anxiety, high blood pressure, migraines, neck pain, coronary disease, and autonomic service dysfunction.

Most research pertaining to information overload and its negative effects regard email as the main source of information overload. It has been shown that people check and answer email compulsively throughout the day (Hair, Renaud, & Ramsay, 2007), and that stress is positively correlated with the amount of email an individual receives (Bellotti, Ducheneaut, Howard, Smith, & Grinter, 2005). In a study of all types of information mediated by technology, Misra and Stokols (2012) found that higher levels of cyber-based information overload predicted higher levels of perceived stress. The authors reported that individuals experiencing higher levels of overload from technological sources also suffered poorer health status (Misra & Stokols, 2012). Furthermore, as

information overload has been shown to lead to decision fatigue (Malhotra, 1982), Hurst found that it can have a demoralizing effect on people (2007), lowering their self-esteem. Thus, negative affect, positive stress, and information overload can all be shown to damage personal health and well-being.

2.6. User Interface Design

Current user interface design generally attempts to follow an established set of guidelines, best practices, and past successful examples to create the most usable and efficient interface possible. According to Shneiderman, Plaisant, Cohen & Jacobs, there are many sets of guidelines, principles, and theories that successful companies such as Apple, Microsoft, and others use when designing from a base level (2010). Raskin, however, states that contemporary graphical user interfaces are flawed, and outlines several solutions to overcome the shortcomings of the current model (2000). Shneiderman et al. argues that guidelines are provided to "cover the design process, general principles, and specific rules" (2010). Sample guidelines include standardizing task sequences to keep tasks uniform across similar conditions, ensuring headings are unique and descriptive to keep users abreast of what they are looking at, and designing pages to ensure printability. Guidelines also govern display organization, manage user attention, and attempt to facilitate data entry. Essentially, a website with proper guidelines should be uniform throughout and ensure that the user incurs the least possible additional cognitive load when moving from process to process, keeping stress to a minimum. Raskin agrees with this, emphasizing that there is no excuse for not keeping

simple tasks simple. Developers often flock towards the potential new and innovative features, and end up obfuscating the base use of the program. Guidelines help enforce usability.

Principles are broader than guidelines, but must be evaluated specifically for each new website. Good principles include the knowledge that not all users have the same skill level. Websites should be designed to the intended skill level, and websites catering to multiple skill levels must be much more carefully designed so that users of all skill levels can operate them properly. Once the typical user is selected, the designer should identify the tasks that the user must complete, and select the method by which the user will communicate with the computer to complete the tasks. Options for this include direct manipulation of familiar objects, menu selection, form fill in, a specific command language, or communicating with a natural user language. Each of these methods have their advantages and disadvantages, and must be selected based on the intended user-base and functionality of the website. For example, a website used primarily by children that attempts to implement a command line interface would probably be considered poorly designed. The same could be said for a True/False section that uses form fill-in rather than drop down windows or radio buttons. Principles should attempt to ward off errors and difficulties in use at the design stage, before the user even encounters them. The word Raskin uses to describe this concept is humane - the interface is "responsive to human needs and considerate of human frailties" (2010). When using the interface, users should set the pace of interaction, not the program. Principles help keep the program logically designed and the user engaged, rather than confused and casting about for the correct method in which to proceed.

The final design category is overarching design philosophies. Developing these overarching architectural thoughts allow designers to further refine and test their new ideas on interface design, improving upon established guidelines and principles. Raskin pioneers several new approaches, designed from theories that he has researched and tested, such as a focus on the Locus of Attention, the total knowledge of what our brains can and cannot do, and attempting to create a total, unified product.

Another approach detailed by Shneiderman et al. is "Design-by-levels," which splits the design process into four levels: conceptual, the user's "mental model"; semantic, the meaning conveyed by user input and computer output; syntactic, the definitions that control semantics; and lexical, the exact specifications of the syntax (2010). This style of design separation works well for designers because it allows innovation in multiple intuitive places, and the results can be easily monitored and tracked to find the successful and unsuccessful theories. There has been an increased push in recent years to test theories less in laboratory conditions and more in real life situations, because, as Shneiderman describes, design is inextricably linked to patterns of use (2010). Though this may lead to convoluted results, real life product use is often non-canonical as well, and less operationalized forms of feedback may be more useful, as they expose everyday bugs and combinations of patterns that may not be encountered in a controlled laboratory setting.

2.7. Usability Testing Theory

Usability testing is a critical step in product development. According to Nielsen (1993), "user testing with real users is the most fundamental usability method and is in some sense irreplaceable, since it provides direct information about how people use computers and what their exact problems are with the concrete interface being tested" (p. 165). This type of testing is called usability testing, which means that the primary goal of testing is to improve the usability of the product. Testing is conducted by real users completing relevant tasks; their use of the product is observed and recorded, allowing for later analysis and improvement of the product (Dumas & Redish, 1999).

There are two aspects of usability testing: reliability and validity. Reliability addresses the differences between users and the concern that results are repeatable. Reliability is a significant concern in usability testing, due to the variability in speed and competency between different users. This difference can be as high as tenfold, and there are large discrepancies between the best and worst 25% of users (Nielsen, p. 166). Validity refers to applicability of the results from the testing to the issues that should be tested, including selecting the proper audience for the product.

Usability testing typically begins with pilot testing, which entails trying the test procedure on a few users. This allows for the clarification of definitions of the measured results and refinement of the experimental procedure, including test timing, instructions, and questionnaires.

Usability testing can continue in two ways: between-subjects testing and within-subjects testing. In between-subjects testing, a user participates in testing only one

system, while in within-subjects testing, each user evaluates all systems being tested. Each method has advantages and disadvantages. The individual variation of skill, preference, etc. can cause difficulty when comparing systems in between-subjects testing. However, in within-subjects testing, the transfer of skill from one program to the next can affect later testing; thus, different users should test the systems in a variety of orders (Nielsen, p. 179). Whichever testing design is used, it is imperative that the tested users should be as representative of the intended users as possible. In some cases, training may be necessary in order to ensure all users are capable of testing the system.

When designing tasks for usability testing, tasks should be chosen to represent the uses of the system when it will be released into the field. Thus, the tasks should be precise and cover the most important parts of the user interface. However, the tasks must strike a delicate balance; each task should be small enough that it can completed in the allotted time, but not so much so that it become trivial. Each task should have a specific way to measure success. A computer can automatically collect statistics or the test administrator can manually observe data. In some cases, different tasks might be tested for novice users than would be for expert users, and vice versa.

Some usability tests compare the product being tested to competitors' products to determine the strengths and weaknesses of each product.

2.8. Product Validation

Information overload is a pertinent problem today that contributes to serious mental and physical maladies. Studies show that overload not only increases the amount of stress of the user, but also deteriorates the user's further written communications

(Jones, Ravid, & Rafaeli, 2004). As most efforts to reduce information overload focus on corporate solutions, our goal is to build on existing solutions to offer an intuitive system to the college student community that helps students better manage their electronic information.

2.9. Machine Learning

The machine learning performed by Brevitus is unique – it has not been implemented previously in commercial clients or research studies; however, some components of our algorithm are well studied topics in the field of computer science, such as text parsing, labeling, and folder usage.

A study conducted by Bekkerman, McCallum, and Huang was one of the first to study the classification of email into folders (2005). In this study, they discussed the differences between email folder sorting and traditional document sorting. Specifically, they mention that folders are created and destroyed often, do not correspond to simple concepts, and vary drastically from user to user. In addition, emails change topic over time, so sorting threads into a single folder can be inaccurate. The study proposes a new evaluation model for sorting email into folders, which requires less training time than previous models; however, the accuracy is low, confirming the challenges for sorting emails into folders accurately. Brevitus aims to avoid these issues by ranking emails based on sender importance metrics rather than relying on a system to automatically place emails in folders that could incorrectly value or sort the messages.

Parsing the raw text in the email is another difficult problem. According to Klimt and Yang, most email text parsing is done in a "bag-of-words" format (2004). In this format, the importance of the email is based on the words it contains. While this provides a good importance indicator for emails containing particular words, it doesn't place any value on phrases or senders. We considered this method during our algorithm design process, but decided that it was overly simplistic – it ignored important components of email communication, and provided substandard results.

3. Chapter 3: Methodology

3.1. Research Design

We used a mixed-methods methodology that consisted of conducting surveys and performing extensive user tests of the software, while concurrently designing the prototype. This approach was in line with the viewpoint that electronic communication achieves its full potential when integrating computerized systems with human input (Nanapoulous, 2011). Observing user interaction with the software provided statistical data that helped improve the product's algorithm's performance and efficacy, while the surveys enabled exploration of the psychological aspects of the project, relating how people react to both electronic communication in general, and specifically, to our product. Only by using both sets of data was it possible to measure the system's ability to handle electronic information overload.

3.2. Subgroup Assignments and Responsibilities

3.2.1 Research Subgroup

The research subgroup developed three sets of surveys. The first survey collected data on features that potential users wanted most for an information management system,. This survey used scaled, multiple choice, and open-ended questions, and was developed by revising pre-existing surveys (see Appendix D for the team's survey) (Moser & Soucek, 2010; Karr-Wisniewski & Lu, 2010; Song & Ling, 2011). The second survey measured affect and was distributed to participants during the formal within-

subjects study, alpha testing, and beta testing (See Appendix F). This survey was based on the PANAS-X scale (See Glossary) (University of Iowa, 1994). In addition to affect, stress was yet another dimension that was accounted for during the formal within-subjects study, alpha testing, and beta testing, for which the Stress Overload Scale (SOS) was used without change (Amirkhan, 2012).

3.2.2 Design Subgroup

The design subgroup explored Application Programming Interfaces (APIs) (see Appendix C) of existing email clients and social networks to decide what services could be integrated into the new information management system. At the same time, the subgroup learned the necessary computer languages and investigated software packages that could be integrated into the system.

The goal for the algorithm was to enable the program to learn the relevance of received electronic information to each user. Development was an incremental process. Initially, a simple sorting algorithm was used to sort information based on the importance of user-defined labels and date. The algorithm was subsequently incorporated into the graphical user interface (GUI) (see Appendix C) of the design. After initial testing, the algorithm was refined, tuning the parameters which determined the importance of information. The overall structure of the algorithm resembles the multiplicative weights method described by Arora, Hazan, and Kale (2005).

3.3. Product Requirements and Design Layout

3.3.1 Product Requirements

Initial product requirements (see Appendix D) were drafted using current literature and advice from the project mentor and other professional contacts. Additionally, Team RIO recognized that transitioning to new software is cumbersome and difficult for users if significantly different from current software (Schlossberg, 1981). Thus, the team consulted interface design books and tested existing email clients to assess components and features of clients and interfaces that should be included..

Initial product specifications included the integration of multiple electronic information sources, such as Facebook and Twitter, into one unified platform, an algorithm to sort those source of information by relevance, and a Graphical User Interface (GUI) to display the most important information, as calculated by the algorithm, cleanly and intuitively. Basic email functionality was to be included in order to facilitate adoption of the platform. Accepted information management actions such as archiving, deleting, forwarding, replying to, and composing messages, were to be included. Furthermore, the product had to handle all of the information in a secure fashion. Thus, the product needed to use encrypted passwords for each user, as shown in the login page (Figure 3.3.1.1), and shows the account and login handling screen of Brevitus. Apart from just a username and password, Brevitus is equipped to securely handle email from Gmail's API if requested by the user. Email and other personal information is not only private, but also can be disastrous in the wrong hands, so we will obtain secure certificates to ensure the confidentiality of all information. The product was named "Brevitus" to reflect the goal of effectively managing information.

As the project progressed the product specifications altered over time based on feedback from the surveys and data acquired from test participants. Most significantly, the focus switched from managing multiple sources of information to managing emails.

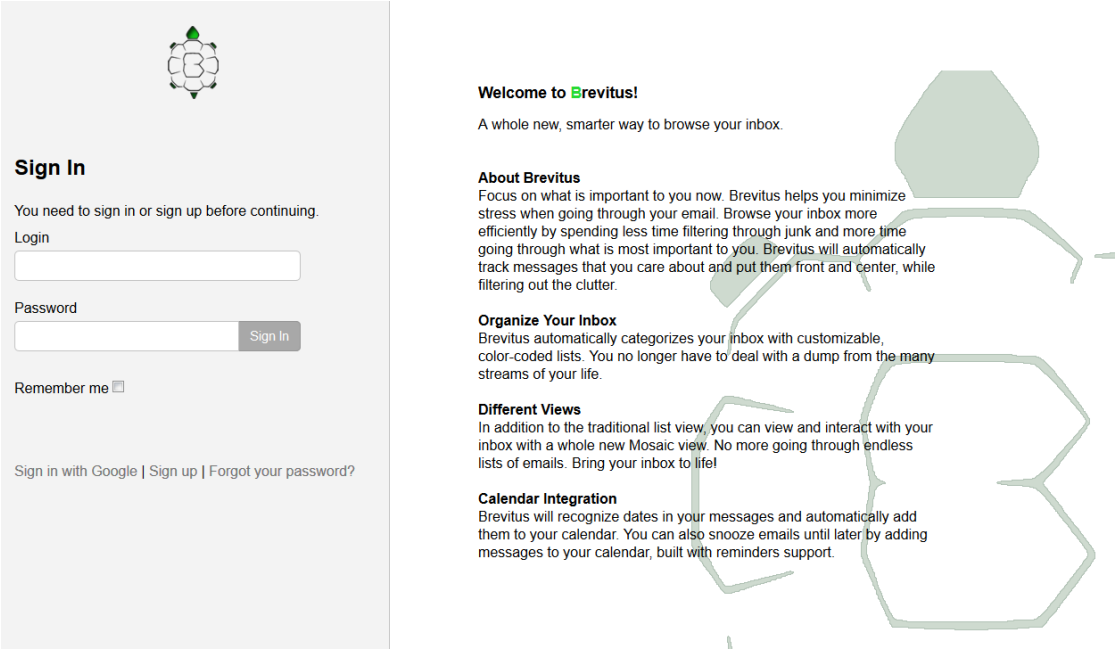


Figure 3.3.1.1: Login and account creation screen for Brevitus.

3.3.2 Product Layout

The most critical decision in the product design was the selection of a layout to display the user's emails. The design had to appeal to college students and provide a mechanism by which to easily navigate throughout the email client without overwhelming students with a radical change to a traditional layout. Thus, it was determined that Brevitus should have four main views: list, contact, calendar, and mosaic. These views were designed so that each was easily accessible through clicking on their

corresponding icons. The arrangement of the messages was determined by a basic placement algorithm for each view.

1. List View

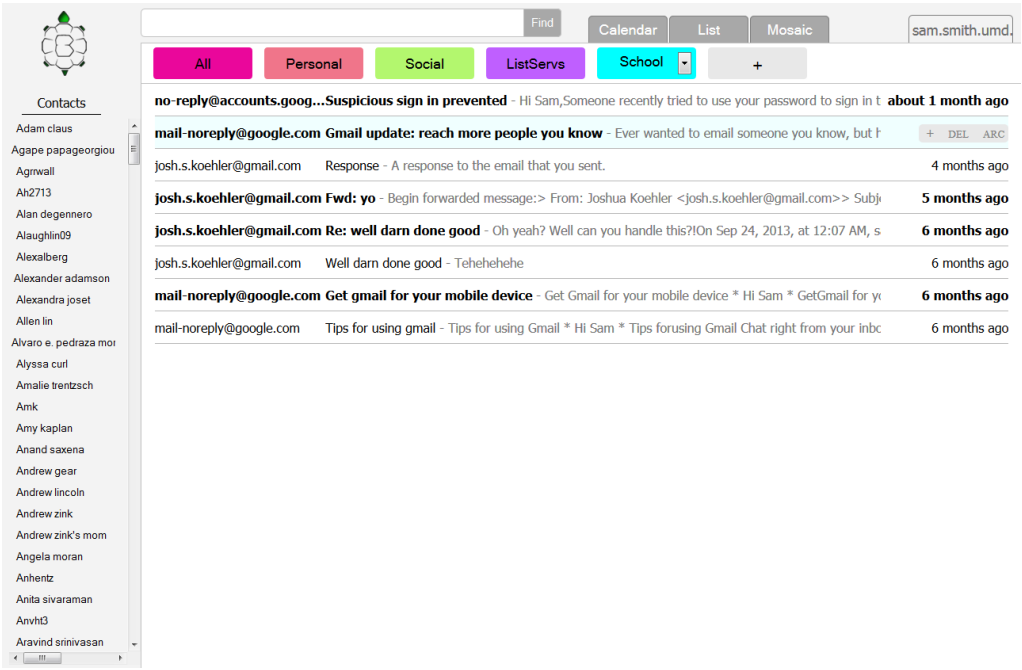


Figure 3.3.2.1: View of the list layout of the Brevitus platform.

This view was included for users who prefer the traditional layout of modern email clients. The emails, along with their subject lines, sender, and first line of the message were laid out in rectangular sections in a list on the right hand side of the screen. Each individual block had a colored bar on its left hand side to indicate an email's category. Clicking on an email block brought up the message in the main viewing area on the right hand screen.

2. Mosaic View

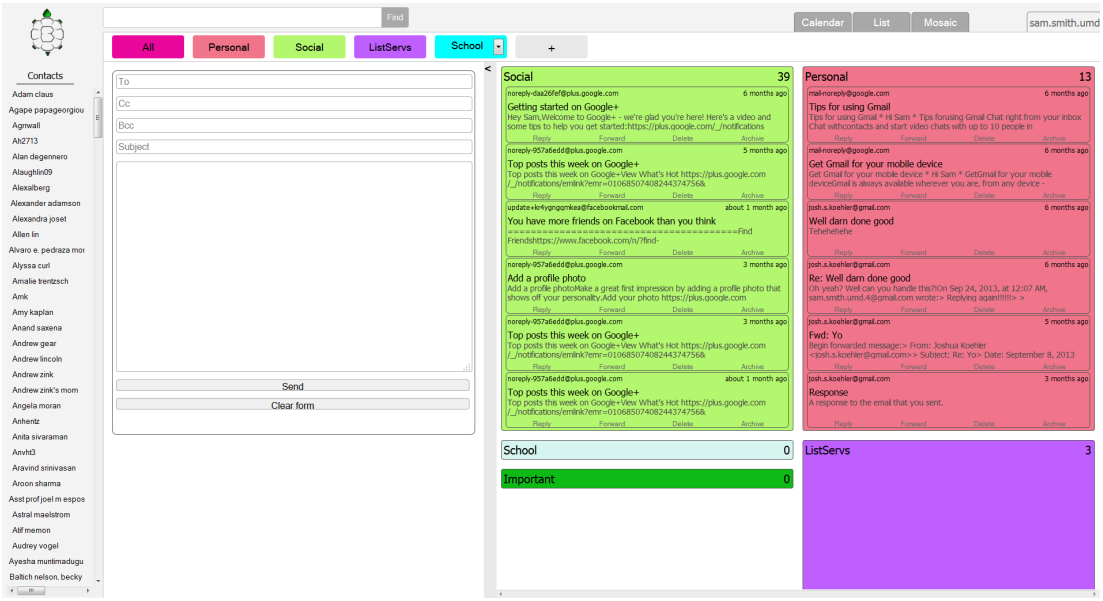


Figure 3.3.2.2: Layout of the mosaic view of the Brevitus platform.

This view was designed to appeal to college student's desire for highly visual interfaces. The screen was divided up into color-coded blocks which correspond to different labels that were created by both the system and users. Emails which were associated with a label were placed in the corresponding label's block. According to a ranking algorithm, the email's block's sizes were scaled - more important emails were displayed more prominently. As in the listserv view, when a label's block was clicked on, the emails and their corresponding blocks were brought into focus and were able to be manipulated.

3. Contact View

Contact view was based on the same principle as list view except the messaged displayed were displayed by a person's contacts. When a contact was selected, only the

emails from that contact are shown. The contacts were imported from a user's pre-existing email service.

4. Calendar View

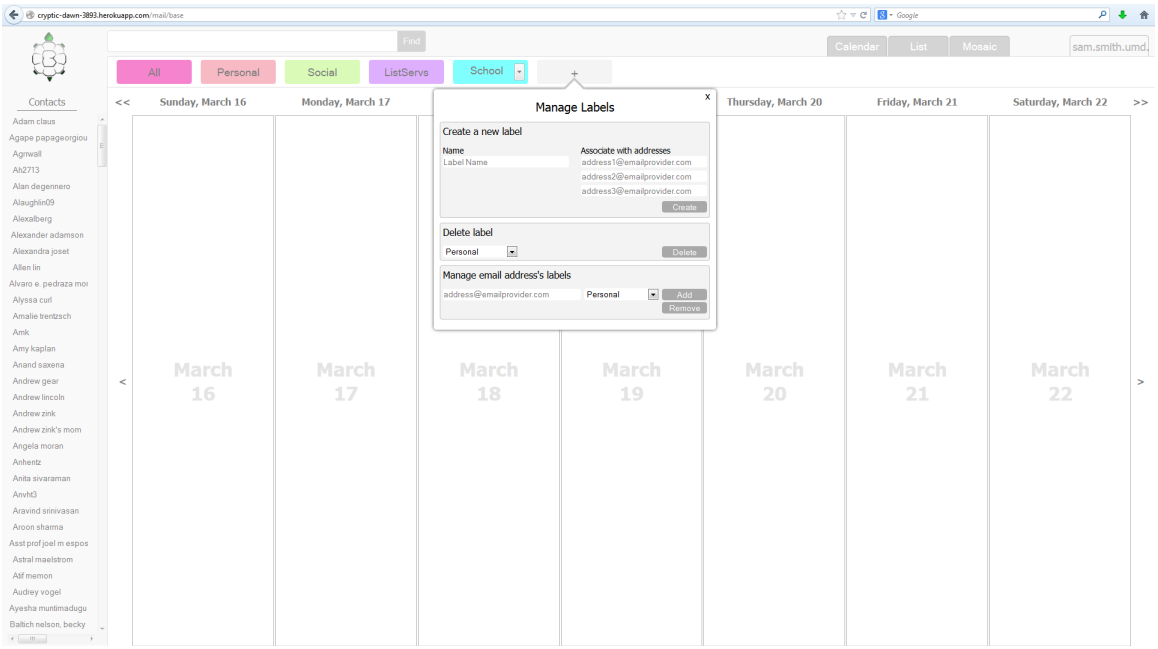


Figure 3.3.2.3: View of the calendar layout of the Brevitus platform.

Calendar view was created as a way for users to schedule and sort their emails based on the time of an event. By clicking a button in the email, a user could associate a date and time with the email. The email would then automatically show up on the calendar view page under the correct date and time.

3.4. Testing Phase 0

3.4.1 Participant recruitment

In order to be generalizable to the entire college student population, recruited participants needed to represent a wide range of demographic backgrounds. For the initial survey the minimum number of participants needed was thirty, and the maximum number

of participants was two hundred. The initial survey was distributed via paper copy and through the internet. Participants were gathered using email listservs, posters, and Facebook. No incentives were provided given the brevity of the survey.

A minimum sample size of thirty participants was needed for the formal study, alpha test, and beta test, to account for attrition. Participants from the target population of college students were obtained through the University of Maryland Psychology department's SONA Psychology research credit system. Participants were incentivized with an entry to a lottery for one of three cash prizes**.**

3.4.2. Initial Survey

Upon receipt of IRB approval, the research subgroup distributed the initial survey (See Appendix D), which sought to find which product features were most important to users. The results were compiled by calculating means and standard deviations and then were forwarded to the design team to address the needs of the population.

3.5. Testing Phase 1

During fall 2012, the research subgroup conducted a formal study to gain insight regarding affect and users' processing of information. An IRB amendment was submitted and granted with the additional survey information and testing script that were used in Phase 1 (see Appendix E). Participants were observed in a closed, single-user computer lab on campus. The test proctor was only in the room for when instructions were given, an environment consistent throughout Phases 2 and 3.

Participants were sourced via the SONA system, listservs, and flyers, with an incentive of three potential raffle prizes ($50, $25, and $25) being awarded. The participant began by completing the consent form. Then, on the computer, the participant completed the SOS survey to measure their stress (see Appendix E), and then filled out the PANAS-X scale survey to measure their affect (see Appendix E). Each participant was then asked to log in and sort through his own primary online email system and process the data as he saw fit for fifteen minutes. During this time, the participants' mouse movements, sorting preferences, read, and unread emails were recorded with specialized software (see Appendix E for later analysis. After the fifteen minutes were complete, the PANAS-X scale survey was once again administered, followed by a usability test that asked about preferences for the interface used.

The results of the SOS survey were analyzed using the standard scoring system and compared to normative data. The results of the PANAS-X scale surveys were analyzed using the system included in the PANAS-X manual. These pre– and post–test surveys were compared to measure the change in affect. The mouse movement data for each participant was stored into an image that was later reviewed to analyze the qualitative data regarding the participant's actions. Combined with the quantitative data, measured, including the number of messages read, messages deleted, and the time spent per message, college students' behavior regarding email was better understood.

3.6. Testing Phase 2

The design team completed the first testing iteration of Brevitus using the information from the within-subjects study, updating and improving upon the program

prototype. Shortly thereafter, alpha testing began with a limited release in the controlled setting of a computer lab. Documentation to the IRB was submitted with the relevant testing script and advertisement documentation (see Appendix E). Advertisements were sent out via flyer and study placements on SONA, and three cash raffle prizes ($50, $25, and $25) were randomly awarded.

The testing began with the SOS survey followed by the PANAS-X scale survey. The program along with all required software was loaded onto a lab computer, and access was given to the user. Prior to experimentation each participant was taught how to use Brevitus through a verbal guide delivered by the proctor.

Afterwards, each participant was asked to log in and sort through two different generated email accounts: once using Gmail, and once using Brevitus. The order in which each participant used these email accounts was determined using a random number generator. The participant was allowed to use each program as he saw fit for 10 minutes, and upon logging out of each platform, a PANAS-X scale survey and usability testing (See Appendix E) was administered. As in the within-subjects study, participants' SOS scores were compared to normative data, and the pre-test and post-test PANAS_X scale were analyzed and compared.

Similar to the within-subjects study, user metrics were gathered. The software tracked the amount, type and source of messages read and deleted, in addition to the length of time users spent per message. Other information such as, sender and topic, was also recorded. The collected data was used to analyze how people sorted through large amounts of information and to measure how Brevitus affected participants' viewing of electronic information.

3.7. Testing Phase 3

After analysis of the data from the Phase 2 lab-oriented testing, the design team modified the product to meet the needs and comments of the participants. Thereafter, another laboratory test was run that was almost identical to Phase 2 in order to gauge the response to the new features and changes made to the product. Amendment documentation to the IRB was submitted with the relevant testing script and advertisement documentation, which was the same as in Phase 2 except for the fact that an updated Brevitus was being used. Participants were sourced solely from SONA, and three cash raffle prizes ($50, $25, and $25) were randomly awarded. The participants followed the same procedure as in Phase 2, and the affect and user interface scores were tabulated and analyzed against the "barometer" of Gmail.

4. Chapter 4: Results

As stated in the methodology, there were four testing phases that were conducted during the product research and development. Phase 0 was a survey-only stage that was meant to gather basic product design requirements from our target audience. Phase 1 set out to gather baseline information as to how email usage in general perturbed the affect and stress of the student population. Finally, Phases 2 and 3 had the goal of testing the team's product, Brevitus, versus an established email platform, Gmail, in the attributes of affect change during usage.

4.1. Phase 0 - Initial Survey

Our initial survey set out to determine the true extent of electronic information overload in college students, while also obtaining information about the email and electronic communication habits of the general body of college students. To accomplish this, the team created a basic survey asking the basic habits of college students in regards to email and social communication, and distributed an online link to this survey through various campus-wide advertising methods (listserv advertisements, flyer posting, chalking, and Facebook advertisements). These advertisements in their full form, along with the entire questionnaire taken by the participants, may be seen in Appendix D.

After closing the survey results on June 4th, 2012, a total of 102 survey participants were recorded. A number of unique attributes of college student's electronic communication habits were discovered after analyzing the results.

4.1.1. User Demographics

To better understand if the sample population's demographics follow the overall University of Maryland-College Park population, we surveyed the ethnicity, year of education, and gender of our participants. In order to do this, questions about the ethnicity, year of education, and gender were asked.

The gender and ethnicity responses were then compared to the overall undergraduate statistics in order to get a sense of how representative the sample was overall. The gender breakdown was not extremely representative, with slightly over 70% of respondents answering being female, compared to the 47% of the total undergraduate body. We posit that this may have been caused by a gender bias in students taking psychology classes requiring SONA participation.

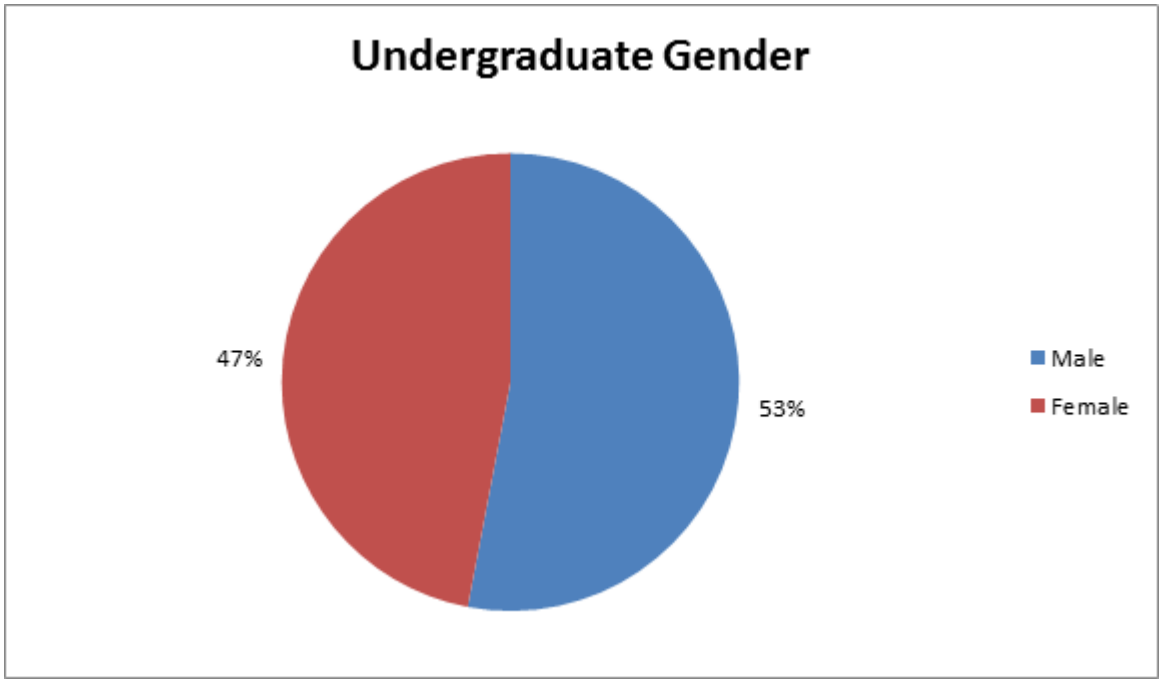


Figure 4.1.1.1. Breakdown of UMD's undergraduate gender

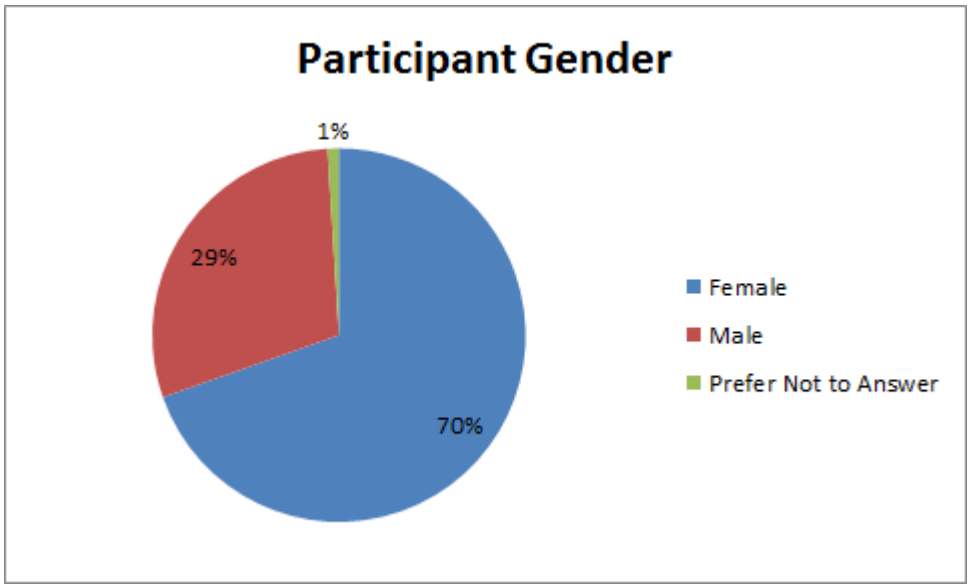


Figure 4.1.1.2. The gender distribution of the participants in Phase 0

The ethnicity responses were far more indicative of a representative sample of the undergraduate population. Compared to the statistics provided by the University of Maryland and the Stamp Student Union, the main minority populations: Asians, African-Americans, and Hispanics, were within a few percentage points of the total undergraduate breakdown, while the total amount of Caucasians was higher due to an underrepresentations of very small minority groups that could not be captured (see Figures 4.1.1.3-4.1.1.4).

