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Sociotemporal Rhythms in E-mail

A case study

Michael G. Flaherty and Lucas Seipp-Williams

ABSTRACT. This study examines sociotemporal rhythms in the volume of e-mail. E-mail is available 24 hours a day, seven days a week, but we hypothesize that there are non-random patterns in the temporal flow of e-mail. We counted the total number of e-mail messages received per hour by any address at our college for more than eight months. Non-random patterns emerged in our data. The volume of e-mail per hour is above average during traditional working hours and below average during the early morning and evening hours. Also, there are significant differences in the mean number of messages per hour/per day. KEY WORDS • e-mail • sociotemporal rhythms • temporality • time

Introduction

The discovery of sociotemporal rhythms figured prominently in the origins of sociology. Durkheim (1897/1951: 108–18) found seasonal, monthly, daily, and hourly variations in his study of suicide. Later, in *The Elementary Forms of the Religious Life*, Durkheim (1915/1965: 23) established the sociology of time in more explicit fashion: 'a calendar expresses the rhythm of the collective activities, while at the same time its function is to assure their regularity.'

Sorokin and Merton (1937: 620) elaborated on Durkheim's work by noting that 'systems of time reckoning reflect the social activities of the group.' Unlike astronomical time, social time is not purely uniform and quantitative, but is characterized by qualitative differences, such as anniversaries and other celebrations. Moreover, Sorokin and Merton point out that calendars often reflect the underlying periodicities in various means of production: 'periodic rest days

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seem to be unknown among migratory hunting and fishing peoples or among nomadic pastoral tribes, although they are frequently observed by primitive agriculturists' (p. 620). By the same token, however, technological transformation can modify sociotemporal rhythms and systems of time reckoning. A famous example is the standardization of time in response to the development of the railroad and telegraph systems (Cottrell, 1939; Zerubavel, 1982a).

Engel-Frisch (1943) advanced our understanding of the relationship between time and technology by distinguishing three temporal aspects of human ecology: rhythm (the times at which people do things), timing (the synchronization of these rhythms), and tempo (the number of activities per unit of time). But 20 years passed before Moore (1963a) rekindled interest in the temporal structure, of organizations. Given that '[m]ost people concentrate their waking activities during "the daylight hours", he concludes that sleep 'represents an apparently biologically necessary but still socially significant segregation of time' (p. 162). The alternation of work and sleep make for traffic patterns that epitomize sociotemporal rhythms, and Moore (1963b) argues that the need for synchronization restricts efforts to address related problems:

> The attempt to reduce rushhour traffic congestion by 'staggered' daily work schedules has early limits if the worker is to have some time synchronized with other members of the family, and a staggered workweek would affect not only the family but also a host of associations ranging from churches to recreational groups. (p. 121)

In contrast to the familiar frustrations of traffic, Melbin (1969) has demonstrated that sociotemporal rhythms can be found where one least expects them: 'patients in a small private mental hospital behave crazily far more often on weekdays than they do on evenings and weekends' (p. 650). Of course, as is typically the case, that rhythm is the product of another: the presence during weekdays of clinicians who are interested in, and tolerant of, symptoms they view as clues to proper therapy.[1] Similar periodicities can be found in very different settings. For example, Fine (1990) reports that restaurant employees must deal with the fact that most people want to eat at roughly the same time, thereby producing a regular 'rush' of customers. As Zerubavel (1976) puts it, timetables and scheduling make for the social organization of time.

Standard temporal units (e.g. the hour, day, week, and month) are integral to less formal types of periodicity as well as other facets of social interaction. Influenced by Durkheim and Sorokin, Zerubavel (1977; 1982b) has examined the relationship between calendars and collective identity. Of special relevance, however, is his study of the weekly rhythm. Zerubavel (1985) shows that, by 'imposing a rhythmic "beat" on a vast array of major activities (including work, consumption, and socializing), the week promotes the structuredness and orderliness of human life' (p. 4). What is more, the weekly rhythm is crosscut by a

distinction between private time and public time as individuals negotiate the boundaries of social accessibility (Zerubavel, 1979).

