

# Attending to Email

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**Email has become deeply embedded in many users' daily lives. To investigate how email features in users lives, particularly how users attend to email, we ran a 2-week study that logged interactions with email and gathered diary entries related to individual sessions. Our study showed that the majority of attentional effort is around reading email and participating in conversations, as opposed to email management (deleting, moving, flagging emails). We found that participants attended to email primarily based on notifications, instead of the number of unread messages in their inbox. We present our results through answering several questions, and leverage conversation analysis, particularly conversational openings, to explicate several issues. Our findings point to inefficiencies in email as a communication medium, mainly, around how summons are (or are not) issued. This results in an increased burden on email users to maintain engagement and determine (or construct) the appropriate moment for interruption.**

## RESEARCH HIGHLIGHTS

In this article, we have several research contributions on how users attend to email, how email features in their lives, and why there is anxiety involved in email use.

- The majority of attentional effort in email is around reading email and participating in conversations, as opposed to email management and triage (e.g. moving or deleting messages).
- Participants in our study respond much more strongly and frequently to notifications about individual messages, as opposed to the overall criticality of the inbox (i.e. the unread count).
- Our participants did not use the unread count, even though this is one of the few methods provided for monitoring email.
- We leverage conversation analysis (CA), particularly around conversational openings and summons-answer sequences to explain how email grabs attention.
- We also categorize emails into four different types of requests for attention.
- Overall, we find that conversations through email increase the burden of determining interruptibility on the receivers of email, when comparing with other mediums (e.g. face-to-face and over the phone).

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## 1. INTRODUCTION

Email has become deeply embedded in many peoples' daily lives. Since its inception, email has become an evermore ubiquitous and central tool, playing a part in many work and personal activities. Email is used to communicate with friends, family and co-workers; interact with automated systems; and to facilitate organization, coordination and collaboration. It is a core application in many of our most familiar personal

computing devices. As a result of all of these factors, email has become a staple for computer users and has received a great deal of attention from both research and industry.

Much of this research and development has focused on the problems centered around email overload (Whittaker and Sidner, 1996), namely around the triaging and management of messages (Whittaker *et al.*, 2006). Hence, the problem of the sheer amount of emails people can receive is well known,

it can take a large amount of time to simply manage the volume. However, an interesting related question is about the *draw* and disruption email can have during our daily lives. There has been comparatively less research around how email features in users' daily lives, particularly how email attracts attention, how users attend to email (Whittaker *et al.*, 2006), engage in sessions and employ strategies to manage their email interaction. While researchers are addressing this gap, there are still calls for qualitative studies around the 'lived experiences' of email (McMurtry, 2014).

Industry publications have noted the common problems with email that we are all familiar with.<sup>1,2</sup> They also propose several strategies in dealing with these problems, or even issue calls to action about collectively reducing email use.<sup>3,4,5</sup> In many senses, we are all very engaged with the problem of email and the effect that it can have on our daily lives. The concerns voiced in the media have been echoed in research communities. Whether it is the breaking down of boundaries associated with email use (Cecchinato *et al.*, 2014), or the amount of time it typically takes to re-engage with the interrupted task (24 min) (Hemp, 2009), or the effect on our productivity and well being (Chase and Clegg, 2011), or simply its propensity to increase burn-out (Reinke and Chamorro-Premuzic, 2014).

In this article, we report our investigation into how email features in users' daily lives, with a particular focus on how users *attend* to email. The purpose of this study is to provide a qualitative depth of understanding to how users engage with email throughout the day, as well as to determine which activities seem to take up the most time. Through our investigation, we gain insight into how users manage email and how it *manages* them (i.e. the way its design, functioning, and status within activities and relationships influences user behavior). We seek to give a greater depth of understanding to several aspects of how users attend to email and propose several questions as the framework for our investigation.

What aspects of email grab user attention and draw them in? What level of engagement with email do users maintain while not specifically using the email application? Furthermore, once users enter into email, what activities do they do and what keeps them in email for longer sessions? What are the consequences and perception of engagement with email? Finally, are users of email developing strategies to manage any of these factors (indicating their awareness of them)? Of course, these questions are not straightforward to answer comprehensively but through studying users we can begin to unlock them.

<sup>1</sup><http://www.businessknowhow.com/manage/email-overload.htm>

<sup>2</sup><http://www.motherjones.com/media/2014/05/smartphone-addiction-statistics-work-charts>

<sup>3</sup><http://blogs.hbr.org/2012/02/stop-email-overload-1/>

<sup>4</sup><http://www.businessweek.com/articles/2013-12-19/asanas-justin-rosenstein-on-e-mail-overload>

<sup>5</sup><http://www.forbes.com/sites/drewhansen/2012/12/15/stop-the-madness-a-call-to-reduce-email-overload/>

Our hypotheses around these questions are that users engage with email for a number of reasons such as, receiving a notification, having a high unread count or engaging in routine sessions. Therefore, there is a complex mixture between situations where users make deliberate, premeditated decisions to engage with email and other situations, where they have been pulled into the application in a less deliberate, more situational manner. We further hypothesize that the activities of these different types of sessions are different in discernible ways. We believe the situation around email is complex and nuanced, relating not only to several features of the email content (and to an extent the technology itself), but also shaped by a wider context of on-going relationships and activities.

To probe these questions we ran a 2-week study of 20 participants, where we logged their interactions with email via IMAP, gathered diary entries for specific usage sessions, and administered a survey to discover any practices and strategies not detected otherwise. With this method, we were able to gather a relatively rich view into each participant's email usage.

We find that much of the work that our participants are engaging in is around reading email and participating in conversations, even though this represents a small portion of the overall number of email messages. Therefore, our participants spent a disproportionately large amount of time reading (engaging with the content of an email) and participating in the conversations that this engagement sparks. When this is compared with the small amount of time that participants spent moving and deleting email, it seems that users are quite suited to finding the relevant emails within their inbox. We bring structure to our analysis through the use of conversation analysis (CA) (Sacks *et al.*, 1992; Schegloff, 1968, 2004). We contrast aspects of email communication (i.e. how email grabs attention and how email use plays out as sequences of interaction) with conversations from other media and outline why certain similarities and differences contribute to and explain particular phenomena and difficulties we observed. We discuss how some features of email can have mixed consequences or be simply unhelpful to people, and discuss how they might be changed. Our analysis points to key topics but it is not exhaustive and therefore suggests several future topics of investigation.

In this paper, we first review the related work, explain the system and method that we used during the study, and finally present and discuss the results of our study. We explain decisions to attend to email through the discussion of email messages and their presentation to us as both summonses and requests (Sacks *et al.*, 1992; Schegloff, 1968). The participants in our study attend to email mostly because of individual notifications and not because of the number of unread messages in their inbox. We highlight decisions and strategies to attend to email to show that the nature of thought that goes into email work appears variable, and outline emails as either summonses to conversations or requests for attention. Users appear at times drawn into email almost without thinking, or to get lost (i.e. spend more time than they intended in doing email), with only realizing after-the-fact.

## 2. RELATED WORK

Email is an important tool worthy of study and has been called one of the most successful computer applications (Dabbish and Kraut, 2006; Whittaker and Sidner, 1996; Whittaker *et al.*, 2007). It is considered to be a common, if not critical, part of everyday life for many, especially at work (Dabbish *et al.*, 2005; Ducheneaut and Watts, 2005; Fisher *et al.*, 2006; Mackay, 1988; Wainer *et al.*, 2011; Whittaker *et al.*, 2011). As such it has a long history of research in its forty years of existence and there have been many tools proposed to help users once they are in the inbox (Cselle *et al.*, 2007; Faulring *et al.*, 2010; Freed *et al.*, 2008; Nardi *et al.*, 2002; Venolia and Neustaedter, 2003; Whittaker *et al.*, 2004). While many of these tools have centered around email triage, Vacek (2014) has recently reiterated the call for better email triaging tools. However, Kokkalis *et al.* (2013) (in creating EmailValet, where task detection was done by the crowd) questioned the utility of the better detection, hypothesizing that it may be causing extra, unnecessary work. A slightly different tool, MinEMail (Rector and Hailpern, 2014), layered an additional level of notification for more important senders. Singh *et al.* (2013), posits that the problems around email are caused by its inability to scale to the volume of emails we receive, as it was designed to mimic paper-based workflows.

Email is also a place to do work. Researchers have both studied and proposed several re-imaginings of the inbox in terms of the tasks that are contained within it. Gwizdka (2000, 2002) called for more explicit support for tasks within the email client, citing the propensity of its users to use it in a variety of ways and in a variety of temporal aspects. Bellotti *et al.* (2003) created a system that brought task management very prominently to the inbox.

Even though email is a place of work, increased engagement with email increases feelings of overload (Sumeckia *et al.*, 2011). Other studies have also identified that email volume contributes to email stress, as well as worrying about email (Jerejian *et al.*, 2013). Along these lines, we seek to understand what the source of worry within email is and what are the causes for increased use.

There have been proposals other than redesigning the tool. Chase and Clegg (2011) proposed that users better manage sender expectations. Others have called for organizational training courses (McMurtry, 2014), or to put limits on email as a company or an individual (Hemp, 2009). Bradley *et al.* (2013) found evidence for the efficacy of these types of approaches in reducing email stress, when they found that infrequent checking is better than frequent checking for email related stress. Although, this is somewhat in contrast to the findings of Dabbish and Kraut (2006), where it was found that frequently checking email reduced email related stress.

There are mixed signals emerging from the research into email use. As such, with this study we endeavor to bring understanding to a key point of email use, how users decide to attend to email. We link qualitative insights about the reasons

our participants engaged with email with quantitative insights into what types of actions cause lengthier sessions. While we acknowledge that not all of these sessions are necessarily destructive, we cite the literature above to substantiate our general treatment of increased email usage as a concern.

Researchers in the area have also proposed multiple frameworks to assist in understanding the topography of research activities. Ducheneaut and Watts (2005) proposed several metaphors for email, a file cabinet, production line or communication genre. Whittaker *et al.* (2007) divide email into activities of allocating attention, deciding actions, managing tasks and organizing messages into folders. We find Whittaker *et al.* (2007) to be particularly useful in highlighting the lack of knowledge in how users decide when and why to attend to email. In fact, when Whittaker *et al.* proposed this framework they highlighted that there has been ‘relatively little systematic study of what causes people to attend to their email’ (Whittaker *et al.*, 2007, p. 172). This was further echoed by McMurtry (2014), who called for more qualitative studies around the ‘lived experience’ of email. Rennecker and Derks (2013) also call for more multi-dimensional investigations of email overload that look at more than just email length or the number of emails.

Whittaker *et al.* (2007) further divide the allocation of attention into (1) the decision of *when and why* to attend to email and (2) deciding *which* messages to attend to once the user has entered into the email client. While the focus of this paper is on the *when and why* users attend to email, we also review the research around *which* messages users attend to as these topics and questions inform each other.