Race/Ethnicity	**Frequency**	**Percentage**
American Indian / Alaskan Native	46	<1%
Asian	4,012	15%
African American / Black	3,192	12%
Hispanic	1,927	7%
Native Hawaiian or Other Pacific Islander	37	<1%
White	15,427	57%

Two or More Races	745	3%
International	632	2%
Race/Ethnicity Not Reported	858	3%

Figure 4.1.1.3 UMD Undergraduate Ethnicity

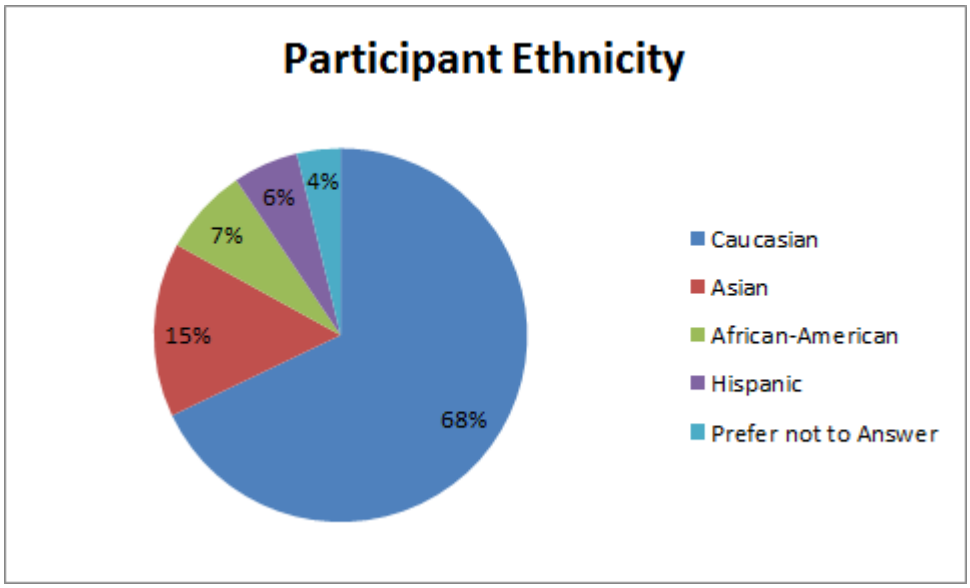


Figure 4.1.1.4 Breakdown of participants' ethnicity in Phase 0.

The year of education was also asked in order to see how far the participants were through their undergraduate studies. It was assumed that roughly a quarter of students were in each year of studies for balance. From the responses, the survey participants were well spread over the grade levels, with a slightly skew towards sophomore participants.

We do not believe that this slight skew will corrupt the survey data, as this skew was below 7% for any under-represented class level.

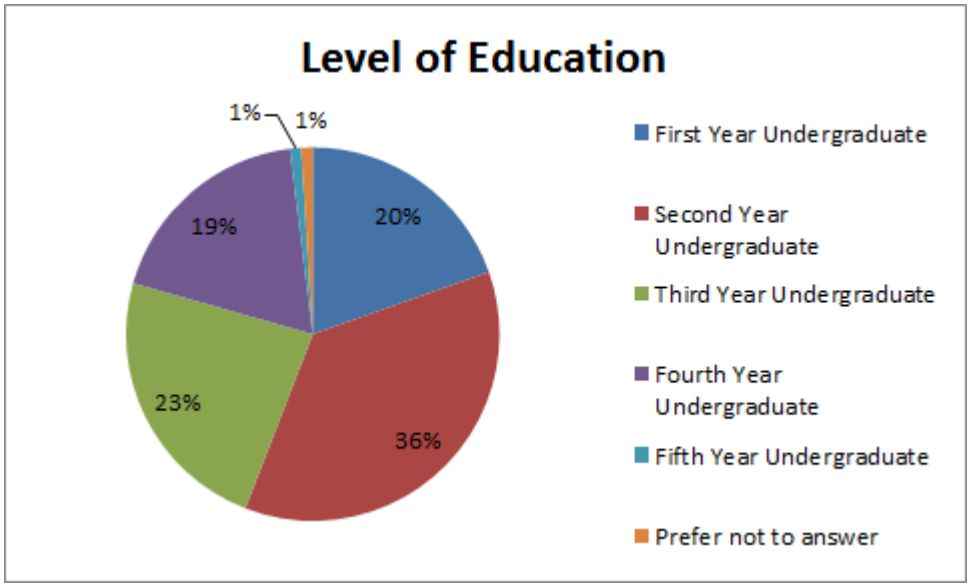


Figure 4.1.1.5 Level of participant education

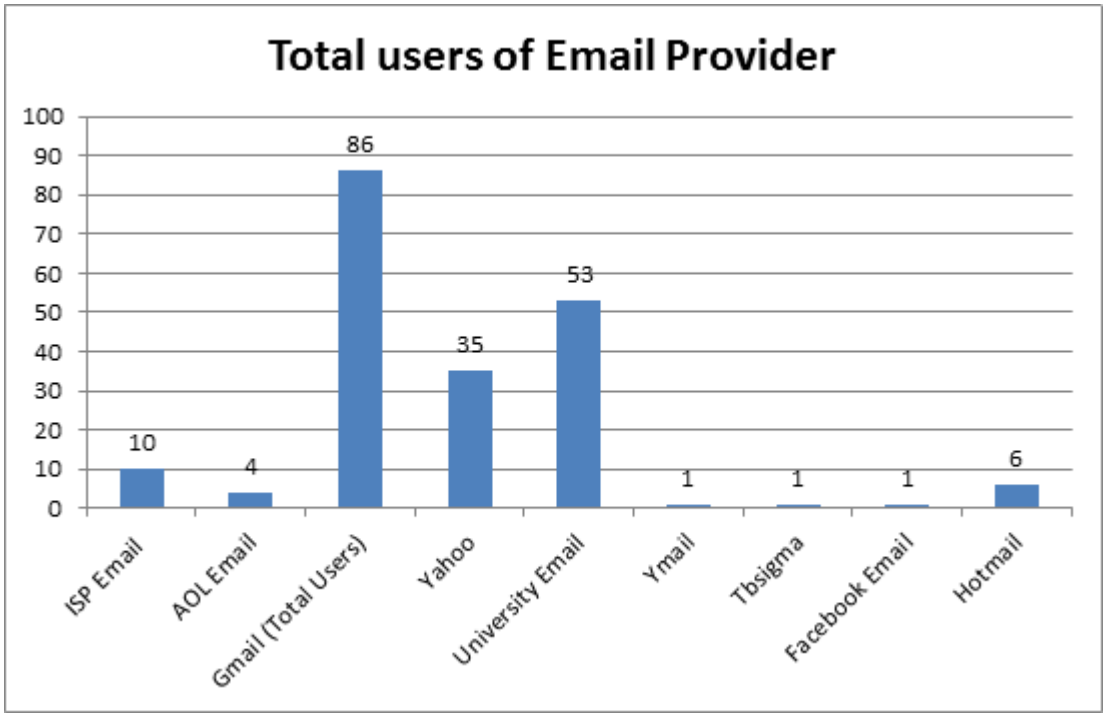


Figure 4.1.1.6 Frequency of email providers used by participants

In order to better understand college students' use of electronic devices, they were polled as to how many desktops, laptops, and mobile devices that they owned. From the results (see Figure 4.1.1.7), it is clear that the majority of students do not own desktop devices. However, we can be confident that we will reach the majority of students through a conventional medium, as most students own a notebook or netbook. Also, while almost all participants own one or more mobile devices, programming difficulties made it challenging for the team to create a mobile-optimized system in addition to the standard internet browser system in the allotted time period.

In order to figure out what email clients were mainly used, participants were asked about their email provider preferences and usage. Overwhelmingly, the answer was

the Google-provided Gmail, with University Email following in second. However, since the UMD email is now being provided by Gmail, Yahoo is actually the second largest provider, with Google taking a larger lead. From this survey, it seems that other clients are almost insignificant based on the responses. Based on the overwhelming popularity of Gmail as an email provider, we used it as a baseline platform for our later tests.

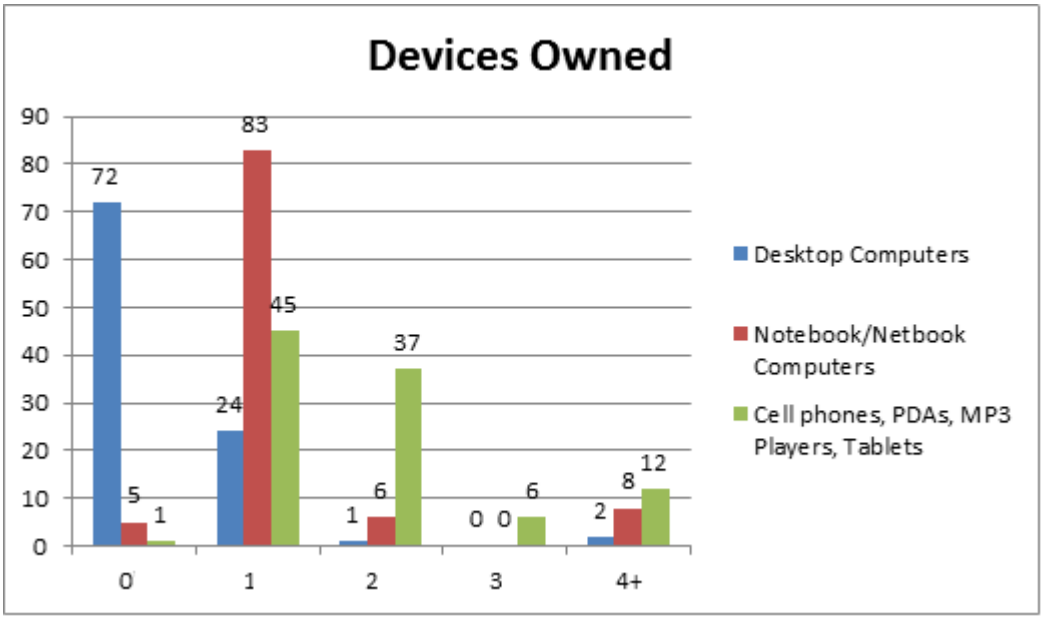


Figure 4.1.1.7. The number of devices owned by participants by category.

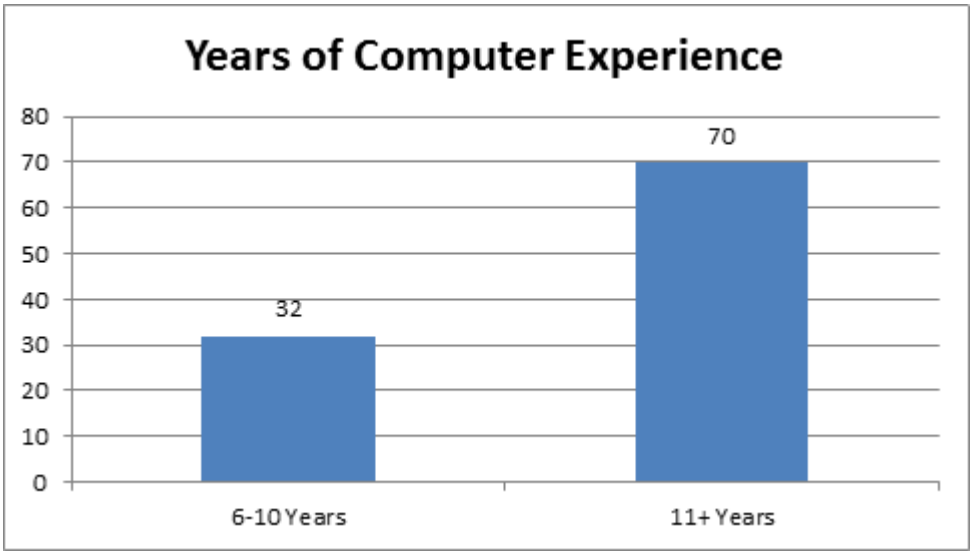


Figure 4.1.1.8. Years of computing experience of participants.

From the above chart, it is also clear that most computer users on campus are quite skilled, with all listed participants having at least six years of experience using computers. This experience indicates that these participants are likely able to adapt to new features and software over time.

Overall, the survey participants appear to be a good representation of the undergraduate community at large. The ethnicity and year of education data, while slightly skewed, adheres well to the general data available from the Stamp Student Union at the University of Maryland – College Park. While our participants' gender distribution differs from UMD's gender distribution, there is still fair representation from both genders in our survey.

Based on the devices owned and email services used categories, it is clear that University of Maryland students own mostly portable computers and mobile devices,

rather than desktop platforms. This ownership data indicates that the team will be designing for smaller screen sizes than is provided by a typical desktop monitor. Also, the fact that the vast majority of participants used either Gmail or Yahoo shows that by integrating the major email providers, the majority of student email accounts can be accessed.

4.1.2. Average Usage of Electronics/Electronic Communications

In order to understand how often students used electronic communications, and of what type, a dedicated set of questions was asked. We began by asking how many email accounts people used on a weekly basis. We found that most college students use more than one email account, with many using upwards of three or more. At the University of Maryland, students typically receive regular emails from multiple email sources, due to the transient nature of a UMD email address. This shows the importance of multiple email integration into a unified communications system.

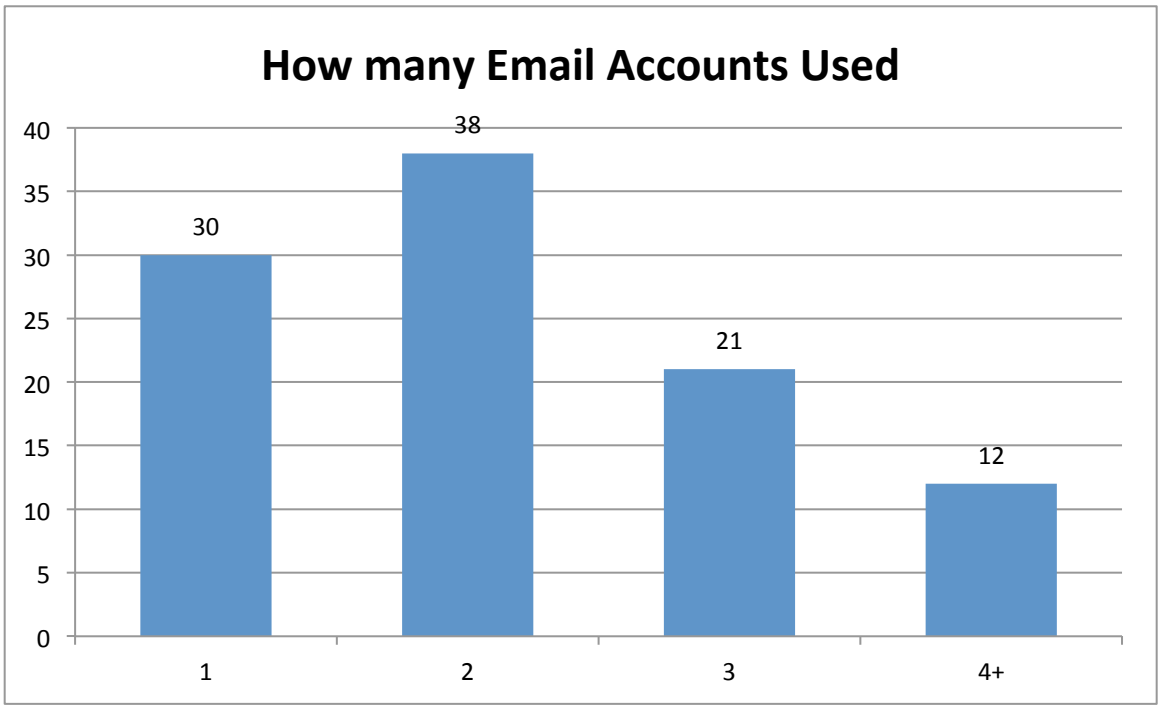


Figure 4.1.2.1. Amount of email accounts used by students on a weekly basis.

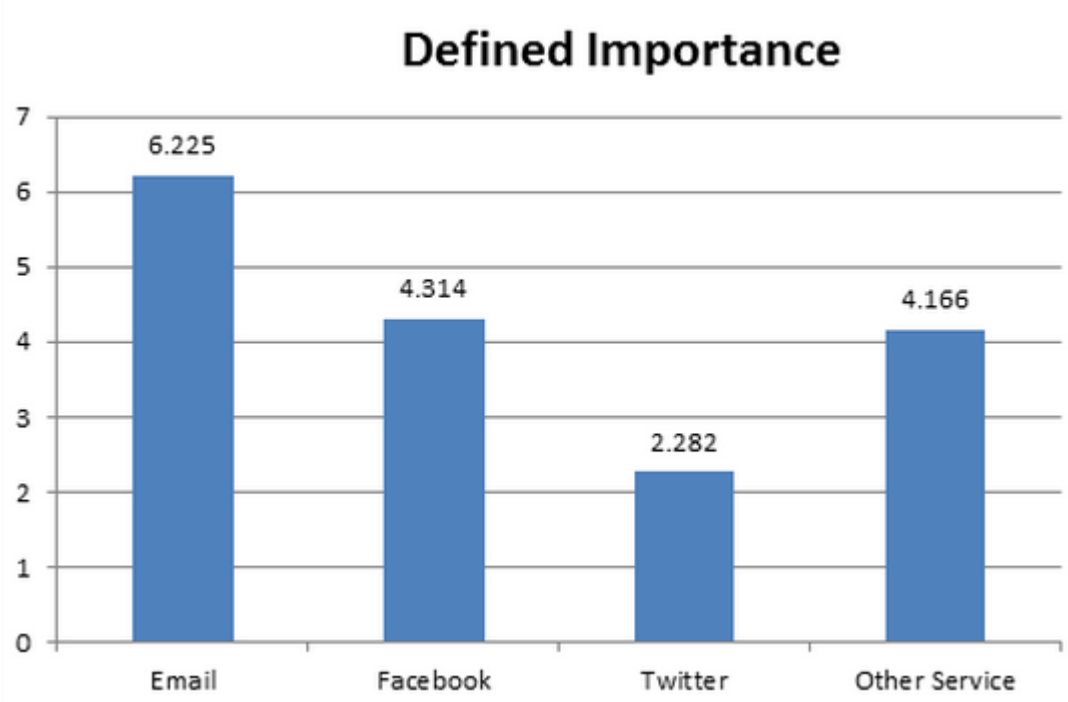


Figure 4.1.2.2. User-defined importance of electronic communication services.

Another important metric we considered is how much people care about the forms of electronic communications that they use. From the above responses, it is clear that email and Facebook are considered the most important services by college students. While the user-defined responses categorized under "other services" seem to lag closely behind, the lack of overall responses for this question sets it apart. Twitter ranks as the least important service, with not many people ranking it highly for importance.

These results indicate which aspects of electronic communication are most critical in a unified communications system. It is evidently clear that the average student at UMD uses multiple email accounts, so a robust email aggregator will potentially be needed. Also, while Facebook has clearly been defined as a very important means of communication for students, Twitter ranked extremely low. This indicates that Facebook is a more important priority than Twitter for potential social media integration.

4.1.3. Reported Problems with Locating Information

It is of use to analyze the present difficulties participants have locating electronic information, specifically email, so as to avoid common pitfalls in the design of our own program. The survey asked participants to cite the top two reasons that contribute most to

their trouble managing and locating their email from a list of options. The top issues were: difficulty remembering the subject of the email and too many emails to search.

Survey responses indicated that students had difficulty organizing and efficiently searching emails. To mitigate this issue, it would be useful to incorporate an intuitive interface to categorize emails and provide a robust search function. The distribution of results, however, illustrates the multifaceted issue that information overload presents and the need to reconsider current approaches to handling information overload. Figure 4.1.3.1 confirms this need as the majority of students have trouble locating important email on at least a monthly basis. Information overload clearly presents a challenge for university students.

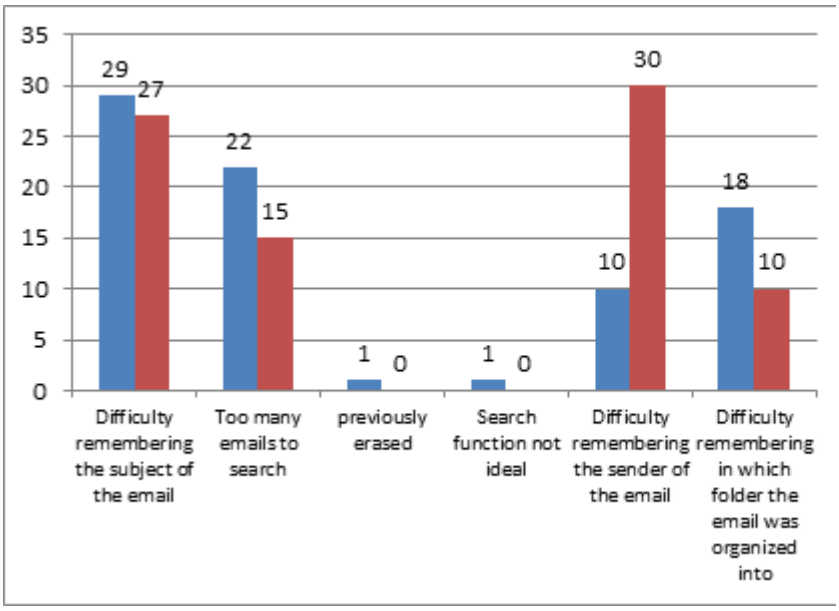


Figure 4.1.3.1. List of responses to the question: “For what reasons do you experience trouble locating email?” Blue is the number one reason listed by the participant, and red is the number two reason.

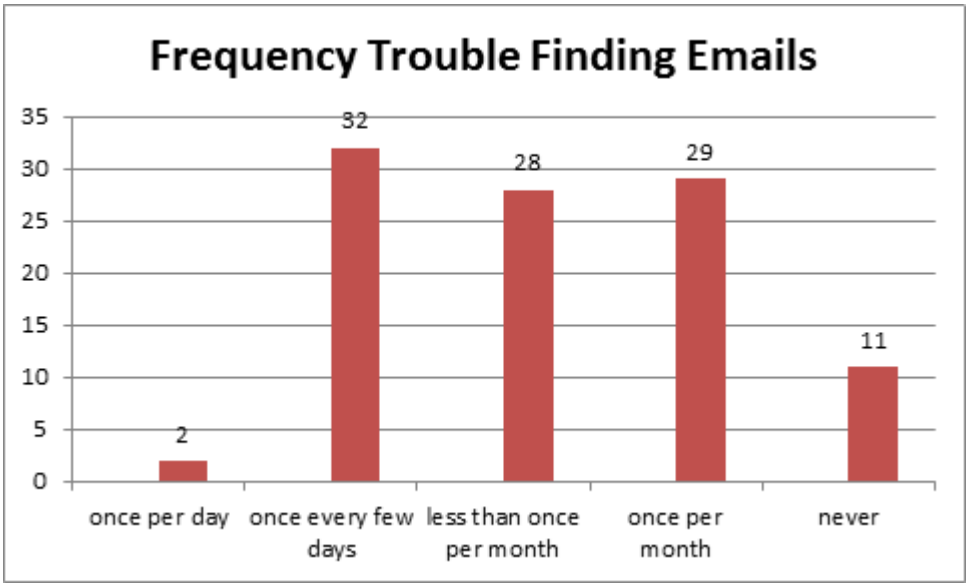


Figure 4.1.3.2: Timing frequency of participants having difficulty finding an email.

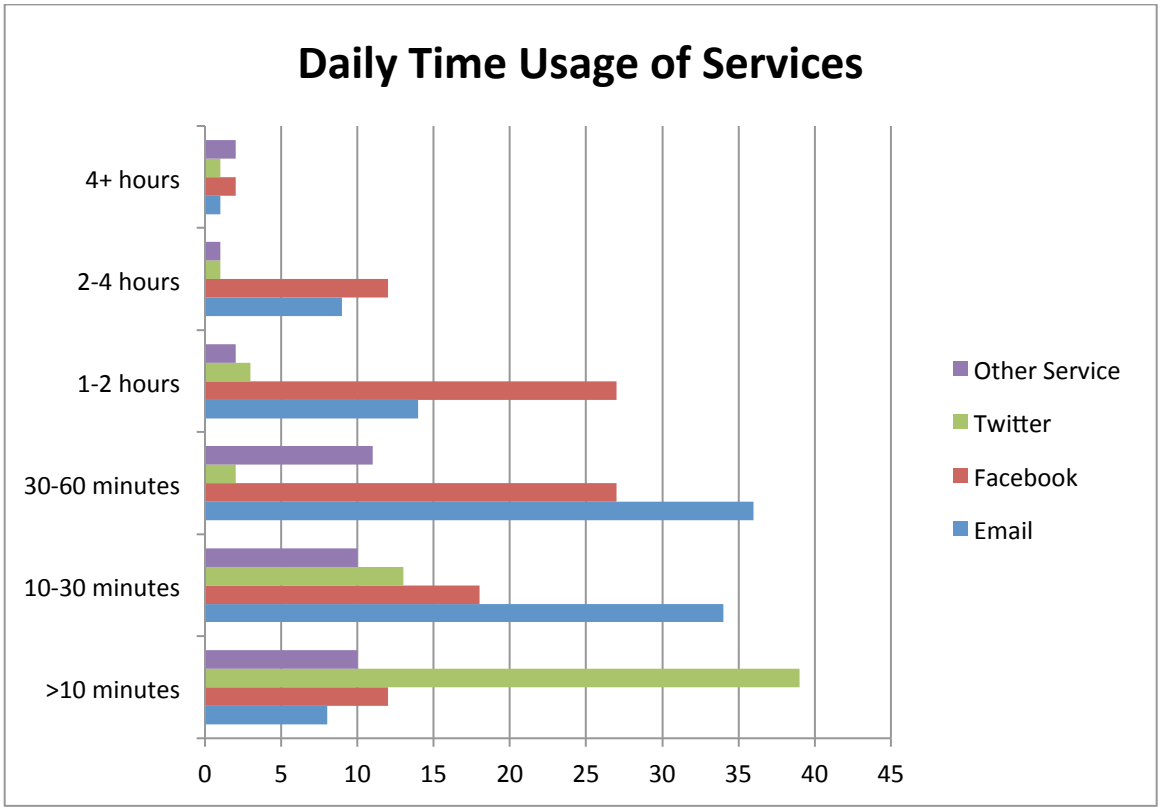


Figure 4.1.3.3. Average daily usage of electronic communication services

Figure 4.1.3.3. shows how much time per day participants spend on average with various forms of electronic communications. Participants spend the most time on Facebook and email. The “other service” category, has a response slightly less than email, while users spend the least amount of time on Twitter. Analyzing these responses, the team determined it was logical to base our device on the integration of email and Facebook.

4.1.4. User-defined Importance of Features

Another metric considered was the user-defined importance of various features of web and email browsing. On a scale “Very Unimportant / Unimportant / Neutral / Important / Very Important” (scaled to 0-5), participants were asked to rank how much they cared about certain features for both email usage and browsing capabilities. The results were then averaged across all participants and a numeric “score” was given (see Figures 4.1.4.1-2).

It is evident from Figures 4.1.4.1-2 that the importance of features across web browsing and email is almost identical, only differing in regards to the two least important features. This shows that UMD students have fairly uniform standards as to what features they want on a piece of software or hardware for mobile communications.

The design team began by determining what features students truly want in a new software application. As shown in Figure 4.1.4.1, the two most important features are device readiness and comfortable input methods. Device readiness indicates that students desire an easy to use interface that quickly boots up. Comfortable input methods indicates that students want an interface that enables them to easily enter data, making reading emails and browsing the internet a more streamlined process. These goals were taken into consideration in further design iterations of the product.

