Email Chronemics: Unobtrusive Profiling of Response Times

Yoram M Kalman
The Center for the Study of the Information Society
University of Haifa
ykalman@study.haifa.ac.il

Sheizaf Rafaeli
The Center for the Study of the Information Society
University of Haifa
sheizaf@rafaeli.net

Abstract

One of the unknowns of emailing is the time it will take the receiver to form and post a reply. Response times vary considerably, and the chronemics of email are an important non-verbal cue which can convey meaning as well as influence interactional coherence. While privacy and technical challenges have so far limited quantitative assessment of responsiveness chronemics, an opportunity became available with the recent release into the public domain of an unprecedentedly large corporate collection of private email messages. An analysis of over 16,000 responses extracted from a large database of email messages created by Enron employees was performed. Responsiveness profiles of individual users and of all users are described, and their aggregate temporal distribution is evaluated. The generalizability of these findings as well as their implication to current theory on email response times is discussed.

1. Introduction

"When will I get a response to this email?" [1]. This question is about technology: was the message sent or received successfully? It is also about human behavior, as in: "when will the recipient check email?", "will my message be read?", and "if and when will the recipient respond to my message?" Because of CMC's interpersonal and organizational centrality, the uncertainty created by such questions can have a significant impact on people using email. A sender who asks for a response but does not receive a timely reply might come up with a spectrum of explanations to the silence, ranging from the relatively benign "the recipient is busy", or "the recipient is now working on the response", all the way to harsh thoughts such as "the recipient does not care about me" or even "the recipient is giving me the 'silent treatment'". Silence was identified as one of the biggest challenges of geographically dispersed teams [2], since the silence was often misinterpreted. In the researched teams, silence was often taken as consent, while in fact it was meant to express disagreement or was a result of inattention. Rintel and Pittam [3] described the increasing frustration and hostility of people who do not receive a reply in an IRC (Internet Relay Chat) session. Williams et al. [4] have coined the term "Cyberostracism" to describe situations such as failing to receive a reply to an online message, and researched the negative reactions of those experiencing cyberostracism.

A common theme in recent work about the way groups and individuals use CMC to create and form impressions, collaborate and work online [5-7] is that despite the apparent "poverty" of cues in online text exchanges, people are richly sensitive to both verbal and non-verbal cues. These cues are used to form impressions of online counterparts, as well as to attempt to influence perception by others. A key non-verbal cue affecting online impression formation and communication is Chronemics: time related messages, such as those conveyed by timestamps [7, 8], and chronemics research studies the role of time in inter-personal communication.

The importance of chronemics in interpersonal communication is a direct result of the key role of time, and specifically of temporal rhythms as underlying organizing factors in social life in general, and in communication in particular. As Scheflen points out [9] the discovery of interactional rhythms was a part of the maturation of the understanding of human communication. Communicators need to act in synchrony, and synchronization is based on timing and sequencing. Feldstein [10] focuses on the importance of temporal

patterning in face to face impression formation, where cues such as speech rates, tempo, pauses and the frequency of talking turns influence and reflect the way the participants in the conversation perceive each other. A key concept in understanding the interplay between time and social behavior in "Entrainment", defined by Bluedorn [11] as "… *the process in which the rhythms displayed by two or more phenomena become synchronized, with one of the rhythms often being more powerful or dominant and capturing the rhythm of the other*." Probably the most powerful entraining mechanism we know is the light and darkness cycle, which affects natural rhythms such as sleep, as well as social rhythms such as working hours. The strength of this powerful entraining principle is evident when these natural rhythms are forced to resynchronize following rapid travel across time zones – commonly known as "jet lag". Examples of strong biological entraining rhythms are the menstrual cycle and circadian rhythms. Through entrainment, people learn what rhythms to expect: they learn that finding an academic in the office is much less likely in August than it is in October, and that finding a parking place in a commercial zone is far easier at 7 am than it is four hours later. Moreover, people learn that divergence from these patterns is a sign that something may be wrong: if an acknowledgement to the receipt of an academic manuscript to a journal is expected to be a few weeks, once a month has passed, the researcher will probably inquire what went wrong at the journal office. Another example given by Bluedorn is the expected time to receive a reply on an email. An excessively quick response (within seconds of delivery) is usually a sign of something gone wrong: an "undeliverable" response or an auto-reply. A delayed response can also be used as a tool to convey nuances of emphasis, humor etc.

