NEW APPROACHES TO OVERCOMING E-MAIL OVERLOAD

Shawn A. Weil*
David Tinapple**
David D. Woods**

* Department of Psychology
**Cognitive Systems Engineering Laboratory
Institute for Ergonomics
The Ohio State University, Columbus, OH

As e-mail has become the preferred medium for communication, the inbox and mail folders become one hub for organizing activities and schedule. The combination of a natural rise in message volume and the large amounts of unsolicited bulk messages (spam) have led some to suggest that the usefulness of e-mail is at an end; users feel overwhelmed by the sheer numbers of individual messages and the effort to manage the inbox. This paper frames the issue of e-mail/message overload as a specific example of data overload and uses previous results to suggest three design concepts – cognitive buoyancy, e-mail constellations, and the intelligent subject line – for use in e-mail.

Frank, a manager at a medium-sized technology company, has just returned from a two-week vacation. He arrives at work an hour before a full day of meetings. Upon checking his e-mail, he finds 900 messages in his inbox. There is very little spam – most messages are legitimate correspondence. Unable to read every message, he attempts to skim the index for the most important, and responds to them as appropriate. However, he meets limited success: he cannot determine the important messages from the trivial. He leaves for his meetings frustrated at his inability and assured in the knowledge that he still has some fires to put out.

INTRODUCTION

E-mail has become the means of choice for much of the world’s correspondence. These benefits become problems when the volume of use becomes very large. According to the popular media, workers feel overwhelmed by the sheer quantity of messages and are less productive as a result. The Toronto Star reported “A majority of business professionals are working more than an additional hour each day because of e-mail overload” (Hamilton, 2002).

Directed communications alone are enough to create overload and workload bottlenecks. Additionally, inter-office chatter, opt-in commercial messages, and newsletters all have the potential to attract and overload at the same time. The extent of spam e-mail messages – unsolicited commercial messages – has exacerbated the issue by increasing the proportion of irrelevant messages. The connectivity expansion represented by email combined with the form of representation – a single message organized as a packed list – add to the difficulties in recognizing more important correspondence against the general message traffic background.

E-mail or message overload may be considered one example of “data overload,” which has been defined as: “…a condition where a domain practitioner, supported by artifacts and other human agents, finds it extremely challenging to focus in on, assemble, and synthesize the significant subset of data for the problem context into a coherent assessment of a situation, where the subset of data is a small portion of a vast data field.” (Woods et al., 2002). Using this definition, message overload occurs when the e-mail user is unable to select the relevant messages for their context from the complete list of messages.

THREE CONCEPTIONS OF E-MAIL OVERLOAD

Woods et al. (2002) identified three ways people have characterized the problem of data overload. The first, overload as clutter, has proven of limited utility. The second, overload as a workload bottleneck, has led to attempts to automate away overload and has transferred the difficulties to machine agents that are rarely designed to coordinate effectively with the human user. The third characterization, overload as difficulties in recognizing significance given context sensitivity,
provides a stronger starting point for identifying new concepts to escape from message overload.

**E-mail overload as clutter: Overload happens because there is too much stuff**

In most commercial e-mail applications, incoming e-mail is displayed in a packed list or index of messages. Like a physical inbox on the desk of a mailroom clerk or secretary, the reader is ideally supposed to read each letter and then file or delete it. Overload is said to occur when the inbox is so full that nothing can be found easily. This may happen when the messages arrive too quickly for the user to keep up, or the user uses the inbox for a task it was not intended to perform, such as task management or archiving (Whittaker & Sidner, 1997), thereby leaving messages in the inbox for longer periods of time. As messages accumulate, the inbox is cluttered so that the important messages are obscured.

The most common response to e-mail overload when characterized as ‘clutter’ is to filter the ‘irrelevant’ information out. This is especially common when managing spam. Before messages arrive in the Inbox, algorithms or rules/list comparisons are used to evaluate the semantic content of the message body and headers to determine validity. ‘Hits’ are either eliminated at the server level or redirected to a folder which is in principle accessible to the user. Unfortunately, filters will make a small but important number of ‘False Alarms’ because the filter is dumb to the importance of the message in the context of the user’s work.

**E-mail overload as a workload bottleneck: There is too much work to carry out to analyze and respond to the messages.**

Each message has an associated workload burden to identify it, read it, re-organize it, respond to it, follow through on it, schedule it and so on. Thus, the pool of messages triggers too many tasks, either directly as a result of the message or indirectly as a result of the need to manage messages as part of their work activities. The workload bottleneck is especially vivid when one returns after event a short vacation without e-mail access, as the burden of sorting through the work implications of several hundred new messages is overwhelming.