A numeric claim, once rare, is now increasingly prevalent in public discourse: 24–7–365. In contrast to the research on social periodicities, these numbers have come to represent the ceaseless availability of service and, more broadly, a round-the-clock level of commitment or involvement. Twenty-five years ago, Melbin (1978: 4) marshaled 'systematic evidence of steadily increasing 24-hour activity' in the United States. Of course, his study preceded the creation of e-mail, which provides almost constant access to innumerable people and on-line services.

E-mail offers a convenient source of data with which to examine the relationship between time and technology. With e-mail, we have technology that is available 24–7–365, so any patterns in the flow or volume of e-mail will be dictated not by the technology itself, but by the rhythms of social activity. Thus, this study has been provoked by the following question: in what ways do sociotemporal rhythms shape the flow or volume of e-mail?

Data and Methods

We asked the System Administrator in the Computer Center to write a program that counts the number of e-mail messages received by any address at our college during every hour of every day. Data collection began on Friday, 15 February 2002, and ended on Thursday, 3 October 2002. The total volume of e-mail per hour was recorded for 5,533 continuous hours, making for 230.5 days, 32.9 weeks, or 8.2 months. All members of the college community have round-the-clock access to their e-mail, free of charge, but those who live off campus must have a personal computer with modem connection to the campus system. There were 279 members of the faculty (including 104 adjuncts), 3,299 students, and 300 members of the administrative staff.

We did not have any access to the content of e-mail messages, and there was no way for us to distinguish between faculty, student, and staff e-mail. Consequently, our data consist of three variables: (a) the volume of e-mail, (b) hour of the day, and (c) day of the week. We used the Statistical Package for the Social Sciences (SPSS) to calculate the means and standard deviations of e-mail per hour and per hour/per day. The resulting distributions were tested through the analysis of variance. We hypothesized that the mean number of e-mail messages per hour would not be equal, and that the mean number of e-mail messages per hour/per day would not be equal.

The design of our campus system is such that we were unable to count the number of messages sent from any address at our college. Still, there may be some virtue in this necessity. Counting the volume of e-mail messages received

(rather than sent) provides us with a rough measure of behavior beyond the confines of the college. The vast majority of our students have families and friends who are in the same or nearly the same time zone. Still, an unknown (but certainly small) proportion of the e-mail was sent from people in very different time zones. Anecdotal evidence indicates that these messages are not concentrated within particular hours or days. If that is the case, then we can assume that the already strong patterns in our findings are only conservative estimates.

There is some unknown amount of spam in our data. Recently published complaints in the popular press suggest that spam is a large and increasing portion of e-mail. However, given strong evidence for sociotemporal rhythms in the volume of e-mail, spam either conforms with, and thereby contributes to the overall rhythms, or it does not conform with the overall rhythms, but there is not enough of it to disrupt those rhythms. Anecdotal observations support both interpretations, but our data do not enable us to distinguish spam from other forms of e-mail.

Results

Messages per hour

Table 1 reports the means and standard deviations for the number of e-mail messages received per hour. In support of our first hypothesis, there are significant differences among the means, with $F(23, 5{,}509) = 105.2$, and $p < .001$. A distinct pattern emerges from these data. The overall mean is 489.1 messages per hour. All of the hours from midnight until 8:00 a.m. have means below that figure. All of the hours from 8:00 a.m. until 6:00 p.m. have means above that figure. All of the hours from 6:00 p.m. until midnight have means below that figure. Of the ten hours above average, four are in the morning and six are in the afternoon. The shape of the distribution is roughly bimodal, with a minor peak in the late morning from 11:00 a.m. to 12:00 p.m. (i.e. just before lunch) and the major peak in the afternoon from 2:00 p.m. to 4:00 p.m. The minimum values occur in the early morning hours from 4:00 a.m. to 7:00 a.m. during which most people are sleeping, preparing to leave for work, or traveling to work. In short, although there is round-the-clock activity, the overall pattern corresponds to the traditional rhythms of the working day.