A key concept in understanding CMC communications is Interactivity [12]. Interactivity is an essential characteristic of effective online communication, and has an important role in keeping message threads and their authors together. Interactive communication (online as well as in more traditional settings) is engaging, and loss of interactivity will result in a breakdown of the communicative process. Research of rhythms in email and other CMC media resulted in claims that text-only CMC is "Interactionally Incoherent": disjointed, without clear turns, and in general "chaotic". But, as noted by Herring [13], text-only CMC is extremely popular, despite obstacles such as disrupted turn adjacency and lack of simultaneous feedback. The online interaction is highly desired, and almost addictive in nature [14, 15]

Part of the explanation is that from a chronemics point of view, text-only CMC allows interactional rhythms not available in other communicative forms, such as multiple simultaneous exchanges. Moreover, text-only CMC allows people to achieve "hyperpersonal communication": "… that is more socially desirable than we tend to experience in parallel FtF interaction." [16]. One of the key principles behind this enhanced social desirability is that when the qualities of CMC are put to good use, CMC allows people to "disentrain" their own rhythms from those of others, without losing the ability to continue affective communication. Thus, people are able to keep their activities synchronized, without the common requirement that the activities be also simultaneous. An important example of a corporate-wide effort to enhance the disentraining elements of email communication is the "Yourtime" initiative in Intel corporation [17], an organizational behavior change program aiming to reduce the impact of e-mail overload across the organization.

We argue that Chronemics should play a central role in enhancing the translucence of systems. Efforts to increase the social translucence [18] of CMC are still exploratory in nature, and raise technological, social and ethical dilemmas [19]. However, the issue of response time, its expression mapping and interpretation are among the more promising and perhaps least threatening of the potential translucence cues, and projects such as "DriftCatcher" [20] have taken this path.

How long does a response take? A review of published literature on response times to emails reveals a relatively fragmented picture. This fragmentation is, in part, a result of the difficulty of ethically collecting and analyzing significant numbers of emails communications created by individual users. A comparative analysis of survey methods using e-mail reported average response times ranging from less than 5 days, to over 14 days [21]. In a comparative study of telephone, fax and email methods of prodding tardy peer reviewers, those who responded to an email prod did so within an average of 4.6 days [22]. In over three thousand medical consultations between military physicians in the Walter Reed Army Medical Center "Ask a Doc" system, the average response time was 11.93 hours [23]. Data on the response time of corporations to customer service requests reveals an average response time ranging from 12 hours [24] to six days [25] with 28% of the emails receiving a response within 24 hours [25], 59% providing an answer within 48 hours, and another 5% within the first 72 hours [26]. In another survey by Jupiter Research [27] 88% of customers expressed an expectation to receive a response within 24 hours, and the relatively sharp drop in satisfaction of consumers not handled within this timeframe is well documented in a research about response times to e-complaints in the hotel industry [28]. Some data about responsiveness in media other than email can be found in a study of Usenet messages [29] which shows an average response time of one day, 90% of the responses created within 2.5 days, and 99% of the responses created within two weeks. In addition, a report about "Google Answers" [30], showed the distribution of response times to posted questions, usually answered within a few hours.