### 2.1. When and why users attend to email

One of the more informative pieces on how users decide to attend to email was done by Mackay (1988), where she performed extensive interviews of office workers in order to gain a richer understanding of their email habits. Among Mackay’s findings were the strategies that the different participants used in attending to email. A few of the users she interviewed strictly managed their engagement with email, citing that they read it only two times a day allowing ‘mail to accumulate and read it only when convenient’ (Mackay, 1988, p.388). However, the majority of her users reported that they read mail as soon as it arrived and were constantly engaged with it.

Another relevant study was conducted by Czerwinski *et al.* (2004), where they conducted a diary study focused around task switching and interruptions. They found that 23% of tasks reported by their participants were email tasks. We draw inspiration from this study in our work, but instead aim our diary studies directly at email and link the diaries to specific usage sessions. This helps to minimize the amount of work needed by our participants, in this way we try to avoid the so-called ‘Heisenberg-style’ challenge mentioned by Czerwinski *et al.* (2004), where heavily measuring a phenomenon can change it.

We also differentiate from this study in that we prompt for diary entries as opposed to depending on participants to choose which sessions they complete a diary entry for.

The *effects* of constantly attending to email have been explored by several researchers. For example, Ducheneaut and Bellotti (2001) cast email as a habitat, which is indicative of the amount of attention that is allocated by users. As part of their work, they highlighted the network effect that results when a group of workers attend to email. As more workers attend and use email, the need arises for the same group to attend to email in increasing amounts. That is, email use feeds itself. Whittaker and Sidner (1996) also touch on the topic in that they recognize users must spend a large amount of time in email due to the sheer quantity of email they deal with. Further support for concern over users' allocation of attention comes from Dabbish *et al.* (2005), who found that university members check their email an average of 19 times a day. Later, Dabbish and Kraut (2006) found this behavior of frequent email checking to reduce email-related stress, somewhat in contrast to the findings of Bradley *et al.* (2013). Venolia *et al.* (2001) found that more than half of their participants keep their mail client visible at least two-thirds of their work time.

A related area of research is the study of the negative effects of interruptions to work. This research has focused on areas such as interruptions from email, instant messaging applications, general notifications and how users recover from interruptions (Adamczyk and Bailey, 2004; Cutrell *et al.*, 2001; Czerwinski *et al.*, 2000; Franke *et al.*, 2002; Hemp, 2009; Mark *et al.*, 2008; Mcfarlane, 1997). This research helps motivate the need for studying why users of email choose to attend to email, even at the detriment to their productivity and work. In addition, the various, sometimes contradicting findings of email research, points to the diversity and variety in these phenomena.

An additional relevant area of research is the research around notifications. Work has been done to determine how notifications should attune to the attention of the user (McCrickard *et al.*, 2003), how users recover from notifications (Iqbal and Horvitz, 2007), as well as how notifications affect users (Cutrell *et al.*, 2001). This area of research is helpful to our research both from a methodological standpoint and in terms of insight from a more general viewpoint.

## 2.2. How users decide which messages to attend to

The next division of attention allocation that Whittaker *et al.* (2007) propose is deciding *which* messages to attend to. This is relevant to our work because it gives additional insight into how users decide which emails are important.

Wainer *et al.* (2011) found that inbox-level cues such as importance indicators as well as curiosity had an effect on users' decision to attend to messages. In the 'Bifrost' tool by Bälter and Sidner (2002), emails were categorized based on factors like the number of recipients, user-defined importance of sender and direct vs. cc messages to facilitate attending to different

messages. Nardi *et al.* (2002) developed ContactMap to provide some support for allocating attention between messages by displaying whether the user had new mail from a contact on their contact card. Bellotti *et al.* (2005) also touched on allocating users' attention between emails, but they focused more on helping users find incomplete tasks in their inbox. Venolia *et al.* (2001) developed a user interface that indicated which messages in a complex thread were either read or unread, which also helped users to decide which messages to attend to. Gwizdka (2000, 2002) found that users attend to messages in different temporal manners, sometimes prospective, retrospective or ephemerally.

## 2.3. Conversation analysis

Research in the area of CA is relevant to our research as a primary use of email is as a communication medium (Ducheneaut and Watts, 2005; Whittaker and Sidner, 1996). That is, email is often used to have a conversation of sorts, similar to a conversation on the phone where CA techniques have been applied (Schegloff, 1968). Conversations through email exhibit several of the *non-basic* settings outlined by (Clark, 1996, p. 11), e.g. they lack copresence, visibility, audibility, instantaneity, evanescence and recordlessness. Of course, while it is true in a basic fashion that email can be quite conversation-like, proceeding mail-to-mail in a chatty, rapid fashion, it is important to note that not all email interactions or messages have this type of form. There are a number of ways in which email, or particular emails, differ quite markedly from conversations (e.g. text can be formal and formally arranged, exchange of messages does not occur, turns are positioned far apart temporally) or conversational turns (e.g. some emails are more like letters, broadcast messages, adverts or information briefings). This said, emails often form into sequences of interaction, and these sequences of interaction are opened up, organized and closed in a way that it is relevant and useful to look at how findings from studies of conversation may be applied to email in order to gain analytic traction on what is going on and why. This article uses CA (Sacks *et al.*, 1992) for this purpose and, therefore, attempts to show its usefulness for this purpose rather in the way that a similar approach of successfully applying CA was taken to text-chat (O'Neill *et al.*, 2003).

Differences withstanding, there are a number of purposes that conversations on email serve, which are common to conversations independent of the medium or setting (e.g. face-to-face, telephone or text-chat). One example is Goffman (1967), and his definition of the job of 'face-work' (i.e. the work to present oneself in a particular manner), which is currently being done over email as well. The idea of 'face-work' is important in CA, and our work, as this is an activity that drives many aspects around conversation, as it is a primary method that individuals use to construct their presentation to others.

Another concept that is used to uncover special events and breakdowns within conversations is that of the 'perceived normal' developed by Garfinkel (1963). That is, one can assume that an event in everyday life is exceptional or normal through the treatment of said event by the participants and their opinions about what is expected.

CA was developed primarily by Sacks *et al.* (1992), along with several colleagues. Sacks worked primarily from detailed transcriptions of phone calls, and his investigations initially centered around the conversations that occurred on a mental health hotline. During his analysis of phone calls, he developed a method for analyzing conversations. Simply put, his method was to uncover and delineate the ways in which the participants in a conversation could be shown to organize their conversations. For example, how did they manage turns of talk? And, how were questions, demands, inquiries, orders and so forth produced, recognized, and oriented to by the collocutors? Sacks was interested in the participants' practices, methods and understandings exhibited in unfolding sequences of talk and its local management, rather than in using externally generated theory as a means of categorizing and explaining talk. In this way, he hoped to get up-close to the real phenomenon.

Sacks' method, CA, was a close relative of ethnomethodology (EM) (Garfinkel, 1967) essentially applying the EM analytic orientation (to uncover the methods, practices and reasoning of those being studied, through using naturalistic methods of study) to the specialized domain of conversation, presented in transcript form. Through his studies and analysis he showed how units of conversation were defined and recognized by the participants (Sacks *et al.*, 1992, p. 4). He showed that units of conversation occurred in pairs and that the utterance of the first unit provides a slot for the next unit to take place, but does not guarantee it. More specifically, the completion of the pair requires the perception and acknowledgment of the first unit through the 'correct,' prefigured response of the interlocutor, e.g. for a question to gain the status of 'question' it needs to be recognized and oriented to as such. Sacks showed that these units make up the various sequences that provide the architecture for conversations. These different sequences serve various purposes in a conversation, the particular sequence that we are most interested in for this research are the exchanges that makeup conversational openings, i.e. how the start of conversations are negotiated and set up.

While we realize and acknowledge that there are other frameworks that can be used to analyze conversations (Clark, 1996; Levinson, 1983; Shiffrin, 1987; Winograd, 1983), we focus primarily on conversational openings as we feel this is the most applicable and explanatory for the phenomenon that we investigated. Which are, in essence, the activities around email notifications and attending to email. Basically, where there is a shift from 'doing' something else to 'doing' email, whether this is a reflex reaction or a conscious decision.

## 2.4. Opening sequences

Conversational openings were described in part by Sacks *et al.* (1992, p. 72) in his description of accountable actions (the grounds for why we are talking, why someone was called, and why it is appropriate), which are used by a summoner to explain how they came to make the call or why they initiated the conversation. Schegloff (1968, 1979, 2004), carried on the investigation of conversational openings throughout his career, of particular note is the paper 'Sequencing in Conversational Openings' (Schegloff, 1968). Much like Sacks, in his investigations Schegloff focused primarily on transcriptions of conversations over the phone.

Several key ideas came out of Schegloff's investigation around the particularities involved in answering the phone. He developed the distribution rule to explain how turns in a conversation function between the two parties on the phone. This rule was used to explain why the answerer speaks first (Schegloff, 1968, p. 1076), even though the answerer does not know who the caller is.

Another important contribution of Schegloff's work is the *summons-answer* sequence. Schegloff described a *summons* as an 'attention getting device' (Schegloff, 1968, p. 1080). For example, in phone conversations the ringing of the telephone is the summons to the conversation, whereas, in face-to-face conversations there is a larger amount of variation (e.g. 'Hey, John' or whistling to get someone's attention) (Schegloff, 2004). An important aspect of a summons, particularly a ringing phone, is how we are beckoned to answer it as it has a compelling nature.

The *summons-answer* sequence when treated together has a more complex relationship with the conversation and is accompanied by several obligations both within the exchange and upon its successful completion. While simply initiating a summons does not necessarily obligate the potential answerer to answer the summons (at which point the potential conversation would not occur), if they do answer the summons it becomes a non-terminal sequence after which the summoner is obligated to speak. The summoner can choose one of several follow-ups at this point, such as an accountable action (e.g. why I got your attention) or the work of identifying parties. In this way summons-answer sequences are non-terminal, while a summons can be merely an 'attention getting mechanism' (Schegloff, 1968, p. 1080), a summons-answer sequence is 'specifically preliminary to something that follows' (Schegloff, 1968, p. 1080).

We want to make a clear distinction between an aspect of a *summons* versus a *summons-answer* sequence, in that a summons is not necessarily non-terminal. More specifically, whether or not the ringing phone is answered it still retains its identity as a summons. That said, while a summons is an 'attention getting device' it is a specific kind that is intended to begin a conversation, whether it is answered or not. This is particularly important to make clear with regards to our later analysis of email as a conversation medium, as it has

several unique features where this and other distinctions around 'attention getting device[s]' necessitate precision in their usage to get a clear view of how they map onto email, particularly in that emails often do not require an immediate response.