When we focus on the workload aspect of message overload, solutions tend to focus on adding machine agents that can do the work of prioritization, sorting, finding connections across messages, or mapping the content of messages to user activities (Bradshaw et al., 2004). The effectiveness of the software agent approach depends on the capabilities of the agent and on its ability to coordinate with the user. The software agent will also have to cope context sensitivity—what is important to the reader depends on the relationship of the individual message to other messages, the user, the sender, and their environments. As Lee (1994) points out, “[people] who receive emails are not passive recipients of data, but active producers of meaning.” Can the software agent participate in a collaborative process to help the user see connections and find importance? Can the software agent learn from the user and update its model of the factors influencing what is important?

There is no doubt that overload has some of the characteristics of a bottleneck. But neither reducing the magnitude of the problem by increasing the size of the bottle nor reducing the amount of information going in the “opening” are feasible. Machine agents would be helpful in alleviating the problem, but only if the mechanisms for prioritization are transparent, based on human behavior, and trust on the agent is tempered by user oversight.

**The significance of messages in context: How do messages relate to each other, to the reader, and to the reader’s goals and expectations?**

The definition of e-mail overload specified that the main issue is one of recognizing significance. If the user is able to discriminate between relevant and irrelevant messages, there is no overload problem. If the problem is the inability to discriminate between signal and noise, the remedy to the problem must include tactics that support seeing relationships and patterns at a glance.

Three design kernels are presented to support recognizing significance in e-mail. These ideas are based on lessons learned in other domains (e.g., Patterson et al., 2001). These ideas concentrates on highlighting relationships among messages.

**THREE DESIGN KERNELS**

**Cognitive Buoyancy**

In a traditional e-mail application environment, mailbox presentation consists of packed lists of messages. When there is an influx of messages, the important are not easily distinguishable from the unwanted. In part this occurs because email is organized around each message when the user participates in conversations and joint activities. Many messages may be part of just a few ongoing interchanges. One message that looks just like many other messages may be much more important because its content signals a new direction for an ongoing activity. An interchange may pick up speed and start to involve more parties or it may go dormant for a period of time given natural rhythms of activity. What is needed is a way to shift from seeing messages to seeing communicative relationships (Tinapple & Woods, 2003).
Building on the ideas developed in Tinapple & Woods (2003), an informational equivalent to ‘buoyancy’ has been developed as an emergent pattern representation. Physically, buoyancy is the tendency of a body to float or to rise when submerged in a fluid. Cognitively, buoyancy is the tendency of a body of "relevant" information to rise to our attention in a workspace. The ‘workspace’ here can be a small screen display, or a large scale operations center.

Following the analogy, the "fluid" in cognitive buoyancy is attention. When new "objects" are placed in representation, they displace (require) some of the observer’s attention. When an object displaces enough attention to offset its ‘weight’ (high enough ‘profit’), it should feel the upward force exerted on it. In physical buoyancy, every object submerged in a fluid feels the upward buoyant force, but they also feel the downward force due to gravity. It is the difference between buoyancy and gravity that determine whether an object will rise or fall. In the cognitive analogy all objects tend to drift down with time unless activity or other indicators of relevance exert an upward ‘force’. Combining the different pressures into a visual computation generates a space of communicative relationships or channels that drift up or down in relevance as activity patterns change.

A channel is a visual representation of a conversation taking place. This conversation has a character, and visually representing this character means showing rhythm, tempo, flurries of activity, and absence of activity. (conversations over time) This means showing messages over time as a base frame of reference. The character of recent communications becomes a visual background against which change can be seen as relationships become quiescent, stale, active, or new. The goal is to shift from managing messages to managing conversations.

In the attempts to study cognitive buoyancy, a channel was defined as all messages from any one sender (including messages/replies back to that sender). The "buoyancy" of a channel was determined primarily by the recency of activity in the channel. A new message always carries its channel to the top of the list. These simple rules had the effect of prominently displaying fresh conversations, while less active or abandoned channels "sink" or are pushed down by the more active channels. The emergent effect when email activity is replayed faster than real time is one of buoyancy.

Expanding on this simple experiment, the rule can be extended to include the 3 most recent messages in a channel (rank then is based on the mean "age" of the 3 most recent messages). Ranking in this manner takes into account the history of the conversation taking place. Three messages in quick succession from a sender will rank higher than 3 messages spaced apart. In this way, message "flurries" will add buoyancy to the sender.

The initial tests only used the senders email address as the defining cue. It is not difficult to imagine more complex definitions of relationships. We might have a channel which "looks" for any appearance of a certain word, phrase, or attachment in messages from -any- sender. We might have channels which are reserved for messages sent only to me, not Cc or Bcc to other recipients, or a channel reserved for a specific topic or project, trained to look for a key phrase from any of a number of people on a project. As a result, a single message might "land" in multiple relationship channels.