The expected response time of 24 hours is reflected again in many (16/24) of the responses of the interviewees in Tyler and Tang's study [1] The response times ranged from 15 minutes to "a few days", and depended on factors such as the urgency of the message, work culture, and the correspondents involved. When interviewees were questioned about their own response times, the researchers identified a "desire to project a specific image of the time between receiving and reading or replying to email". The researchers termed this projection the user's "Responsiveness Image", and linked it to Goffman's notion of "interaction as performance" [31]. In many cases the wish was to project a responsive image, though some chose to use long response times to project inaccessibility, as well as non-urgency. A part of the responsiveness image of 11 out of the 13 of the interviewees was to reply within the workday or within 24 hours, even if the response is only an acknowledgement of receiving the email and a message that a full response will be sent at a later time. The researchers also described a timeline starting from the sending of an initial message, until a decision that a "breakdown" has occurred, (that interactivity is broken), and that the expected answer will probably not be received. At that point in time, people might decide to follow up with an additional email, a phone call, or a face to face visit. The interviewees of Tyler and Tang described various mechanisms they use to evaluate why a response to a message is delayed, mechanisms such as checking the calendar of the recipient, "auto-reply" messages, and other contextual information about the recipient. Besides highlighting the poor state of current Social Translucence in CMC, these observations also draw attention to the need to improve awareness of work rhythms [32] of colleagues. Work on such visualizations and applications to assist in collecting, processing, and presenting this socially critical meta-information is an ongoing effort [33, 34], and at present is mainly based on information collected within the confines of a specific organization's mail servers.

We set out to answer the question "When will I get a response to this email" by seeking a large, independent sample of email messages, created by a large population of users, measure the chronemics of responsiveness of these users, and look for systematic patterns or distributions. The research question is therefore how long does it take for users to respond to email messages.

2. Method

The messages analyzed in this research were collected from a database [35] published by the US Federal Energy Regulatory Commission (FERC) as part of its investigation of the manipulation of energy prices by the Enron Corporation [36]. It contains various types of documents produced by Enron employees, including emails (work related messages, as well as private correspondence carried out using corporate email accounts), scans of printed documents, transcripts, trading floor audio files, and more. The purpose of this project was to identify as many email responses which can clearly be attributed to a single responder, and from which body and timestamps it is possible to extract how long it took the responder between receiving the original email, and sending the response. The messages are of two types: regular (termed .pst), and scanned emails which were produced by OCR'ing scans of printed emails. In addition, a small portion of the emails were removed from the database for privacy reasons, and were later re-released [37]. The database that was used in this research was the largest and most stable subset, called Enron Email (.pst). It included 1,368,755 documents. Another database, based on scanned documents was not reliable enough for automated analysis, and one with re-released emails was unstable, as well as relatively small in comparison (a little more than 20,000 documents). Selecting only the subset described here was justified and not expected to affect the results, since the folder location in any of these subsets, and the response times are independent factors. A processed version of this database is described in [38].

This study focuses on the content of "sent mail" folders of individuals, aiming to generate representative chronemic profiles for each user. We measured the response times of each user through an analysis of the timestamps of their email replies. This produced a profile of the individual response behavior of each user, as well as a composite (aggregate) responsiveness profile of all Enron email users.

The messages were harvested from the FERC website using the provided search engine, which is able to search for the occurrence of individual words in the texts, as well as provide meta-information about each document such as a reference number (SDOC_NO), Sender (From), Recipient (To), date and time of message, subject, and the body of the document. The above seven items were extracted for every email in a "sent" folder, and which "body" contained the word "original (since "original message" is the standard text that accompanies every email that has the original message in it). The emails of each sender were exported into a separate Excel sheet, and analyzed separately.

Of the 1,368,755 documents, about 15% were in "sent" folders, ranging in date from 1998 to 2002. A few dozen messages from senders which could not be positively identified (such as senders called "@ECT", or "Legal Temp 7") were not included in the analysis. The spreadsheet was used to:

- Remove empty messages. For an unknown reason, the results included a significant number (at least 5-10%) of empty (no message attributes

and no body) messages with an SDOC_NO of 0. These were discarded.