Another interesting aspect, particularly in comparison with email, is Schegloff's interest in the physical barrier between the summoner and answerer, which makes it more difficult to communicate what type of response a summons has garnered. This sometimes has the result of, for example, the continued knocking at the door or repeated phoning of someone, this is perceived as over-insistence and considered impolite (Schegloff, 1968). There are also things that can be inferred from unanswered summons, particularly with phone summons like 'they weren't home.' These inferences are important in our analysis of email, where there is a potentially greater level of ambiguity.

### 2.5. Contrasting phone and face-to-face

A device that Schegloff used to illuminate the particularities of summons-answer sequences is to contrast instantiations of them across mediums (Schegloff, 2004). His comparisons between phone and face-to-face are relevant in that we are extending this comparison with email. This particular comparison helps to explain why certain aspects of each medium are unique and at times problematic or advantageous.

The first part of the summons-answer sequence is the issuing of the summons, when Schegloff compared how this works between face-to-face and on the phone he uncovered several differences. One relevant aspect to our work is how the interruption of the summons is mediated and by whom. In a face-to-face setting, much of the negotiation of when to interrupt the answerer is navigated by the summoner. In this case, the summoner has many visual indicators as to whether the person is engaged in a conversation or activity, it is simply considered rude to interrupt someone mid-conversation. Therefore, they are responsible for looking at the circumstances and determining an appropriate moment for the interruption. When we contrast this to how the interruption of a summons is negotiated on the phone, much more of the responsibility is shifted to the answerer. This is due in large part to the physical barrier between the parties, as such the summoner has little responsibility in determining an appropriate moment for the interruption, other than issuing the summons at a 'reasonable' hour.

Another aspect that is interesting, especially in the analysis of email, is the amount of information that is available to both the summoner and the answerer. On the phone, at least when Schegloff did his initial work, the ring of a phone was just that, and the only information that was available was speculative. The lack of information creates an information imbalance, where the summoner knows significantly more than the answerer about the parties and topics to be involved in the conversation (i.e. the purpose). This is quite different from a face-to-face summons

where the amount of information is far more balanced, there is no visual barrier and the answerer can clearly see the summoner.

A related feature of these two mediums is the amount of information that is packaged with the summons itself. On the phone the granularity, or isolation of the summons is relatively stark. The phone rings, it contains virtually no additional information than simply to summon the person to a conversation. However, in face-to-face settings far more information can be packaged or accompanied with a summons, the most obvious being who it is (although this is not true on modern mobile phones). The summons could be packed into a request, e.g. 'John, could you do this for me', where the summons is a term of address within the request. This term of address also allows for targeted summonses, where on the phone this targeting was more or less targeted at a location instead of at a specific person. As a result in phone summons-answer sequences there is quite a lot of work that goes into the identification of the parties, sometimes it is done solely by voice recognition and is an act of intimacy (Schegloff, 1979).

This analysis of what is unique to the phone and face-to-face summonses is useful. Of course, the concept of the summons required a bit of reconfiguration when moving from face-to-face to the phone, and we require a degree more in extending it to email communication. Schegloff's work serves as a framework with which we can analyze email through contrasting similar phenomenon with other conversation media. This work still holds mostly true now with the advent of caller id and mobile telephony, however, the imbalance of information in the knowledge of the identity of the caller is a bit more redressed and this has impacted practices yet again. The impact of this change in technology has of course been investigated by a number of researchers that we now review.

### 2.6. Impact of mobile phones

Two clear changes that mobile telephony have brought with it are ubiquitous caller-identification and the ability to answer the phone anywhere. These phenomena have both been studied, and both generally result in more personalized exchanges.

Weilenmann (2003), in the aptly named 'I can't talk now, I am in a fitting room,' investigates how the answerer of a mobile phone summons contextualizes and negotiates their availability in order to have a conversation. Often the exchange begins with the summoner posing the question 'what are you doing?' which acts as the prompt where the answerer can explain their availability. Often, this is done through contextualizing their availability with their location and current activity. This helps to give the summoner information to negotiate (with the answerer) the interruptibility of the answerer.

Moreover, since the imbalance of information is much less with caller id, the answers are being tailored, as the summoner is generally known to the answerer and the answerer can assume that they are the ones being summoned (Arminen and Leinonen, 2006). Interestingly, once the information deficit

begins to close and the answerer knows the identity of the summoner the sequence of answering the phone begins to change. Instead of the opening sequence that establishes identity, the answerer does a tailored answer to begin the conversation to acknowledge that the identification sequence is unneeded. However, further validation of Schegloff's work is clearly seen when the summoner is not identified by the caller id, and the behaviour previously attributed with answering a land line phone is reverted to.

In the comparisons between face-to-face, land-line and mobile phone openings one can see how the technologies impact how people perform these openings and begin a conversation, as well as how they in turn provide and conceal information. In this work, we further this comparison with the differences between these and email. Email, as it is a different communication medium with additional affordances and missing other affordances (like synchronous exchange) necessitates additional analysis to describe how it functions.

### 3. SYSTEM AND METHOD

In our study, we focused on isolating and studying the natural occurrence of an email session and relating a diary study to the specific instances of email activity across devices. To establish the relation between the diary and a session we utilized a mixed method approach in which we directly logged email events and gathered diary entries. Diary studies have been conducted for interruptions in the past, see *Czerwinski et al. (2004)*. However, we differentiate ourselves in several ways. First, we aim very specifically at the act of deciding to attend to email and what happens in the immediate email session after that decision. As such, we take a more experiential sampling approach to our diary study, where we prompt the user for a diary entry as opposed to them determining the time to fill out a diary entry. Along these lines, we link specific diary entries with usage sessions through the mechanism that we use for prompting for diary entries. As such, the system that we built for this study is comprised of two parts: the email logger that recorded any changes to the email corpus; and the front-end that participants used to enroll for the study and complete diary entries.

Our email logger used IMAP to log session details such as length, preconditions of the email corpus and activities that the participant performed during the session. Similar activity logs have been used to study interactions with computers before (*Iqbal and Horvitz, 2007*). More specifically, usage logs have been used to study different phenomena in email, for example, the utility of filing (*Whittaker et al., 2011*), the distribution of information (*Fisher and Dourish, 2004*) and response rhythms (*Tyler and Tang, 2003*).

We implemented a front-end using Django<sup>6</sup> that participants would use to fill out specific diary entries associated with a particular session. Diary prompts were sent to users based on

their activity as measured by the email logger. More detail about the email logger and when and why we dispatched diary prompts can be found below in their respective sections.

We recruited 20 participants from our university; 12 were female and 4 were male (4 didn't report). Our participants ranged from the ages of 23 to 37, with  $\bar{x} = 25.6$  and  $\sigma = 4.6$ . Within our participant group 11 were graduate students, 1 was an undergraduate student, 1 was a stay at home dad, 5 were working professionals and 2 did not report. Participants engaged in 2462 email sessions; 14 participants filled out 215 diary entries. Participants were required to be Gmail<sup>7</sup> users; however, all of our university email is run on Gmail, so everyone qualified. That said, participants could use whichever Gmail account they preferred. This study was approved by our IRB (#12-664) and, as we are dealing with participants' personal information, whenever there was a choice between respecting our participants' privacy or making our data richer, we opted for the absolute minimum amount of information that we would need to answer our research questions. For enrolling in the study, participants received a five dollar gift card, and if they filled out over half of their diary prompts, they received an additional five dollar gift card. For any statistical analysis, we used the R statistical package, version 3.0.

#### 3.1. Logging email usage

To initiate the logging of their email, participants first enrolled in the study using our web application. After the participants created an account on our system, they then granted us the proper privileges that are required to access their email. Since we made use of Gmail we were able to use OAuth<sup>8</sup> so that we did not have to collect or store our participants' passwords. OAuth provided an additional benefit to our participants, in that they were able to shut down our access to their email at any time during the study without having to ask us. Our web application also provided participants with the ability to delete any sensitive/overly private emails from our system; however, none of the participants used this feature.

Once the participants were properly enrolled in the service the study began in earnest. The primary driver for this study was the IMAP logger, in that it gathered quantitative data that were used both in our analysis and to dispatch diary prompts. The IMAP logger connected to the Gmail IMAP server every 3 min to take a snapshot of the state of the email corpus and determine if this state differed in anyway from the last snapshot.

We were able to take a snapshot of each participant's entire email corpus for every 3 min because we did a bulk request on a subset of headers from the IMAP server. This bulk request was done for each email folder (or tag in Gmail), this request

<sup>7</sup>Shortly after we collected data, Google announced a tabbed inbox. This feature was released after we had collected data for our study and therefore had no implication in our study. But it is clearly related and requires further study.

<sup>8</sup><https://developers.google.com/accounts/docs/OAuth2>

<sup>6</sup><https://www.djangoproject.com/>

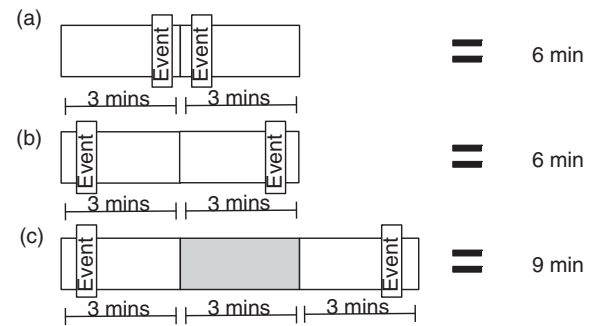
contained the header information (or metadata) for all of the emails in that folder. The header data for an email are comprised of the address it was sent to, if it had attachments, if it has been read or not, along with timestamps for when it was sent. We also ignored any activity in folders that were labeled as *Junk* or *Spam*, to ensure that we were looking at the already filtered email that our participants were receiving. We determined, empirically, that 3 min was the minimum amount of time necessary to complete the snapshot in our pilot.

Throughout the study we did not collect the body of any emails and we anonymized each email address using an md5 hash function before we stored it in the database. By using this hash function we could tell that a participant had sent or received  $n$  number of emails to or from a certain address, we just did not know what the address was. For example, if the user received 10 emails from *author@inst.tld*, we would see that they had received 10 emails from *25446962*, the first 8 characters of the md5 hash. At the end of the study we deleted all of the OAuth tokens granted to us and sent an email to all participants with instructions on how to revoke our privileges.

Since we had snapshots of the entire email corpus every 3 min, we were able to keep track of many aspects of our participants' email activity. We group them into three main categories:

- (i) *Running totals*: We kept track of several running totals that informed us of the preconditions for each session. We tracked the total number of messages, unread messages, new messages since the last session, messages in the inbox, unread messages in the inbox, new messages in the inbox since last active and number of composed/replied to messages.
- (ii) *Activity counts*: For each session, we tracked what messages they had read, deleted, composed and replied to.
- (iii) *Interactions*: We also kept track of to whom (anonymized) they were sending/reading/replying (although this is not used in this paper).