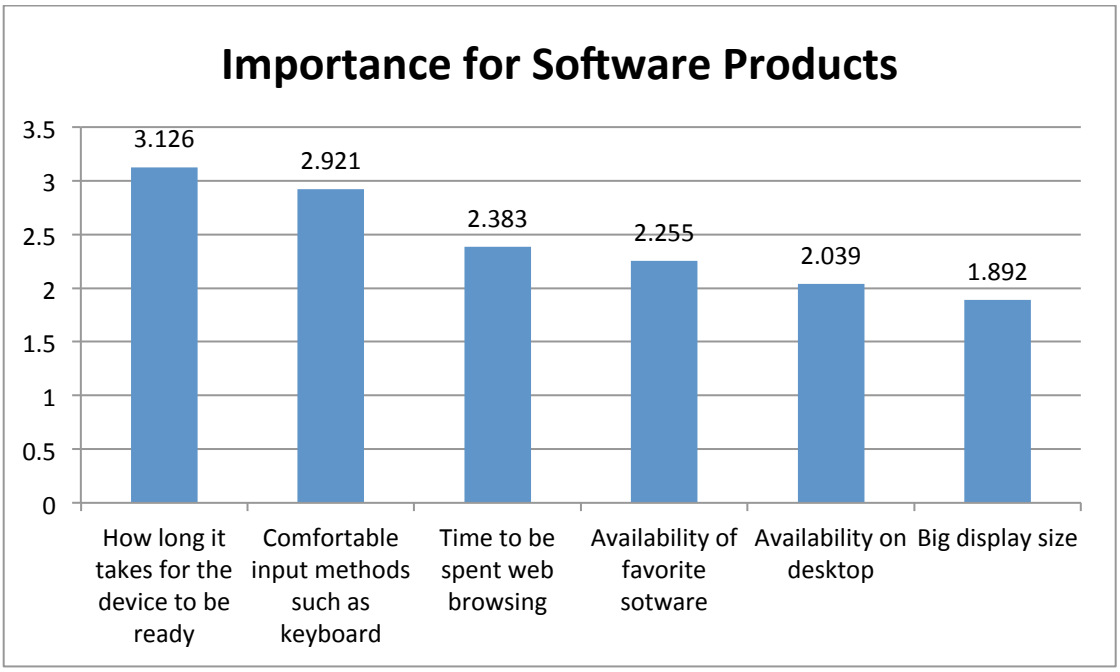


Figure 4.1.4.1: Averaged importance of email features

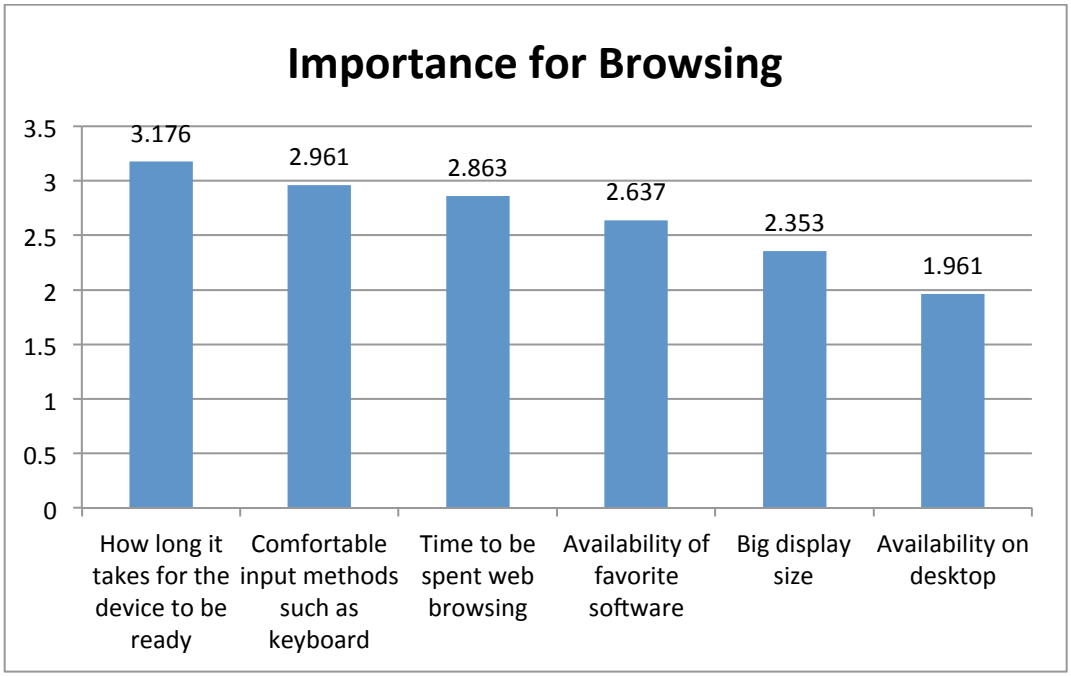
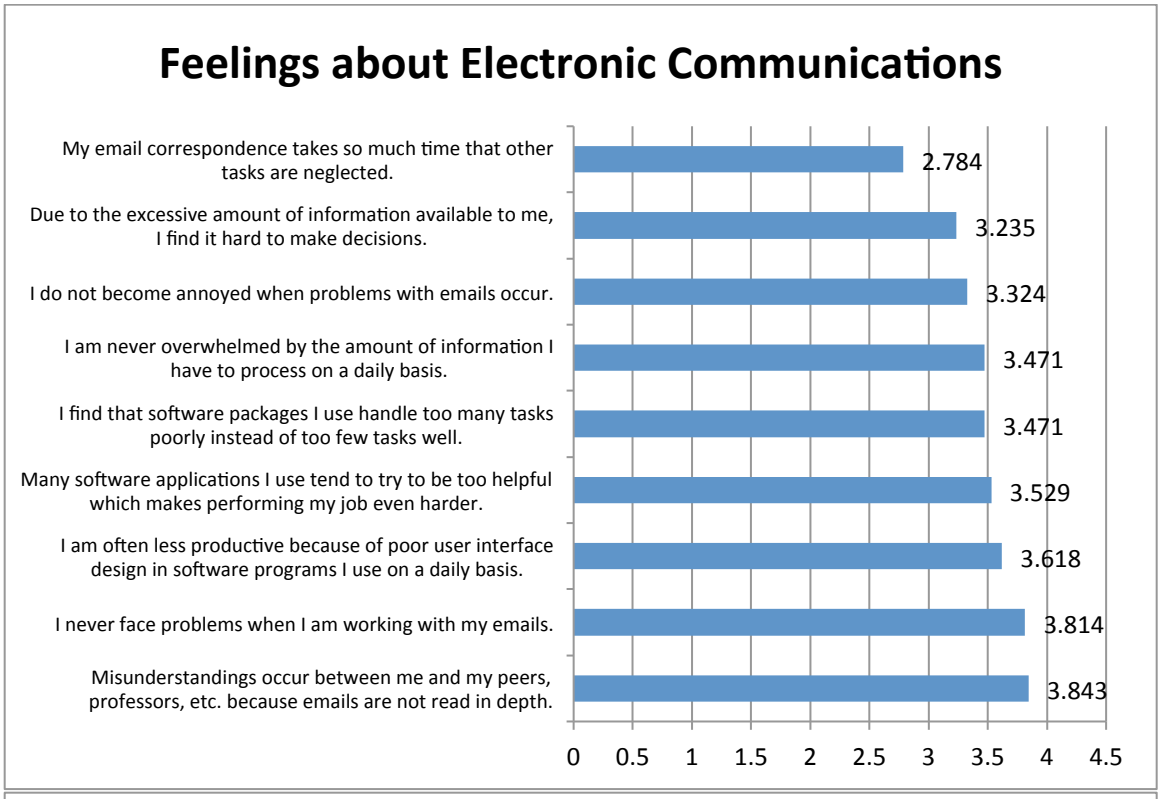


Figure 4.1.4.2: Average importance of web browsing feature

It is also clear that the display size and desktop availability do not matter to students nearly as much as other features. This is posited to be largely due to the participants use of mobile devices and smaller screen size devices.



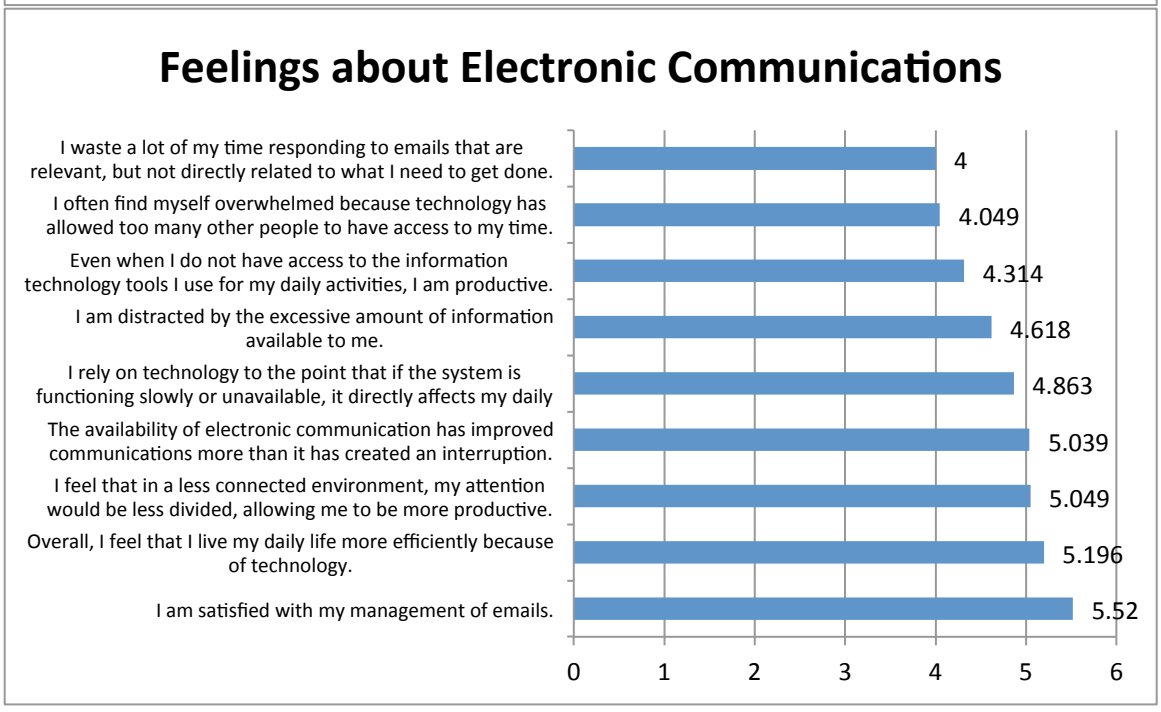


Figure 4.1.5.1. User preference statements regarding electronic communications.

4.1.5. Overall feelings about Information Overload

A final series of statements was asked to users concerning their general feelings about the impact of information overload on their lives. The question was asked on a scale of 1 to 7, and then averaged and plotted in Figure 4.1.5.1.

Overall, survey responses showed that most participants were very satisfied with their email management. However, they also felt that they could be more productive if their attention were less divided, showing how our product should be targeted at focusing user attention where it will be most useful, instead of simply organizing data. Responders felt their current software programs were adequate in terms of task management, but could use interface improvement. In addition, users valued their personal time, expressing desire for reliable systems that allow users to limit the demands by others on their time, as well as filtering the most relevant emails first. We can fill this niche by providing a reliable system that does not press the user for responses to trivial tasks, while subtly promoting the most important tasks in an unobstructed manner. Overall, participants were most satisfied with their time management, but felt their time could be better spent if a program allowed them to focus their efforts, which is what our program aims to accomplish.

4. 2. Phase 1

In Phase 1, a lab-based test was implemented to determine how a college student's affect and stress changed after using a basic email account. The user was instructed to log into their own email account, and was allowed fifteen minutes to use their email account. Surveys were given before and afterwards to measure their change in affect.

Stress and affect data was calculated from these survey results, and the results were then analyzed for significance using a t-test, as we wished to test the hypothesis that students were (or were not) affected by using email programs. A total of forty participants participated in Phase 1.

4.2.1. Demographics

In order to view the general demographics of the testing population, the gender, ethnicity, and level of undergraduate education was asked of each student. The overall demographic results of this testing phase may be seen in Figures 4.2.1.1-4.2.1.3.

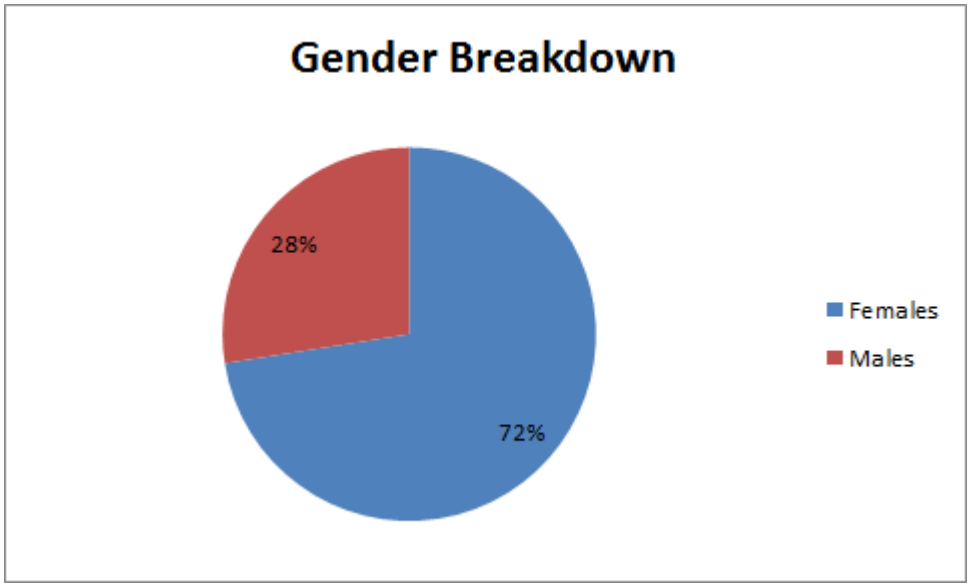


Figure 4.2.1.1. Gender breakdown of testing participants.

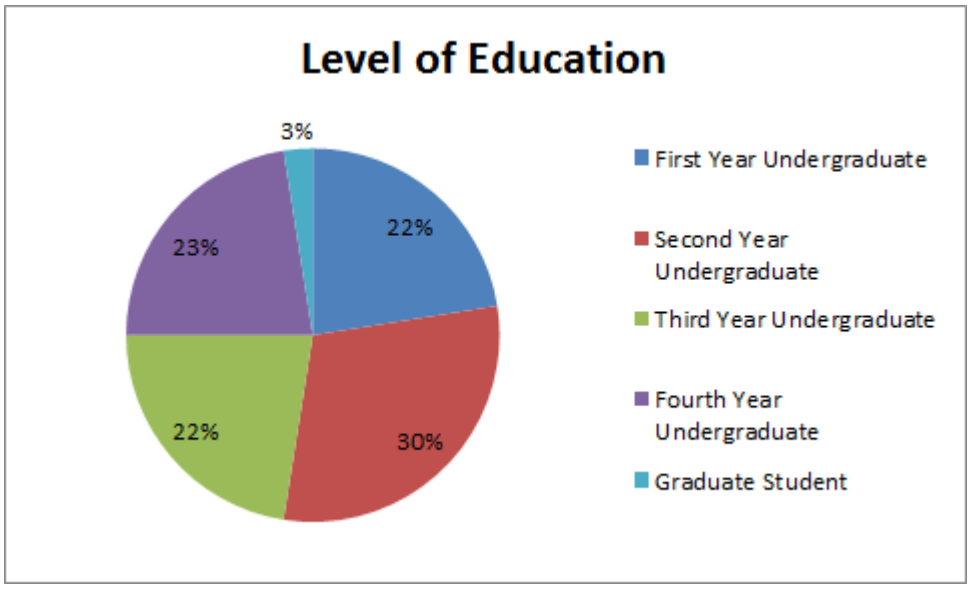


Figure 4.2.1.2. Level of education breakdown of participants.

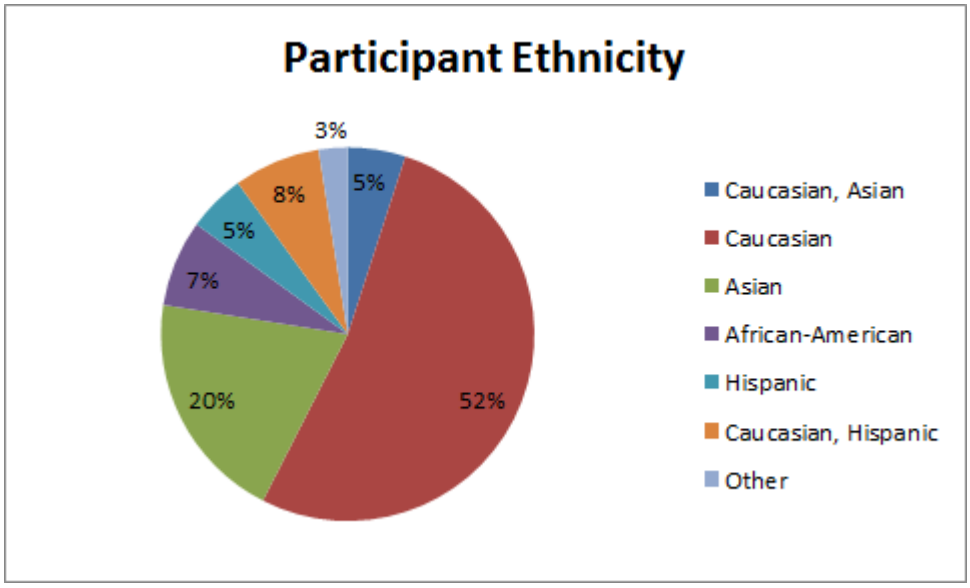


Figure 4.2.1.3. Ethnicity breakdown of participants.

Overall, while the gender breakdown of our participants is slightly skewed, with a majority of participants being female, the level of education as well as the ethnicity sections show a fairly representative population for this trial. We believe these demographics will not significantly bias the results of the data collected during this phase of testing.

4.2.2. Stress Loadings

Stress can be broken down into two subcategories: personal vulnerability and event loading. The meaning of how these two variables relate to stress can be seen in Figure 4.2.2.1.

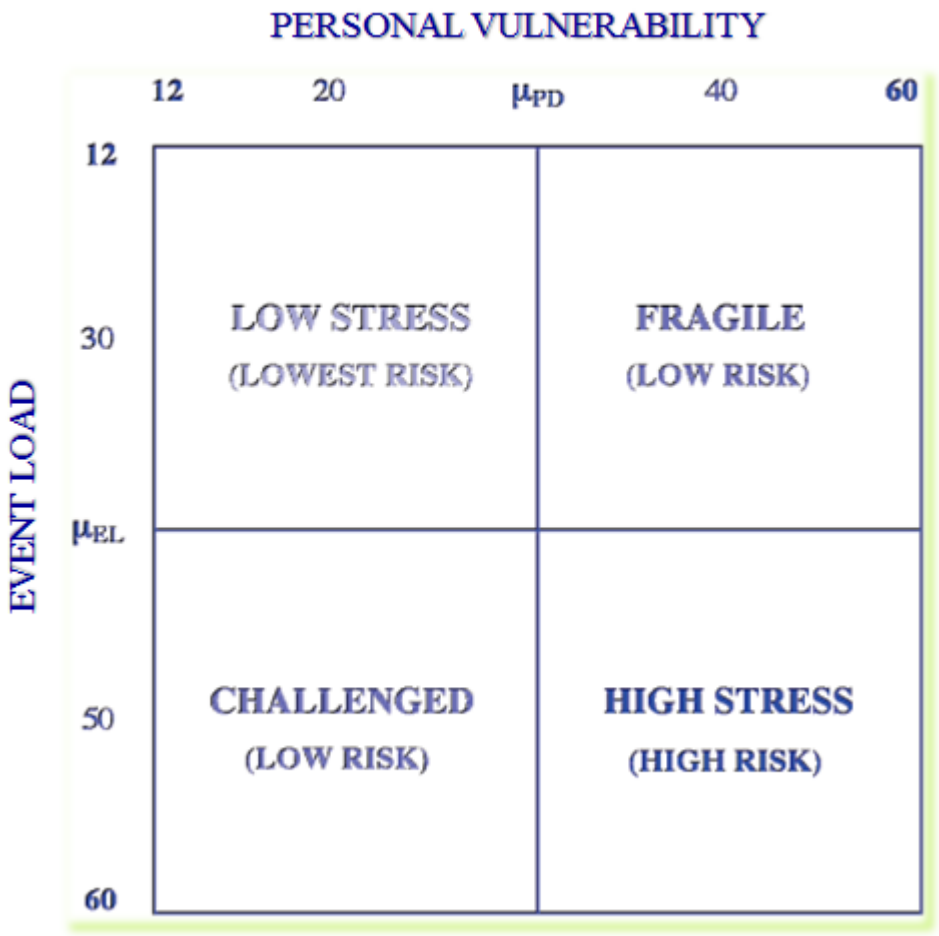


Figure 4.2.2.1. The two axis representation of stress, with quadrants showing each possible "stress-level" category.

The general population mean data, along with the data that we collected, can be seen below:

	Personal Vulnerabilit	Personal Vulnerabili ty Std.	Event Load Mean	Event Load Std. Dev.	Personal Vulnerabili	Event Load Median

	y Mean	Dev.			ty Median	
Expected Population Mean	28		38			
Lab Participants	21.1	6.95	30	9.87	19	30

The personal vulnerability and event load markings were well below that of the population average, showing a significant difference using a two-tailed t-test, as shown in figure 4.2.2.2 ($p<0.001$). This could show that the students in the lab were simply less stressed in general compared to the population, potentially by being in a lab environment.

Stress Indicator	T-test p value
Event Loading	0.00015
Personal Vulnerability	<0.0001

Figure 4.2.2.2. T-test p values for event loading and personal vulnerability.

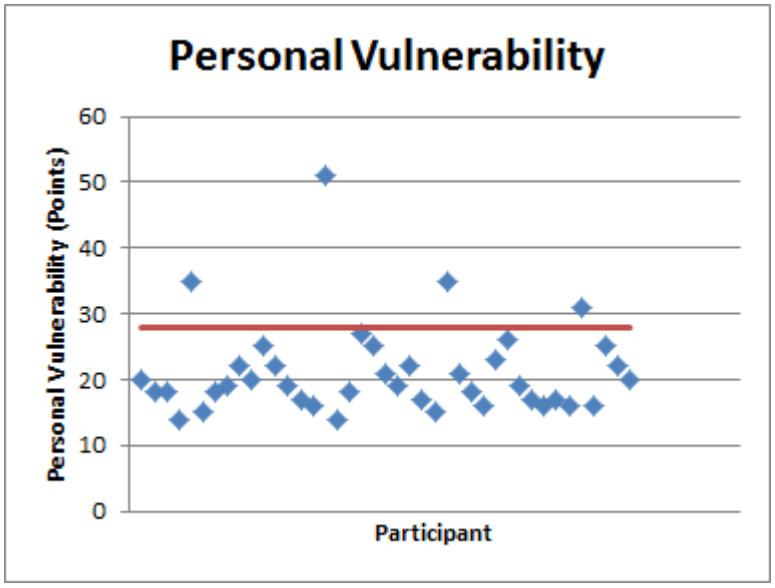


Figure 4.2.2.3. Personal vulnerability scores, with the red line indicating the population mean.

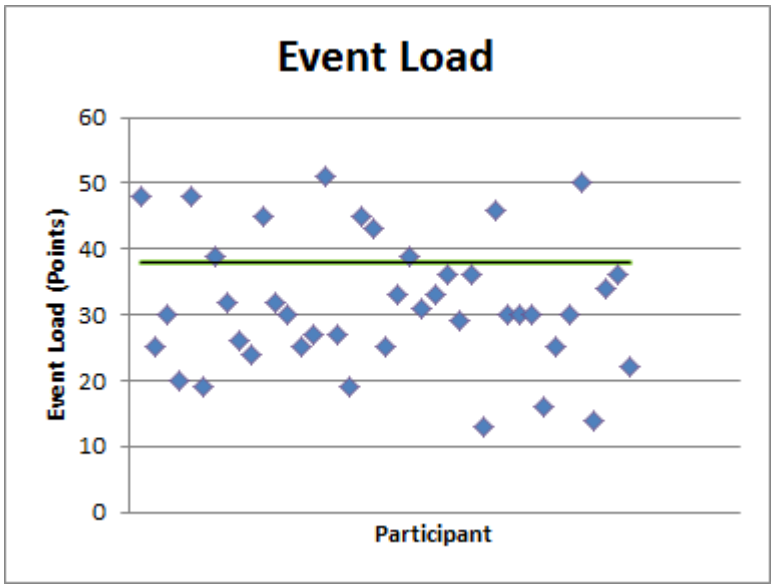


Fig 4.2.2.4. Event Load scores, with the green line indicating the general population mean.

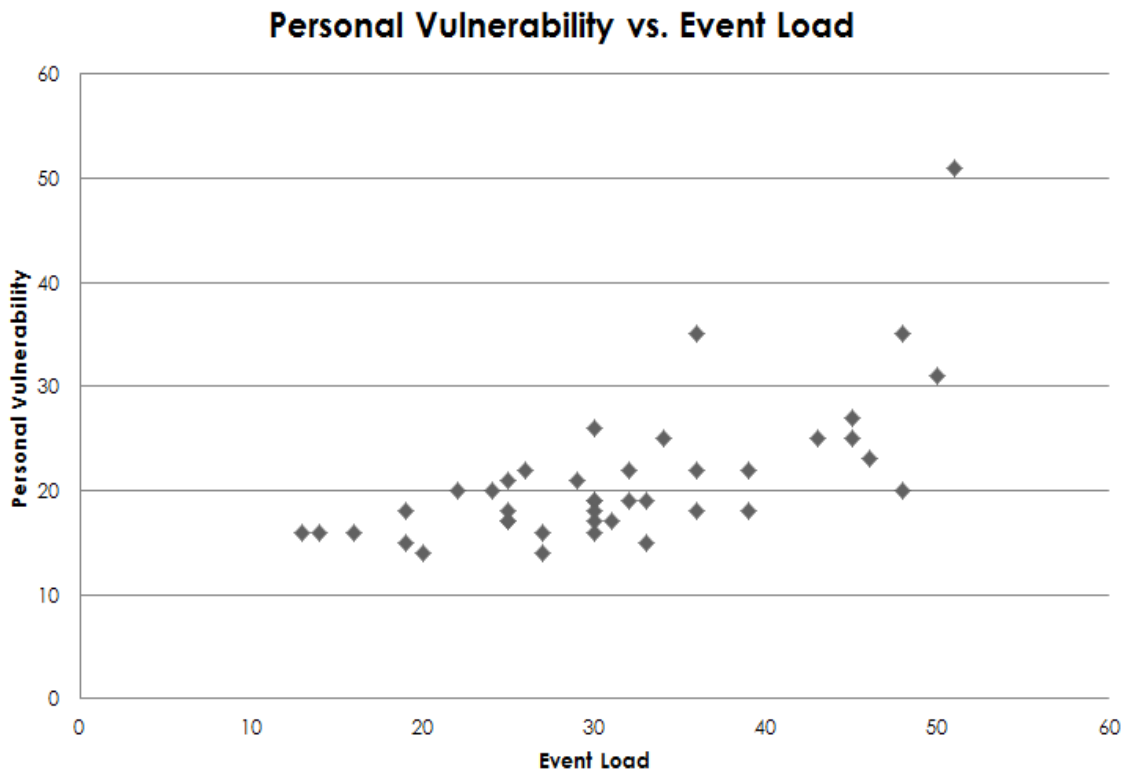


Figure 4.2.2.5. Personal vulnerability versus event load scores.

The graph of personal vulnerability versus event load can be seen in Figure 4.2.2.5. The correlation value of personal vulnerability versus event load was determined to be r = .669, showing a weak positive correlation between personal vulnerability and event load. This could show that the participants were equally stressed on both measured axes, meaning that they were not necessarily additionally stressed in vulnerability versus event load.

4.2.3 Negative Affect

Affect can be measured on two major axes: positive and negative. These axes determine the level of emotion of a user, with both levels elevating indicating arousal, and both levels lower indicating non-arousal. Negative and positive affect alone indicate typically negative and positive emotional responses.

Overall, the participant's negative affect rose slightly throughout this testing, with a mean difference in score of -0.775. Performing a t-test leads to a p-value of 0.12, which while not significant to a p=.05 level, shows some pattern of a decline in negative affect throughout the testing. This could lead us to believe that user's negative emotions dropped while checking their email, due to the potential stress of having to deal with their accumulation of electronic communications being released.

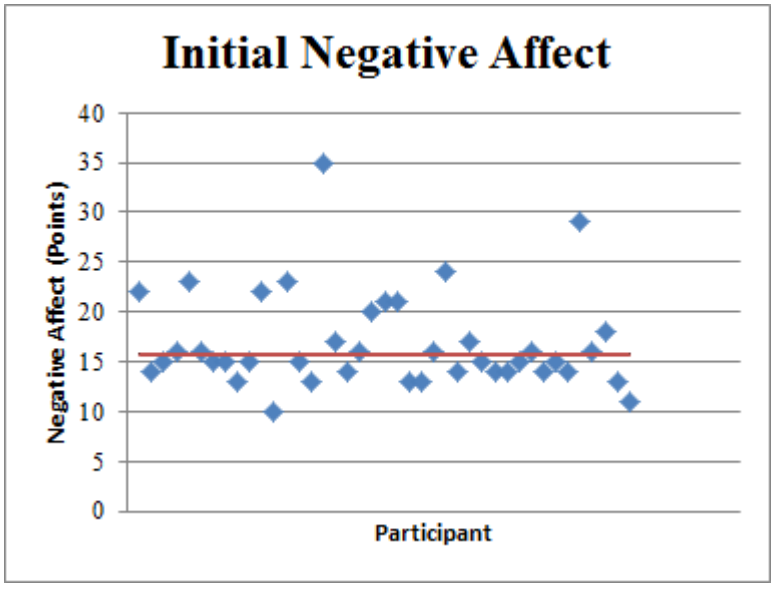


Figure 4.2.3.1. Initial measurement of participant's negative affect.

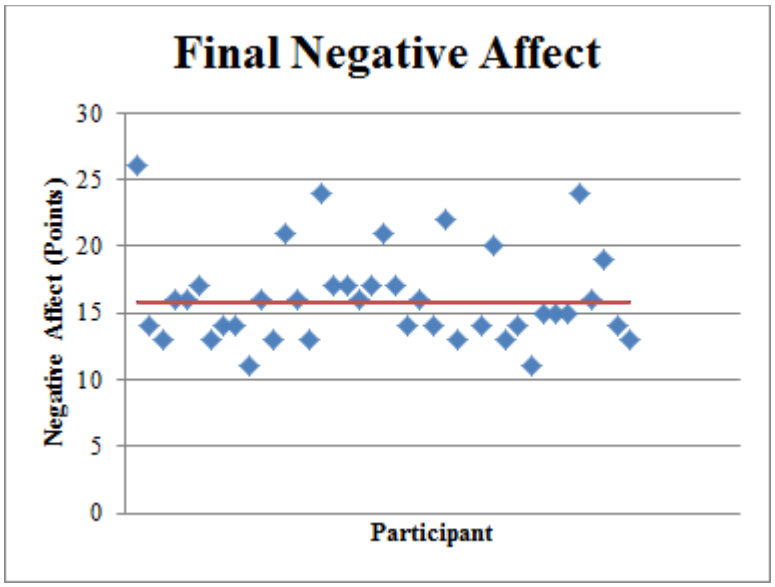


Fig 4.2.3.2. Final measurement of participant's negative affect.

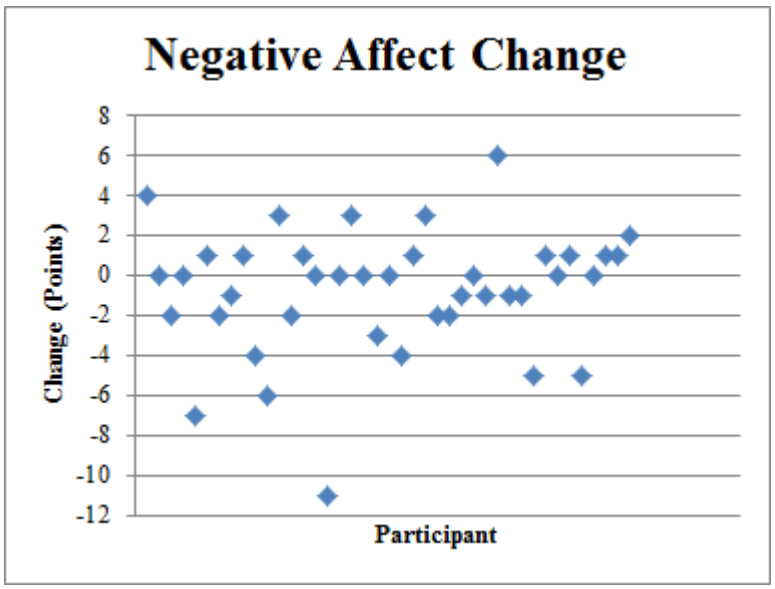


Fig 4.2.3.3. Overall negative affect change from participants.

4.2.4 Positive Affect

Change in positive affect was also measured while the subject was using the email client of their choice. In this case, the change had a mean of -1.15 with a t-test significance value of .18. This is not a significant change from normal based on the team's established significance level, but is a general reduction from normal. This led us to believe that the user experienced a decrease in both axes of affect during the testing, leading to a reduction in arousal, not just positive or negative emotions, during the process of checking email. This could simply mean that the participants were more tired, sluggish, and dispassionate based on the stress of dealing with all of their electronic communications.