- Verify that there was only one sender in the exported data file. Since the "From" field was inconsistent in its representation of last names and first names, as well as of initials, there were many occurrences of the "from" field containing both the "last_name first_name" and the "first_name last_name" (for example "Yoram Kalman" and "Kalman Yoram"). These were assumed to originate with the same person.
- Calculate the first timestamp (date and time) in the body of each email message, hence isolating the time and date of the initiating message that was replied to. This timestamp was subtracted from the time and date attributes of the analyzed message, to calculate reply time. Most time attributes were labeled "GMT", and a calculation was made of the time zone differences, based on the content of specific messages, as well as on comparing timestamps in "Peri-synchronous" [1] message threads. The best estimate of the time zone difference between the time attributed by the time stamp, and the timestamp in the message body was five hours, and this number was used in the response time formula. In cases where the time attribute of the user's messages was not in GMT, this correction was not performed, and in rare cases where some times were in GMT and some without GMT, an attempt was made to adjust calculations individually.
- Identify identical messages which were repeated throughout the database (probably due to the fact that the database contained an aggregate of .pst files collected from several servers or sources in Enron). In case of identical messages, the response time of all identical messages was treated as a single occurrence.

3. Results

16,093 email messages met all of the criteria: a) in the sent folder of an identified individual user b) a message header starting with Re: c) message body contains a retrievable timestamp of the original message to which the user replied d) in case of multiple identical messages, the message was counted only once. In all, the messages in our sample were created by 144 separate individuals (Average: 112 messages per person. Min: 1 message. Max: 662 messages. Median: 52.) Four outlying messages (unreasonably high or negative response times) were removed. The resulting average response time of the users was 1.2 days (28.8 hours). The remaining negative response times (about 5% of the sample) were not removed, and were grouped with the responses within 1 day. A distribution of the aggregated response times of all users, grouped by days, is described in Figure 1. A sample responsiveness profile of a representative individual user is described in Figure 2. A detailed table showing the cumulative percentage of responses received during the first six hours is presented in Table 1. It also shows also the "negative" response times mentioned above.

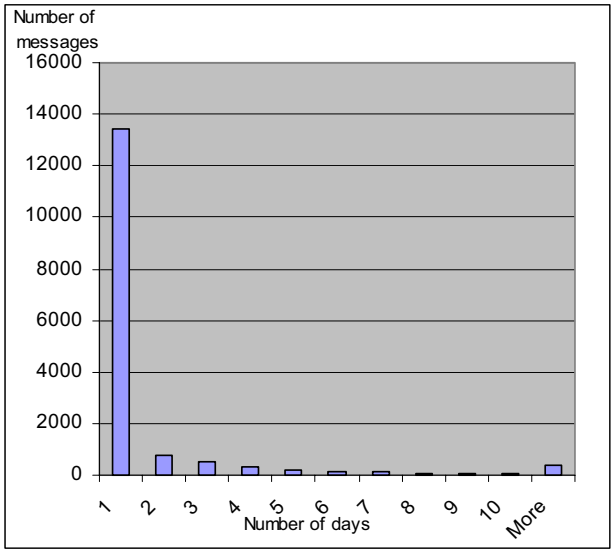

Figure 1: Aggregate responsiveness profile. Number of messages all users responded to within x to x-1 days. Grouped by days.

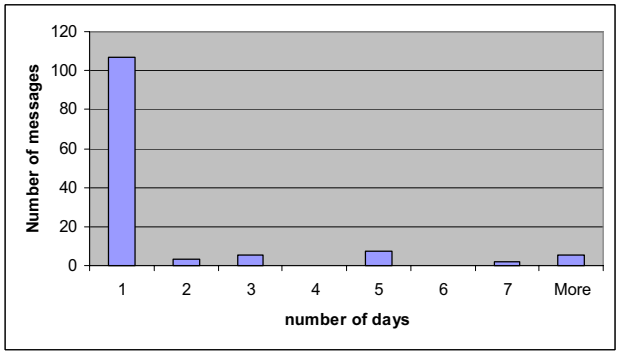

Figure 2: Responsiveness profile of user BG. Number of messages user BG responded to within x to x-1 days. Grouped by days.

Hours	*Cumulative %*
-6	.15%
-5	.81%
-4	2.62%
-3	3.35%
-2	3.87%
-1	4.22%
0	4.85%
1	25.61%
2	49.39%
3	58.76%
4	63.97%
5	66.53%
6	68.16%

Table 1: cumulative percentage of answers created within n hours from receiving, from all answers created. See text for explanation of apparently negative response times.