How we determined whether a participant was in the *active* state, and how long they were in that state, requires further explanation. We define the *active* state as one where the participant is doing some sort of action within email, e.g. reading, moving or composing a message. First, to determine if a participant was active, we compared snapshots gathered from our email logger to detect when the participant modified any aspects of their email corpus. So, if they had moved an email, read an email, composed an email etc. We flagged them as being active in that 3 min slice of time. Secondly, to determine an active email session's length, we summed these active slices of time. However, if there were a 3 min inactive slice that was straddled by two active slices, then we considered that to be a contiguous block of activity. An inactive slice is one where no activity was detected, i.e. the participant did not move,



**Figure 1.** Description of how 3 min intervals were used to determine length of each session.

read or compose any messages. A few different possibilities are illustrated in Fig. 1. In Fig. 1a, two active events occurred in a relatively short-time span, however, this gets categorized as a 6 min session. Contrast this with Fig. 1b, where two active events occur in a longer time span, however, this is also categorized as a 6-min session. To illustrate some of the smoothing we did see Fig. 1c, where two events occurred in two time slices that straddled an inactive slice of time, in this case we count this as one session and it is categorized as a 9 min session. A participant was deemed inactive if there was more than three inactive time slices. While this method is not perfect, we feel it is a sufficient approach to capture most discrete active sessions.

### 3.2. Collecting diary entries

When the email logger detected that a period of activity had ended, then it triggered a request (in the form of a URL) to the user to fill out a diary entry through SMS. This happened at most twice a day and only during 'typical work hours' of the participant's timezone with a minimum of 4 h between prompts. The diary entries were a web-based form where the participant filled out the following information: the motivation for initiating the email session, which task (if any) was interrupted by the email session, and information about what constituted the email session. We opted to keep the number of text fields low, in order to decrease the amount of work for our participants. Keeping the amount of time required to fill out an individual diary relatively low was also important for us to capture the particular moment in time, we wanted to avoid the 'Heisenberg' problem (Czerwinski *et al.*, 2004).

We categorized the reported motivations for attending to email in an iterative manner where we used the words of the participant to label each entry. Once this initial set of labels was determined, we grouped entries with essentially the same motivation and used the most descriptive term. After several iterations of this process, we maintained the terms of the



participants and arrived at a unique set of categories. The final categories appear below:

- (i) *Anxiety*—participants cited that they had not checked their email in a long time and were concerned if they had received something unexpected.
- (ii) *Compose a message*—participants cited that they needed to send a message.
- (iii) *Curiosity*—participants cited that they were curious if they had received anything interesting.
- (iv) *Down time*—when participants did not have anything in particular to do and decided to check their email.
- (v) *Expecting communication*—when participants were anticipating the arrival of a specific message from someone (e.g. an advisor or boss).
- (vi) *Inbox*—sometimes participants initiated a session because their inbox caught their attention.
- (vii) *Notification*—participants cited their phone buzzing or receiving a desktop notification.
- (viii) *Previous awareness*—participants cited that someone mentioned an important email in conversation or they saw an email in a previous session.
- (ix) *Refinding*—participants sometimes went into email to find something specific, like a meeting location or a work item.
- (x) *Routine*—many participants checked email first thing in the morning, right after lunch or when they first arrived to work.
- (xi) *Unread count*—participants sometimes noticed they had a few unread emails and decided to read them.
- (xii) *Not reported*—participants sometimes put ‘Nothing’ for motivation or left it blank.

### 3.3. Limitations and advantages of our method

Our method has two limitations: first, it only captures actions that change IMAP status, therefore rereading of email is not captured; and secondly, rules used to automatically file incoming messages can cause false positives. The first limitation is unavoidable as re-opening an email does not change any of the flags or information in IMAP. However, if they did anything within the same 3 min snapshot other than reread email, then the effect was mitigated as the session was still counted as active. So the limitation is in under-counting sessions that consist exclusively of just rereading an old email.

The second limitation, that rules can cause false positives for active status, was more complex to avoid. As we were aware of this limitation throughout our study and pilot, we developed heuristics based around the amount of time between when a message was received and when it was filed (or tagged) into a different folder. During our pilot, we paid careful attention to the number of false positives and found that the above method was sufficient in reducing this number.

While these two limitations cannot be discounted, the advantages to our method are numerous. From the perspective of the participant, the advantages are as follows. Participants are not limited to a particular client or platform, they just need to use Gmail. Due to this advantage, we are able to capture activity across all of the devices that each participant uses. The impact on the user is not heavy, there are no plugins to install and they need to only answer a short-diary entry twice a day on weekdays.

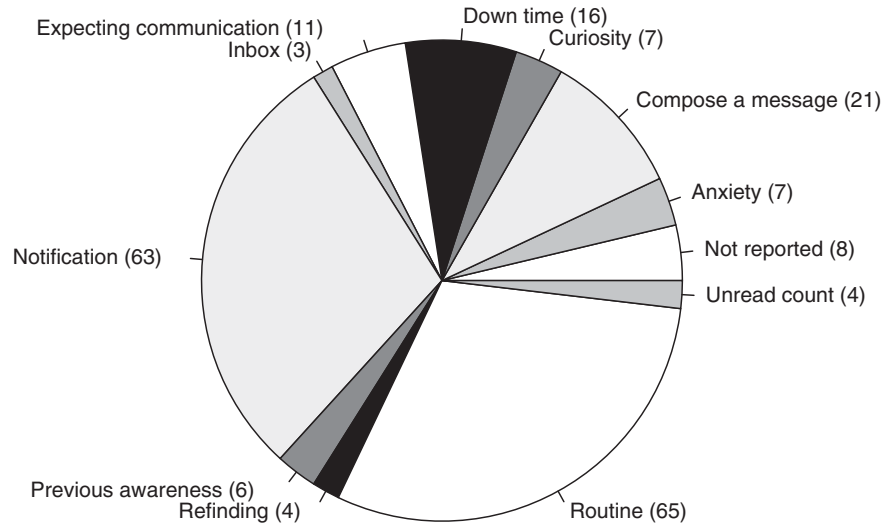
In terms of the data gathered, the advantages are as follows. Through the combination of OAuth and limiting the data that we request and store we are able to maintain the privacy of our participants, while still being able to gather detailed data about them over a period of time (a challenge endemic to studies of Personal Information Management practices). The logs of user activity help to determine bounds around the different email sessions and provide further quantitative insights into the different email activities, minimizing what they had to enter in the diary. We are able to determine the entire writing process of emails since drafts are often stored in IMAP folders, and their statuses updated as they are being written. The way in which we were able to do this longer study, grabbing email data as it unfolded instead of just a full, one-time snapshot afforded greater insight into our participants’ activities than many previous email studies.

## 4. RESULTS

Our analysis focuses on answering our questions through leveraging both the quantitative and qualitative data that we collected. Through this process we were able to gain a good deal of insight into the process of attending to email. First, we address the question of what is drawing users into email, specifically we examine how some of the various reasons our participants attended to email relate to conversations on other mediums. Secondly, we present evidence for the way in which our participants are maintaining a relatively high level of engagement with email. We then examine what types of activities our participants engaged in while attending to email and which activities correlate with longer sessions. Using the length of sessions and feedback from the diary entries we present the evidence around the negative consequences that our participants experienced for attending to email. Finally, we evidence our participants’ awareness about these issues by presenting the various strategies that the employed or reported in surveys, diaries and interviews.

### 4.1. What draws users into email?

Our investigation into what draws users into email was primarily done through examining diary entries. A main finding of this investigation is that our participants often decide to attend to email because of a fairly specific prompt. That is, instead of



**Figure 2.** Total number of diary entries was 215, each slice of the pie has the number of occurrences in parenthesis.

responding to a large unread count they instead cite notifications about an important message, or often even the *expectation* of an important message as primary factors in their decision, time and time again. The different reasons cited by users and their frequency are presented in Fig. 2.

One unexpected result of this analysis is the relative absence of mentions of the unread count as a reason to attend to email within the diary entries. In fact, only four diary entries mentioned this, compared with roughly a third of the diary entries citing notifications as the reason for attending to email. This is interesting in that the unread count does not seem to be utilized by our participants. The apparent lack of utility of the unread count is especially stark, as email clients typically give only two methods for maintaining awareness of incoming email: first, email clients typically give some sort of aural or visual notification for individual emails; and secondly, they often give a rather prominent count of unread emails. We believe the primary reason that our participants did not seem to make use of the unread count can be found in the way they *did* respond to the *summons* quality of notifications. Among our participants, they decided to attend to email based more on individual summonses to conversations, and not the overall criticality of the amount of emails or general state of their inbox. Furthermore, the absence of any type of specific, attention-getting mechanism with regards to conversation takes the meaning and power out of the unread count as a draw to a conversation.

In the remainder of this section, we provide examples and further analysis of the primary reasons that our participants attended to email. The purpose of this analysis is to examine and show the overarching reasons that our participants attended to email, we further group the categories of responses from Fig. 2 more generally below. In each of the cases, we highlight example diary entries.

#### 4.1.1. Individual notifications

Notifications about individual messages were a strong draw for attending to email. In our analysis, we found that they acted much like the *summons* in *summons-answer* sequences involved in conversational openings. Messages, particularly important messages that required some sort of response, beckoned our participants to answer them much like a ringing phone or person requesting their attention. For the diary entries in which this situation was mentioned (frequency: 63/215, session length (min):  $\bar{x} = 7.98$   $\sigma = 20.08$ ), the participant usually indicated that the message was from an important collaborator or significant person in their lives, and they therefore attended to email. We must note, that in our analysis we treated visual and aural notifications the same, as we did not have the granularity of data to determine which type of notification was encountered. However, based on the diary entries of our participants we speculate that the notification is what grabs attention, while the details that indicate the relative importance of the email are what prompt action.

Many of these quotes hint at the ongoing relationships that email helps to serve. These responses point to our participants treating emails from certain individuals as more important than others.

**P4:** Working on adding to a collaborative paper. New mail notification Replied to an email from a committee member.

**P9:** Heard the notification on my phone, saw that it was from my supervisor, and decided to see if it was important.

**P12:** I received a new email notification. I responded [...].

Roughly, a third of the diary entries mentioned a specific, individual notification. However, many of the diary entries also stipulate that since the notification was from someone or about something important to them that is the reason they responded.

This evidences that not all notifications evoke this behavior, and there are in fact notifications that, once attended to, are subsequently ignored. Our participants appear to selectively respond to new email notifications.

#### 4.1.2. Composing emails

Another relatively common reason for attending email was composing an email for a collaboration or coordination (frequency: 21/215, session length (min):  $\bar{x} = 8.20$ ,  $\sigma = 14.42$ ). Many of these emails were also in reference to individuals that they have on ongoing relationship and possibly a work activity in common with.