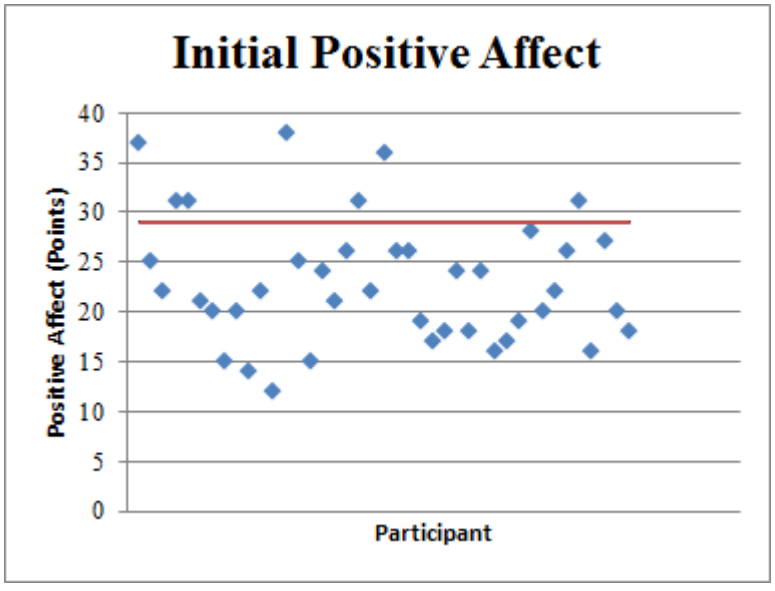


Figure 4.2.4.1. Initial positive affect of users.

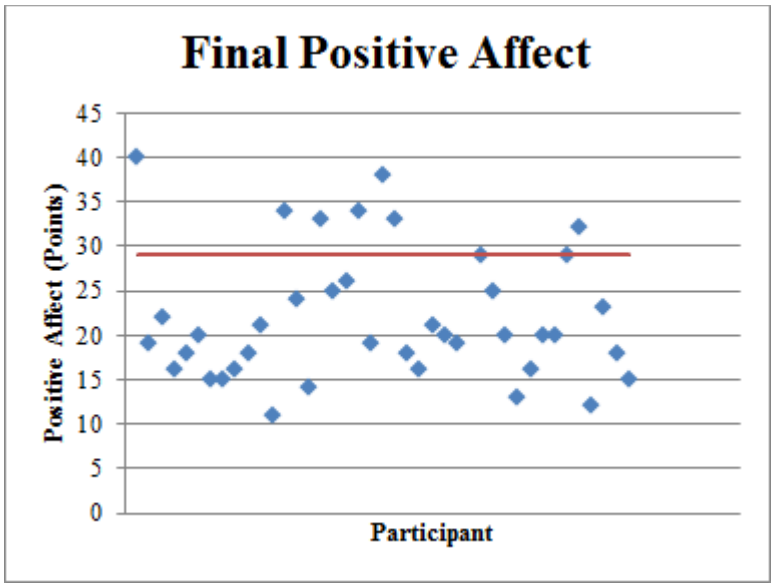


Figure 4.2.4.2. Final positive affect of users.

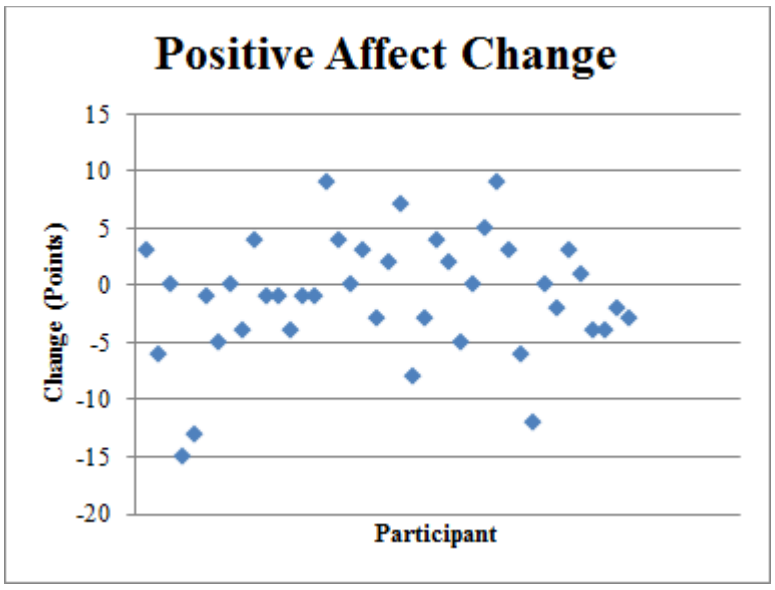


Figure 4.2.4.3. Change of positive affect over time.

4.2.5. Other Affect Measurements

	Negative Affect	Positive Affect	Fear	Guilt	Sadness
Average	-0.775	-1.125	-0.025	0.675	-0.2
Standard Deviation	3.158	5.326	2.281	2.912	2.594
Median	0	-1	0	1	0
t-test p-statistic	0.12	0.18	0.944	0.142	0.623
	Self-Assurance	**Attentiveness**	**Fatigue**	**Serenity**	**Surprise**
Average	-0.975	-4.075	-2.4	-1.1	-0.925
Standard Deviation	2.983	2.615	3.087	1.707	2.068
Median	-1	-4	-2	-1	-1

t-test p-statistic	0.04	<0.0001	<0.0001	<0.0001	0.005

Figure 4.2.5.1. Table of affect measurements other than positive and negative affect.

Figure 4.2.5.1 shows some of the before-after differences of the other major attributes of affect that were gathered from the surveys given to the participants. The significant differences are shown in self-assurance, attentiveness, fatigue, and serenity, with all of these categories having a significant ($p<.05$) drop. This could be potentially attributed to the user's drop in attentiveness after checking their email, along with a drop in self-assurance based on the information overload that they were experiencing.

4.3. Phase 2

Using the data gathered from the first phases of research, the design team developed an email platform in order to reduce the level of information overload experienced by college students. Since the vast majority (over 82% from our Phase 0 study, not including those users of the Gmail-based campus email) of college students use Gmail, the team decided to compare our Brevitus platform to Gmail, while analyzing the change in affect associated with checking email. For Phase 2, the participants were

allowed ten minutes to sort through a pre-generated inbox using both Gmail and Brevitus, in order to view both the change in affect as well as the user satisfaction with the interface design of both platforms. The testing involved having the participant using both Brevitus and Gmail for ten minute intervals (randomized using a number generator), with affect being measure before and after these trials using a PANAS-X test. Participants went through an inbox of 100 generated emails for each platform. A total of 67 participants were recruited - however, due to technical errors, only 63 participants' testing data was usable.

4.3.1 Demographics

In order to view the general demographics of the testing population, the gender, ethnicity, and level of undergraduate education was asked of each student. The overall demographic results of this testing phase may be seen in Figures 4.3.1.1-4.3.1.3. While the level of education and ethnicity, shown in Figures 4.3.1.2 and 4.3.1.3 respectively, are a seemingly good representative sample of the college population, the gender statistic is heavily biased towards females (Figure 4.3.1.1). While this is a potential confounding variable for our study, we believe that the test was still viable to measure the electronic communications preferences of college students.

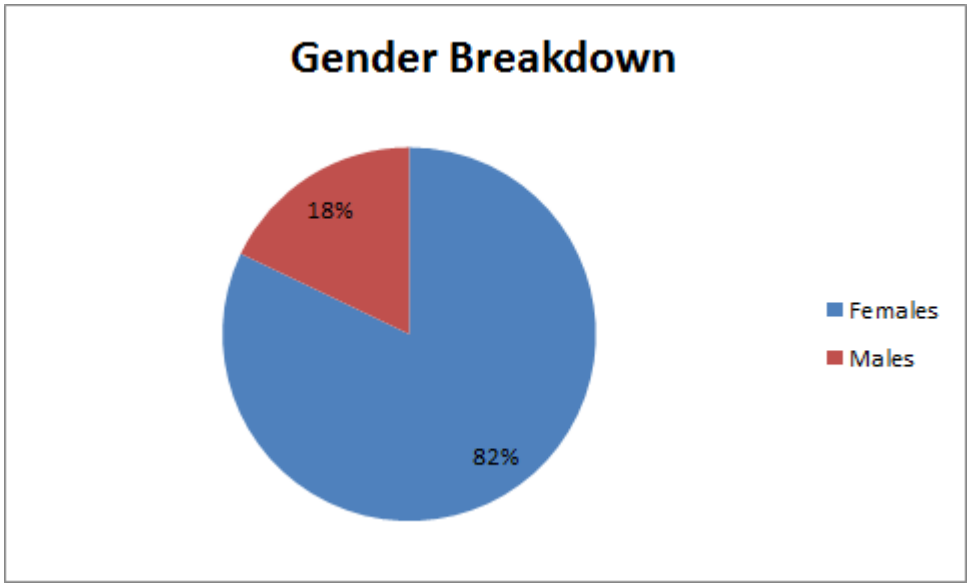


Figure 4.3.1.1. Gender breakdown of participants

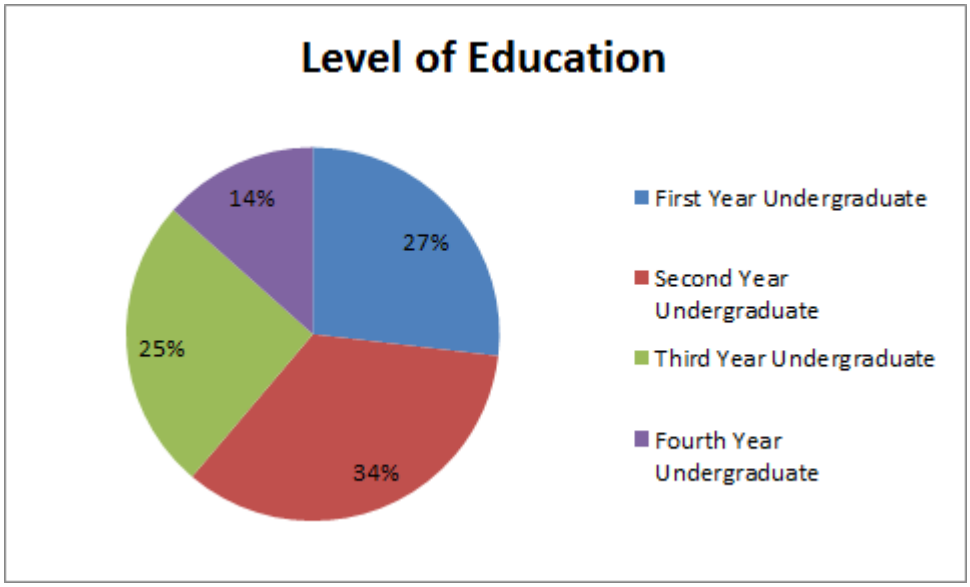


Figure 4.3.1.2. Level of education of participants.

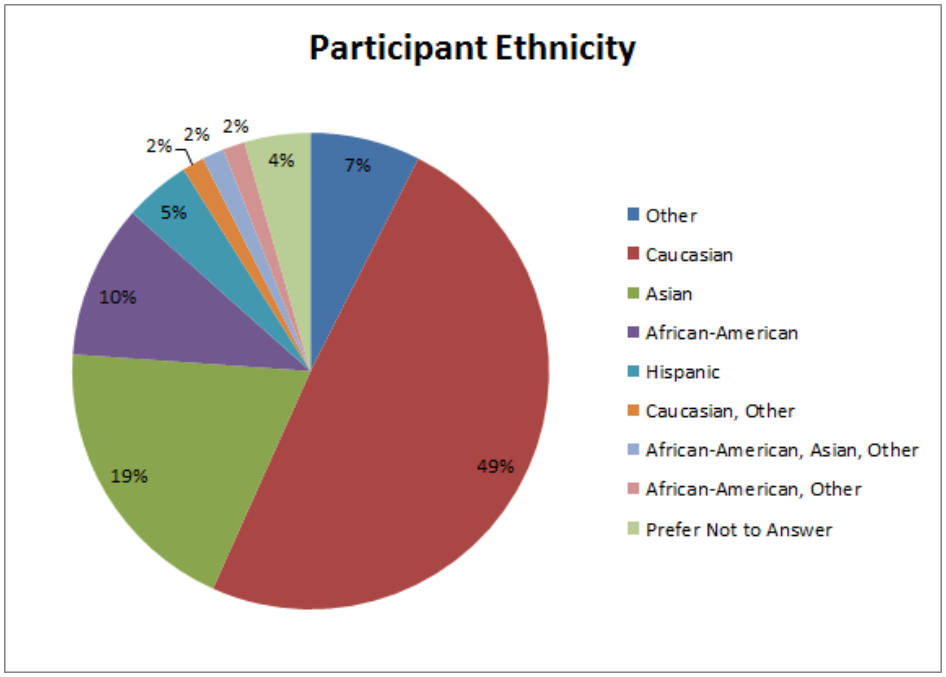


Figure 4.3.1.3. Ethnicity of participants.

4.3.2 Negative Affect

Negative affect was measured at three different points during the testing: at the beginning of testing, after the use of the first email platform (Gmail or Brevitus), and then after the use of the second product. It can be seen that the negative affect drop was lower for Brevitus in comparison to Gmail, with Gmail having a statistically significant ($p<.05$) drop after the use of each email service using a single tailed t-test, used in order to ensure the directionality of the drop of the affect score. This could show that Brevitus affected participants less in the negative emotional sense compared to Gmail, as Gmail might have reduced the student's negative affect by allowing them to feel less stressed

because they “completed” going through their email in a more timely fashion. It was determined via a two-tailed difference of means t-test that the drop in negative affect was significantly different between Brevitus and Gmail ($p<.05$)

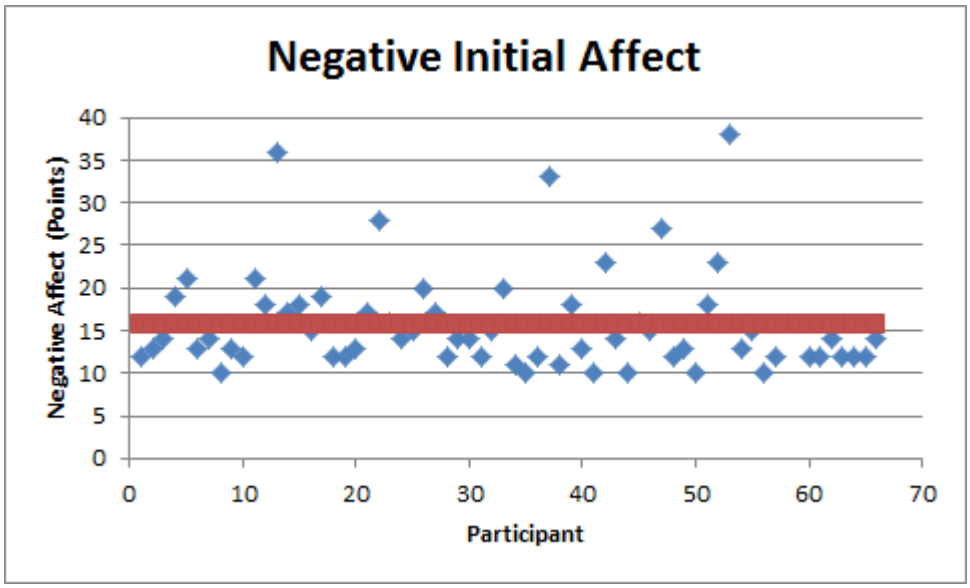


Figure 4.3.3.1. Initial negative affect from the test participants. The red line is the expected population mean for negative affect.

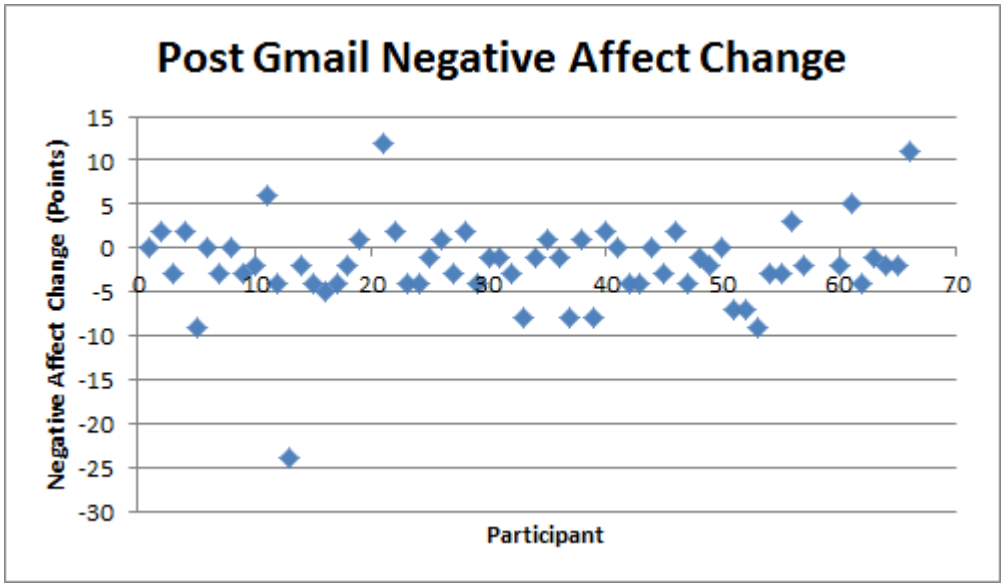


Figure 4.3.3.2. Negative affect difference post-usage of the Gmail platform.

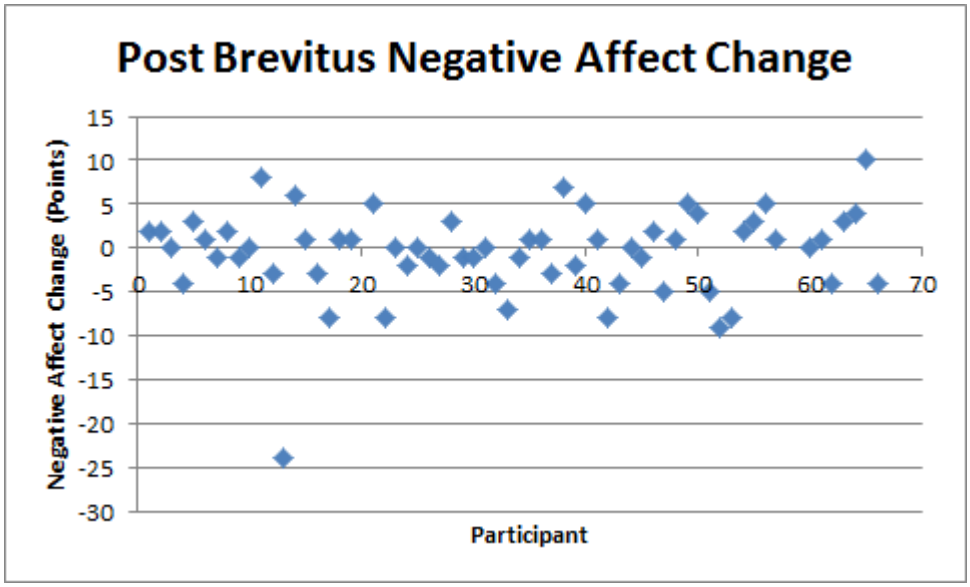


Figure 4.3.3.3. Negative affect change after usage of the Brevitus platform.

4.3.3 Positive Affect

The testing team measured the positive affect of the participants at three points during the test: before the user used any program, after the use of Gmail, and after the use of Brevitus. Shown below are the initial positive affect readings of the participants, along with the change in positive affect of the participants after the use of each email client.

One can see a significant reduction in positive affect for both clients, with Gmail dropping by an average of around 2 points, and Brevitus dropping with around an average of 4 points. This indicates that students' positive emotions were drastically dropped after going through their electronic communications, even if these emails were generated and not their own. The drop for Brevitus could be higher because the user was not as used to using a new email browser compared to Gmail, which is a standard for all university email accounts and is used by the majority of participants. It was determined via a two-tailed difference of means t-test that the drop in positive affect was significantly different between Brevitus and Gmail ($p<.05$)

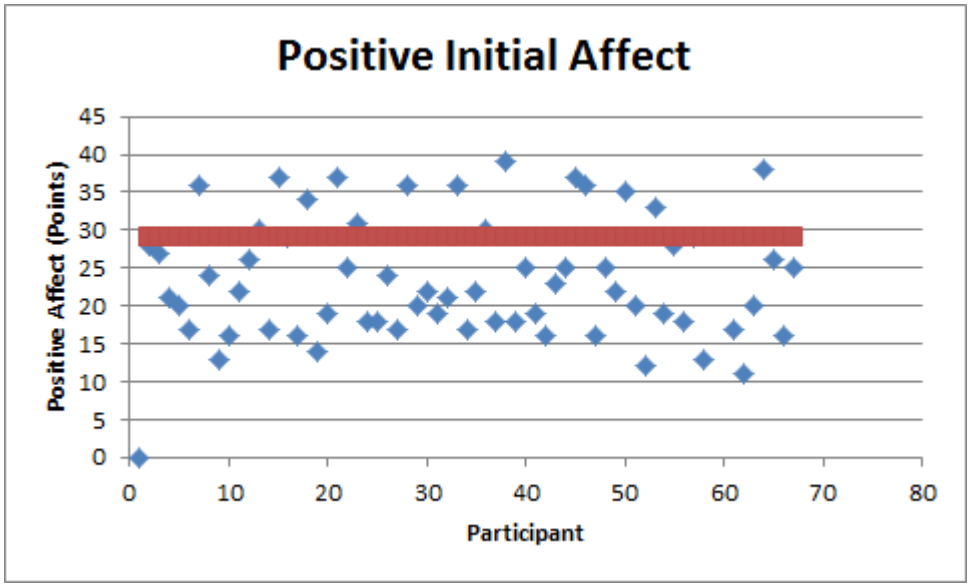


Figure 4.3.4.1. Initial Positive Affect

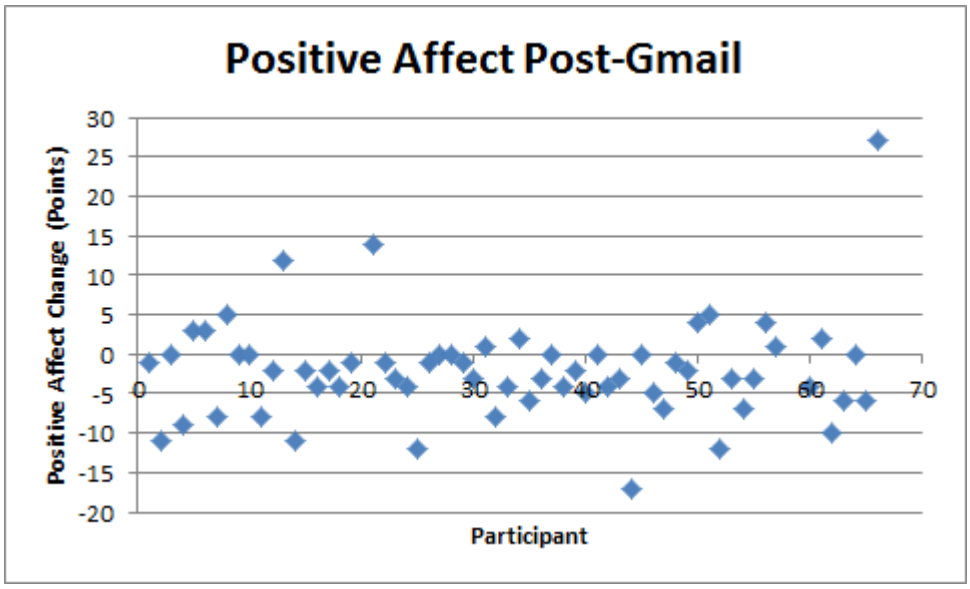


Figure 4.3.4.2. Positive affect change measured after the ten-minute usage period of the Gmail client.

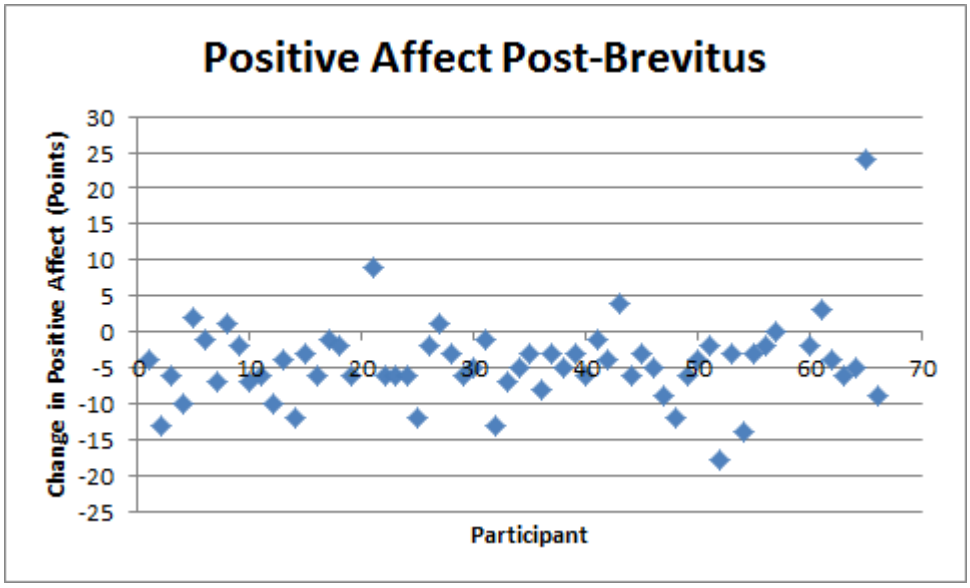


Figure 4.3.4.3. Positive affect change measured after the ten-minute usage period of the Brevitus client.

4.3.4. Other Affect Measurements

Figure 4.3.5.1 shows the change in the various affect sub-emotions from the participant after they use Gmail and Brevitus, along with the relevant one-tailed t-test significance values for these emotions. A significant drop in self-assurance was seen for both Brevitus and Gmail, which could show an overall drop in self-assurance figures in college students after using email platforms. However, fatigue and sadness had less significant drops after using the service, which shows that some of the added features may actually have worthwhile implications for helping students sort through their electronic information overload.

	Negative Affect Post-Gmail	Positive Affect Post-gmail	Fear Post-Gmail	Guilt Post-Gmail	Sadness Post-Gmail	Self-Assurance Post-Gmail	Attentiveness Post-Gmail	Fatigue Post-Gmail	Serenity Post-Gmail	Surprise Post-Gmail
Mean	-1.88889	-2.01587	-1.01587	-1.14286	-1.20635	-0.90476	-1	-1.46032	-0.49206	-0.06349
Std. Dev.	4.85636	6.429499	2.876445	2.827612	2.572552	3.527378	3.202821	3.364067	2.972308	1.584939
Median	-2	-2	0	0	0	-1	-1	-1	-1	0
T-Test	0.002493	0.014151	0.005874	0.001701	0.000298	0.043893	0.014549	0.000778	0.19127	0.751048
	Negative Affect Post-Brevitus	**Positive Affect Post-Brevitus**	**Fear Post-Brevitus**	**Guilt Post-Brevitus**	**Sadness Post-Brevitus**	**Self-Assurance Post-Brevitus**	**Attentiveness Post-Brevitus**	**Fatigue Post-Brevitus**	**Serenity Post-Brevitus**	**Surprise Post-Brevitus**
Mean	-0.52381	-4.34921	-0.8254	-0.26984	-0.63492	-2.47619	-1.61905	-0.4127	-1.65079	0.031746
Std. Dev.	5.02849	5.814772	3.410324	2.93041	2.541917	3.373794	3.438063	3.410775	3.188481	1.665284
Median	0	-5	0	0	0	-2	-2	-1	-2	0
T-Test	0.409933	2.72E-08	0.057022	0.466227	0.049626	4.6E-08	0.000282	0.338725	7.16E-05	0.879976

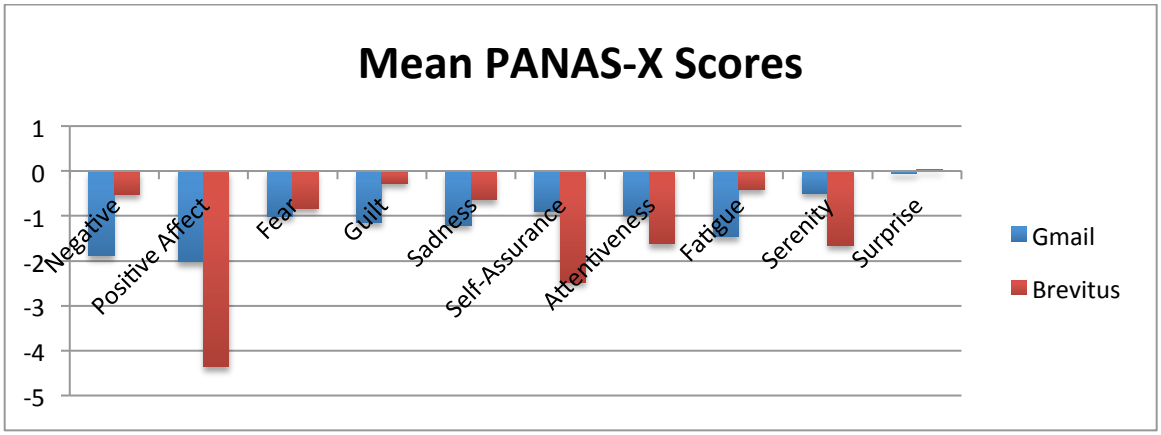


Figure 4.3.5.1: Post Gmail and Brevitus changes in related affect-based emotions, with the p-value of the t-test being listed under "T-Test". The chart shows a visual comparison of score changes.

4.4. Phase 3

Phase 3 is essentially a continuation of Phase 2, with a refined Brevitus product that was tweaked using comments and suggestions from Phase 2. Once again, users are

given ten minutes each to go through two generated inboxes using Gmail and Brevitus in a randomized order.

4.4.1. Demographics

In order to view the general demographics of the testing population, the gender, ethnicity, and level of undergraduate education was asked of each student. The overall demographic results of this testing phase may be seen in Figures 4.4.1.1-4.4.1.3. The gender of the participants is once again heavily skewed, with females being the majority of testing participants. For class level, the amount of freshman and sophomores outweigh that of juniors and seniors. Finally, the ethnicity of participants give a good level of diversity within the test subjects.

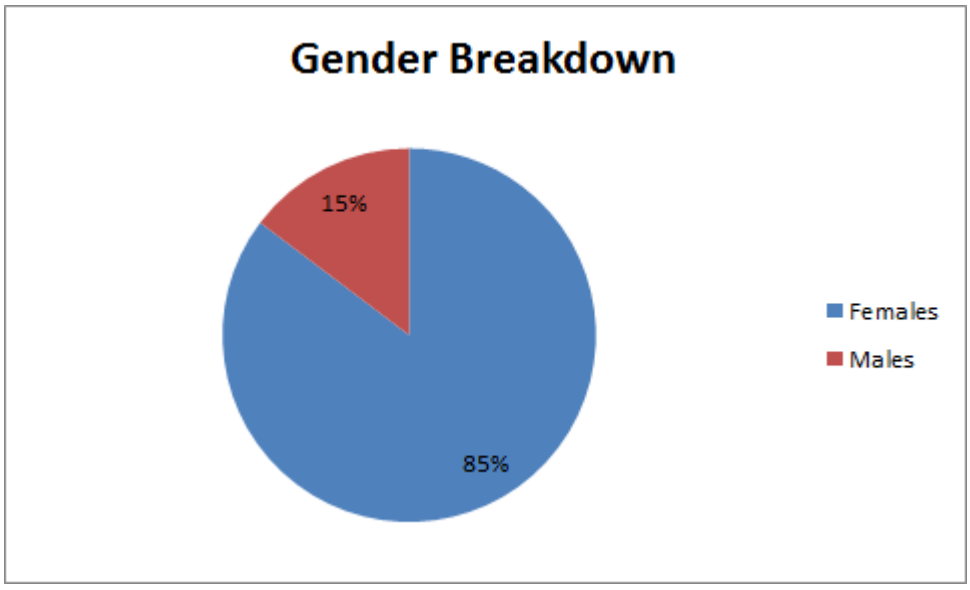


Figure 4.4.1.1. Gender of participants for Phase 3.