Two distinguishing parameters were used to describe the response patterns of individual email users: the cumulative proportion of emails the individual responded to within 1 day, and the cumulative proportion of emails the individual responded to within 5 days. The denominator of the proportion is always the total number of reply messages of the individual user. These are described in Figure 3. Fig 3 (i) indicates that a vast majority (97%) of the population responded to at least 30% of the emails within the first day. Fig 3 (ii) indicates that 97% responded to at least 70% of the emails within 5 days. 5% of the users fall outside of these boundaries. Consequently it is possible to generalize and estimate that a typical email user (95% of the population) in this sample responded to at least 30% (30-100%, on average 84%) of the emails within one day, and to at least 70% (70-100%, on average 95%) of the emails within five days. An additional analysis of the distribution of all positive response times up to 10 days (14,740 observations) was performed using SAS version 8.0 [39]. Of the five distributions evaluated (Weibull, Normal, Exponential, LogNormal and Gamma), the Gamma distribution best approximated the observed aggregate distribution. This distribution is presented in Figure 4.

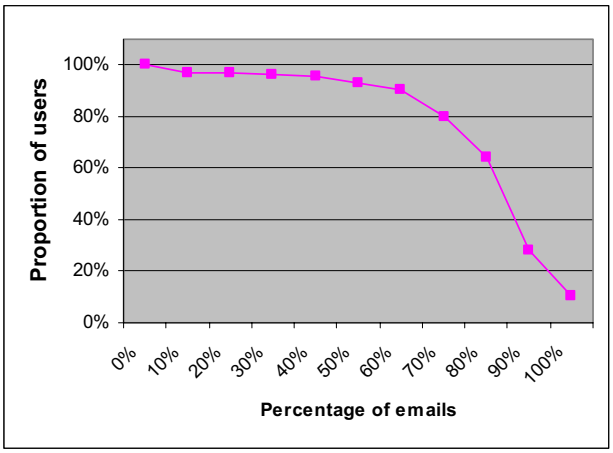

Figure 3 (i): Proportion of users who replied to at least x% of the emails within **one** day

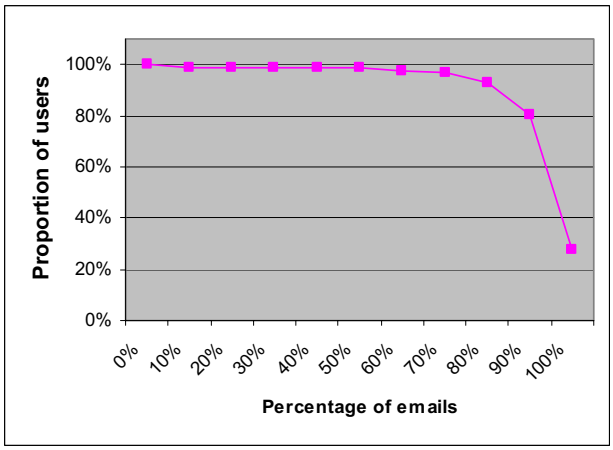

Figure 3 (ii): Proportion of users who replied to at least x% of the emails within **five** days