The trends from hour to hour are consistent with the foregoing interpretation. Beginning at midnight, there is a general downward trend (with two small exceptions from 1:00 a.m. to 2:00 a.m. and 6:00 a.m. to 7:00 a.m.). The number of messages increases steadily from 7:00 a.m. until noon, with the three largest increases during the day from 7:00 a.m. to 8:00 a.m. (+ 64.7), 8:00 a.m. to 9:00 a.m. (+ 101.6), and 9:00 a.m. to 10:00 a.m. (+ 65.0). There are a few sizable increases during the late morning and early afternoon (+ 34.4 from 11:00 a.m. to

TABLE 1
E-mail messages received per hour: means and standard deviations

Hour	*N*[a]	*Mean*	*SD*
00	230	385.5	111.8
01	230	378.6	108.4
02	229	392.1	109.3
03	230	366.7	104.5
04	230	355.1	95.1
05	230	345.5	100.2
06	230	347.8	101.3
07	230	346.5	96.1
08	230	411.2	117.1
09	231	512.8	192.3
10	231	577.8	237.8
11	231	604.2	214.1
12	231	638.6	244.6
13	231	604.1	213.3
14	231	628.1	218.2
15	231	666.4	234.2
16	231	666.2	239.2
17	231	654.3	259.9
18	231	576.8	207.1
19	231	488.7	161.2
20	231	469.6	152.3
21	231	468.5	149.0
22	231	438.6	146.0
23	230	409.1	125.0
Total	5,533	489.1	207.9

[a] *N* represents the number of hours during which data were collected.

12:00 p.m., + 24.0 from 1:00 p.m. to 2:00 p.m., and + 38.3 from 2:00 p.m. to 3:00 p.m.), but nine of 12 trend differences are negative in the afternoon, with the two largest drops coming from 5:00 p.m. to 6:00 p.m. (–77.5) and 6:00 p.m. to 7:00 p.m. (–88.1). Of course, these are hours during which most people are leaving work.

Messages per hour/per day

In Table 2, we present the means and standard deviations for the number of e-mail messages received per hour/per day. Again, in support of our hypothesis, there are significant differences among the means, with $F(6, 5{,}526) = 397.4$, and $p < .001$. And again, there is an obvious pattern in these figures. Using the

TABLE 2
E-mail messages received per hour/per day: means and standard deviations

Day	*N*[a]	*Mean*	*SD*
Sunday	791	296.4	80.8
Monday	792	508.8	200.7
Tuesday	791	582.6	194.2
Wednesday	783	599.0	215.0
Thursday	792	576.8	209.5
Friday	792	526.2	168.9
Saturday	792	335.0	92.2
Total	5,533	489.1	207.9

[a] *N* represents the number of hours during which data were collected.

overall mean of 489.1 messages per hour as a point of reference, we can see that the means for Saturday and Sunday are much lower at 335.0 and 296.4, respectively. On average, there are 154.1 fewer messages per hour on Saturday, and 192.7 fewer messages per hour on Sunday. In contrast, the means for Monday (508.8), Tuesday (582.6), Wednesday (599.0), Thursday (576.8), and Friday (526.2) are higher than the overall mean. Moreover, there is a good approximation to the normal curve, with the distribution of means peaking on Wednesday and tailing off in both directions toward Sunday and Saturday.

We used a factorial design to test the possibility of interaction between hour of the day and day of the week. The interaction term is significant, with $F(6, 23, 138) = 14.3$, and $p < .001$. Generally speaking, the volume of e-mail per hour is higher during the late morning and early afternoon as well as workdays. By the same token, the volume of e-mail per hour is lower during the early morning and evening hours as well as the weekend. These factors interact because the volume of e-mail during the early morning and evening hours of the weekend is even lower than it is during workdays, while the volume during the late morning and early afternoon during workdays is even higher than it is during weekends.