Fundamentally, this approach capitalizes on metadata to determine buoyancy. Increasing the number of dimensions that influence the determination of buoyancy, or tacitly correlating channels with user behavior, would increase the usefulness. Each indicator of relevance is imperfect and new ‘smarter’ mechanisms will emerge. However, used together to indicate emergent ‘buoyancy patterns,’ a robust visualization of relevance may result which can increase user recognition of ‘important’ messages in context.

The Message Constellation

Relationships among the messages may not be apparent when incoming messages appear in the Inbox and outgoing in a Sent e-mail folder (Figure 1). Changing the grain of display from single messages to groups of messages would support tracking ongoing conversations and joint activities among several individuals.

The ‘message constellation’ provides an alternative visualization for ongoing e-mail conversations. Consider the conversation depicted in Figure 2. In this very simple e-mail conversation, three individuals are deciding where to go for lunch. The traditional packed list presentation is illustrated in Figure 1 from the perspective of the ‘diamond.’ In this representation, a gross indication of relationship is given by the similarity in subject line and proximity of dates.

Figure 3 illustrates the message constellation. The icons in the bottom pane represent individual incoming and outgoing e-mail messages. In a space that is separate from the packed list representation, these icons are grouped together in ways that are meaningful to the user, via automation and user direct manipulation of messages and objects. In this illustration, the horizontal axis represents time. Lines connecting messages and objects are indicators of the relationships among the icons they connect. Anchored to the representation of the constellation is a window that displays the text of the message.
The e-mail constellation can reduce e-mail overload by providing a framework for new messages to automatically appear in the context of existing conversations. If the automation is accurate, incoming messages that are likely candidates for existing constellations could be displayed more prominently, or can be conditionally inserted. The constellations themselves could be displayed in another window, with the relationship between the new message and the existing messages highlighted. If the constellations are used for project management, the inbox would no longer have to be used for that purpose, thereby clearing away messages that are no longer relevant.

**Intelligent Subject Line**

The subject line is perhaps the most important part of the e-mail message today for users to determine potential relevance. E-mail marketers conceive of the subject line as the “invitation” to the message (Rhodes et al, 2001). When deciding which messages to open and which to skip, it is the subject line which ideally allows the user to make decisions about relevance, about organization, and about context. Despite of this, subject
line construction has not been studied, and good subject line composition is not supported by e-mail applications. Using generic subject lines (i.e., “Meeting” or “FYI”) do not support discriminating the relevance of messages. With more consistent composition, automated and manual selectivity would have higher efficiency, reducing e-mail overload.

Subject lines could be predefined by an administrator and used when applicable, in conjunction with manual submissions. Users could write their e-mail and choose a subject line from pulldown choices. These pulldowns menus could be hierarchical; the listings in the second or third column could be dependent on the second column. If the semantic content of the message is rich enough, it is possible for automation to add to the subject line – a truly intelligent subject line.

When an e-mail is received, there is further opportunity to use the subject line. The subject line serves as part of the collaborative process that leads to common ground; an opportunity for all parties to understand what the referent is. The subject line could be a good referent for the sender, yet meaningless to the receiver. Semantic analysis of incoming messages could be used to alter subject lines, making them more meaningful to the recipient.

The intelligent subject line leads us to consider a basic paradox: how to provide readers with ways to predict the context of the message before reading it (or what Woods [1995] called preattentive reference).

CONCLUSIONS

E-mail overload is a fact of the modern workplace and will likely become worse. Solutions that rely solely on filtering hobble the user by insuring that some wanted messages will never be seen. The design seeds introduced in this report are examples of the need to shift to relationship based organizations and to help users see emergent patterns in their communication space. These concepts require background automation to support the visualization concepts. They also can be used to integrate the results from new algorithms that attempt to identify relevant content or messages. None of these ideas have been instantiated in existing systems to be tested empirically. However, both Rohall (2002) and Kerr (2003) describe approaches that are similar in style to the e-mail constellation which are currently in development.

ACKNOWLEDGEMENTS

Prepared through collaborative participation in the Advanced Decision Architectures Consortium sponsored by the U. S. Army Research Laboratory under the Collaborative Technology Alliance Program, Cooperative Agreement DAAD19-01-2-0009.

Correspondence concerning this article should be addressed to Shawn Weil, who is now at Aptima, Inc., 12 Gill St., Suite 1400, Woburn, MA 01801, USA. E-mail: sweil@aptima.com

WORKS CITED