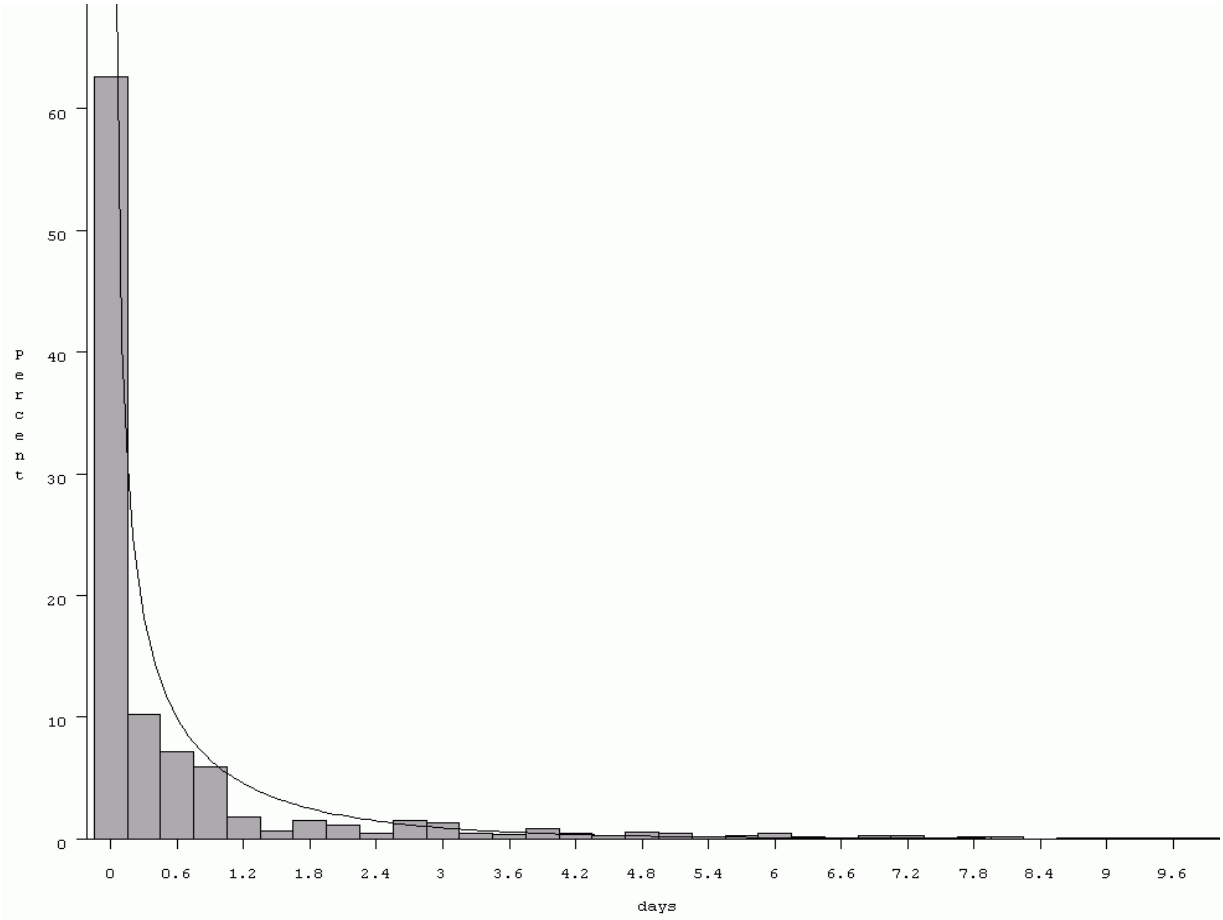

Figure 4: Graph of optimized Gamma distribution (alpha=0.37, Beta=1.72) superimposed on the aggregate responsiveness profile of all users. n=14,740

4. Discussion

The results presented here describe, in quantitative terms, a well known phenomenon: messages requiring a response should be dealt with as soon as possible. Messages left "for later" have a strong chance of remaining unanswered. These results corroborate the "24 hour expectation" reported in the literature on corporate email [1] and in customer service [27, 28]. While not counterintuitive, these findings are not self evident, and are, to the best of our knowledge, unique in their broad quantitative foundation and unobtrusiveness [40] as well as in a wide range of email types analyzed post factum and in a "real world" (non-laboratory) setting. The fact that the results are based on an unobtrusively collected, quantitative, "real world" dataset adds validity to the results of this study, in relation to previous qualitative, interview based work. One of the most intriguing findings is the *strength* of the 24 hour phenomenon: on average, 84% of all the replies are created within 24 hours. A higher resolution inspection of the data is somewhat more difficult due to inherent measurement biases that will be discussed later, but even allowing for some imprecision, detailed data (Table 1) demonstrates that on average more than 50% of all replies are created within 2-3 hours. The resulting gamma distribution which is highly skewed to the left, with a stretched out and rapidly diminishing right tail, seems to be similar in shape to other responsiveness profiles described before [25, 29, 30]. Another important finding which is an extension of the "24 hour" finding is that the email responsiveness profile of the various users at Enron is relatively similar. As the relatively sharp "knee" in Figure 3 shows, 95% of the users still show a relatively wide spectrum of responsiveness profiles, but a somewhat tighter focus on 80% of all of the users already shows significantly more uniformity: They respond to at least 70% of the emails within the first day, and to at least 90% within 5 days. A tighter focus on 50% of the responsiveness profiles shows that they fall within 5% of the average 5 day aggregate responsiveness percentage of 94.6%.