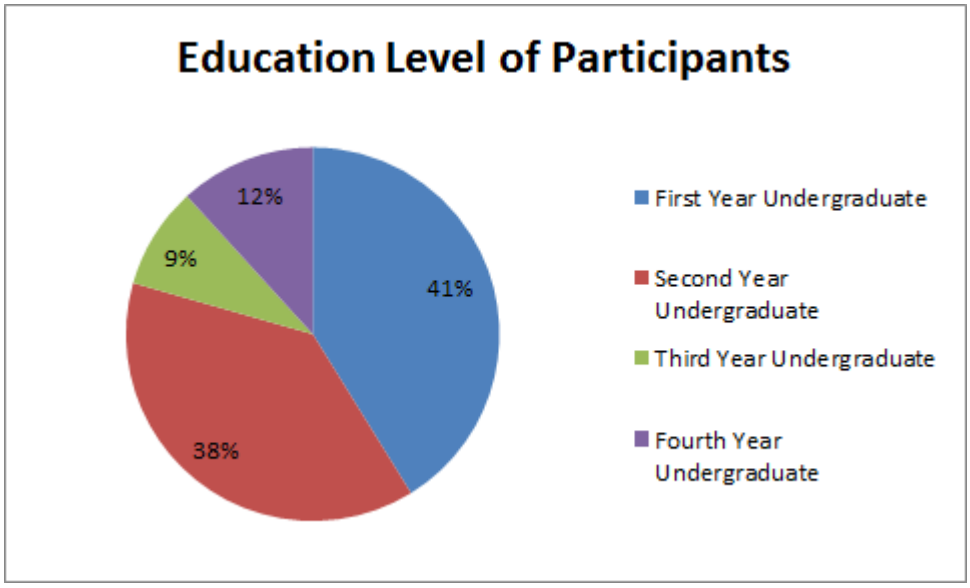


Figure 4.4.1.2. Level of education of participants.

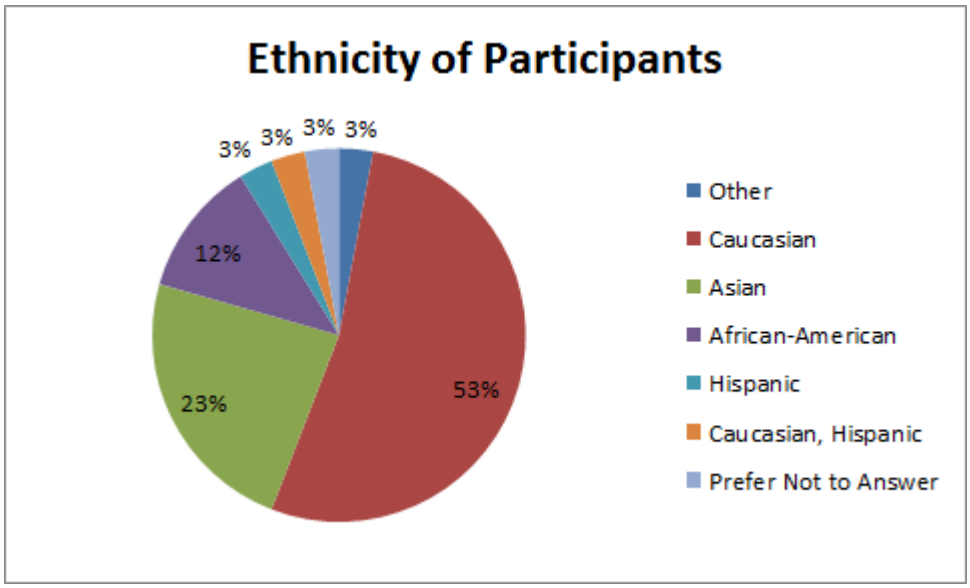


Figure 4.4.1.3. Ethnicity of test participants for Phase 3.

4.4.2. Negative Affect

For this phase of testing, both email platforms had users experiencing a quite similar drop in negative affect after the first test ($p<.05$), showing a significant change from the mean using a one-tail t-test. However, the difference between the two email platforms was only around .03 points, which shows that there may not be a significant difference between the two platforms for a reduction in negative affect ($p>.05$ using a two-tailed difference of means t-test). Compared to the results from Phase 2, this small difference show that the features added in between the testing phases (such as a simplified labelling and archiving system, a calendar-oriented view, and performance enhancements) helped Brevitus perform on par to Gmail on the scale of negative affect.

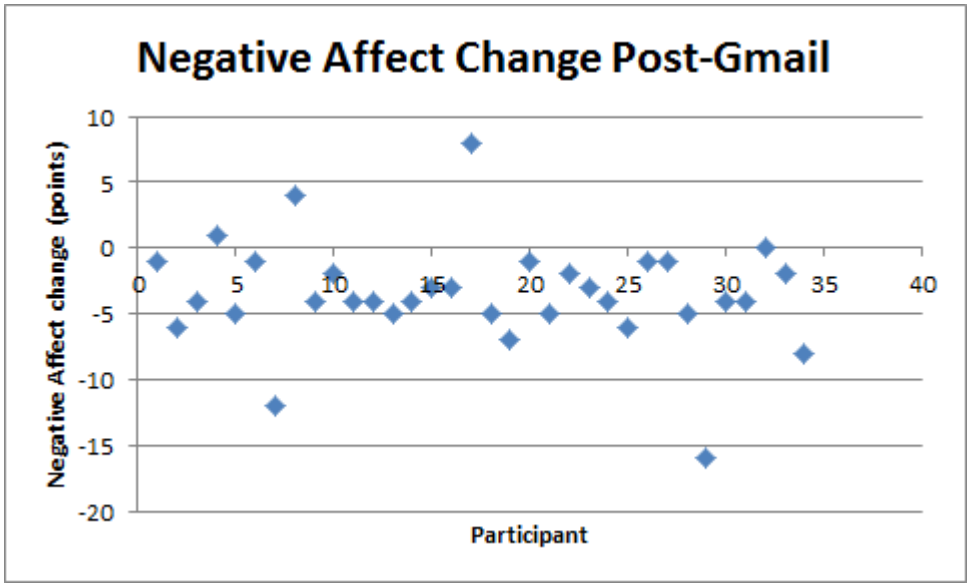


Figure 4.4.2.1. Negative affect change after ten minutes use of the Gmail platform.

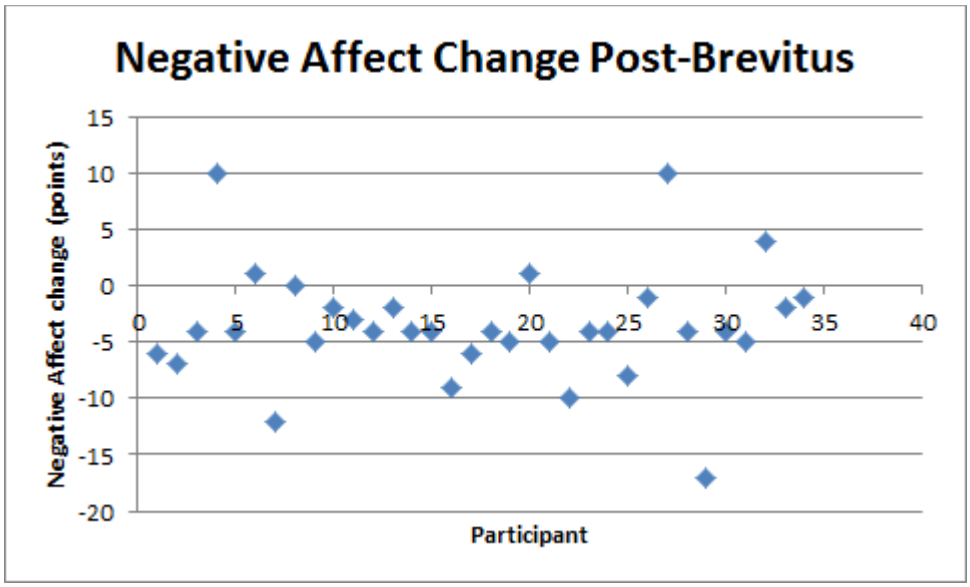


Figure 4.4.2.2. Negative affect change after ten minutes use of the Brevitus platform.

4.4.3. Positive Affect

Positive affect was also reduced after using both platforms, which is similar to the results found in Phase 2. However, Brevitus, while still having a lower comparative affect drop after usage, now no longer necessarily has a significant change from the drop in Gmail's positive affect ($p>.05$ in a two-tailed difference of means t-test). This indicates that Brevitus has improved its post-affect drop post-use, when examined relative the Gmail platform.

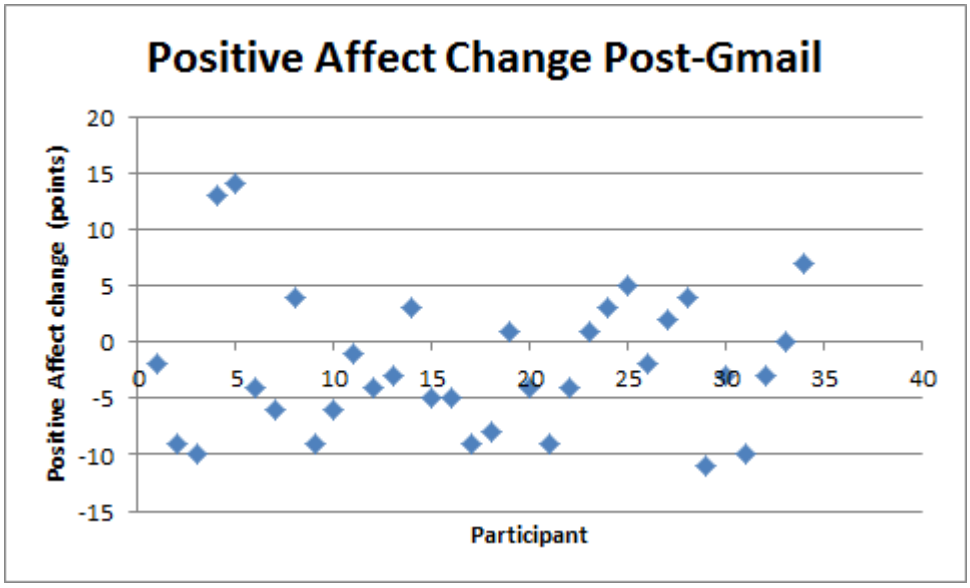


Figure 4.4.3.1. Positive affect change after ten minutes use of the Gmail platform.

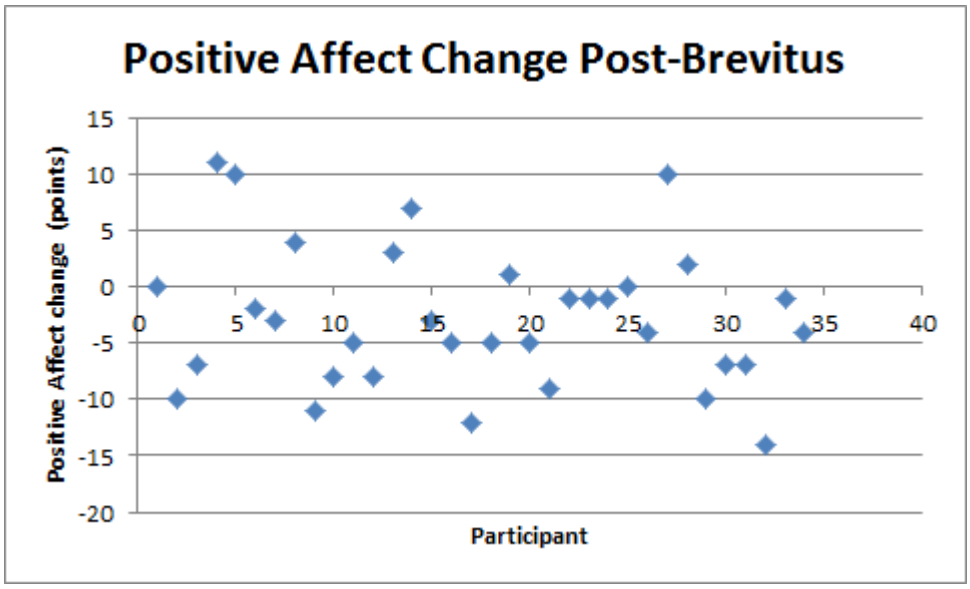


Figure 4.4.3.2. Positive affect change after ten minutes use of the Brevitus platform.

4.4.4. Other Affect Measurements

In addition to the positive and negative affect measurements, certain sub-emotions were also measured using the PANAS-X affect test. Shown below are the aggregate means, standard deviations, and significance p-values for these emotional changes from the baseline of zero change. A zero-change hypothesis test was conducted as the team wanted to see if using these two email platforms would change any of the measured emotional values from the PANAS-X test.

Post-Gmail Change	Negative Affect	Positive Affect	Fear	Guilt	Sadness	Self-Assurance	Attentiveness	Fatigue	Serenity	Surprise
Mean	-3.5	-2.05882	-1.91176	-0.35294	-1.32353	-1.02941	-0.70588	-1.11765	0.5	-0.76471
Std. Dev.	4.069472	6.232569	2.65567	4.326678	3.598995	2.801356	3.326017	3.73164	2.286323	1.875824
Median	-4	-3	-2	0	0	-1	-1	-1.5	0	-1
T-Test	4.24E-06	0.058394	8.24E-05	0.635895	0.035693	0.03583	0.220284	0.085394	0.206716	0.020358

Post-Brevitus Change	Negative Affect	Positive Affect	Fear	Guilt	Sadness	Self-Assurance	Attentiveness	Fatigue	Serenity	Surprise
Mean	-3.52941	-2.79412	-2.17647	-0.58824	-1.38235	-1.58824	-0.88235	-0.76471	-0.02941	-1.11765
Std. Dev.	5.153612	6.299492	2.599191	3.542963	3.256832	2.92448	3.319042	3.285033	2.812152	1.628621
Median	-4	-3.5	-2	0	0	-1.5	-1	-1	0	-1
T-Test	0.000166	0.011914	6.96E-06	0.336525	0.015903	0.002335	0.125892	0.179291	0.951556	0.000162

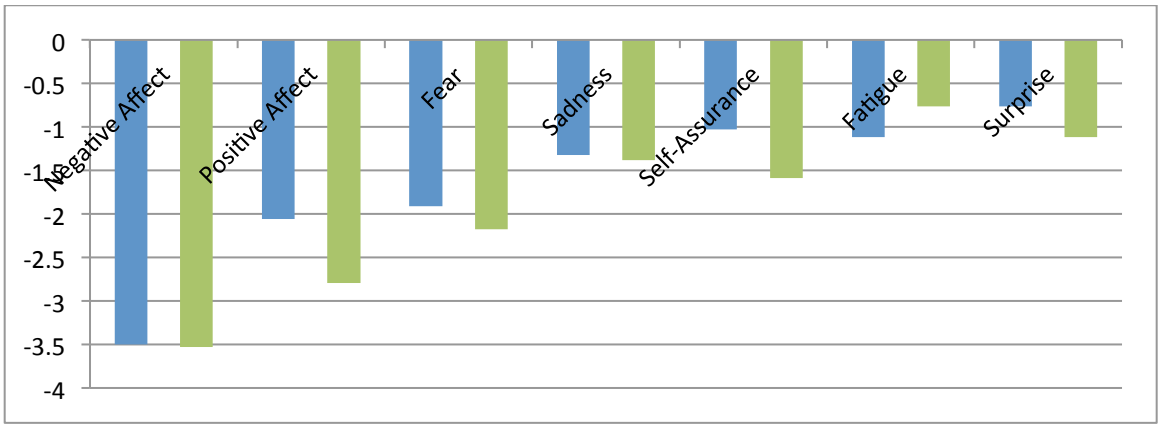


Figure 4.4.4.1. General affect measures post-Brevitus and post-Gmail, with some comparisons given in chart form (Gmail = blue, Brevitus = green).

Following usage of both platforms, all general emotions displayed a decline. For both email platforms, a significant decline from a mean emotional change of zero over the ten-minute testing window can be found for sadness, self-assurance, surprise, and fear (using a t significance level of $p<.05$). Since there was a significant drop for both email platforms, it is possible that these emotional changes occur across all electronic-communication based platforms during their use. This could be due to the user reducing the levels of unknowns regarding the emails in their inbox, suppressing their levels of surprise and fear.

Gmail alone has a significantly reduced ($p<.05$) amount of fatigue during Phase 3. This reduction could be due to the fact that users who are familiar with Gmail may be able to sort through the relevant email more quickly, or experience less fatigue and attentiveness loss while using a product that they have used before.

4.4.5 User Interface Preferences

The below charts show the user's preferences regarding the user interface for Gmail, as well as Brevitus. The overall trend shows that the team has some areas in interface design to continue polishing (in order to meet the integration and

cumbersomeness statistics). However, Brevitus nearly met Gmail in attention direction (with a difference of only .174 on a five point scale) and overcame Gmail in ease of data entry, with a rise of .24 points compared to Gmail. These attributes of Brevitus show that the current platform indeed has merits moving forward as a platform for college students.

	I think that I would like to use this system frequently.	I found the system unnecessarily complex.	I thought the system was easy to use.	I think that I would need the support of a technical person to be able to use this system.	I found the various functions in this system were well integrated.	I thought there was too much inconsistency in this system.	I would imagine that most people would learn to use this system very quickly.	I found the system very cumbersome to use.	I felt very confident using the system.	I needed to learn a lot of things before I could get going with this system.	Rate the standardization of tasks (consistency of similar tasks) for this platform on a scale from 1-5.	Rate the usefulness of headers/page titles for this platform on a scale from 1-5.	Rate the layout and organization for this platform on a scale from 1-5.	Rate how well you felt this program directed your attention on a scale from 1-5.	Rate how easy it was to enter data for this platform on a scale from 1-5.
Mean	3.617647	2.147059	3.941176	1.588235	3.676471	1.852941	4	2.176471	3.823529	1.823529	3.764706	3.794118	3.705882	3.352941	3.058824
Std. Dev.	1.30302	1.258483	1.204566	0.957194	1.093246	0.892132	1.180652	1.266601	1.113841	1.028992	0.889631	0.844928	1.030722	1.177629	1.475891

	I think that I would like to use this system frequently.	I found the system unnecessarily complex.	I thought the system was easy to use.	I think that I would need the support of a technical person to be able to use this system.	I found the various functions in this system were well integrated.	I thought there was too much inconsistency in this system.	I would imagine that most people would learn to use this system very quickly.	I found the system very cumbersome to use.	I felt very confident using the system.	I needed to learn a lot of things before I could get going with this system.	Rate the standardization of tasks for this platform on a scale from 1-5.	Rate the usefulness of headers/page titles for this platform on a scale from 1-5.	Rate the layout and organization for this platform on a scale from 1-5.	Rate how well you felt this program directed your attention on a scale from 1-5.	Rate how easy it was to enter data for this platform on a scale from 1-5.	Rate the usefulness of the Mosaic view in comparison to a standard list view.	Rate the usefulness of the Contact view in comparison to a standard list view.	Rate the usefulness of the Contact view in comparison to a standard list view.	Rate the usefulness of the Calendar view in comparison to a standard list view.
Mean	2.14705882	3.205882	2.852941	2.294118	2.441176	2.705882	3.147059	3.176471	2.911765	2.647059	3.176471	2.970588	2.617647	3.176471	3.294118	2.705882	2.617647	2.617647	2.676471
Std. Dev.	1.15816869	1.273968	1.104601	1.142284	0.990598	1.268008	1.373612	1.113841	1.111037	1.276414	0.999108	1.218178	1.101368	1.113841	0.938387	1.087934	1.015477	1.044893	1.093246

Figure 4.4.4.1. Participant's answers to questions about Gmail's (top) and Brevitus' (bottom) user interface.

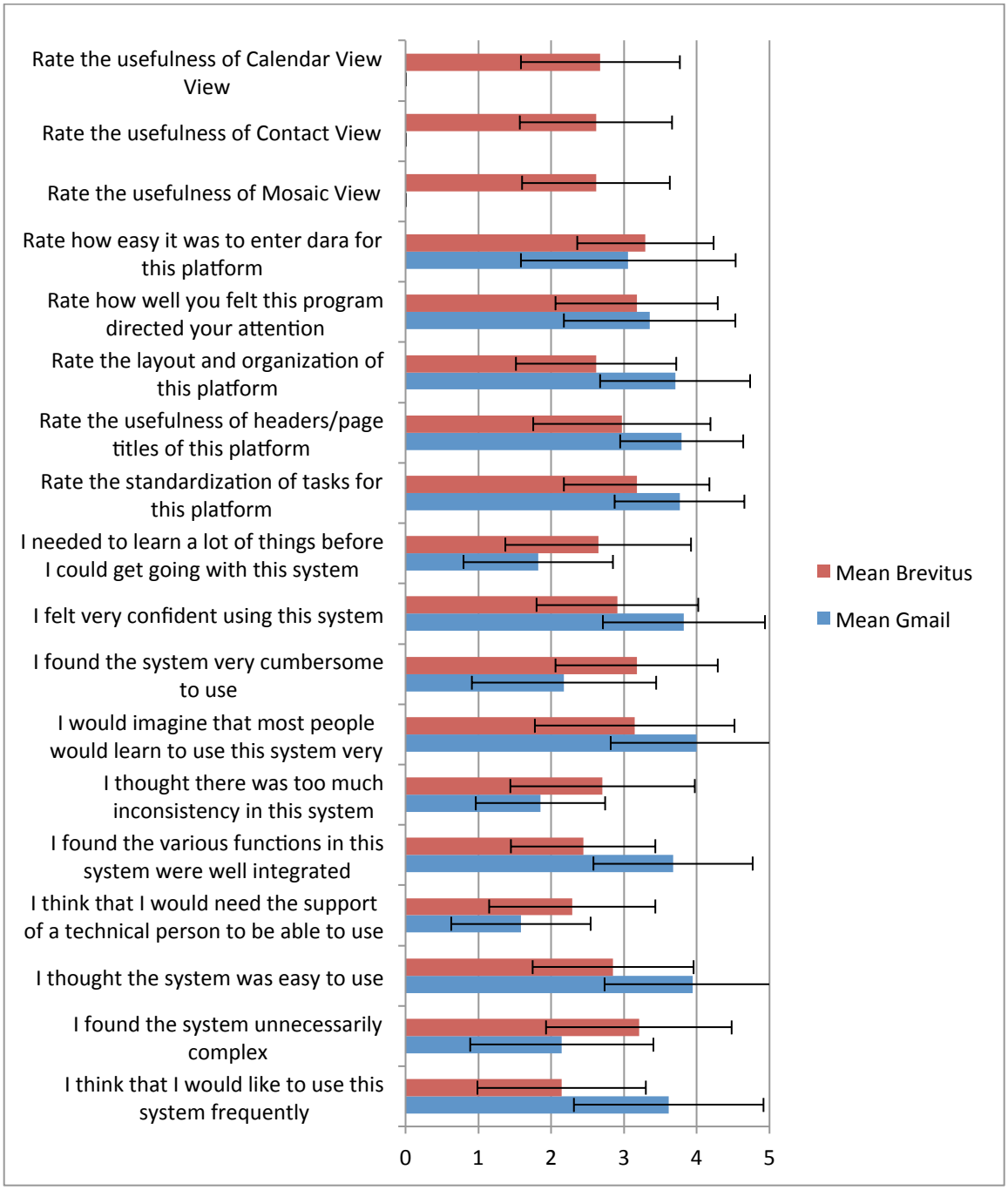


Figure 4.4.4.2. Visual comparison chart of the above data with standard deviation error bars.

4.5. Product Design Timeline and Documentation

Starting in the spring of 2012, the design team of Team RIO began to learn web development. Specifically, the first semester of development was spent becoming comfortable with and understanding web design concepts and languages. For the design of the User Interface (UI), the team developed using the coding languages of HTML, CSS and Javascript. PHP was initially the language that was chosen and practiced for the server side design. The entirety of the work done this semester by the design team prepared them for future development of Brevitus, but was not on Brevitus itself.

Beginning in the fall of 2012, the design team decided to use a framework in order to make the programming of our system more efficient and straightforward. The Ruby on Rails framework was chosen because of its extensive libraries and community support. This framework was unfamiliar to the team, so much time was spent during the semester learning its idiosyncrasies. Various demo sites were programmed during the course of the semester in order to gain experience using Ruby on Rails. Also during this time, the UI design of the first version of Brevitus was first conceptualized. Towards the end of the semester, time was spent researching various libraries and online resources that could help simplify the construction of the site.

The first design of Brevitus was started in the spring of 2013. The initial design was vastly different than the current version of Brevitus. The design appeared similar to most modern email clients such as Apple's Mail and Microsoft's Outlook with a column listing of emails position next to a full viewing pane. Although not innovative, this initial

design allowed the team to become accustomed to designing email clients, which served useful in designing later versions of Brevitus.

Over the summer of 2013, the initial design of Brevitus was scrapped because of Team RIO's desire to change the architecture of the system. From the beginning of the summer until September of the fall, an improved version of Brevitus was built that followed better web design practices. This version is what was used during the testing of Team RIO's participants during the fall of 2013 semester. Although this version of Brevitus did contain the basic core functionalities, there were many aspects of the system that needed to be improved. Namely, the calendar and mosaic view components were not in working order, and the list view did not have completely functioning delete, labelling and archive actions.

Over the course of the fall and winter of 2013, a working prototype of Brevitus was completed. This completed version of Brevitus was tested during the spring of 2014 and contained many new functional and stylistic features. Most importantly, the newer version of Brevitus had a complete calendar integration and mosaic view, two main features that make our email system unique. Further features that were added for this release included: an improved labeling with distinctive colors and better filtering techniques, the ability to add messages to the calendar, the archiving of messages, the viewing of messages related to a specific contact, and complete label organized mosaic email tiles. These changes between the platform used for testing in the fall of 2013 and the platform used in the spring of 2014 helped to improve the results of our tests and the overall reception of it by our Phase 3 participants.

5. Chapter 5: Discussion and Future Work

5.1. Extraneous and Confounding Variables

Studying individuals and their reactions to unconstrained stimuli leads to certain inevitable confounding variables. Differing personal backgrounds, mental states, and time constraints will undoubtedly occur within our sample population; however, although each individual is unique, past research has shown that people's actions on the Internet can be predicted by using majority based algorithms such as tagging and sorting of basic web-based resources (Cattuto, Loreto & Pietronero, 2007). These algorithms are based from the idea that large groups of people respond to circumstances similarly, as stated in social representations theory (See Appendix C). Therefore, a certain degree of control for personal backgrounds between participants can be achieved. A similar confounding variable present in our study is the participant's affect at the time of participation. Having a test participant with a very extreme initial positive or negative affect could lead to irregular overall results. We account for this variability by measuring the subject's change in affect through pre– and post–test surveys, rather than simply measuring raw affect after use.

For our study, one of the primary confounding variables for demographics was the majority of our testing participants were female, which does not represent the undergraduate breakdown of gender. This is potentially due to the recruitment method which we used, the SONA system. This system sources participants mainly from the Psychology 100 students, who are required to participate in a certain number of SONA

studies. While we believed that a 100-level undergraduate elective course would serve as a good representation of the student population, it is possible that this led to some gender bias selection issues.

Another confounding variable is the difficulty for participants to adapt to immediate change. Past studies by Schlossberg have shown that users are easily frustrated by new and unfamiliar systems (1981). People resist system changes if they do not experience immediate profit from the change, and as a result, they subsequently fail to utilize all available features a new system provides. Schlossberg found that only time and familiarization with the new environment allows the user to realize future benefits (1981). To alleviate this initial frustration and increase the likelihood that our program is used to its fullest potential, we taught each participant how to use the program by presenting him or her with verbal instruction and demonstration before the participant tests the platform.

A final potential confounding variable is participant bias while using the two different email platforms. While nowhere on the Brevitus platform was it indicated that it was created by University of Maryland students or Team RIO, students could have inferred that the platform unknown to them was the focus of the study. Students participating in the test know that they are using two different email platforms, and could potentially realize that Gmail is not the primary program being evaluated by the lab team. These students could attempt to bias their test results to favor Brevitus in a misguided attempt to help the researchers. It is difficult to determine whether or not think issue caused any biases in the testing results.

5.2. Conclusions and Discussion

After we developed our program, Brevitus, to combat information overload, we determined the effectiveness of our software by measuring the change in affect of the participant throughout their usage of Brevitus and Gmail in a laboratory environment. We expected our information management system to decrease the time spent sifting through electronic communications. Similar to what other studies have found, we anticipated that there would be a positive correlation between this decrease in time spent processing electronic communications and positive affect (Hair et al., 2007; Bellotti et al., 2005; Lazar et al., 2006; Klausegger, 2007; Karr-Wisniewski & Lu, 2010). This would, in turn, raise the participants' satisfaction with electronic communication and the platform used to facilitate it.

5.3. Phase 0: Product Preferences Survey

From the initial product survey, the team found that college students did indeed have different and more frequent habits of using electronic communications than the general populace. The amount of times that students check email, the amount of accounts on various electronic communication sites they have, and the number of electronic devices they own show the breadth of their involvement in electronic communications.

These statistics give credence to the fact that our target population of college students likely experience more frequent and persistent amounts of electronic information overload. This gives us an ideal population to study the effects of electronic information overload across different email platforms.

We have found that college students had an average of over 2.15 email accounts, and on average checked their email for over 40 minutes per day. We believe that this large amount of time spent checking email, along with the numerous email accounts that college students maintain, leads them to potentially benefit through the use of our platform Brevitus.

5.4. Attentiveness and Electronic Information Overload

Another attribute measured by the administered affect test is attentiveness. From previous studies by Malhotra in the field of information overload, we know that a glut of information can reduce a person's attentiveness (1982). This finding has been echoed by the data collected during the three phases of testing, with lab participants experiencing a decrease in attentiveness after usage of both email platforms during Phases 1 and 2. This was statistically verified using a t-test ($p<.05$). Given that Gmail is the most-used email platform by University of Maryland students, these results suggest that most email platforms lead to a loss of attentiveness over time. This reduction of attentiveness was expected, as previous studies have shown that an overabundance of information can lead to loss of attentiveness and information fatigue (Information fatigue, 2011; Gleick, 2011).

These results affirm that this loss of attentiveness occurs in electronic information overload as well and indicate that it may not be possible to mitigate this loss beyond a certain baseline. Based on the "tipping point" of the information overload curve (see Appendix F, Figure 3), once a person is presented with too much information, their information processing ability declines. This degradation of processing ability could contribute to the lack of attentiveness shown by these tests.