The weekly cycle

The strength and stability of the weekly cycle are evident in Table 3. Despite round-the-clock availability of e-mail, a distinct, non-random pattern is apparent. The daily volume of e-mail per hour begins at its lowest point on Sunday – the traditional day of rest – which ranked seventh for 30 of 32 weeks and never higher than sixth. Monday was typically ranked fifth, although it was fourth

TABLE 3
Number of weeks (out of 32) that each day was at each rank by volume of e-mail received

Rank	*Sun*	*Mon*	*Tue*	*Wed*	*Thu*	*Fri*	*Sat*
1st			8	16	7	1	
2nd			11	12	9		
3rd		1	10	3	13	5	
4th		11	3		2	17	
5th		19		1	1	9	1
6th	2	1					29
7th	30						2

Note: Only full weeks were classified in this table.

about one-third of the time. Tuesday was a busy day, coming in first eight times, but more likely to be second or third. Wednesday earns its name – 'hump day' – by being the peak of the distribution 16 times and coming in second 12 times. By Thursday, volume begins to drop, with only seven first place finishes and a modal rank of third. The decline continues on Friday, with a modal rank of fourth. On Saturday, the volume drops to its second from the lowest point, with 29 sixth place finishes. And then the weekly cycle begins again.

The curvilinear pattern in Table 3 would have been even more distinct were it not for a single week during which Wednesday was ranked fifth and Friday was ranked first. Yet that week provides us with a classic case of the 'exception that proves the rule' since the week in question was not only the first anniversary (Wednesday) of the 9/11 attack on the United States, but also the first full week of classes for the school year. Here, we have striking evidence for the difference between social time, with its qualitative periodicities, and astronomical time, where every day is just another day (Sorokin and Merton, 1937).

Finally, it is worth noting that the total volume of e-mail is a very 'mixed bag'. A sizable proportion of it is strictly work-related, but a great deal is produced by personal correspondence and various forms of recreation. Given this variation in content, it is all the more remarkable to find distinct patterns in the temporal flow of e-mail.[2]

Discussion

An individual can commit suicide at any hour of the day, any day of the week, and any month of the year, yet Durkheim (1897/1951) observes that suicides are not randomly distributed across the clock or calendar. Within a very different

context, he concludes that time is a 'social institution' in relation to which 'all things are temporally located' (1915/1965: 23). Likewise, individuals have access to e-mail 24 hours a day, seven days a week, but our findings indicate that, as with suicide, their use of this technology is not temporally random. On the contrary, there is ample evidence that the volume of e-mail per hour and per hour/per day is structured by sociotemporal rhythms. What is more, in accord with previous studies (Melbin, 1969; Fine, 1990), it would appear that rhythms in the volume of e-mail are related to other forms of periodicity. Of primary relevance would be the biological need for regular sleep coupled with the sociological need for interpersonal synchronization (Engel-Frisch, 1943; Moore, 1963a; 1963b). Indeed, temporal coordination is integral to social interaction. A member of the college community who sleeps during the day in order to use e-mail at night would be out of 'sync' with nearly everyone else.

It remains to be seen whether e-mail will transform sociotemporal rhythms and systems of time reckoning as thoroughly as did the railroad and telegraph in an earlier era (Cottrell, 1939; Zerubavel, 1982a). Melbin (1978) predicted that the colonization of night would continue, but, due to the need for interpersonal coordination, not in unimpeded fashion. Our findings support this projection. There is considerable e-mail at all hours of the day and days of the week, but there also is evidence of resistance to round-the-clock use of this technology. Clearly, the traditional rhythms of the day and the week continue to exert a powerful influence on the use of e-mail despite its nearly ceaseless availability. The weekly cycle that dominates our society, and much of the contemporary world, has its roots in the Hebraic story of 'Genesis' and the need for agricultural people to rest periodically (Sorokin and Merton, 1937). However, Zerubavel (1985) points out that God gave us only one day of rest; the unions gave us another.