**P4:** *Emails out the tantalum collaborative paper for additional comments.*

**P16:** *Sent an image to a professor.*

**P3:** *Wrote an email to a friend and deleted facebook notifications.*

#### 4.1.3. Routine sessions

A typical behavior among our participants was the strategy of routine sessions (frequency: 65/215, session length (min):  $\bar{x} = 6.37$ ,  $\sigma = 6.57$ ). These sessions were often in the morning as the first activity or after returning from a lunch break. During routine sessions participants often engaged in *pruning* (Mackay, 1988), this behavior also occurred when sessions were motivated by downtime or boredom. In our case, pruning typically involved the participants archiving (when the participants said they were deleting they were almost always archiving when we looked at the logs) to clean up unimportant emails. Within these sessions participants also responded to messages that they had left from previous sessions.

Typically, the diary entries for these sessions were short and not terribly detailed, indicative of the unspecified nature of these tasks, because the primary goal is to clear out the queue.

**P5:** *check email, delete email.*

**P17:** *cleared out junk mail. Read important emails.*

Related to routine sessions, but more opportunistic, are sessions that are motivated by down time (frequency: 16/215, session length (min):  $\bar{x} = 12.43$ ,  $\sigma = 17.65$ ). Where participants were between tasks, not particularly involved in any task or even bored. These sessions functioned much the same as the routine sessions and were used to sift through unimportant messages and answer any accumulated messages that required a response.

**P17:** *deleted unwanted emails. Read one new message.*

We believe that the reason these sessions exist is primarily 2-fold. First, missing an important email message was clearly an ongoing concern for our participants (as explicated in the section below). Secondly, there is a want to 'keep up' with emails, it

was clear from the survey responses that the participants heavily connected their efficacy (especially the projection of it) with email responsiveness. This harkens back to some of the 'face-work' that Goffman (1967) said served as a motivator for many conversations. The awareness of others' response rhythms and the projection of it was also touched on by Tyler and Tang (2003).

#### 4.2. Are users maintaining engagement?

Results for our study evidence a high level of engagement with email among our participants, as well as the anxiety that can result from it. The most salient and interesting finding is that our participants cited that they attended email because they had an expectation that they had received an important email. The email in question was usually from someone important to them, e.g. a supervisor or collaborator, and the entries usually implied or mentioned some ongoing responsibility or important relationship. While these sessions were not terribly frequent (frequency: 11/215, session length (min):  $\bar{x} = 12.89$ ,  $\sigma = 15.03$ ), we believe they are indicative of the existence of a consistent, continuous engagement with email that our participants were maintaining.

Sessions triggered by these feelings where the participants did not receive the expected message (9) were very short (all but one were 3 min sessions). This is presumably because, while the participant was nervous that they may have missed an important email, it was simply not there. In fact, none of the sessions of 9 min or more (39) involved a session where the participants expected to receive an email from a specific person and that expectation was unfulfilled.

**P13:** *Damage control: making sure my PI didn't email.*

**P15:** *Was looking for a particular email from my professor I work for.*

**P1:** *See if I had an email I expected from my sister.*

This phenomenon also cropped up in a less direct manner when participants cited a worry or interest about receiving an unspecified email as the reason for their session. These sessions were motivated by anxiety or curiosity (frequency: 14/215, session length (min):  $\bar{x} = 5.78$ ,  $\sigma = 6.39$ ), however, they were less specific about a particular reason that they were anxious. The primary reasons for these sessions instead seem to be motivated by the loss of continuous engagement with email.

**P15:** *Checked my email. There were a ton (I had been in a meeting for a while and couldn't check my email) so I had a bunch waiting for me. Responses to some, not all. Didn't even get around to reading them all.*

Sessions that are tangentially related to this category are sessions where the participant was already aware of an important email message (frequency: 6/215, session length (min):  $\bar{x} = 6.50$ ,  $\sigma = 6.39$ ). Within these sessions there were instances

where the participant had been told by someone outside of email or had seen the email in a previous session.

**P11:** *My advisor wanted something to be forwarded.*

Overall, 31/215 sessions can be directly attributed to reasons associated with anxiety or interest in maintaining an awareness and continuous level of engagement with the participants' email.

### 4.3. Which activities are they undertaking?

In this section, we present the activities that the participants performed throughout our study in their email sessions. Table 1 contains a summary of these activities as well as the mean and standard deviation for the group.

The aspects that are summarized in the table are as follows:

- (i) *Sessions*: the number of sessions that the participant engaged in, where a session is a contiguous set of active 3 min blocks.
- (ii) *Usage (min)*: the number of total minutes that they were active, this is measured in terms of adding the 3 min slices where they were active.
- (iii) *Messages*: the number of messages that they received and sent over the course of the study regardless of which folder they arrived in or whether they were read or not.
- (iv) *Inbox*: the number of messages that they received in their inbox.

- (v) *Read*: the number of messages that they read.
- (vi) *Moved*: the number of messages that were either moved or tagged, when a message received multiple tags this counter increments by one.
- (vii) *Deleted*: the number of messages that were moved to a trash folder or tag.
- (viii) *Composed*: the number of messages written, not including the messages that were written in reply to another email.
- (ix) *Replies*: the number of messages that were written as replies to another email.

Similar to previous research, we find quite a bit of diversity in the number of incoming emails and the strategies that participants develop to manage them. This is evidenced by each column having a large variance in relation to the mean.

These large variances in Table 1 make some of the different strategies evident. One example where there is a fair amount of variance is in the portion of messages that participants read. Some participants (1, 9 and 15) read every message that they receive, while others (2, 3 and 20) nearly read all incoming emails. However, the majority of our participants are only reading a small portion of their incoming emails.

When we separate the messages into distinct groups, e.g. read vs. unread or filed vs. unfiled, we find that many messages are never acted upon at all. Specifically, among our participants only around half of incoming messages were read, with only a few

**Table 1.** Details about the activities that participants undertook during our study.

Participant	Sessions	Usage (min)	Messages	Inbox	Read	Moved	Deleted	Composed	Replies
1	88	396	125	24	125	24	0	0	4
2	133	627	376	337	335	0	0	10	18
3	107	534	321	227	257	0	0	13	38
4	154	846	426	412	334	0	0	2	7
5	110	519	295	243	219	243	86	14	38
6	231	1326	909	818	208	35	4	17	36
7	40	135	546	393	42	0	0	4	1
8	166	996	443	375	240	14	14	16	17
9	96	354	109	97	109	0	0	1	4
10	223	1005	444	365	297	104	0	20	17
11	43	237	483	176	102	150	17	33	3
12	165	876	845	765	372	182	106	31	28
13	112	606	433	353	207	1	0	16	21
14	150	1332	819	475	690	220	17	65	177
15	170	828	271	271	271	0	0	1	6
16	219	2022	1720	766	910	74	14	103	124
17	16	105	299	286	59	0	0	2	7
18	128	579	199	156	96	8	0	15	15
19	97	570	482	403	328	0	0	21	57
20	14	123	34	13	25	0	0	2	1
$\bar{x}$	123.10	700.80	478.95	347.75	261.30	52.75	12.90	19.30	30.95
$\sigma$	64.20	477.22	374.88	226.88	215.30	81.36	29.28	24.92	44.43

rigorously reading incoming mail. Also, we find only ~15% of messages that were received were moved or deleted, meaning 85% of messages were left in the inbox. This suggests that a large portion of email was not terribly important or pertinent to our participants, keep in mind that these numbers exclude any messages in *Junk* or *Spam* folders.

In summary, our participants read about half of their messages, delete very few of their messages and leave the vast majority of them unfiled in the inbox. This provides insight into why we did not see many instances of the unread count as a motivating factor in the decision to attend to email. Mostly because, the majority of behaviors that we see run contrary to using a raw unread count, if they are only reading half of their email, their unread count is constantly increasing. Likely, the unread count only really stands out if you read all (or almost all) of your messages. Secondly, there is a large amount of variance in the practices of our participants, illustrating the difficulty in developing consistently useful indicators.

These results also further evidence that different email messages have vastly different levels of importance to our participants. A subset of incoming messages is read, an even smaller subset is acted upon and an additionally smaller subset is replied to. Therefore, many emails do not require a reply, or are at least not taken to require one and therefore are not meant to start conversations.

#### 4.4. What leads to longer sessions?

We were specifically interested in answering two questions with regards to session length. First, does the unread count have any quantitative bearing on how long our participants' sessions were. That is, just because they are not citing the unread count as a reason for attending email, *should* they be using this to make decisions to attend to email. Secondly, what activities are correlates to longer sessions.

To investigate these questions, we present the results of the analysis of our logs. We present the results of a Spearman correlation by giving the correlation coefficients and their level of significance indicated by \* for  $P \leq 0.1$ , \*\* for  $P \leq 0.05$  and \*\*\* for  $P \leq 0.001$ . We chose to use the Spearman correlation because we did not have a truly continuous measure of time. The table of these results is found in Table 2. This analysis informs the utility of the unread count and related indicators to estimate the length of the next session. The measures we chose to include in our analysis are described below, we limited ourselves to this group as we were interested in investigating two questions. First, whether or not there are easily tracked quantitative aspects of email that correlate with session length. In essence, do our

participants have a reliable way to estimate the length (or level of disruption) of their next session. Secondly, what activities correlate with session length, to give insight into what is taking up the majority of time in email use:

- (i) *Messages*: the total number of messages in their mail corpus at the start of the session.
- (ii) *Unread*: the total number of unread messages in their mail corpus at the start of the session.
- (iii) *Inbox*: the total number of messages in their inbox at the start of the session.
- (iv) *Inbox unread*: the total number of unread messages in their inbox at the start of the session (this is what the unread count is based on).
- (v) *Inbox new*: the number of new messages that have arrived in their inbox since the previous session.
- (vi) *Read*: the number of messages that they read during the session.
- (vii) *Moved*: the number of messages that they moved or tagged during the session.
- (viii) *Deleted*: the number of messages that they deleted during the session.
- (ix) *Composed*: the number of messages that they composed excluding messages that were in reply to another message during the session.
- (x) *Replies*: the number of messages that they wrote in reply to another message during the session.

It is worth noting that *none* of the above preconditions that had a strong, significant correlation with session length. These results indicate that users do not have reliable mechanisms to estimate the length of their next session, other than staying aware and engaged with their email client and incoming messages. We illustrate this through contrasting the two more salient results of our analysis, the apparent lack of utility of the unread count versus the strong, significant correlation between session length and the read count.

##### 4.4.1. Unread count

Throughout our analysis, we find that the unread count is not a primary reason for participants to attend to email. One aspect of our analysis points to a particular reason why this is the case. Mainly, the number of unread messages is not an indication of how many *important* email messages that you have, and certainly not indicative of how long your next session is likely to be. In our analysis we found that the number of unread messages in participants' inboxes did not have a strong, significant correlation with session length.

**Table 2.** Spearman correlation coefficients against session length (\* for  $P \leq 0.1$ , \*\* for  $P \leq 0.05$  and \*\*\* for  $P \leq 0.001$ ).