5.5. Self-Assurance and Electronic Information Overload

The testing performed in Phase 2 allowed the team to see some of the general changes in affect and stress that checking email caused to our in-lab participants. As stated in the literature review, it was previously found by Hurst that regular information overload can negatively impact a person's self-esteem (2007). All three of our in-lab tests have shown that the user has a significant ($p<.05$) drop in self-assurance after the usage of any email platform (in this case Gmail or the team's platform, Brevitus). This shows that electronic communication does indeed affect a college student's self-esteem on a wide scale. On a qualitative note, self-assurance dropped less while testing the improved model of Brevitus (Phase 3), compared to the original prototype (Phase 2). This difference in self-assurance could be attributed to the improved and more positive affect-increasing features of the product, showing how a more usable product can lead to a smaller loss of self-assurance over time.

5.6. Affect and Electronic Information Overload

Throughout all phases of lab testing, negative affect decreased for participants. While in Phase 1, in which only Gmail was tested, we did not see a significant ($p>.05$) drop in negative affect, we saw a significant (t-test significance level of $p<.05$) drop in negative affect using Gmail in Phases 2, and both platforms in Phase 3. In Phase 2, the negative affect drop associated with Gmail was significant and much greater than that of Brevitus. This information, along with the negative user interface survey reports from the first iteration of Brevitus, indicate that the user's preference of one platform over another does indeed relate to the affect changes that occur while using the product. In Phase 3, the difference in negative affect drop between Gmail and Brevitus was smaller than during Phase 2. This could be due to the changes that were made regarding the user comments and interface questions from the first round of testing, such as the increased ease of labelling, archiving, and sorting emails.

Positive affect also fell for both Gmail and Brevitus for each phase of testing. While the drop was not significant for Phase 1 (Gmail only), the drop in positive affect was significant for both platforms in Phase 2 and 3 (one-tailed t-test, $p<.05$). As opposed to the negative affect scores, the positive affect for Brevitus fell far further than that of Gmail during the first phase of testing. However, in Phase 3 of testing, with the improved version of Brevitus, the difference in positive affect change between the two platforms was smaller, supporting the possibility that an improved platform could reduce the drop in positive affect in email platforms. Watson et al. found that a drop in positive affect

over time leads to a more "drowsy, dull, and sleepy" mood on the affect ellipse (1999), which matches well with the drop in attentiveness seen throughout testing both email platforms.

One interesting note is that while positive and negative affect significantly fell during both Phase 2 and 3 of testing, they did not significantly fall during Phase 1. One primary difference between these two phases is that the user was using their own email in Phase 1, but not in Phases 2 and 3. In Phases 2 and 3, they were using a generated inbox of emails. One confounding variable to note for Phase 1 was the variability between users regarding when they last checked and sorted their email. If it was immediately prior to their trial time, it is possible they had no information to sort through, and therefore no perceived information overload. A possibility of why this significant versus non-significant drop occurred is the possibility that the users, based on time of day or week before the testing, did not actually experience information overload during the testing, while using their own email inboxes. While using a pre-generated inbox with a set number of unread emails, the time of testing would not have impacted the level of information overload that they experienced. For Phase 1, this would put the users to the right of the U-shaped information processing curve, meaning that, according to Hwang and Lin, they had not reached the height of their information processing limit and were not yet overloaded (1999).

5.7. Brevitus vs. Gmail Product Analysis

During the creation of Brevitus, Team RIO attempted to design an email platform that would outperform Gmail in certain categories, specifically categories regarding time spent writing, reading, and responding to emails. We knew that outperforming one of the most successful email services in the world was an unreachable goal, so we attempted to focus on the college audience and categories in which we felt we could generate value by improving specific email-platform features. Some of these categories included positive affect loss/negative affect gain, self-assurance loss, along with other affect and stress-oriented metrics. Initially, the first phase of testing showed that Brevitus performed worse than Gmail. Negative affect change was higher, positive affect change was lower, and the individual emotional statistics fared no better. A t-statistic for significance computed from the difference of the two sample means (our platform and our baseline of Gmail), showed a significant, worse difference between the overall affect scores between Brevitus and the "barometer" of Gmail ($p<.05$).

Upon the completion of Phase 3, the second round of testing with Brevitus, the team realized that the initial difference had potentially evaporated. Based on the user suggestions brought up during the first round of Brevitus testing, the design team added an easier sorting method, more streamlined calendar and mosaic views, and a more intuitive standard listing system. The product design team also created an intuitive method for email folder or "label" creation as well as a bold and simplified user interface header design. The design team was able to create a more intuitive method through the

use of color-coordinated labels and increased sizes of label bars/headers, while also adding an easier way to enter an email into a label, a direct button near the viewed email instead of having to add them on the home page.

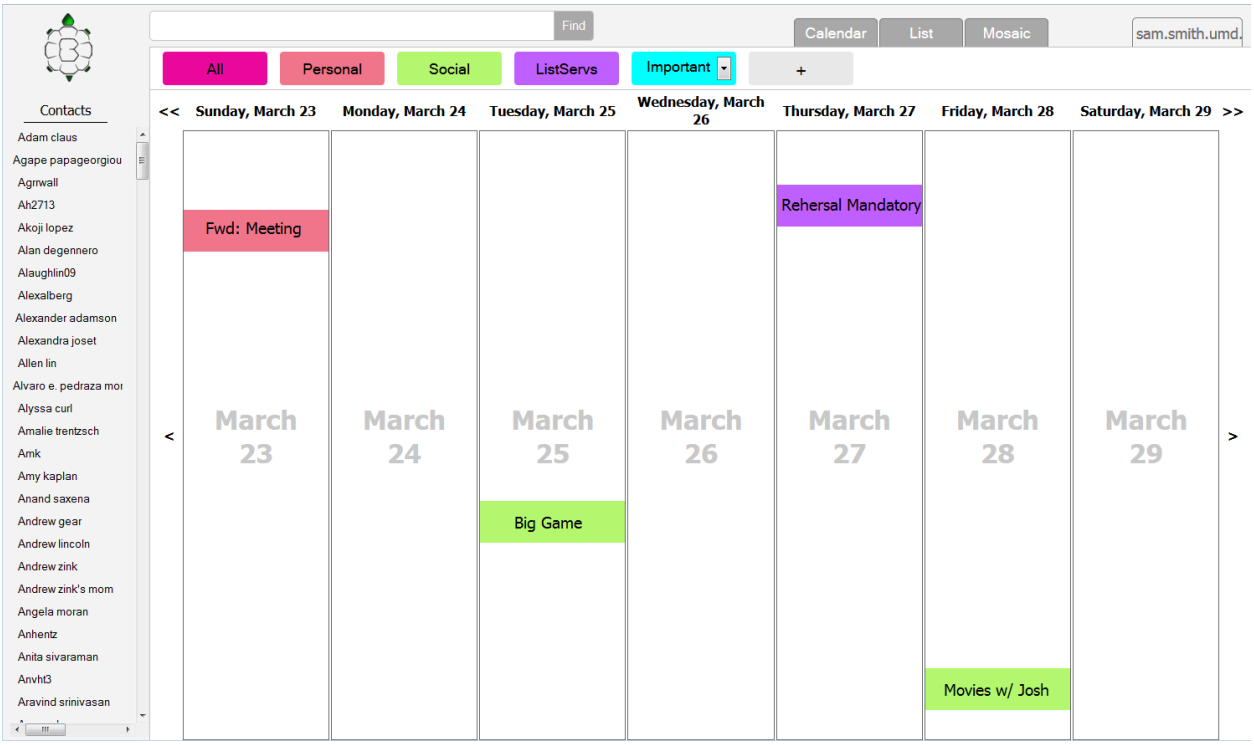


Figure 5.7.1. An example of a populated calendar view of Brevitus.

The team also collected data on the participant's thoughts on the usability of each system's graphic interface. While these results were generally lower for Brevitus as compared to Gmail, this was expected due to the confounding variable of unfamiliarity that Schlossberg described with our new system (1981). This could have potentially been alleviated by requiring participants to use the platform before coming to the in-lab

testing. However, the limitations of the SONA system, as well as the stability of the web-ready product, made that solution infeasible for our testing methodology.

5.8. Conclusion

A large amount of literature on information overload currently exists; however, almost no research has been conducted on information overload produced from simultaneous electronic sources. Our research explores how effective it is to minimize information overload from email by creating a targeted and intuitive platform for college students. Additionally, our research approaches information overload from two unique perspectives, psychological and technological, and combines them to produce an optimal solution to electronic information overload. In practice, we hope our research and resulting system will reduce the amount of time wasted dealing with electronic social media. Due to the limited sampling population we have access to, our research study focuses solely on college students. We suggest future research to include a more generalized participant pool.

5.9. Future Directions for Project

With the wealth of qualitative and quantitative data gathered regarding how well Brevitus works as compared to more prominent email clients, we aim to release an

improved beta version of the product to a wider user base. A few minor usability issues need improving and some more important security details must be accounted for prior to a wider release. With regards to security, the site must be hosted with an SSL certificate. SSL certificates allow for encryption of the connection between the servers on which the site is hosted and the computer on which the end user accesses that site, which is especially important when dealing with personal and potentially sensitive data transmitted via email. Additionally, data stored on the servers hosting Brevitus and the servers themselves must be secure. As we will have our initial servers in a locked facility and data will be encrypted in the databases it is stored in, both of these stipulations are provided for.

After applying these changes and minor improvements, we plan to roll out the beta to a limited user base - mostly colleagues, friends, and family of the team - in order to get a good idea of how the product works in the real world. With this small, close group, we can have direct person to person communication between the designers and engineers who built the product and the end users, ensuring that issues can be communicated quickly and dealt with as they come up while not inundating those developing with complaints, suggestions, and the like. After a sufficient period of time has passed as to allow for the solidification of Brevitus, we will then release the product to a larger limited group, like all students at the University of Maryland. This has the advantage of again being a more manageable user base than all those with access to the internet and those users being persons of a demographic for which the product was originally designed and targeted. After a similar period of allowing for issues to be raised

and resolved and our development team and hardware being scaled to the newly enlarged user base, we can then release an open beta to the public.

The system produced by this project, Brevitus, is a work in progress, so naturally there is much improvement that can be made to its current state. In addition to addressing the cosmetic layout items that are missing in our application (such as continued refinement of headers and email listing), there are more major additions and improvements we would like to make in continuing its development. First, we would like to enable Brevitus to access and sort other sources of information from a user's online persona in order to further reduce their information overload. The initial aim of the project was to collate multiple sources of online information overload, including social media, such as Twitter and Facebook. After realizing that such integration was out of the scope of what we could accomplish in the short length of time available to both develop and test our product, we decided focusing on email was a critical first step to developing a platform to reduce information overload. In fact, social media integration adds an entirely new set of confounding variables to a study of electronic information overload, such as the number of services being used, the methods in which users use them, and the amount of time spent per service. It may even be necessary to study how each of these social media platforms affect college students' information overload, before examining their integration with email. Integrating additional social media platforms is a crucial task in the reduction of information overload. While email is a major contributor to information overload, by volume alone, we believe that the amount of mental effort dedicated to task switching and having to use discrete, separate interfaces to access all the facets of a user's online persona contribute to information overload. By producing a

unified management system, we could have a greater positive impact on the user's affect. At the same time, care must be taken in general to prevent too much information from being presented to the user at once, to keep them from reaching the "tipping point" of information overload on the information processing curve.

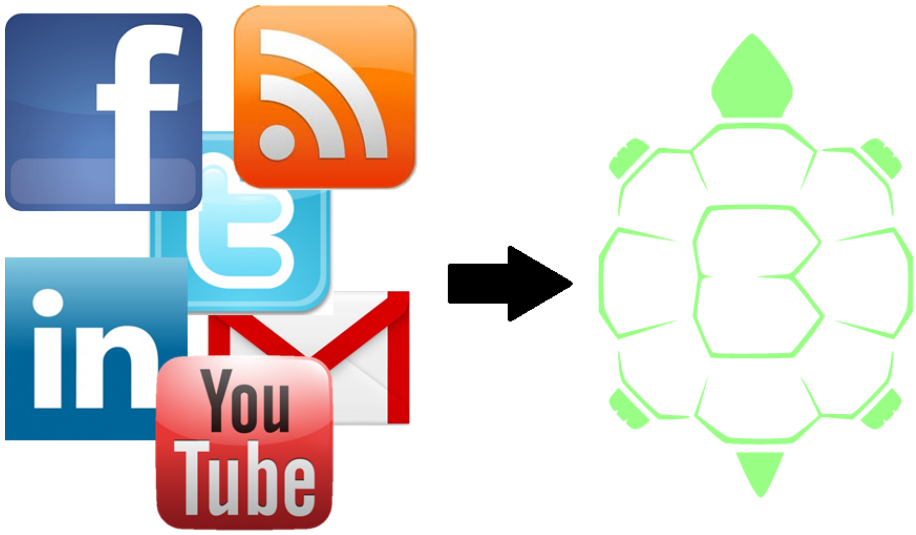


Figure 5.9.1. The end goal of Brevitus - a unified electronic communications system.

Secondly, we would improve the actual value that Brevitus provides users. In addition to integrating additional services, we want Brevitus to be flexible and helpful to its users. Part of this helpfulness is to aid the user in finding critical information, which Brevitus currently does via some elementary machine learning. To extend on that provision would be the goal; allowing the user to teach Brevitus what information is important and novel, not just in emails, but in other communication media, is tantamount to ensuring that users stay abreast of the swell of information constantly aimed at them.

Differentiating importance between different media (e.g. ranking email, tweets and wall posts in the same list) is a truly novel application that holds great promise, and would be a worthy of additional study and product development. Together, the provision of more supported inputs (user's accounts) and the intelligent integration of those into a unified stream would be a logical and beneficial direction in which to continue this project.

6. Chapter 6: References

API. (2011). In Encyclopædia Britannica. Retrieved from http://www.britannica.com/EBchecked/topic/1472947/API

Amirkhan, J. (2012). Stress Overload: A New Approach to the Assessment of Stress. American Journal of Community Psychology, 55-71. doi: 10.1007/s10464-011-9438-x

Arora, S., Hazan, E., & Kale, S. (2005). Fast algorithms for approximate semidefinite programming using the multiplicative weights update method. Foundations of Computer Science, 339-348. doi: 10.1109/SFCS.2005.35

Autonomic nervous system. (2012). In Encyclopædia Britannica. Retrieved from http://www. britannica.com/EBchecked/topic/45079/autonomic-nervous-system

Baumeister, R.F. & Bushman, B.J. (2011). Social psychology and human nature. Belmont, CA: Wadsworth Cengage Learning.

Bellotti, V., Ducheneaut, N., Howard, M., Smith, I., & Grinter, R.E. (2005). Quality versus quantity: E-mail-centric task management and its relation with overload. Human-Computer Interaction, 20(1/2), 89-138. doi: 10.1207/s15327051hci2001&2_4

Bekkerman, R., McCallum, A., & Huang, G. (2005). Automatic Categorization of Email into Folders: Benchmark Experiments on Enron and SRI Corpora. *The SelectedWorks of Andrew McCallum* Retrieved from http://works.bepress.com/andrew_mccallum/144

Bilezikjian, M., Tang, J.C., Begole, J., & Yankelovich, N. (2002). Exploring web browser history comparisons. Proceedings from CHI EA '02: extended abstracts on Human factors in computing systems, 828-9. doi: 10.1145/506443.506618

Blair, A. (2010). Information overload, then and now. Chronicle of Higher Education, 57(15), B4-B5. Retrieved from http://search.ebscohost.com.proxy-um.researchport.umd.edu/login.aspx?direct=true&db=aph&AN=55804842&site=ehost-live

Blair, A. (2010). Too much to know: Managing scholarly information before the modern age. New Haven, Conn.: Yale University Press.

Bleicher, A. (2011). A memory of webs past. IEEE Spectrum, 48(3), 30-37. doi: 10.1109/MSPEC.2011.5719723

Cattuto, C., Loreto, V., & Pietronero, L. (2007). Semiotic dynamics and collaborative tagging. Proceedings of the National Academy of Sciences of the United States of America, 104(5), 1461-1464. doi: 10.1073/pnas.0610487104

Cohen, S., Janicki-Deverts, D., Miller, G. (2007). Psychological Stress and Disease. JAMA. 2007; 298 (14), 1685-1687. doi: 10.1001/jama.298.14.1685.

Dumas, J., Redish, J. (1999). A Practical Guide to Usability Testing. Great Britain: Intellect Books.

Eppler, M. & Mengis, J (2004). The concept of information overload: a review of literature from organization science, accounting, marketing, MIS, and related disciplines. Information Society 20(5), 325-344. doi: 10.1080/01972240490507974

Evaristo, R., Adams, C., & Curley S. (1995). Information load revisited: A theoretical model. ICIS 1995 Proceedings. Retrieved from http://aisel.aisnetorg/icis1995/18

Feldman, L.A. (1995). Valence focus and arousal focus: Individual differences in the structure of affective experience. Journal of Personality and Social Psychology, 69(1), 153-166. doi: 10.1037//0022-3514.69.1.153

Golder, S. & Huberman, B. (2006). Usage Patterns of Collaborative Tagging Systems. Journal of Information Science, 32(2). 198-208. doi: 10.1177/0165551506062337

Gleick, J. (2011). Drowning, surfing and surviving. New Scientist, 210(2806), 30-31. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=iih&AN=61021161&site=ehost-live

Graphical user interface (GUI). (2011). In Encyclopædia Britannica. Retrieved from http://www. britannica.com/EBchecked/topic/242033/graphical-user-interface

Hair, M., Renaud, K.V., & Ramsay J. (2007). The influence of self-esteem and locus of control on perceived email-related stress. Computers in Human Behavior, 23(6), 2791-2803. doi: 10.1016/j.chb.2006.05.005

Huber, G., & Daft, R. (1987). The information environments of organizations. In F. Jablin, L. Putnam, K. Roberts & L. Porter (Eds.), Handbook of organizational communication. Beverly Hills, CA: Sage.

Hurst, M. (2007). Bit literacy: Productivity in the age of e-mail and information overload. Charleston, SC: Elevate.

Hwang, M.I., & Lin J.W. (1999). Information dimension, information overload and decision quality. Journal of Information Science, 25(3), 213-218. doi: 10.1177/01655515990250030

Information fatigue. (2011). In Oxford English Dictionary. Retrieved from http://www.oed.com/view/Entry/261138?redirectedFrom=information%20fatigue#eid

Jones, Q., Ravid, G., & Rafaeli, S. (2004). Information overload and the message dynamics of online interaction spaces: A theoretical model and empirical exploration. Information Systems Research, 15(2), 194-210. doi: 10.1287/isre.1040.0023

Ju, B., & Gluck, M. (2011). Calibrating information users' views on relevance: A social representations approach. Journal of Information Science, 37(4), 429-438. doi: 10.1177/0165551511412030

Karr-Wisniewski, P., & Lu, Y. (2010). When more is too much: operationalizing technology overload and exploring its impact on knowledge worker productivity. Computers in Human Behavior, 26(5), 1061-1072. doi: 10.1016/j.chb.2010.03.008

Klausegger, C. (2007). Information overload: A cross-national investigation of influence factors and effects. Marketing Intelligence & Planning, 25(7), 691-718. doi: 10.1108/02634500710834179

Klimt, B., & Yang, Y. (2004). The enron corpus: A new dataset for email classification research. Lecture Notes in Computer Science, 3201, 217-226. doi: 10.1007/978-3-540-30115-8_22

Larsen, R.J., & Diener, E. (1992). Promises and problems with the circumplex model of emotion. In M.S. Clark (Ed.), Emotion (pp. 25-59). Review of personality and social psychology. Newbury Park, CA: Sage.

Lazar, J., Jones, A., Shneiderman, B. (2006). Workplace user frustration with computers: an exploratory investigation of the causes and severity. Behavior & Information Technology 25(3), 239-251. doi: 10.1080/01449290500196963.

Lightsey, O.R., Maxwell, D.A., Nash, T.M., Rarey, E.B., & McKinney, V.A (2011). Self-control and self-efficacy for affect regulation as moderators of the negative affect-life satisfaction relationship. Journal of Cognitive Psychotherapy: An International Quarterly 25(2), 142-154. doi: 10.1891/0889-8391.25.2.142

Malhotra, N.K. (1982). Information load and consumer decision making. Journal of Consumer Research, 8(4), 419-430. doi: 10.1086/208882

Marois, R., & Ivanoff J. (2005). Capacity limits of information processing in the brain. Trends in Cognitive Science, 9(6), 296-305. doi: 10.1016/j.tics.2005.05.006

Miller, G. (1956). The magical number seven, plus or minus two: Some limits on our capacity for processing information. The Psychological Review, 63(2), 81-97. doi: 10.1037/h0043158

Milord, J.T., & Perry, R.P. (1977). A methodological study of overload. The Journal of General Psychology, 97(1), 131-137. doi: 10.1080/00221309.1977.9918509

Misra, S., Stokols, D. (2012). Psychological and Health Outcomes of Perceived Information Overload. Environment and Behavior, 44(6), 737-759. doi: 10.1177/0013916511404408

Morgan, R.F. (1996). An intelligent decision support system for a health authority: Solving information overload, The Journal of the Operational Research Society, 47(4), 570-582. doi:10.1057/jors.1996.62

Moser, K., & Soucek, R. (2010). Coping with information overload in email communication: Evaluation of a training intervention. Computer in Human Behavior, 26(6), 1458-1466. doi: 10.1016/j.chb.2010.04.024

Myers, D.G. (2010). Consciousness and the two-track mind. In Exploring Psychology (8th ed.) (pp.157). New York, NY: Worth Publishers.

Nanopoulous, A. (2011). Item recommendation in collaborative tagging systems. IEEE Transactions on Systems, Man, and Cybernetics-Part A: Systems and Humans, 41(4), 760-771. doi 10.1109/TSMCA.2011.2132708

Newman, J. (2013). How Gmail will sort your email for you with new automatic labeling. Retreived from http://www.techhive.com/article/2040237/gmail-will-sort-your-email-for-you-with-new-automatic-labeling.html

Nielsen, J. (1993). Usability Testing.

O'Reilly, C.A. (1980). Individuals and information overload in organizations: Is more necessarily better? The Academy of Management Journal, 23(4), 684-696. doi: 10.2307/255556

Raskin, J. (2000). The humane interface: New directions for designing interactive systems. Crawfordsville, Indiana: ACM Press.

Remington, N., Fabrigar, L.R., & Visser, P.S. (2000). Reexamining the structure of affect. Journal of Personality and Social Psychology, 79(2), 286-300. doi: 10.1037/0022-3514.79.2.286

Renaud, K., Ramsay, J., & Hair, M. (2006). "You've got e-mail!" ...shall I deal with it now? Electronic mail from the recipient's perspective. International Journal of Human-Computer Interaction, 21(3), 313-332. doi: 10.1207/s15327590ijhc2103_3

Roets, A., & Van Hiel, A. (2011). An integrative approach on judgment and decision making: The impact of arousal, affect, motivation, and cognitive ability. Psychological Record 61(3), 497-520. Retrieved from http://search.ebscohost.com.proxy-um.researchport.umd.edu/login.aspx?direct=true&db=aph&AN=65033135&site=ehost-live

Schlossberg, Nancy K. (1981). A model for analyzing human adaptation to transition. The Counseling Psychologist, 9(2), 2-18. doi: 10.1177/001100008100900202

Senol-Durak, E., & Durak, M. (2010). The mediator roles of life satisfaction and self-esteem between the affective components of psychological well-being and the cognitive symptoms of problematic internet use. Social Indicators Research, 103(1), 23-32. doi: 10.1007/s11205-010-9694-4

Shneiderman, B., Plaisant, C., Cohen, M., & Jacobs, S. (2010). Designing the user interface: Strategies for effective human-computer interaction. Boston, MA: Addison-Wesley.

Song, G. & Ling, C (2011). Users' attitude and strategies in information management with multiple computers. International Journal of Human-Computer Interaction, 27(8), 762-792. doi: 10.1080/10447318.2011.555307

Spier, C., Valacich, J.S., & Vessey, I. (1999). The influence of task interruption on individual decision making: An information overload perspective. Decision Sciences, 30(2), 337-360. doi: 10.1111/j.1540-5915.1999.tb01613.x

Spira, J.B. (2011). Overload!: How too much information is hazardous to your organization. Hoboken, New Jersey: Wiley.

Strauss, E., Sherman, E. & Spreen, O.. (2006). A compendium of neuropsychological tests: Administration, norms, and commentary. Oxford: Oxford University Press.

Terracciano, A., McCrae, R.R., Hagemann, D., & Costa P.T. (2003). Individual difference variables, affective differentiation, and the structures of affect. Journal of Personality, 71(5), 669-704. doi: 10.1111/1467-6494.7105001

University of Iowa. (1994). The PANAS-X: Manual for the positive and negative affect schedule - expanded form. Iowa City: Watson, David & Clark, L. A.

Wang, Y.D., & Forgionne, G. (2008). Testing a decision-theoretic approach to the evaluation of information retrieval systems. Journal of Information Science, 34(6), 861-876. doi: 10.1177/0165551508091308

Watson, D., Wiese, D., Vaidya, J., & Tellegen, A. (1999). The two general activation systems of affect: Structural findings, evolutionary considerations, and psychobiological evidence. Journal of Personality and Social Psychology, 76(5), 820-838. doi: 10.1037/0022-3514.76.5.820

Whittaker, S. and Sidner, C. (1996). Email overload: exploring personal information management of email. In CHI '96 Proceedings of the SIGCHI conference on Human Factors in Computing Systems. ACM, New York, NY, USA, 276-283. doi: 10.1145/238386.238530

7. Chapter 7: Glossary of Terms

Application Programming Interface (API): A list of specifications and methods that should be followed in order to help programs communicate to each other, listing preconditions (assumptions when going into the function) and post-conditions (assumptions the programmer can make when the function ends). Created for client programmers, who will be using the preexisting functions to write new programs (API, 2011).

Autonomic System Dysfunction: The autonomic nervous system is the part of the nervous system, in the vertebrates, that voluntarily controls and regulates the internal organs without conscious recognition. For example, the autonomic nervous system affects heart rate, digestion, salivation, perspiration, urination, sexual arousal, and respiration rate. Autonomic system dysfunction is an impairment or abnormality in the regulation of this system (Autonomic nervous system, 2012).

Complexity: Specific aspects of information that can have an impact on how information is processed. Highly complex information will have aspects that require individual attention and significant thought (Evaristo, Adams, & Curley, 1995).

Diversity: Differences among information items (Huber & Daft, 1987).

Folksonomy: A classification system derived from human consensus. In web applications, folksonomy refers to the classification system created from electronic tags that users associate with items. It can be thought of as a word bank where every word points to a specific element on the web (Cattuto, Loreto, & Pietronero, 2006). A global

folksonomy emerges from users' interaction with information as individuals rank information as it is relevant to themselves.

Graphic User Interface (GUI): As seen in Encyclopædia Britannica, a graphical user interface is a computer program that allows a user to interact with it visually. Specifically, the program will display its layout or information in a graphical manner on a viewing device (monitor or screen) on which a user can interact, typically using a pointing device like a mouse and a keyboard for textual input. The Microsoft Windows and Mac OS X operating systems are both examples of graphical user interfaces, but this does not prohibit programs running within them (web browsers, word processors, or music players) from also having GUI's.

Information Fatigue: Apathy, indifference, or mental exhaustion arising from exposure to too much information, [especially]…stress induced by the attempt to assimilate excessive amounts of information from the media, the Internet, or at work" (Information fatigue, 2011).

Interdependence: Specialization of information. Requires competence in many and diverse topics to gain complete understanding (Huber & Daft, 1987).

Mouse Tracking Software: Software that enables the tracking of mouse movement during the use of the program. Depending on the software chosen, the tracking will record important information such as mouse movement trend paths, points where the mouse is held for a while (e.g. during clicking or other repetitive actions), and number and frequency of said mouse clicks. This will enable optimization, as buttons that are

frequently clicked in sequence can be moved closer together or combined, and user efficiency can be measured with the amount of clicks required to manage tasks.

Numerosity: The "number of relevant actors or components in the environment, such as the number of competitors, suppliers, and so forth" (Huber & Daft, 1987).

PANAS-X Scale: Surveys, most commonly Likert scale surveys, have been the main tool to measure affect in past studies. To obtain quantitative results, a Likert scaled survey uses an odd number of points to create a point-scale. For example, on the 9-point Likert scale, points range from 1-strongly disagree to 9-strongly agree. This type of survey is "accepted as a customary tool in psychometric analysis" (Karr-Wisniewski & Lu, 2010). A specific Likert scale survey that is frequently used to measure affect is PANAS-X scale. This self-reported mood inventory assesses positive and negative affect, as well as other affective states such as shyness, fatigue, serenity, and surprise. It consists of single-word items that are answered using a 5-point Likert scale (see Appendix F – Figure 4). Responses range from "very slightly or not at all" to "extremely." (Watson & Clark, 1994).

Social representations theory: The idea that large communities act in a similar fashion (Ju & Gluck, 2011).

Stress Overload Scale (SOS): In an attempt to strengthen the link between stress and health, Dr. James H. Amirkhan developed a new psychological test called the Stress Overload Scale (SOS) (Amirkhan, 2012). This test is a combination of nine objective, subjective and hybrid measures for stress. The SOS is unique for three reasons. First, it is psychometrically strong as it has undergone rigorous testing, especially when

compared to other popular measures. Second, it is a brief test and fits a broad demographic spectrum. Third, it cross-sections individuals into risk categories. It is for these three reasons, namely conceptually, psychometrically, and practically, that the SOS is an improvement over other existing tests for stress. Conceptually, the SOS is derived from constructs shared by stress theories. As discussed before, psychometrically, it is relaible and valid. Practically, it is appropriate for all demographics and is relatively brief. (Amirkhan, 2012).

Sub-emotions: Scored emotions given by the PANAS-X scale that lead to the scoring of, but are not positive or negative affect.

Turbulence: Reflects the frequency and unpredictability of change in information caused by instability and randomness. For example, highly similar information has low turbulence. Greatly dissimilar information has high turbulence (Evaristo et al., 1995).

Uncertainty: Knowledge inadequacy. Can be caused by inaccessibility to, novelty of, or low reliability of information (Evaristo et al., 1995).

Volume: The amount of information available to process (Evaristo et al., 1995).

8. Chapter 8: Appendices

8.1. Appendix A: Timeline

Our timeline is split into two codependent halves: the research team and the design team. The teams will work separately, but we have several members who can work on either team depending on the amount of work that needs to be done.

- Through Fall 2012, we will be finishing preliminary work.
    - For the research team, this includes developing an introductory user preference survey and securing IRB approval for testing on human subjects. If possible, they will then start administering the surveys.
    - During this time, the design team will be examining existing platforms to ascertain what makes them successful and useful. They will also be learning the API's of the existing software and how services such as Facebook and Gmail communicate with new programs that want to use their data. The design team will also start to develop a sorting algorithm to manage the data and begin working on drafting product specifications based on preliminary surveys from the research team.
- In the Fall of 2012, the main body of the project begins. The interdependence of the two teams is most evident during this time, as a constant communication feedback loop of data and corrections will occur between the two teams.
    - The research team conducts and refines surveys, the first of which they will then give to the first test group. This will be the preference survey, which will help the programming team know what features to include in the user interface.
    - Once the design team has a working prototype, they will conduct an alpha test among a few users in a closed environment.
    - The research team will then survey the users, and the user data and responses will be used by the design team to improve the prototype.
    - A beta test will be implemented in order to view the change of the users opinion based on an edited product; with features and general layout being changed from their feedback in the alpha test.
    - The research team will be examining how the program affected the user's affect, and the design team will assess the effectiveness of the algorithm and the technical improvements such as time spent on email, total important messages seen, and other user metrics.
- Finally, from the Fall of 2013 to the Spring of 2014, we will conclude analysis of affect from the accumulated surveys and review the performance of the algorithm based on server data and tester satisfaction. The final task will be to compose our thesis, which will be presented at the Team Thesis Conference in Spring 2014.