Of course, this research has some major limitations. First, the sample is limited in scope. We used only archives of employees of a single corporation. These are users who have probably logged in to their accounts on a daily basis, and many of whom probably monitored their inboxes continuously throughout the work day. Different user populations who may log on to their accounts less often (for example as a result of a corporate effort like Intel's "Yourtime" initiative [17]), or only once or twice a week, will probably display a different responsiveness profile, probably with a similar distribution though with different parameters, due to a random addition of many hours, days and sometimes weeks to response times. Also, it is impossible to know why some of the "sent mail" folders were populated by few or many messages: it could be the result of the level of activity of the individual user, but it can alternatively be a result of the archiving behavior of the individual, as well as depend on the archives that the FERC investigators managed to seize. In addition, since the extraction of the timestamp from the original message body was automated, and failed in some of the cases, it can be assumed that the extraction was more likely to fail in replies to differently formatted messages from users outside of Enron, than in replies to the uniformly formatted messages originating from Enron email server or servers. Research of additional "sent mail" boxes of individuals in academia, at home and in other situations should augment the picture generated from the Enron database. Moreover, it is possible to investigate the inboxes and incoming email archives of users (including those in the Enron database) and uncover the responsiveness profile of various people who responded to the messages of these users.

A second limitation is the tool used to measure response time: computer generated timestamps. Estimates based on these timestamps are inevitably inaccurate due to factors such as being located in various time zones, computer (and mail server) clock inaccuracies, delays in updating computers to daylight saving time (DST) as well as varying DST regimes, and the possibly inconsistent use of GMT in the database generated timestamps. Compounded, these inaccuracies can result in imprecise response time estimations. The most obvious manifestation of these inaccuracies is the appearance of ostensibly negative response times. About 4% of the response times are 0 to (-5) hours, and almost 1% are even less than (-5) (Table 1). This means that the granularity of the usable results is of at least a few hours, and that any higher resolution analysis is subject to unpredictable deviations. Nevertheless, we do not believe that these variations influence the generalizations about responses within one and five days, since adding or subtracting a few hours from the one day or the five days boundaries do not materially affect the generalizations reached. The most important issue that a higher granularity will allow to investigate is the responsiveness profile during the first day, and specifically within the first few hours. The granularity that should be attempted is of minutes, to allow the corroboration of the finding that many replies are produced almost immediately following the receipt of a message. Another source of bias resulting from the timestamp tool used is the inability to measure responses which did not have a "RE:" header, or did not include the original message.

A third limitation is that the response times were aggregated, regardless of message content and the identity of the recipients. The analysis does not treat peri-synchronous [1] messages differently, or distinguish between personal and work related messages. The analysis does not check if the originating message was

"urgent", or asked for an immediate response, nor does it look at who else was copied on this message. It does not check if the response was really a reply to the email message, or if the sender simply used a reply to save the retyping of the recipient's email address. All of the above, and other details, can influence responsiveness [1, 41, 42]. An added difficulty of the missing context is that there was no individual information about the users in the Enron database. This deficiency might even have resulted in a few cases of merging two separate users with identical names, or with interchangeable last and first names into a single responsiveness profile. The missing context also makes it impossible to look into corporate hierarchy and how it affects responsiveness. Last but not least, the inability to receive additional chronemics and geographical location information about each of the users, did not allow us to breakdown the response time into components such as time between sending and receipt, between receipt and reading, and between reading and replying.