Participant	Messages	Unread	Inbox	Inbox unread	Inbox new	Read	Moved	Deleted	Composed	Replies
All	0.11***	0.11***	-0.11***	-0.09***	0.08***	0.60***	NA	0.24***	0.48***	0.38***

When we ignore the unread count and instead look only at the *Inbox New*, which represents the number of new messages received since the last session, we still only see a significant, weak positive correlation of 0.08 ( $P \leq 0.001$ ). These results suggest that the number of unread messages in your inbox, or even just the number of new messages, is not an effective means of estimating the length of the next session.

#### 4.4.2. Longer sessions

A clear indicator of the misleading nature of the unread count is the significant, strong correlation between the number of messages that participants read during their session and the session length ( $\rho = 0.60$ ,  $P < 0.001$ ). This correlation is particularly informative because it is a clear signal from the participants about which messages they thought were important during their session. Keep in mind that this is only capturing messages that change from an unread to a read state, which is a subset of the unread messages. We acknowledge that unread does not mean unlooked at, we just take it to indicate a different level of engagement.

Correlates between session length and archiving/deleting messages are quite weak, especially when compared with the time it takes to read a message. This is understandable, as we found that many messages are left untouched in the inbox, meaning that participants are not spending much time filing or deleting and that the bulk of work in email is in simply reading messages. Other strong correlates with session length were composing and responding to emails, other indicators for important messages. All of this points to the bulk of work in email being around reading important emails and participating in conversations.

#### 4.5. What are the consequences of attending to email?

An aspect of our diary analysis that points to problematic interactions with email is around a phenomenon we call *getting lost in email*. This is when a participant indicated in their diary entry that they wound up spending more time and doing more things within email than they originally intended. Our participants reported that they *got lost in email* in 23% of their diary entries.

Participants reported *getting lost in email* for both short and long sessions. Surprisingly, there were many cases where our participants got lost in short, 3 min sessions. However, these cases only comprised 21% of all 3 min sessions. This is in contrast to the sessions greater than or equal to 12 min, where 57% of sessions resulted in getting lost. Clearly, as a session goes on longer the probability that they are engaging in more email related tasks than they intended goes up.

In our analysis of diaries, we found that participants reported being further distracted by falling into distraction chains (Iqbal and Horvitz, 2007). This may help to explain the surprisingly high number of lost occurrences during short sessions, as the diaries often indicated the distraction chain carried them outside

the bounds of email, and our ability to log their activity. In some cases, they stayed in email doing other types of work before resuming their primary task.

**P14** *I read a couple of emails, which had links to articles so I read the articles too.*

**P2:** *The last time I was on my email though I responded to 3 emails and checked facebook since it was telling me I had some facebook messages.*

#### 4.6. Do users develop any strategies?

In our surveys, we found evidence that our participants were aware and actively managing several of the issues that we observed. Of particular note is the strong link between email and the projection of efficacy. When our participants were asked what they considered successful about their email practices, the most common response (27/52) was that they responded quickly and promptly. One response even mentioned the etiquette around email. As not all of the respondents of this survey elected to continue as participants after this survey, we have indicated them with an 'R'. We continue to indicate the participants in the full study with a 'P'.

**R50:** *I respond in a timely manner; I know proper e-mail etiquette.*

**R11:** *quick responses, readily available.*

**R13:** *I read all email that I receive soon after I see them, and attempt to respond promptly (within 8 h).*

We see one participant engineering a method to mitigate the chance of missing an email from someone important (their advisor).

**P7:** *Emails on phone; emails from academic advisor get filtered into her own folder.*

Another participant employed a similar method in a more general way, where they elevated the summons of certain types of messages.

**R52:** *I filter incoming mail, and if certain keywords are used, or there are certain authors, I get a text sent to my cell phone. This helps me filter IMMEDIATELY important information to my phone, which is a 'non'-smartphone. I then go and check emails on my computer or using my ipod touch.*

Some managed their level of engagement either through defined sessions or periods of ignoring email.

**R48:** *[...] I do, however, do a 24-h email hiatus once per week.*

**R42:** *I try not to check it in first hour of day. I check once I get engrossed in some other work. This way, I just read through them in a hurry. / If I start my day by reading mails then I read a lot of them and go to their links also.*

**P13:** *I have a very organized system of how I read and respond to emails. I use flags and stars to denote which I need to respond to immediately. I also set aside time, several times a day, to read and respond to emails.*

These different strategies evidence that the participants in our study are clearly aware of several of the problematic aspects that we observed in our study. Furthermore, they are thinking about them enough to develop specific interventions to mitigate their effects. Their strategies tend to acknowledge that they understand that engagement with email leads to activity within email, which in turn breeds demands on them.

## 5. DISCUSSION

When discussing how users are attending to email we feel that it is important to look at email primarily as a communication medium. This is because the most important activities that occur in email are centered around communication and conversation-like threads, as evidenced by the amount of time that we found our participants engaging in these activities and because their reasons for checking email were centered around these types of interactions. In examining emails as a conversation medium, the decisions to attend to email are influenced by similar factors as conversational openings, particularly conversational openings on the phone. Contrasting the manner in which aspects of conversational openings (especially the process of receiving a summons) function over face-to-face, phone and email gives insight into some of the roots of the issues that we found in our study.

### 5.1. Email messages as summons

First, let us clearly explain what aspect of email usage we consider a summons. Schegloff (1968) called summons 'attention getting mechanisms' and we find that the manner in which notifications appear, ring, or whichever flavor they take are clearly similar to a ringing phone or a person requesting their attention. Therefore, we consider receiving a notification about an email a summons. While, Schegloff originally meant for summons to be specifically for conversational openings, we feel that the nature of email necessitates some flexibility in this aspect of its definition. This is because of the *indiscriminate* way that email clients issue notifications for email messages and the amount of noise that is typical of the email channel. Therefore, in the communication medium of email there exists the nearly guaranteed possibility of receiving a *false summons*.

To be more explicit about what we do not consider a summons, and how some conversations may lack it, let us explain some instances that are merely similar to a summons. We do not consider the unread count a summons, it is an indicator of the number of unread messages and does not contain the same draw or specificity that is required for a summons. The unread count is a figure against a background, if one is used to a high unread mail count it is not indicative in any precise way. However, we imagine if the user notices a shift in the unread count it becomes more distinct against the background. This, in part, is precisely what inbox management techniques like 'Inbox

Zero' seek to do, make any shift in the unread count distinct against the background of email. Contrast this with a ringing phone, that may lack information about the summoner, it is still specifically from someone requesting to begin a conversation with the answerer. Furthermore, we do not consider a single unread message in one's inbox a summons to a conversation, while it certainly shares some aspects with a summons, it simply does not satisfy the condition of being an 'attention getting mechanism.' The only thing that we consider a summons within the email channel is the notification that you have received an email from a specific person.

The fact that an email conversation can occur without a summons, is a significant difference from initiating a conversation face-to-face or over the phone. When the indiscriminate nature of issuing a summons within the email client is coupled with the large amount of noise that we found in the email channel, a reason for our participants' anxiety around missing an email and their reasons for maintaining engagement with email becomes quite evident. *There is no guarantee that a summons will be issued for a conversation in email, or that you will receive a summons if it is issued.*

### 5.2. Emails as requests for attention

To expand on the concept of emails as summons, we see each email as a request for some amount of attention, no matter how little attention or how remote the possibility of receiving the attention. Only a subset of these requests receive a summons from the interface and a further subset of those requests are true summons to a conversation. Part of the difficulty in using email is distinguishing summons or requests for a conversation, from relevant informational email and spam email. As each email is a request for attention, we propose that there are roughly four groups of emails based on the level of attention that they necessitate.

- (i) *Ignore*: many messages that are ignored have no realistic expectation that the recipients will properly read the email, let alone respond to them. Some of these messages even explicitly say to not respond to them, other examples include spam mail and mass advertisements. In our study, 45% of emails went unread (specifically 4352/9578 messages went unread).
- (ii) *Accountable non-answer*: an accountable non-answer response is when the recipient is expected to engage with the email, but not reply to it. An example is a newsletter that is emailed to a list, where the sender expects receivers to attend to the message and keep abreast of certain topics, but not reply to the message. This is evidenced in our study by the large amount of read mail that was not replied to. More specifically of the 5226 messages read only 619 were responded

to, meaning that the majority of read messages do not require a response.

- (iii) *Postponed reply*: some emails require a reply, but do not require an immediate reply. The responses to these emails can wait till a later session. We saw evidence of this in routine sessions, where users replied to already read messages. In the messages that we captured both the receiving and replying (491 messages) 145 were postponed by 30 min or more. Of these 145 messages, 39 were postponed for more than 12 h and no messages were postponed for more than 24 h.
- (iv) *Immediate reply*: some messages arrive beckoning an immediate response. We found evidence of this in the diaries and logs when the participants report seeing a notification and replying to it right away. We also found evidence in the logs when participants read the message and immediately replied. Of the 491 messages that we captured both the receipt and reply, 346 of them were replied to within 30 min, and 207 were replied to in 3 min or less.

### 5.3. Answering an email summons

What we consider to be an answer to a summons over email is not obvious and requires some additional explanation as well. To completely explain what we categorize as an answer, we must pull apart what happens to an email that a summons has been issued for. First, the sender composes an email that requires a reply and sends it. The next requirement for a summons to be issued is that the sender of the email must receive and acknowledge a specific notification about the email. *The answer to the summons happens when the receiver directs their attention to the notification.* However, a particularity of email is that the completion of this sequence (or whether it ever happens) is completely opaque and unknown to the sender of the email. The sender of an email does not know if a summons has even been issued.

However, this sequence (the issuing and answering of the summons) by definition is non-terminal, and upon attending to the email an obligation is placed on the receiver to respond to this message. We see direct acknowledgement of this responsibility (and the opacity to the sender) in the anxiety over ‘missing’ an important email in our diary entries. The sender of the email only knows that their message has been seen and acknowledged *after* they receive the response to the email. The physical barrier between the summoner and answerer in the conversation is now even wider and contains a temporal element to it. Due to the physical and temporal barrier that is a result of the asynchronous nature of email, the single exchange of a message and its response has a number of opening sequences packed into it. This is different from the cases of phone and face-to-face, where sequences are more atomic because, as the communication is synchronous, they do not necessitate interleaving sequences.