Both days of the weekend have unique histories, but what about the other days of the week? Why should any weekday differ from another in systematic fashion? Zerubavel (1985) notes that each day of the week has socially defined attributes – an observation anticipated by Thompson (1967: 74) when he describes the eighteenth- and nineteenth-century custom among European workers of celebrating 'Saint Monday' (i.e. neglecting work on Mondays for the sake of leisure as well as 'marketing and personal business'). Zerubavel's (1985) assertion is corroborated by the distinct patterns in our data. Following two days of rest and recreation, many people find it difficult to 'resettle into a productive state of mind' (p. 90). And, of course, it is tempting to extend the weekend by 'calling in well' on Monday (generally acknowledged by moving many national holidays to Monday, even when the original holiday marked a particular date, like Washington's birthday).[3] In combination, these tendencies make Monday the least productive day of the week. Similarly, there are retrospective and prospective reasons for the relatively low volume of e-mail on

Friday. It is 'the last day of the workweek' and, as such, 'many people succumb to the fatigue they [have] accumulated during the preceding four days' (pp. 90–1). There is also 'preoccupation with how the coming weekend is going to be spent' (p. 91). In fact, some people get a head start on the weekend by loafing while at work, leaving work early, or not coming in at all.

Zerubavel states that 'whatever "qualities" Tuesday, Wednesday, and Thursday might have, they are generally experienced not quite as intensively as the other four days' (1985: 113). Nonetheless, Tuesday, Wednesday, and Thursday represent the productive heart of the weekly cycle. Those days account for 31 of 32 first place rankings in terms of volume of e-mail per hour, with Wednesday claiming half of them and the balance almost evenly divided between Tuesday and Thursday. By Tuesday, people are geared into productivity; Tuesday's momentum carries over into Wednesday; by Thursday, they are not yet exhausted. Moreover, these are not the best days to 'call in well' since a day off in the middle of the week cannot be combined with the weekend for a three-day break. These are the busy days of the week, where most of the work is done.

Further research on sociotemporal rhythms is warranted. In particular, e-mail offers a constant tide of measurable units that seems to ebb and flow in response to the pull of social forces. The findings of this study can only be confirmed by comparable research within organizations of different kinds and sizes, but it is difficult to collect this information across organizational boundaries. In addition, longitudinal studies of e-mail could reveal whether there is a continuing trend toward 24-hour activity. The content of e-mail provides further opportunities for research. De Certeau (1984) has described 'what in France is called *la perruque*, "the wig"', a term that represents 'the worker's own work disguised as work for his employer' (p. 25). This is a form of temporal deviance because 'the worker. . . diverts time' from productive labor. We can expand the concept to include those who pretend to work while they are merely playing. Conduct of this type is not new, but the increasing use of personal computers makes it easier to disguise play as work. How much of e-mail at work (and, for that matter, at home) is actually work-related? Research on questions of this sort will help us to understand the dynamic and often clandestine relationship between labor and leisure.

Notes

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1. According to Anderson (1999), inner-city violence exhibits a contrapuntal rhythm: 'in the morning and early afternoon, the surrounding neighborhood is peaceful

enough, but in the evening the danger level rises. Especially on weekends, tensions spill over, drug deals go bad, fights materialize seemingly out of nowhere, and the emergency room becomes a hub of activity' (p. 27).

2. Other forms of electronic communication (such as surfing websites and visiting chat rooms) may exhibit very different patterns.
3. George Washington, commander of rebel forces during the Revolutionary War and first President of the United States, was born on 11 February 1731, under the Julian calendar. His birthday changed to 22 February when the Gregorian calendar was adopted 20 years later. From 1865 through to 1970, the United States celebrated 22 February as a national holiday in his honor. In 1968, Congress passed legislation moving the celebration of his birthday to the third Monday in February (effective from 1971), thereby creating a three-day weekend.

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