8.2. Appendix B: Proposed Budget

The following allocations are for the purpose of estimating potential expenditures associated with our project:

Description of Expense	**Estimated Time Needed**	**Cost Associated**
SSL (Secure Sockets Layer) certificate to allow prototype testers to securely communicate with the prototype server. Potentially sourced through Comodo Group, Incorporated or DigiCert, Incorporated (certificate authorities).	Fall 2013	$120 – 200 / 1 year
Domain name registration of a domain for our prototype (RIOproject.com, minimusproject.com, RIOumd.com, minimusumd.com, etc.) through Pair Networks, Incorporated or Network Solutions, LLC.	Spring 2012	~$20 /year
Server hosting of prototype system. This could be through any number of different providers and the university could possibly even help.	Spring 2012	$16 /quarter
Cash prize raffle with which to incentivize participants	Phase 1,2,3 Prizes	($50, $25, $25)*3 =$300
	Total	~$650

8.3. Appendix C: Proposed Product Specifications

Purpose: This document is intended as an overview of the team's thoughts on the current direction of their project from a purely software side. It sets out to describe a few specific features, some general elements, and then presents design renderings to show how these elements could be worked together into a polished package.

Specific Features (most to least important):

--Clean, simple, consistent, customizable, functional interface

An easy-to-use interface is necessary to reduce negative affect, and all of these attributes will improve the interface, save perhaps customizable as giving the user too much choice to play around with things could be counter to the cause.

--Mobile (touch-based) interface

Early implementations will not have this, but a mobile application will be important to maintain relevance in the market and to keep users satisfied. Currently, however, to ensure consistent interfaces between mobile and desktop-based viewing, the general interface should be designed to be easily used and interacted with in either context.

--Sorting by calendar, contact, and content

In order to effectively interact with and manipulate content, the team posits that easy access to all three of these facets is essential.

--Integrated schedule management

When a message contains an event, the system will parse it, and either display an indication of the user's availability in the message, or clicking will open their calendar to display that day. Also, if a message does not need to be dealt with for some time, it can be set to remind the user later, or automatically be promoted in the main window.

--Hot-updateable / push-enabled

When a user receives new content, the system should immediately process it and display it accordingly.

--Easy setup

This goes without saying. Setup and linking of accounts should be stupidly simple.

--Easy to free data

Consumers' willingness to use a product and the legality of that product is increasingly determined by if the user's data can be removed easily.

--Security (through compartmentalization)

Because the product is to be used everywhere and because certain data, especially that of employers, is sensitive, the product can be integrated into multiple aspects of a user's life and work, but certain parts may need to be kept private from others.

For example, Sam works at the DoD and has a personal account with RIO's service. His employer also wants to use RIO's service to increase worker efficiency, but wants to ensure confidential information stays secret. Sam's accounts are linked, but his personal one cannot see learned data from his DoD account, while his DoD account may be able to see his personal one to increase sorting effectiveness.

--Universal chat

If used as intended (a central portal), users may also want the service to have a universal chat client that works seamlessly across their integrated services. Perhaps this should not be integrated immediately, if at all, but it would be wise to think about.

--UI themes

These are presets that configure the interface to its proper setting. Again, because of the question of how much control a user should have, their inclusion is questionable.

General elements (most to least important):

--Intuitive interface

With the success of iDevices and iOS, especially, it is now clear that cumbersome interfaces deter users, whereas intuitive interfaces attract them. The interface should be so easy to understand that people should never need to look at the help file.

--Integration

Everything is in one place. This goes along with the 'full service integration' item from above, but further in that people should want to use the interface and integration this product provides more than the original products.

--Learning order

By far the most important feature of the system will be its ability to learn what information and messages are important and to display those prominently. The user should be able to intervene or give feedback to the rating system (thumbs up or thumbs down, like Pandora), but the system should still be able to learn latently what is important from what messages are opened, hovered over, highlighted, or read first; for how long; and from what they contain.

--De-duplication

When multiple messages say the same thing, or there are messages resent as “reminders,” the system can eliminate them, or file them under the same thread to reduce wasted time. This will hopefully include items from different LISTSERVs, as in many instances information across multiple sources is the same.

--Learning interface

The interface of the system should morph to what the user wants. This feature may not be necessary or even possible, but if users do want different things from the interface, the system should figure that out and provide.

Renderings:

Render 1 General Properties:

--Few buttons on a thin bar (contains a drop-down menu with the user's name, under which one can presumably find settings and other assorted things, a compose button, a prominently displayed search bar, a help button, and a logout button at the top right)

--Dynamically sized message tiles in a large space of screen real-estate (size and differed coloring indicates importance)

--Message tiles generally contain a contact or other relevant picture for visual cueing, in addition to a subject which could be a system-customized synopsis of the message, a sender name (clickable, refers to contact), and a short summary of the message and important points (or snippet)

--Special types of message tiles will display their attached content (messages with just pictures will have an interactive slideshow, messages just with file attachments could have an enlargeable preview which could be downloaded without opening the message)

--The snipped top right corner of a message tile, when hovered over, will display a downward-pointing menu button, which will give a few quick options of what to do with the message

--The background color could be customized, or could be dynamically changing if soothing

Render 2 General Properties:

--Generally the same concept as render 1

--Omission of help button and of dedicated compose button

--Addition of dedicated email, Facebook, twitter, and chat buttons (can function as filters OR as indicators of the quantity of that particular medium of communication (by color gradient or numerical indication) OR both) (this addition is also contested among the team as some believe it is counter to the purpose of showing people what is important to give them an option of filtering things)

--Addition of page shift buttons (like Chrome's new tab page) to go through messages

8.4. Appendix D : Product Specification Survey

Appendix D.1: Survey Advertisements

Email/Facebook Advertisement

From the Gemstone Program – Team RIO (Reducing Information Overload)

Hello, we are Team RIO from the Gemstone Program and as our team name suggests, we are interested in reducing information overload we are met with when using our day to day social media programs. Interested in helping us with our first survey? You can take the survey at http://survey.websurveycreator.com/s.aspx?t=d149c902-d881-488e-a852-9a85fa7dfbe5&lang=en. The surveys take about 5 minutes and you will be compensated with treats if you stop by the front of North Campus Diner hall on *date* from *time* to *time*!

For more information contact us at:
teamriogemstone@gmail.com

or come visit us at our blog: http://teamrio.blogspot.com/
or our website: sites.google.com/site/teamrio2014/

Flyer Advertisement

Come Take a Survey
For an Undergraduate Research Team!

Gemstone Team RIO
(Reducing Information Overload)

5-10 minute study

The survey involves questions about
Email, facebook, etc. and if they stress you out!

We are looking for students of any demographics

If interested, visit our blog, which links to the survey:

teamrio.blogspot.com

Or contact

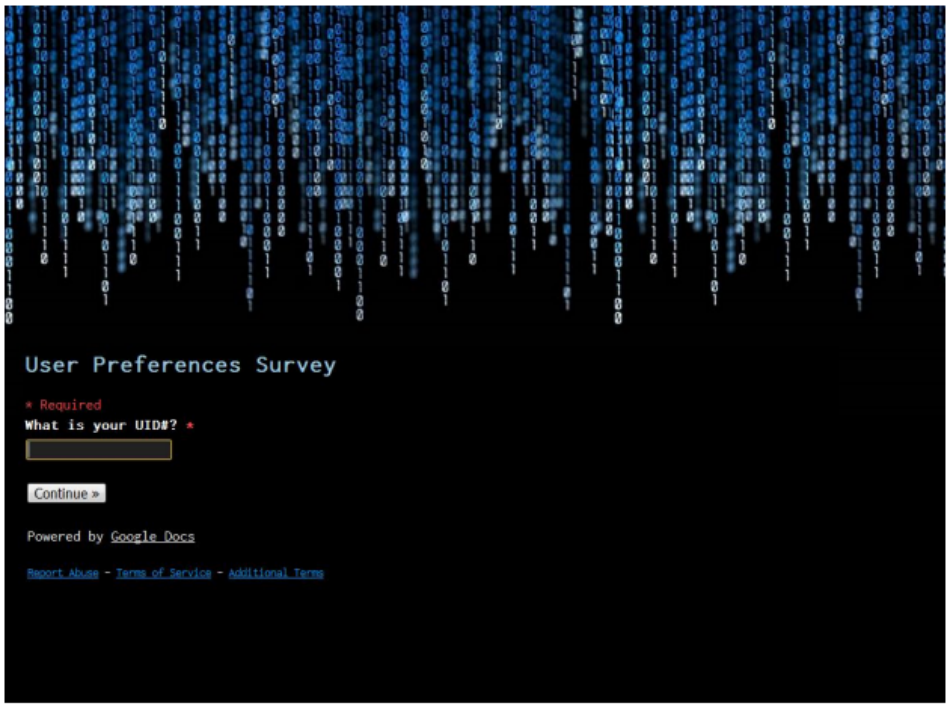
teamriogemstone@gmail.com

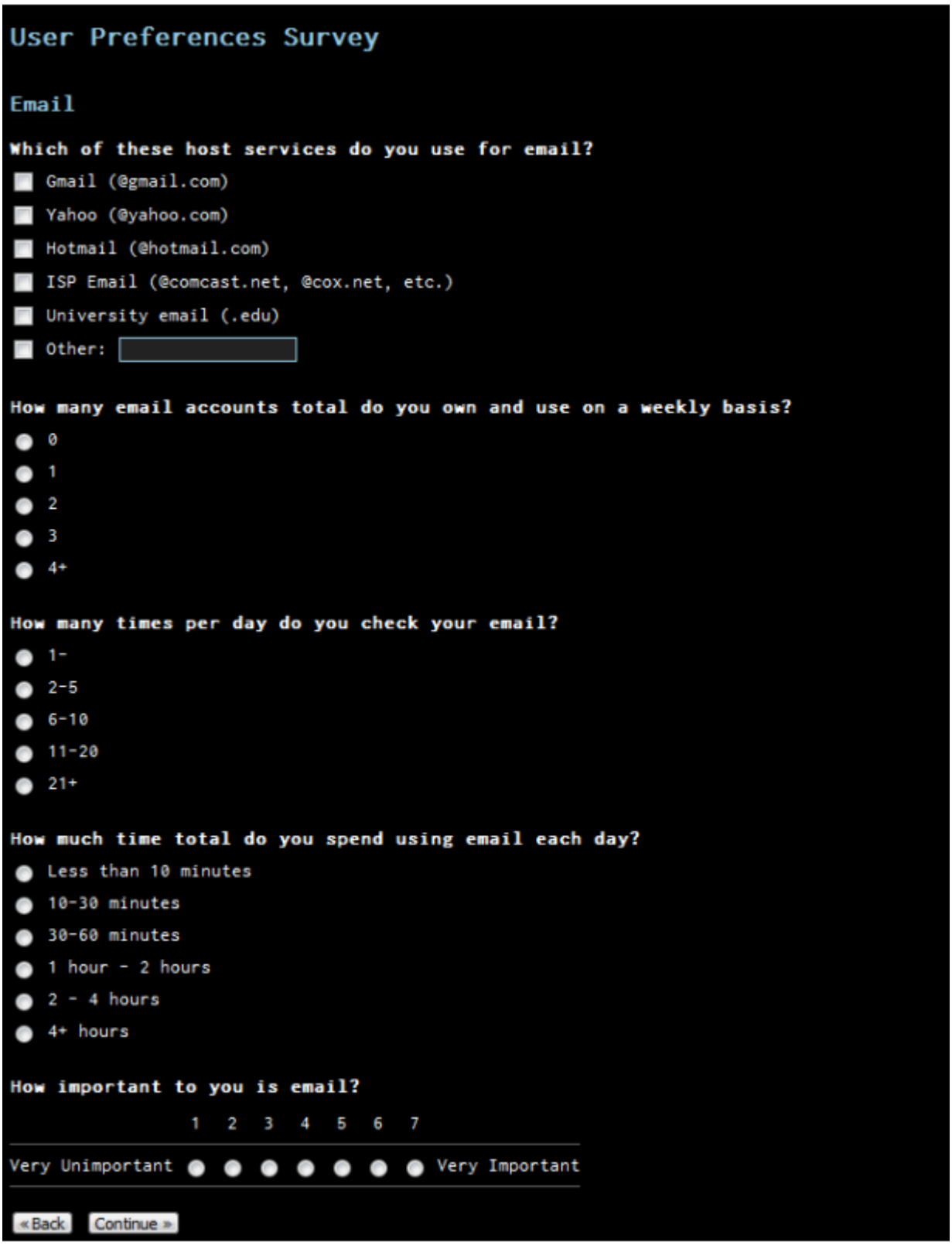
And visit us at

http://teams.gemstone.umd.edu/classof2014/rio/

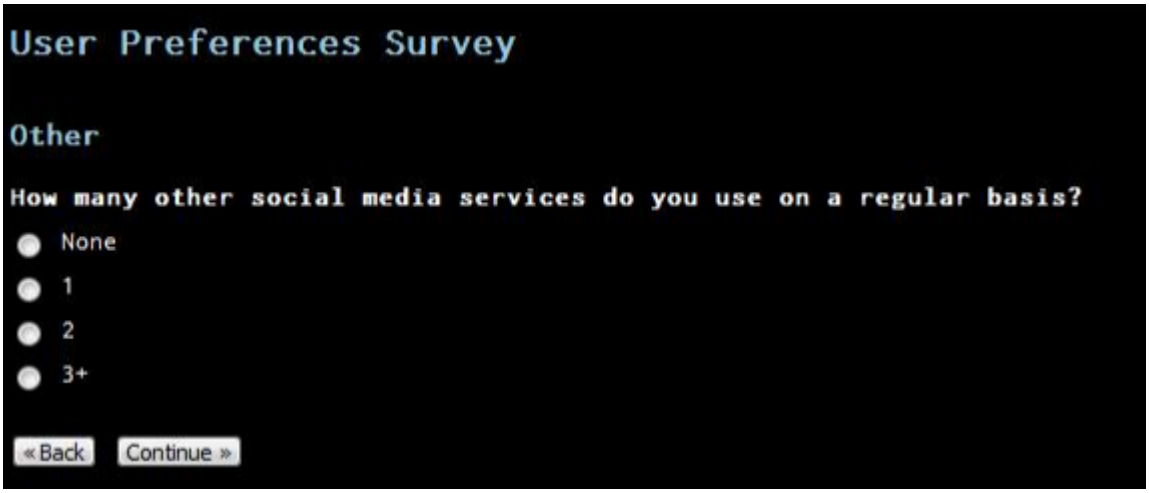
For a closer look at what we are doing!

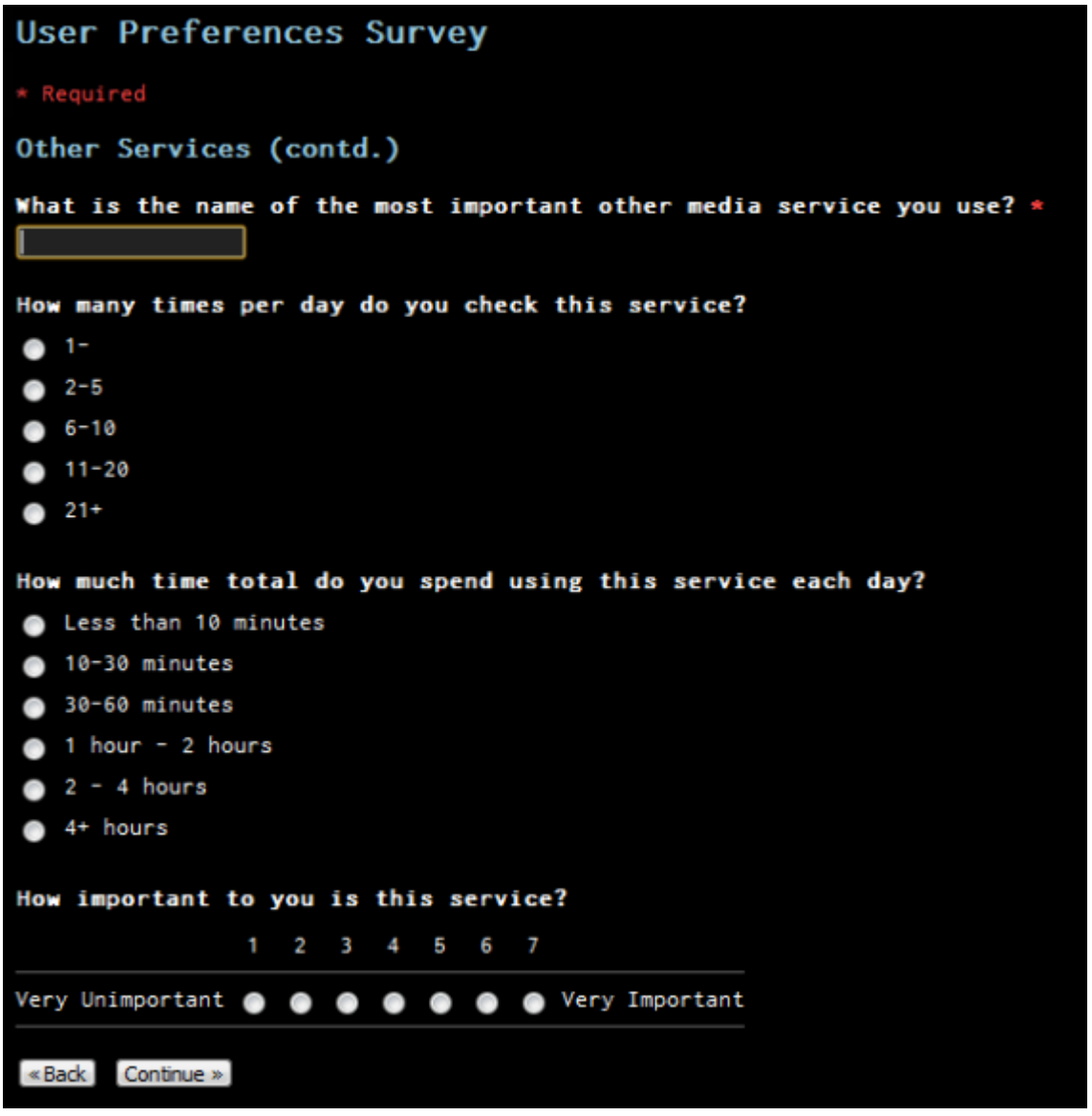
Appendix D.2: Product Specification Survey Questions:

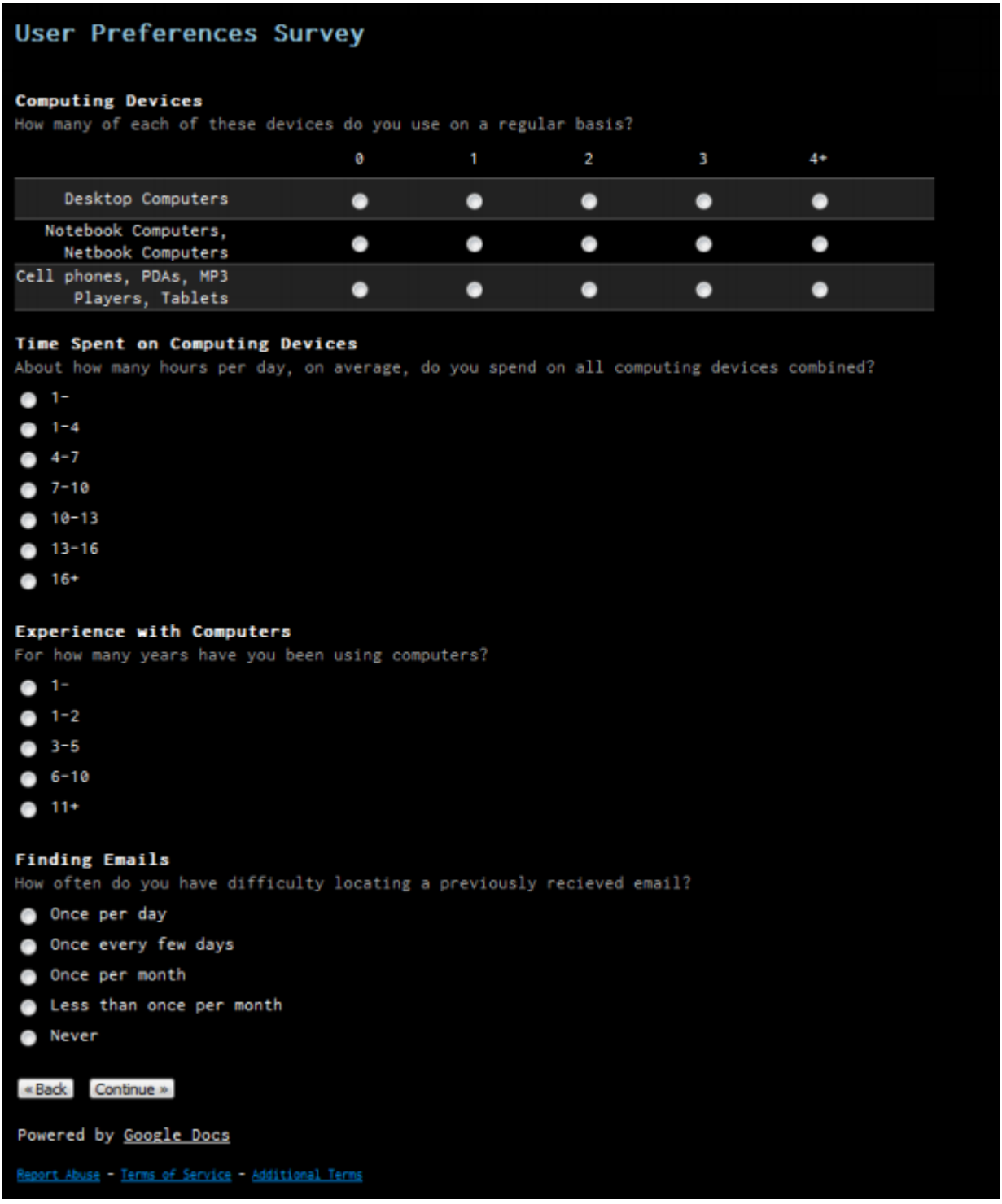



User Preferences Survey
Email
Which of these host services do you use for email?
Gmail (@gmail.com)
Yahoo (@yahoo.com)
Hotmail (@hotmail.com)
ISP Email (@comcast.net, @cox.net, etc.)
University email (.edu)
Other:
How many email accounts total do you own and use on a weekly basis?
0
1
2
3
4+
How many times per day do you check your email?
1-
2-5
6-10
11-20
21+
How much time total do you spend using email each day?
Less than 10 minutes
10-30 minutes
30-60 minutes
1 hour - 2 hours
2 - 4 hours
4+ hours
How important to you is email?
1 2 3 4 5 6 7
Very Unimportant
Very Important
« Back
Continue »


User Preferences Survey
Facebook
Do you have a Facebook account?
Yes
No (continue on to the next page)
How many times per day do you check Facebook?
1-
2-5
6-10
11-20
21+
How much time total do you spend using Facebook each day?
Less than 10 minutes
10-30 minutes
30-60 minutes
1 hour - 2 hours
2 - 4 hours
4+ hours
How important to you is Facebook?
1 2 3 4 5 6 7
Very Unimportant
Very Important
« Back
Continue »


User Preferences Survey
Other
How many other social media services do you use on a regular basis?
None
1
2
3+
« Back
Continue »


User Preferences Survey
* Required
Other Services (contd.)
What is the name of the most important other media service you use? *
How many times per day do you check this service?
1-
2-5
6-10
11-20
21+
How much time total do you spend using this service each day?
Less than 10 minutes
10-30 minutes
30-60 minutes
1 hour - 2 hours
2 - 4 hours
4+ hours
How important to you is this service?
1 2 3 4 5 6 7
Very Unimportant
Very Important
« Back
Continue »



User Preferences Survey

Computing Devices

How many of each of these devices do you use on a regular basis?

	0	1	2	3	4+
Desktop Computers	○	○	○	○	○
Notebook Computers, Netbook Computers	○	○	○	○	○
Cell phones, PDAs, MP3 Players, Tablets	○	○	○	○	○

Time Spent on Computing Devices

About how many hours per day, on average, do you spend on all computing devices combined?

- ○ 1-
- ○ 1-4
- ○ 4-7
- ○ 7-10
- ○ 10-13
- ○ 13-16
- ○ 16+

Experience with Computers

For how many years have you been using computers?

- ○ 1-
- ○ 1-2
- ○ 3-5
- ○ 6-10
- ○ 11+

Finding Emails

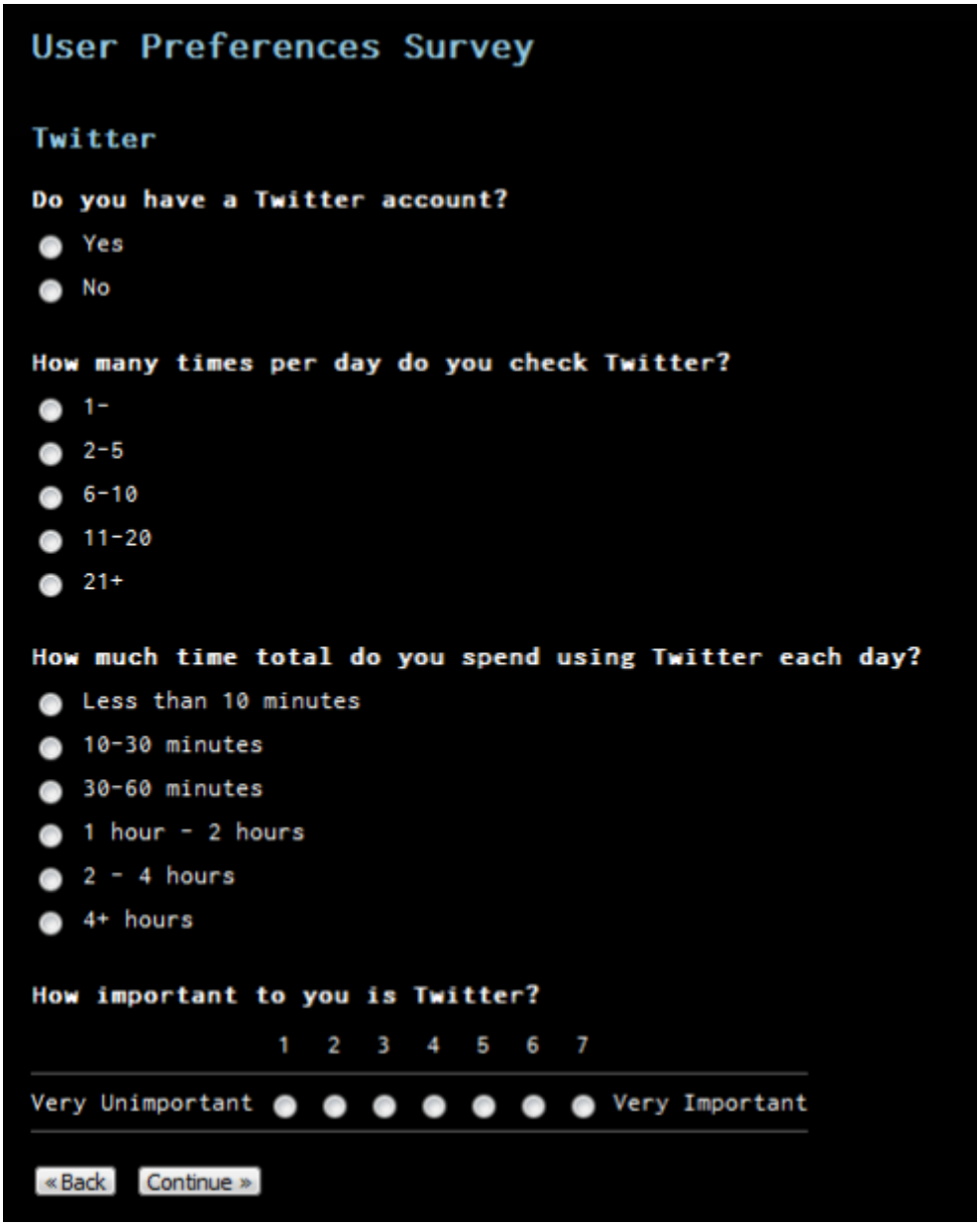
How often do you have difficulty locating a previously recieved email?