### 5.4. Cumbersome conversations

Another aspect of email as a communication medium that we gain insight into through leveraging the summons-answer concept is their sometimes cumbersome nature. Each turn in a conversation over email requires the directing of attention to the conversation when another turn has been completed by the participant. This may or may not be a summons on the interface, however, with each turn the request for attention is re-initiated and several actions must be remembered, or re-established by each participant. This is why the functionality of email threads is so useful. At each turn accountable actions must at least be recalled by the participant beginning their part of the turn. *The re-initiation of an email conversation at each turn, coupled with the requisite interleaving of sequences, can make email conversations cumbersome and difficult.*

### 5.5. Determining interruptibility

The manner in which summons are dispatched and answered within email points to an interesting contrast between the different mediums of face-to-face, phone and email. This contrast is in the transition of the responsibility in determining interruptibility shifting from the summoner to the answerer. In face-to-face conversations, Schegloff (2004) notes that a great deal of the decision on the interruptibility of the answerer is done by the summoner. It is simply rude to interrupt people in the middle of a conversation or activity. This is less true when issuing a summons over the phone, in that the only real decision is what time is reasonable to make a call. However, it is not beyond expectation (especially, before answering machines and caller id) that you will have to call the person back later. Move to email and nearly all of the decisions for interruptibility transfer to the answerer. It is completely acceptable to email someone at 3 AM (contrary to Schegloff’s phone example). Instead it is considered far more socially unacceptable (as evidenced in our survey results and diary entries) to take time to respond to an email. *In this way the receiver, or answerer, of the summons is now almost entirely responsible for determining (or constructing) the appropriate moment for the interruption, as well as maintaining engagement with email as to not miss any conversations.*

## 6. CONCLUSION

Our findings suggest that email is disruptive to users’ work and lives, even when they are not directly engaged with it. Email usage has many of its users in a state of anticipation that can cause anxiety or at least pique curiosity. The lack of proper notifications or signals to make informed decisions to attend to email adds to this problem. While some of our findings uphold intuition and commonly held beliefs, our principled investigation into these matters has increased the depth of understanding of these phenomena. Our contribution to this



field of research is in bringing focus to email as a conversational medium and situating common problems within CA.

Through the lens of CA, we are able to explain in what manner many of the commonly known problems with email are in fact problematic. Take for example the unread count, through our analysis we have established that this mechanism is not being used by our participants and, situated within CA, are able to cite their lack of summons as a root. Other studies have established the anxiety around email (Chase and Clegg, 2011; Reinke and Chamorro-Premuzic, 2014; Wainer *et al.*, 2011), our analysis has found that much of this anxiety is rooted in the lack of a reliable mechanism to receive summons and the worry that a user has 'missed' an important email. Furthermore, we found that this was an important worry as the projection of ones efficacy is highly linked to the promptness with which they respond to important messages.

In contrast to the large concern with email triage (Cselle *et al.*, 2007; Faulring *et al.*, 2010; Freed *et al.*, 2008; Nardi *et al.*, 2002; Vacek, 2014; Venolia and Neustaedter, 2003; Whittaker *et al.*, 2004), we found that our participants were well suited to locating important messages (or the lack thereof). We found this through the explicit linking of diary entries with usage sessions, where we found that when users were expecting an important message the sessions were quite short, suggesting that they did not spend very long looking for this message. We also found that 'pruning' sessions were also quite short, suggesting that the rating of non-important messages was quite efficient.

Additionally, as a result of our study we are able to give quite a bit of insight into our original questions.

*What aspects of email grab user attention and draw them in?* The pressure, whether real or imagined, involved around promptly responding to emails that are part of a conversation is a key factor in drawing users into email. Couple this with the non-deterministic nature of how summons are issued within the email client and it is easy to see the reasons for routine sessions, anxiety over missing email and the draw of the notifications.

*What level of engagement with email do users maintain while not using the application?* We find evidence for a relatively high level of engagement with email. This is evidenced by the anxiety over missing an important email and the simple requirement imposed on users by the interface lacking mechanisms to assist in maintaining engagement with email.

*What activities are they doing and what takes longer?* As one might expect reading, composing and replying to messages is what leads to longer sessions. Interestingly, pruning messages (deleting or archiving) is not associated with longer sessions. Our participants seem rather well suited to finding the messages that mattered to them. Perhaps the focus around triaging messages (Cselle *et al.*, 2007; Faulring *et al.*, 2010; Freed *et al.*, 2008; Nardi *et al.*, 2002; Vacek, 2014; Venolia and Neustaedter, 2003; Whittaker *et al.*, 2004) is more about making it more obvious that you have received an important message.

*What are the consequences of attending to email?* We found that users became further distracted than they originally

intended in 23% of our diary entries. We call this *getting lost in email*. This in turn could have more negative implications in the cost of resuming their work (Adamczyk and Bailey, 2004; Cutrell *et al.*, 2001; Czerwinski *et al.*, 2000; Franke *et al.*, 2002; Hemp, 2009; Mark *et al.*, 2008; Mcfarlane, 1997). It seems to us (and our participants through their strategies) that engagement with email leads to additional email activity, which in turn breeds demands on us.

*Do users develop different strategies that indicate awareness of these different factors?* We saw that users employ a number of strategies, similarly to previous research and their recommendations (Bradley *et al.*, 2013; Chase and Clegg, 2011; Hemp, 2009). From as basic to just saying they respond promptly, to having routine sessions, and to even turning off the notifications on their phone. The combination of the strategies that we saw our users develop, we feel, is a clear indicator of awareness and concern for the very issues that we encountered in our study. Moreover, as the majority of these strategies (with the exception of projecting an image of responsiveness Tyler and Tang, 2003) are around the *limiting* of attention paid to email, we see this as evidence to the destructive draw of email and somewhat contrary to several functional directions of email (e.g. always-on access and push notifications).

We do not address the efficacy of one strategy over the other, however, we hypothesize that (similarly to previous PIM studies Jones, 2007; Teevan *et al.*, 2007), there are various strategies that users employ and prefer for themselves.

## 7. RECOMMENDATIONS

Our study points to a broad need to remember and refocus on email as a communication medium and functionality that assists email users in communicating and maintaining their relationships. Many activities occur in email (work, task management etc.), this is perfectly reasonable as one place that communication occurs is in email. Put more simply, anything that we are doing can be communicated about through email, as it is a rich communication medium. While much research has focused on the individual activities that occur in email, researchers and designers must keep in mind that these activities are accomplished through communication. Supporting this communication and the conversations that support them is vital to making email less stressful for its users. Perhaps the current trend of adding functionality to email clients, which often has the effect of increasing the complexity and number of decisions involved in triage, should be reexamined, and the intuitions behind them affirmed. Our findings, coupled with other recent research (i.e. Whittaker *et al.* (2011) showed that the advantages of filing may not be exactly as assumed), suggest new functionality is not representative of where the bulk of time in email is spent.

There is of course functionality being proposed and research being done along these lines. MinEMail (Rector and Hailpern,

2014), for example, is trying to elevate important notifications to an SMS message. However, we suggest that functionality to limit the notifications that are issued for non-conversational emails be investigated as well. Also, based on our CA of email, we believe that putting tools for determining urgency, escalation etc. in the hands of the sender is problematic. As CA informs us, these decisions are a matter for the two parties to determine and the acceptance of the status by the recipient is crucial. If these decisions were solely in the hands of the senders, then the result is recipients to treat them much like the ‘boy who cried wolf.’

*Expecting an email.* The anxiety that our participants felt around email points clearly at two things: first, that email, or at least the expectations around it, is being moved from an asynchronous to a synchronous communication medium; second, that email has several deficiencies in this regard that can be mitigated with a few changes. This move, of email from asynchronous to synchronous, and the expectations around it, are evidenced in a number of our findings, but most starkly in the number of emails that were *immediately* replied to (207/491), as well as in the amount of anxiety and import that our participants placed on sending prompt responses to emails.

Another recommendation that we have is to remove the ephemeral nature around summons, by reducing the indiscriminate nature that notifications are issued by and receiving notifications for conversation-based emails. One aspect that could also reduce the anxiety of our participants around the expectation of an email, is to provide functionality to elevate the notification, or summons, to a particular sender that they are anticipating. This set of functionality could help to remove the ephemeral, indiscriminate and non-deterministic nature of the summons, which is one of the primary sources of anxiety among our participants. Note that this is different from establishing an entirely new inbox for important people, similar to Apple’s VIP inbox.<sup>9</sup>

*Channels of communication.* As there are clearly emails that have different levels of importance, we feel that they should be more clearly distinguished within the email channel. A recent example of functionality that is moving toward this direction is Gmail’s tabbed inbox.<sup>10</sup> Further study is required to see if further modifications to the unread count in the new Gmail interface would have an impact on attention to email.

As future work, we plan to further explore email interactions in the frame of CA. Particularly, the analysis of how users interleave conversation pairs (Sacks *et al.*, 1992, p. 4) in email exchanges, each email often seems to contain multiple ‘halves’ of these units. This represents a potentially large difference between phone or face-to-face conversations and may be another source of confusion in email. Furthermore, additional research is needed into how the anxiety over immediately responding to an email is reciprocated by the original sender.

Are email users putting an undue burden on themselves, or is their perception correct?

Simply put, we feel that email tools must do a better job of letting users manage the relationships and conversations within their email, instead of it requiring them to maintain ever vigilant to any change.

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## REFERENCES

- Adamczyk, P.D. and Bailey, B.P. (2004) If Not Now, When? The Effects of Interruption at Different Moments Within Task Execution. In Proc. CHI 2004, pp. 271–278. ACM Press.
- Arminen, I. and Leinonen, M. (2006) Mobile phone call openings: tailoring answers to personalized summonses. *Discourse Stud.*, 8, 339–368.
- Bälter, O. and Sidner, C.L. (2002) Bifrost Inbox Organizer: Giving Users Control Over the Inbox. In Proc. NordiCHI 2002, pp. 111–118. ACM Press.
- Bellotti, V., Ducheneaut, N., Howard, M. and Smith, I. (2003). Taking Email to Task: The Design and Evaluation of a Task Management Centered Email Tool. In CHI’03: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 345–352. ACM, New York, NY, USA.
- Bellotti, V., Ducheneaut, N., Howard, M., Smith, I. and Grinter, R.E. (2005) Quality versus quantity: E-mail-centric task management and its relation with overload. *Hum.–Comput. Interact.*, 20, 89–138.
- Bradley, A., Brumby, D.P., Cox, A.L. and Bird, J. (2013) How to Manage Your Inbox: Is a Once a Day Strategy Best? In Proceedings of the 27th International BCS Human Computer Interaction Conference, BCS-HCI’13, pp. 20:1–20:6. British Computer Society, Swinton, UK.
- Cecchinato, M., Cox, A.L. and Bird, J. (2014) ‘I Check My Email on the Toilet’: Email Proactices and Work-Home Boundary Management. In MobileHCI’14. ACM, Toronto, Canada.
- Chase, N. and Clegg, B. (2011) Effects of email utilization on higher education professionals. *Int. J. Technol. Hum. Interact.*, 7, 31–45.
- Clark, H.H. (1996) *Using Language*. Cambridge University Press, Cambridge.
- Cselle, G., Albrecht, K. and Wattenhofer, R. (2007) Buzztrack: Topic Detection and Tracking in Email. In Proc. IUI 2007, pp. 190–197. ACM Press.
- Cutrell, E., Czerwinski, M. and Horvitz, E. (2001) Notification, Disruption, and Memory: Effects of Messaging Interruptions on Memory and Performance. In Proc. Interact 2001, pp. 263–269. IOS Press.