Despite the limitations of this research, these findings do provide answers to a few important questions, and opens the door to new and interesting questions. Some of the questions that can now be tackled have to do with online silence. Silence is a well researched area in traditional communication research [43-45]. Nevertheless, with the exception of lurking [46, 47], temporal issues have received relatively little attention in the CMC field, and this is despite the strong disruptive potential the interpretation of online silence can have [2-4]. In congruence with the findings of traditional communication research, communicators from varying cultures use and interpret silence differently, and these differences are a source of potential misunderstanding and confusion. This potential is compounded and amplified in the online domain, where geographic and national cultures are mixed, as well as corporate cultures, and many other idiosyncratic and evolving online cultures. In a research on factors which hamper inter-team collaboration, difficulty interpreting the meaning of silence was identified as one of the most common problems, negatively affecting 100% of the researched teams [2]. The potential of online silence to inadvertently convey the wrong message is enormous. One of the major obstacles in researching online silence is the lack of a benchmark for online silence. This deficiency stems, in part, from the difficulty of obtaining access to relevant databases, a difficulty resolved by the auspicious release to the public domain of the Enron Corpus. The results reported here provide such a benchmark. We also suggest a methodology to produce such a generic "responsiveness profile" for all media and settings. The drawing of a responsiveness profile of individual or cumulative users allows a likelihood estimate for receiving a response as a function of the time since sending, and thus silence can be defined as no response after an x period of time, at which, say, 99% or 97% of the responses have already been created. For example, according to the aggregate Enron email data, x will equal to 20 and 8 days, respectively. When no empirical data exists, the Gamma distribution can be estimated, and used to provide a first approximation.

This ability to extrapolate from a responsiveness profile is important also for practical reasons. A relatively simple mechanism on the user's side can extract the responsiveness profile of individuals the user is corresponding with, and unobtrusively provide the user with an estimate of when it can reasonably be expected to receive a reply from this person, and at what stage the probability for that is negligible. This simple tool will add to Social Translucence [18], without requiring any cooperation from the side of other users and without infringing any privacy. Nevertheless, like any extraction of explicit information from implicit data, some users might feel that such an analysis is indiscreet. Users may even introspectively "turn this tool on themselves", observe their own responsiveness profiles, and utilize the information captured by it. An interesting attempt to achieve such a goal is DriftCatcher [20].

Future research on responsiveness profiles of various users using different media in a variety of contexts can use the responsiveness profile and the distribution information reported here as a benchmark. The fact that the aggregate profile and the distribution represent many thousands of messages created by dozens of different users over a long period of time, means that they can be utilized both in order to assess how varying parameters such as those mentioned above, influences the profile, as well as to estimate a responsiveness profile in cases where the number of observations is smaller, and there is a need to extrapolate.

The findings reported here require us to reassess one of the prominent attributes of email: its purported asynchronicity. As already mentioned in regards to peri-synchronous email [1], emails are sometimes used in a synchronous manner, and from the aggregate response time profile of the Enron users, the ubiquity of this phenomenon is established: a significant percentage of replies are created very shortly after receipt of the initiating message, sometimes within minutes and seconds. We wish to suggest that the level of synchronicity is actually not an attribute of a specific technology (email, chat, discussion group, instant messaging). With today's efficient networks, a traditionally asynchronous medium like email can be used synchronously, for a rapid exchange of thoughts and ideas, and a traditionally synchronous medium like chat or instant messaging can be used to communicate asynchronously. We hypothesize that the choice of medium is less a result of its level of synchronicity, and more a function of variables such as availability, context, cost and security. This hypothesized blurring of

boundaries is important to consider when discussing convergence of electronic media.

In summary, the methodology of measuring the responsiveness profile of individual CMC users and of aggregates, as well as the findings about the responsiveness profiles of Enron users show that email is not as asynchronous as it is sometimes portrayed, and that most replies are created shortly after receipt; they present a framework for comparing responsiveness profiles in various settings, of various users, and in various media, as well as a benchmark responsiveness profile and a benchmark distribution. These findings should promote research of online responsiveness, as well as of online silence, and they provide a new perspective on two central concepts in CMC research: interactivity and synchronicity.

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