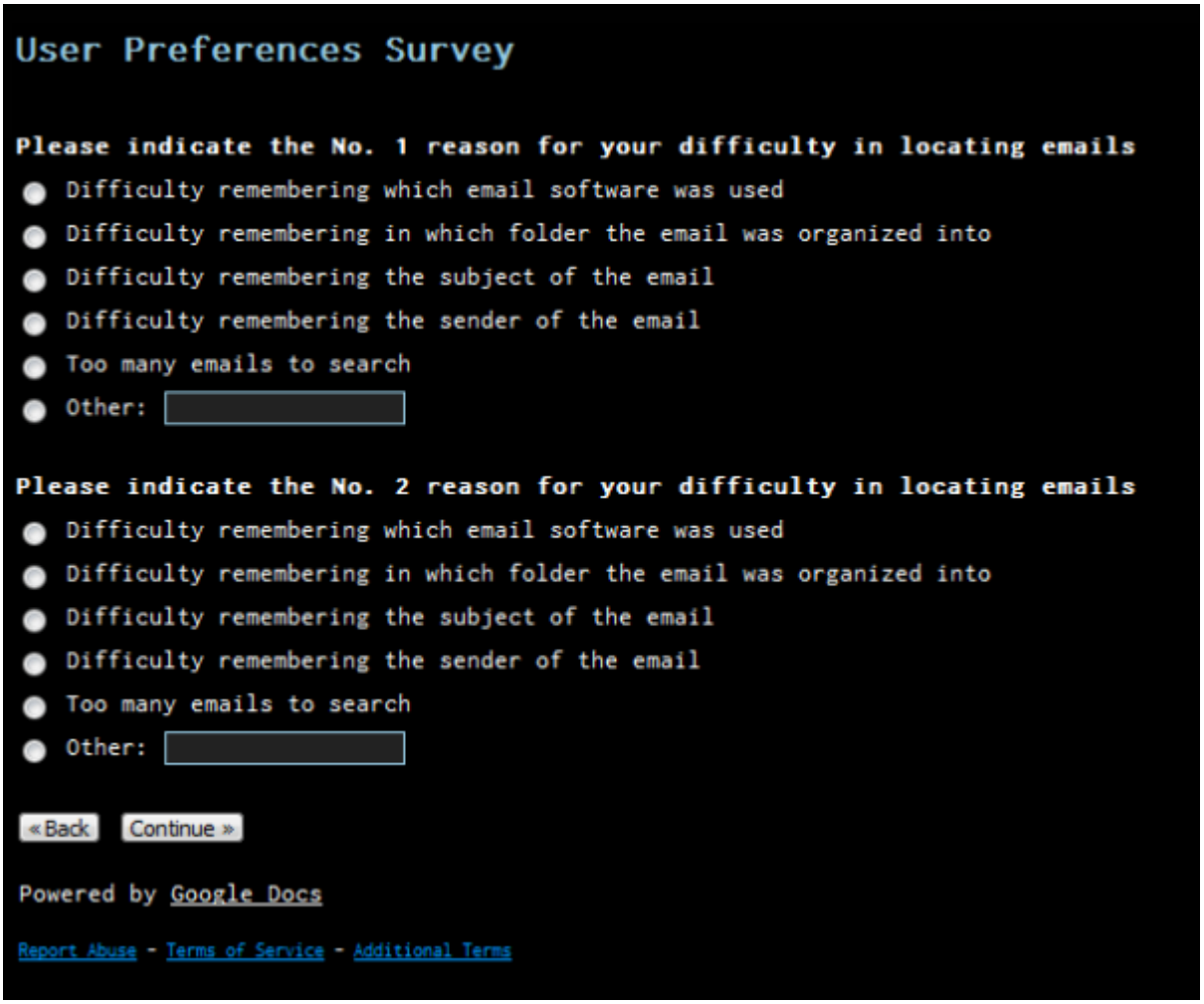
- ○ Once per day
- ○ Once every few days
- ○ Once per month
- ○ Less than once per month
- ○ Never

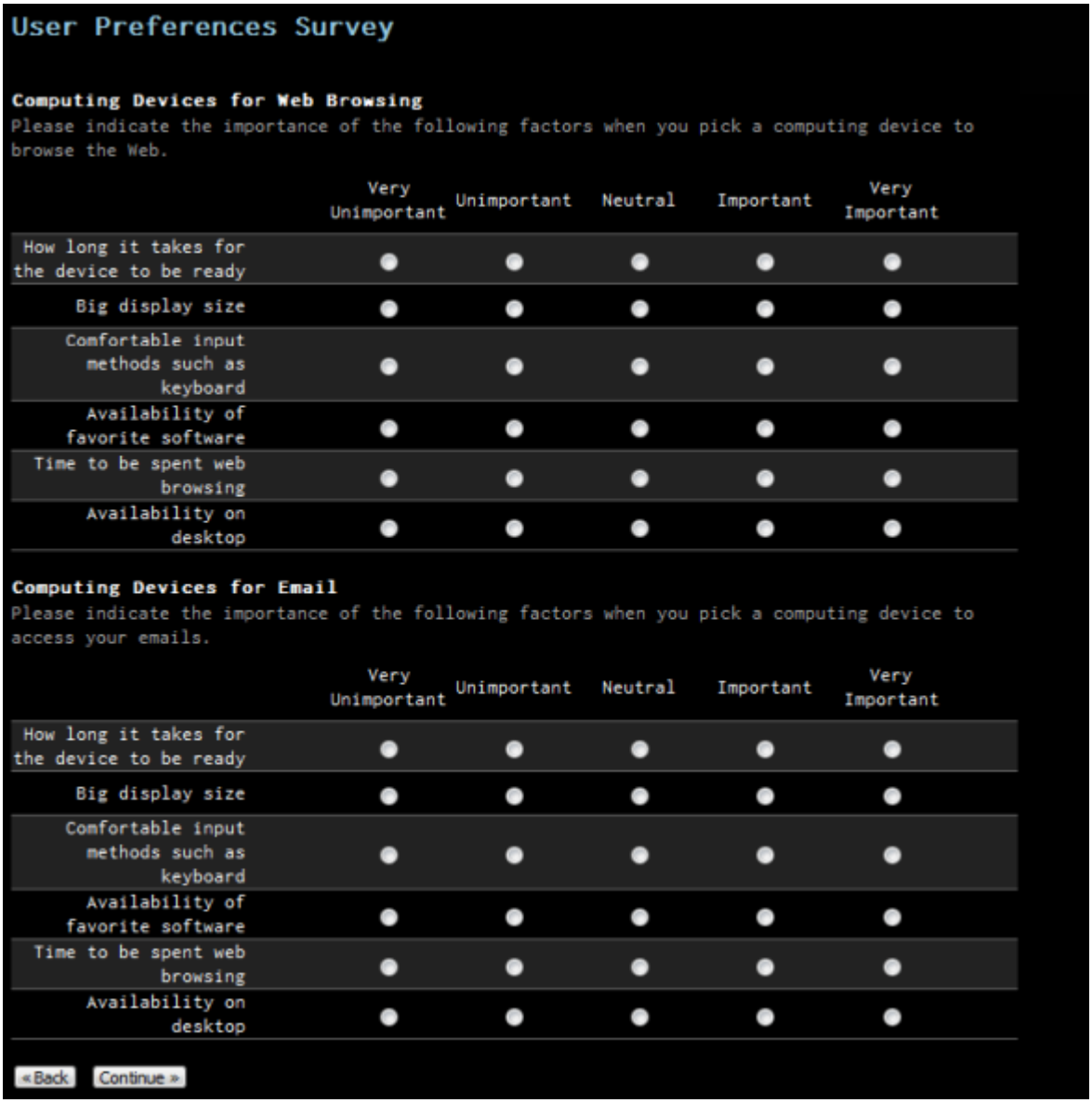
« Back Continue »

Powered by Google Docs

Report Abuse - Terms of Service - Additional Terms


User Preferences Survey
Twitter
Do you have a Twitter account?
Yes
No
How many times per day do you check Twitter?
1-
2-5
6-10
11-20
21+
How much time total do you spend using Twitter each day?
Less than 10 minutes
10-30 minutes
30-60 minutes
1 hour - 2 hours
2 - 4 hours
4+ hours
How important to you is Twitter?
1 2 3 4 5 6 7
Very Unimportant
Very Important
« Back
Continue »


User Preferences Survey
Please indicate the No. 1 reason for your difficulty in locating emails
Difficulty remembering which email software was used
Difficulty remembering in which folder the email was organized into
Difficulty remembering the subject of the email
Difficulty remembering the sender of the email
Too many emails to search
Other:
Please indicate the No. 2 reason for your difficulty in locating emails
Difficulty remembering which email software was used
Difficulty remembering in which folder the email was organized into
Difficulty remembering the subject of the email
Difficulty remembering the sender of the email
Too many emails to search
Other:
« Back
Continue »
Powered by Google Docs
Report Abuse - Terms of Service - Additional Terms



User Preferences Survey

Computing Devices for Web Browsing

Please indicate the importance of the following factors when you pick a computing device to browse the Web.

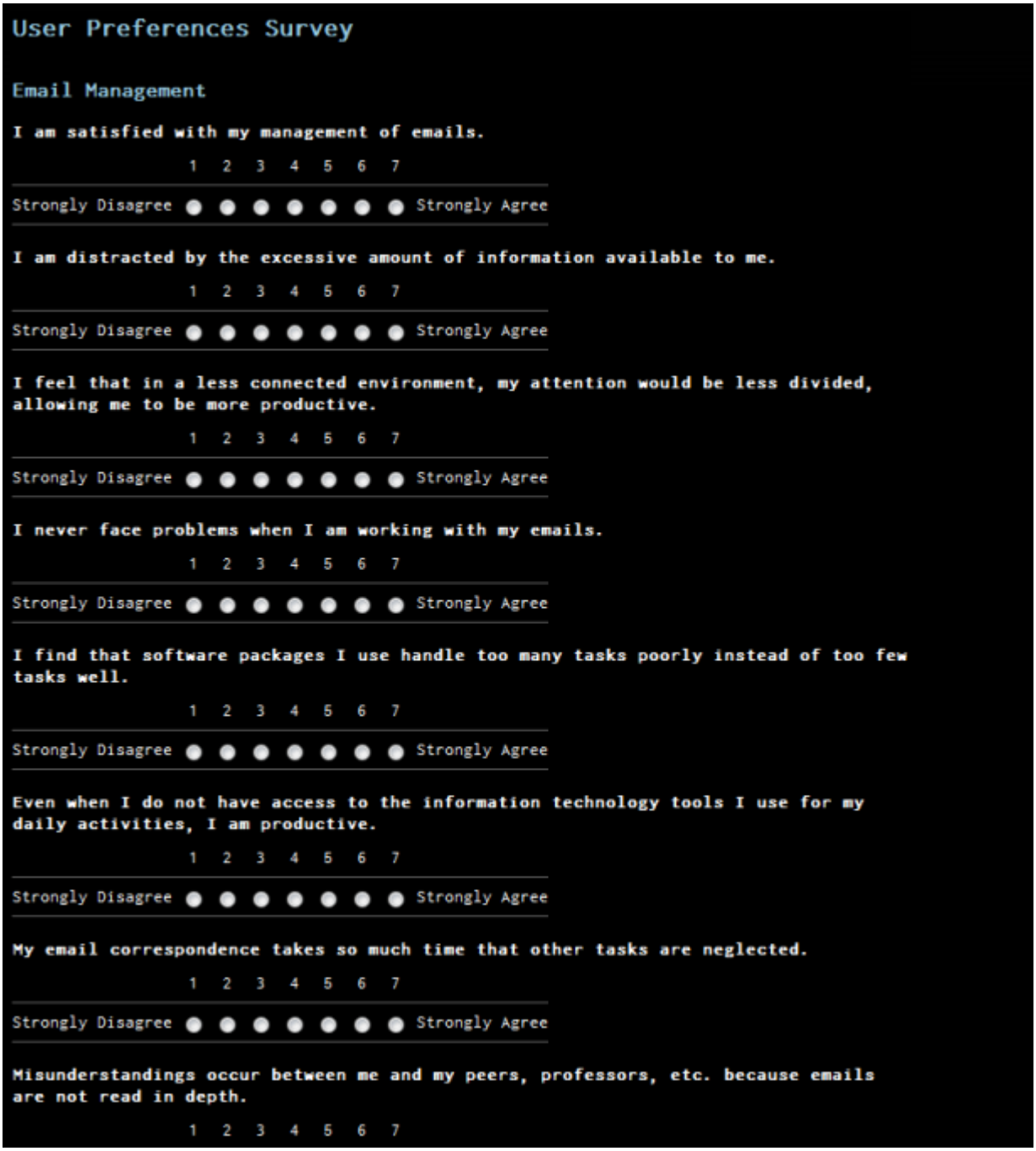
	Very Unimportant	Unimportant	Neutral	Important	Very Important
How long it takes for the device to be ready	○	○	○	○	○
Big display size	○	○	○	○	○
Comfortable input methods such as keyboard	○	○	○	○	○
Availability of favorite software	○	○	○	○	○
Time to be spent web browsing	○	○	○	○	○
Availability on desktop	○	○	○	○	○

Computing Devices for Email

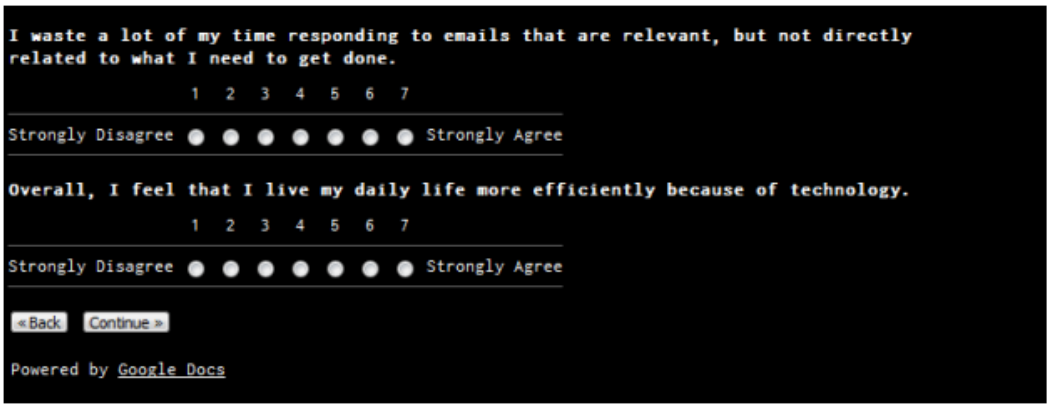
Please indicate the importance of the following factors when you pick a computing device to access your emails.

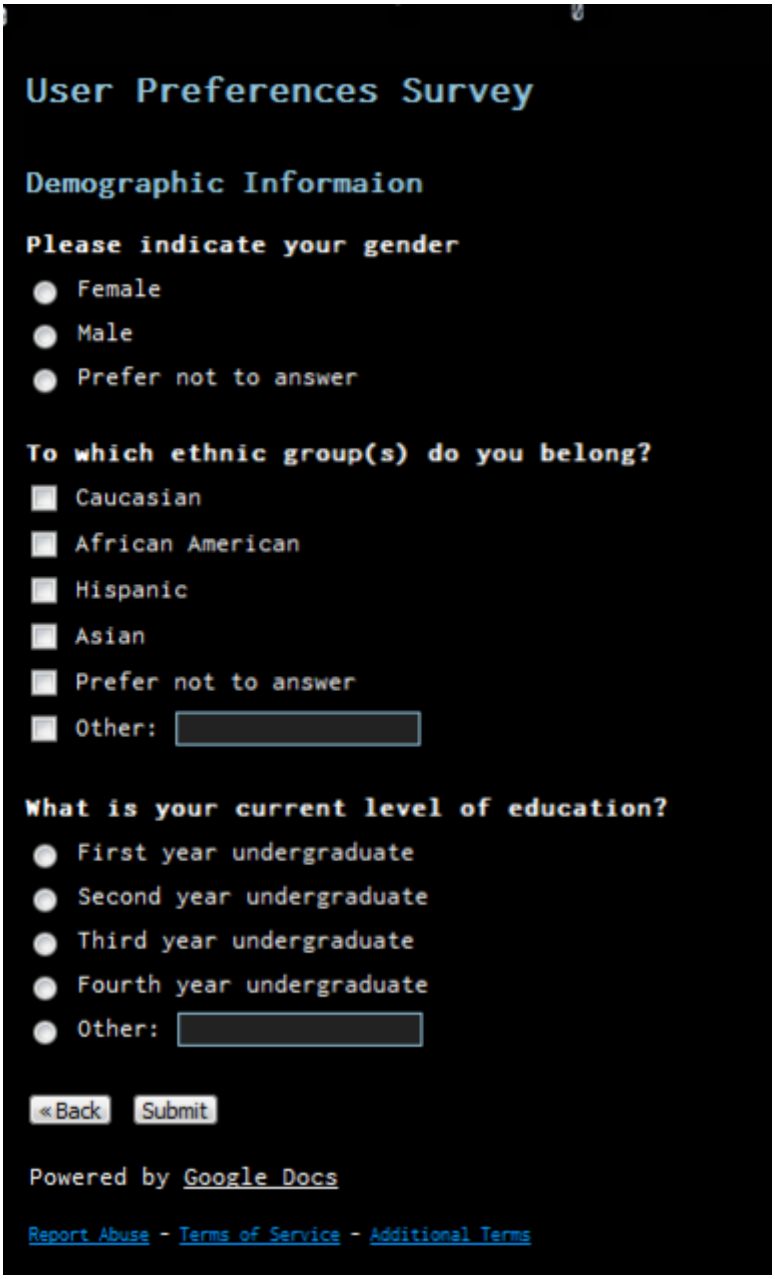
	Very Unimportant	Unimportant	Neutral	Important	Very Important
How long it takes for the device to be ready	○	○	○	○	○
Big display size	○	○	○	○	○
Comfortable input methods such as keyboard	○	○	○	○	○
Availability of favorite software	○	○	○	○	○
Time to be spent web browsing	○	○	○	○	○
Availability on desktop	○	○	○	○	○

« Back Continue »


User Preferences Survey
Email Management
I am satisfied with my management of emails.
1 2 3 4 5 6 7
Strongly Disagree Strongly Agree
I am distracted by the excessive amount of information available to me.
1 2 3 4 5 6 7
Strongly Disagree Strongly Agree
I feel that in a less connected environment, my attention would be less divided, allowing me to be more productive.
1 2 3 4 5 6 7
Strongly Disagree Strongly Agree
I never face problems when I am working with my emails.
1 2 3 4 5 6 7
Strongly Disagree Strongly Agree
I find that software packages I use handle too many tasks poorly instead of too few tasks well.
1 2 3 4 5 6 7
Strongly Disagree Strongly Agree
Even when I do not have access to the information technology tools I use for my daily activities, I am productive.
1 2 3 4 5 6 7
Strongly Disagree Strongly Agree
My email correspondence takes so much time that other tasks are neglected.
1 2 3 4 5 6 7
Strongly Disagree Strongly Agree
Misunderstandings occur between me and my peers, professors, etc. because emails are not read in depth.
1 2 3 4 5 6 7

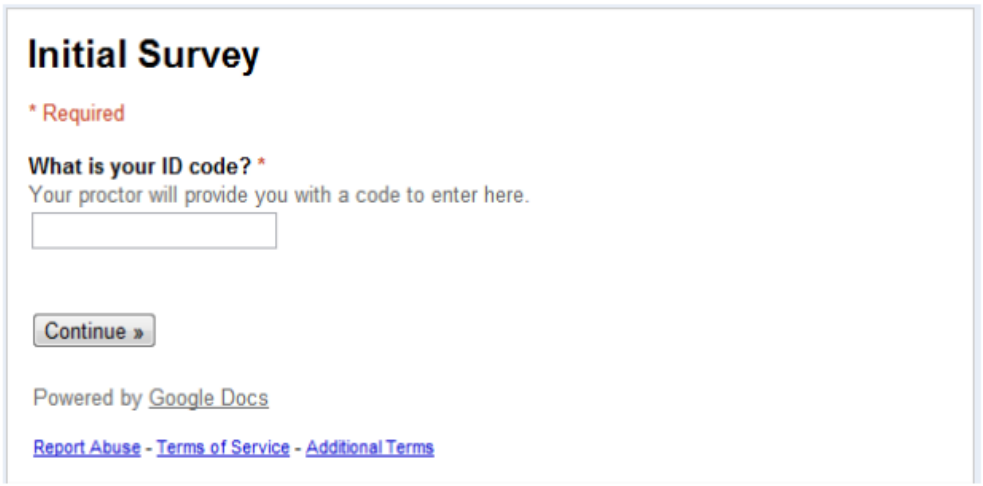

I rely on technology to the point that if the system is functioning slowly or unavailable, it directly affects my daily life.
1 2 3 4 5 6 7
Strongly Disagree
Strongly Agree
I do not become annoyed when problems with emails occur.
1 2 3 4 5 6 7
Strongly Disagree
Strongly Agree
Due to the excessive amount of information available to me, I find it hard to make decisions.
1 2 3 4 5 6 7
Strongly Disagree
Strongly Agree
I am never overwhelmed by the amount of information I have to process on a daily basis.
1 2 3 4 5 6 7
Strongly Disagree
Strongly Agree
I am often less productive because of poor user interface design in software programs I use on a daily basis.
1 2 3 4 5 6 7
Strongly Disagree
Strongly Agree
The availability of electronic communication has improved communications more than it has created an interruption.
1 2 3 4 5 6 7
Strongly Disagree
Strongly Agree
Many software applications I use tend to try to be too helpful which makes performing my job even harder.
1 2 3 4 5 6 7
Strongly Disagree
Strongly Agree
I often find myself overwhelmed because technology has allowed too many other people to have access to my time.
1 2 3 4 5 6 7
Strongly Disagree
Strongly Agree


I waste a lot of my time responding to emails that are relevant, but not directly related to what I need to get done.
1 2 3 4 5 6 7
Strongly Disagree
Strongly Agree
Overall, I feel that I live my daily life more efficiently because of technology.
1 2 3 4 5 6 7
Strongly Disagree
Strongly Agree
« Back
Continue »
Powered by Google Docs


User Preferences Survey
Demographic Informaion
Please indicate your gender
Female
Male
Prefer not to answer
To which ethnic group(s) do you belong?
Caucasian
African American
Hispanic
Asian
Prefer not to answer
Other:
What is your current level of education?
First year undergraduate
Second year undergraduate
Third year undergraduate
Fourth year undergraduate
Other:
« Back
Submit
Powered by Google Docs
Report Abuse - Terms of Service - Additional Terms

8.5. Appendix E: Affect, SOS/QUIS, and UI Surveys

Appendix E.1: PANAS-X Pre-test and SOS/QUIS Survey



Initial Survey

* Required

What is your ID code? *

Your proctor will provide you with a code to enter here.

Continue »

Powered by Google Docs

Report Abuse - Terms of Service - Additional Terms

Part 1 *

This scale consists of a number of words and phrases that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you are feeling this way when using technology OVER THE PAST WEEK. Use the following scale to record your answers:

	very slightly or not at all	a little	moderately	quite a bit	extremely
calm					
strained					
inadequate					
overextended					
confident					
bored					
no sense of getting ahead					
swamped by your responsibilities					
that the odds were against you					
that there wasn't enough time to get to everything					

Part 2 *

This scale consists of a number of words and phrases that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you are feeling this way when using technology OVER THE PAST WEEK. Use the following scale to record your answers:

	very slightly or not at all	a little	moderately	quite a bit	extremely
generous					
like you were rushed					
like you couldn't cope					
like you had a lot on your mind					
like nothing was going right					
carefree					
powerless					
overcommitted					
like your life was "out of control"					
like things kept piling up					

Part 3 *

This scale consists of a number of words and phrases that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you are feeling this way when using technology OVER THE PAST WEEK. Use the following scale to record your answers:

	very slightly or not at all	a little	moderately	quite a bit	extremely
like you could focus on important things					
like you had to make quick decisions					
like asking "what else can go wrong"					
like you didn't have time to breate					
like things coulnd't get worse					
peaceful					
like there was no escape					
like you wre carrying a heavy load					
like just giving up					
like there was "too much to do, too little time"					

Part 4 *

This scale consists of a number of words and phrases that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you are feeling this way when using technology AT THE PRESENT TIME. Use the following scale to record your answers:

	very slightly or not at all	a little	moderately	quite a bit	extremely
sad	○	○	○	○	○
active	○	○	○	○	○
angry at self	○	○	○	○	○
calm	○	○	○	○	○
guilty	○	○	○	○	○
enthusiaastic	○	○	○	○	○
attentive	○	○	○	○	○
afraid	○	○	○	○	○
downhearted	○	○	○	○	○
tired	○	○	○	○	○
nervous	○	○	○	○	○
sluggish	○	○	○	○	○
amazed	○	○	○	○	○
lonely	○	○	○	○	○
distressed	○	○	○	○	○

Part 5 *

This scale consists of a number of words and phrases that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you are feeling this way when using technology AT THE PRESENT TIME. Use the following scale to record your answers:

	very slightly or not at all	a little	moderately	quite a bit	extremely
daring	○	○	○	○	○
shaky	○	○	○	○	○
sleepy	○	○	○	○	○
blameworthy	○	○	○	○	○
surprised	○	○	○	○	○
excited	○	○	○	○	○
determined	○	○	○	○	○
strong	○	○	○	○	○
hostile	○	○	○	○	○
frightened	○	○	○	○	○
alone	○	○	○	○	○
disgusted with self	○	○	○	○	○
proud	○	○	○	○	○
astonished	○	○	○	○	○
relaxed	○	○	○	○	○

Part 6 *

This scale consists of a number of words and phrases that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you are feeling this way when using technology AT THE PRESENT TIME. Use the following scale to record your answers:

	very slightly or not at all	a little	moderately	quite a bit	extremely
alert	○	○	○	○	○
jittery	○	○	○	○	○
interested	○	○	○	○	○
irritable	○	○	○	○	○
upset	○	○	○	○	○
ashamed	○	○	○	○	○
confident	○	○	○	○	○
inspired	○	○	○	○	○
bold	○	○	○	○	○
at ease	○	○	○	○	○
fearless	○	○	○	○	○
blue	○	○	○	○	○
scared	○	○	○	○	○
concentrating	○	○	○	○	○
drowsy	○	○	○	○	○
dissatisfied with self	○	○	○	○	○

Appendix E.2: PANAS-X Post Test

Part 1 *

This scale consists of a number of words and phrases that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you are feeling this way AT THE PRESENT MOMENT. Use the following scale to record your answers:

	very slightly or not at all	a little	moderately	quite a bit	extremely
sad	○	○	○	○	○
active	○	○	○	○	○
angry at self	○	○	○	○	○
calm	○	○	○	○	○
guilty	○	○	○	○	○
enthusiastic	○	○	○	○	○
attentive	○	○	○	○	○
afraid	○	○	○	○	○
downhearted	○	○	○	○	○
tired	○	○	○	○	○
nervous	○	○	○	○	○
sluggish	○	○	○	○	○
amazed	○	○	○	○	○
lonely	○	○	○	○	○
distressed	○	○	○	○	○

Part 2 *

This scale consists of a number of words and phrases that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you are feeling this way AT THE PRESENT MOMENT. Use the following scale to record your answers:

	very slightly or not at all	a little	moderately	quite a bit	extremely
daring	○	○	○	○	○
shaky	○	○	○	○	○
sleepy	○	○	○	○	○
blameworthy	○	○	○	○	○
surprised	○	○	○	○	○
excited	○	○	○	○	○
determined	○	○	○	○	○
strong	○	○	○	○	○
hostile	○	○	○	○	○
frightened	○	○	○	○	○
scornful	○	○	○	○	○
alone	○	○	○	○	○
disgusted with self	○	○	○	○	○
proud	○	○	○	○	○
astonished	○	○	○	○	○

Part 3 *

This scale consists of a number of words and phrases that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you are feeling this way AT THE PRESENT MOMENT. Use the following scale to record your answers:

	very slightly or not at all	a little	moderately	quite a bit	extremely
relaxed					
alert					
jittery					
interested					
irritable					
upset					
ashamed					
confident					
inspired					
bold					
at ease					
energetic					
fearless					
blue					
scared					
concentrating					
drowsy					
dissatisfied with self					

Appendix E.3: User Interface Post-Test

Please answer the following 10 questions regarding the system you used to organize your electronic communications. Use the following scale:

I think that I would like to use this system frequently. *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

I found the system unnecessarily complex. *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

I thought the system was easy to use. *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

I think that I would need the support of a technical person to be able to use this system. *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

Demographic Information

Please indicate your gender

- ○ Female
- ○ Male
- ○ Prefer not to answer

To which ethnic group(s) do you belong?

- ☐ Caucasian
- ☐ African American
- ☐ Hispanic
- ☐ Asian
- ☐ Other
- ☐ Prefer not to answer

What is your current level of education?

- ○ First year undergraduate
- ○ Second year undergraduate
- ○ Third year undergraduate
- ○ Fourth year undergraduate
- ○ Other: _____

I found the various functions in this system were well integrated. *

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

I thought there was too much inconsistency in this system. *

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

I would imagine that most people would learn to use this system very quickly. *

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

I found the system very cumbersome to use. *

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

I felt very confident using the system. *

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

I needed to learn a lot of things before I could get going with this system. *

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

8.6. Appendix F

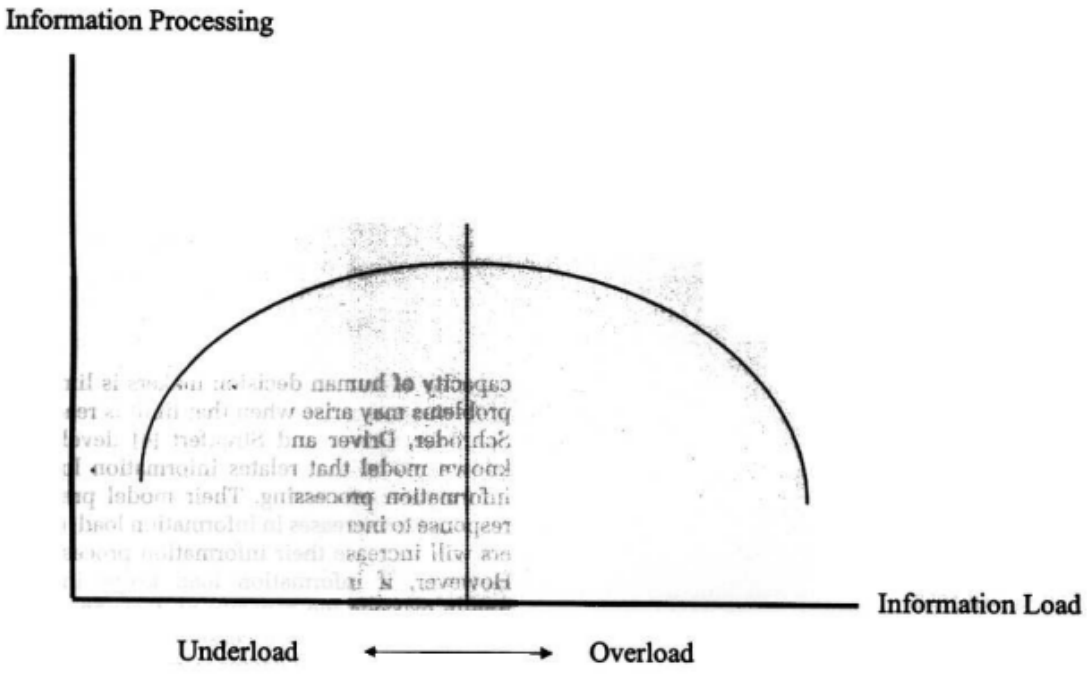


Figure 1: The amount of information processing versus information loading.

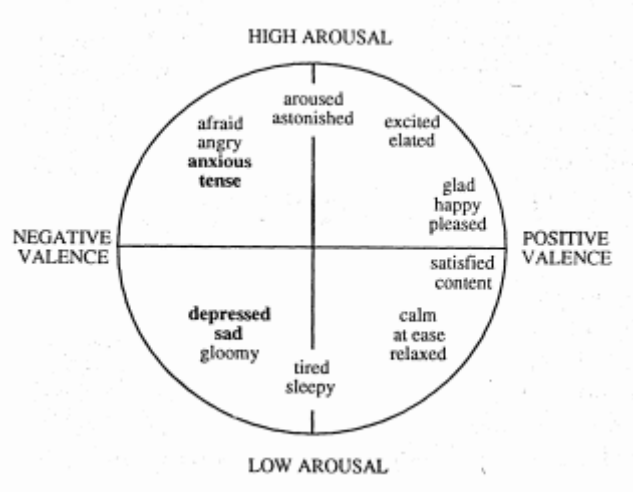


Figure 2: Circumplex representing affect.

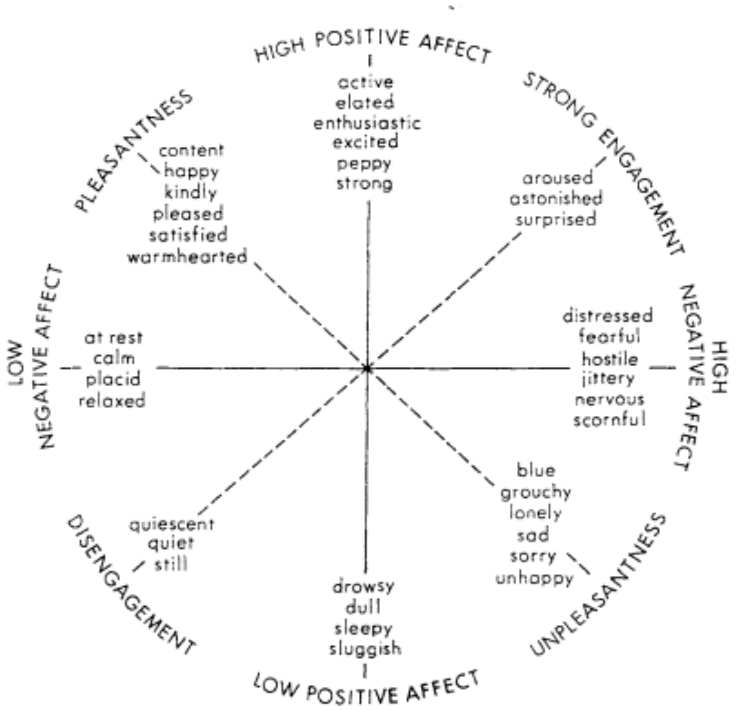


Figure 3: Ellipse Representing Affect