<sup>9</sup><http://support.apple.com/kb/PH11728>

<sup>10</sup><https://support.google.com/mail/answer/3055016?hl=en>

- Czerwinski, M., Cutrell, E. and Horvitz, E. (2000) Instant Messaging and Interruption: Influence of Task Type on Performance. In Proc. OZCHI 2000, pp. 356–361.
- Czerwinski, M., Horvitz, E. and Wilhite, S. (2004) A Diary Study of Task Switching and Interruptions. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, CHI'04, pp. 175–182. ACM Press, New York, NY, USA.
- Dabbish, L.A. and Kraut, R.E. (2006). Email Overload at Work: An Analysis of Factors Associated with Email Strain. In Proceedings of the 2006 20th Anniversary Conference on Computer Supported Cooperative Work, CSCW'06, pp. 431–440. ACM Press, New York, NY, USA.
- Dabbish, L.A., Kraut, R.E., Fussell, S. and Kiesler, S. (2005) Understanding Email Use: Predicting Action on a Message. In Proc. CHI 2005, CHI'05, pp. 691–700. ACM Press, New York, NY, USA.
- Ducheneaut, N. and Bellotti, V. (2001) E-mail as habitat: an exploration of embedded personal information management. *Interactions*, 8, 30–38.
- Ducheneaut, N. and Watts, L. (2005). In search of coherence: a review of e-mail research. *Hum.–Comput. Interact.*, 20, 11–48.
- Faulring, A., Myers, B., Mohnkern, K., Schmerl, B., Steinfeld, A., Zimmerman, J., Smailagic, A., Hansen, J. and Siewiorek, D. (2010) Agent-Assisted Task Management that Reduces Email Overload. In Proc IUI 2010, pp. 61–70. ACM Press, New York, NY, USA.
- Fisher, D. and Dourish, P. (2004) Social and Temporal Structures in Everyday Collaboration. In CHI'04: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 551–558. ACM Press, New York, NY, USA.
- Fisher, D., Brush, A.J., Gleave, E. and Smith, M.A. (2006). Revisiting Whittaker & Sidner's "Email Overload" Ten Years Later. In CSCW'06: Proceedings of the 2006 20th Anniversary Conference on Computer Supported Cooperative Work, pp. 309–312. ACM Press, New York, NY, USA.
- Franke, J.L., Daniels, J.J. and Mcfarlane, D.C. (2002) Recovering Context After Interruption. In Proc. Cognitive Science Society 2002, pp. 310–315.
- Freed, M., Carbonell, J.G., Gordon, G.J., Hayes, J., Myers, B.A., Siewiorek, D.P., Smith, S.F., Steinfeld, A. and Tomasic, A. (2008) Radar: A Personal Assistant that Learns to Reduce Email Overload. In AAAI, pp. 1287–1293.
- Garfinkel, H. (1963) A Conception of, and Experiments with, "Trust" as a Condition of Stable Concerted Actions. In Harvey, O. (ed.), *Motivation and Social Interaction: Cognitive Approaches*, pp. 187–238. Ronald Press, New York.
- Garfinkel, H. (1967) *Studies in Ethnomethodology*. Prentice-Hall.
- Goffman, E. (1967) *Interaction Ritual: Essays in Face-to-Face Behavior*. Aldine Transaction.
- Gwizdka, J. (2000) Timely Reminders: A Case Study of Temporal Guidance in PIM and Email Tools Usage. In CHI'00 Extended Abstracts on Human Factors in Computing Systems, CHI EA'00, pp. 163–164. ACM Press, New York, NY, USA.
- Gwizdka, J. (2002) Reinventing the Inbox: Supporting the Management of Pending Tasks in Email. In CHI'02 Extended Abstracts on Human Factors in Computing Systems, CHI EA'02, pp. 550–551. ACM Press, New York, NY, USA.
- Hemp, P. (2009) Death by information overload. *Harv. Bus. Rev.*, 87, 82–89.
- Iqbal, S.T. and Horvitz, E. (2007) Disruption and Recovery of Computing Tasks: Field Study, Analysis, and Directions. In Proc. CHI 2007, pp. 677–686. ACM Press, New York, NY, USA.
- Jerejian, A., Reid, C. and Rees, C.S. (2013) The contribution of email volume, email management strategies and propensity to worry in predicting email stress among academics. *Comput. Hum. Behav.*, 29, 991–996.
- Jones, W. (2007) *Keeping Found Things Found: The Study and Practice of Personal Information Management*. Morgan Kaufmann Publications.
- Kokkalis, N., Köhn, T., Pfeiffer, C., Chorny, D., Bernstein, M.S. and Klemmer, S.R. (2013). Emailvalet: Managing Email Overload Through Private, Accountable Crowdsourcing. In Proc. 2013 Conference on Computer Supported Cooperative Work, CSCW'13, pp. 1291–1300. ACM Press, New York, NY, USA.
- Levinson, S. (1983) *Pragmatics*. Cambridge University Press, Cambridge.
- Mackay, W.E. (1988) Diversity in the use of electronic mail: a preliminary inquiry. *ACM Trans. Inf. Syst.*, 6, 380–397.
- Mark, G., Gudith, D. and Klocke, U. (2008) The Cost of Interrupted Work: More Speed and Stress. In Proc. SIGCHI Conference on Human Factors in Computing Systems, CHI'08, pp. 107–110. ACM Press, New York, NY, USA.
- McCrickard, D.S., Catrambone, R., Chewar, C.M. and Stasko, J.T. (2003) Establishing tradeoffs that leverage attention for utility: empirically evaluating information display in notification systems. *Int. J. Hum.–Comput. Stud.*, 58, 547–582.
- Mcfarlane, D.C. (1997) *Interruption of People in Human–Computer Interaction: A General Unifying Definition of Human Interruption and Taxonomy*. Nrl Formal Report, US Naval Research Laboratory, Washington, DC.
- McMurtry, K. (2014) Managing email overload in the workplace. *Perform. Improv.*, 53, 13–37.
- Nardi, B.A., Whittaker, S., Isaacs, E., Creech, M., Johnson, J. and Hainsworth, J. (2002) Integrating communication and information through contactmap. *Commun. ACM*, 45, 89–95.
- O'Neill, J. and Martin, D. (2003) Text Chat in Action. In Proceedings of the 2003 International ACM SIGGROUP Conference on Supporting Group Work, pp. 40–49.
- Rector, K. and Hailpern, J. (2014). MinEMail: SMS Alert System for Managing Critical Emails. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, CHI'14, pp. 783–792. ACM Press, New York, NY, USA.
- Reinke, K. and Chamorro-Premuzic, T. (2014) When email use gets out of control: understanding the relationship between personality and email overload and their impact on burnout and work engagement. *Comput. Hum. Behav.*, 36, 502–509.

- Rennecker, J. and Derks, D. (2013) The Psychology of Digital Media at Work, chapter Email Overload, pp. 14–31. Current issues in work and organizational psychology. Taylor & Francis.
- Sacks, H., Jefferson, G. and Schegloff, E.A. (1992). Lectures on Conversation, vol. 1. Blackwell, Oxford.
- Schegloff, E.A. (1968) Sequencing in conversational openings. *Am. Anthropol.*, 70, 1075–1095.
- Schegloff, E.A. (1979). Identification and Recognition in Telephone Conversation Openings. *Everyday Lang.: Stud. Ethnomethodol.*, pp. 23–78.
- Schegloff, E.A. (2004) Answering the phone. *Pragmat. Beyond. New Ser.*, 125, 63–107.
- Shiffrin, D. (1987) *Discourse Markers*. Cambridge University Press, Cambridge.
- Singh, N., Tomitsch, M. and Maher, M.L. (2013) Understanding the Management and Need for Awareness of Temporal Information in Email. In Proc. 14th Australasian User Interface Conference, vol. 139, AUIC'13, pp. 43–51. Australian Computer Society, Inc., Darlinghurst, Australia.
- Sumeckia, D., Chipulua, M. and Ojiakoa, U. (2011) Email overload: Exploring the moderating role of the perception of email as a 'business critical' tool. *Int. J. Inf. Manage.*, 31, 407–414.
- Teevan, J., Capra, R. and Pérez-Quinones, M.A. (2007) *Personal Information Management, Chapter How People Find Personal Information*, pp. 22–34. University of Washington Press.
- Tyler, J.R. and Tang, J.C. (2003) When Can I Expect an Email Response? A Study of Rhythms in Email Usage. In ECSCW'03: Proceedings of the Eighth Conference on European Conference on Computer Supported Cooperative Work, pp. 239–258. Kluwer Academic Publishers, Norwell, MA, USA.
- Vacek, M. (2014) How to Survive Email. In 9th IEEE International Symposium on Applied Computational Intelligence and Informatics, pp. 49–54. IEEE.
- Venolia, G.D. and Neustaedter, C. (2003) Understanding Sequence and Reply Relationships Within Email Conversations: A Mixed-model Visualization. In CHI'03: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 361–368. ACM Press, New York, NY, USA.
- Venolia, G.D., Dabbish, L., Cadiz, J. and Gupta, A. (2001) Supporting Email Workflow. Technical Report, MSR-TR-2001-88: Microsoft Research.
- Wainer, J., Dabbish, L. and Kraut, R. (2011). Should I Open this Email? Inbox-Level Cues, Curiosity and Attention to Email. In Proc. 2011 Annual Conference on Human Factors in Computing Systems, CHI'11, pp. 3439–3448. ACM Press, New York, NY, USA.
- Weilenmann, A. (2003) 'I can't talk now, I'm in a fitting room': formulating availability and location in mobile-phone conversations. *Environ. Plan.*, 35, 1589–1605.
- Whittaker, S. and Sidner, C. (1996) Email Overload: Exploring Personal Information Management of Email. In Proc. CHI 1996, pp. 276–283. ACM Press, New York, NY, USA.
- Whittaker, S., Jones, Q., Nardi, B., Creech, M., Terveen, L., Isaacs, E. and Hainsworth, J. (2004) Contactmap: organizing communication in a social desktop. *ACM Trans. Comput.–Hum. Interact.*, 11, 445–471.
- Whittaker, S., Bellotti, V. and Gwizdka, J. (2006) Email in personal information management. *Commun. ACM*, 49, 68–73.
- Whittaker, S., Bellotti, V. and Gwizdka, J. (2007) *Personal Information Management, Chapter Everything Through Email*. University of Washington Press.
- Whittaker, S., Matthews, T., Cerruti, J., Badenes, H. and Tang, J. (2011) Am I Wasting My Time Organizing Email? A Study of Email Refinding. In Proc. 2011 Annual Conference on Human Factors in Computing Systems, CHI'11, pp. 3449–3458. ACM Press, New York, NY, USA.
- Winograd, T. (1983) *Language as a Cognitive Process*, vol. 1. Addison-Wesley, Reading, MA.