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In Search of Coherence: A Review of E-Mail Research

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ABSTRACT

E-mail research encompasses a vast and diverse body of work that accumulated over the past 30 years. In this article, we take a critical look at the research literature and ask two simple questions: What is e-mail research? Can it help us reinvent e-mail? Rather than defining an overarching framework, we survey the literature and identify three metaphors that have guided e-mail research up to this day: e-mail as a file cabinet extending human information processing capabilities, e-mail as a production line and locus of work coordination, and, finally, e-mail as a communication genre supporting social and organizational processes. We propose this taxonomy so that designers of future e-mail systems can forge their own direction of research, with knowledge of other directions that have been explored in the past. As an illustration of the possible future work we want to encourage

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with this review, we conclude with a description of several guidelines for the reinvention of e-mail inspired by our journey through the literature.

1. E-MAIL: A MULTIFACETED RESEARCH OBJECT

E-mail is an evolving sociotechnical phenomenon. Whereas e-mail was once restricted to a limited circle of technocrats, it has now become a part of everyday life for many people beyond the world of science and technology. From advertisements on the sides of buses to children's television programs, e-mail is omnipresent. "E-mail" has officially passed into the English language, as both noun and verb (Pearsall, 2001):

> *n.* the system of sending messages by electronic means from one computer user to one or more recipients via a network.
> *v.* mail or send using e-mail.
> —DERIVATIVES e-mailer *n.*
> —ORIGIN C20: abbrev. of electronic mail.

If someone said they would send you an e-mail, in all probability you would know what they meant without a moment's hesitation. Yet for all the certainty that use of the term seems to imply, e-mail has proved to be deceivingly simple as an object of research. Indeed, if we consider the aforementioned definition from the Oxford dictionary more carefully and try to unpack its meaning, the multifaceted nature of e-mail quickly becomes apparent. First, e-mail is a "system:" it presupposes the existence of a technological infrastructure, not only "a network" as mentioned earlier but also an e-mail client and its interface to compose messages in the first place. These messages do not appear out of the blue either: they need to be composed, sent, received, and eventually managed as more accrue over time. Human beings perform most of these tasks; as such, they are not taking place randomly but within a social context that gives meaning to and influences the act of communicating that is e-mail. We could go into even more detail but one thing is already clear: there is more to e-mail than one may initially assume.

Probably as a result of this complexity, 30 years of research on e-mail has not produced a unified set of results. E-mail research as a whole is a loosely interwoven body of findings, broadly divided into a collection of separate research fields. Each field brought its expertise to bear on a separate facet of e-mail, generating important results but not assembling them into common threads that could define how the main issues relate to one another. Most importantly, e-mail interfaces have remained surprisingly static: A great deal of this research has failed to influence the (re)design of e-mail.

Therefore, we think it is worthwhile at this point to ask two simple questions: What is e-mail research? Can it help us reinvent e-mail? The body of work produced on e-mail is so diverse and expansive that developing a unifying framework is, we think, probably beyond reach today: E-mail has been looked at from such a variety of disciplines and theoretical perspectives that some gaps are simply impossible to bridge. However, we think it remains possible to organize e-mail research into broad categories that could be useful to future researchers. In this article, we describe such a categorization of e-mail research. Our hope is that anyone interested in the design of future e-mail systems can use our review to forge their own direction of research, with knowledge of other directions that have been explored in the past.

In the remaining sections of this article, our survey of the literature traces the emergence of three themes in e-mail research over time. We acknowledge that our taxonomy is but one particular path through the literature: Other classification schemes could fruitfully have been used and, in fact, we invite our readers to think about their own. Our approach has been to identify metaphors reflecting the "collective imagination" of different disciplinary fields regarding e-mail. The three metaphors we propose are as follows:

1. E-mail as a *file cabinet.* In this literature, the research focus has been essentially on cognitive aspects of information organization and retrieval in e-mail. Filters, folders, inbox organization, and their possible substitutes have been examined in great depth and innovative interfaces have been developed to try and alleviate some of the problems that have been identified. There is, however, little discussion of how messages relate to e-mail users' work activities and practices. A great majority of this research comes from two research fields: human–computer interaction (HCI) and artificial intelligence (AI).
2. E-mail as a *production facility.* This line of research has been concerned with the efficiency and effectiveness of organizational communication, adopting a viewpoint on e-mail that focuses on collective effort, workflow, and its situated articulation. A great deal of the e-mail research in Computer-Supported Cooperative Work (CSCW) adheres to this view.
3. E-mail as a *communication genre.* Years of research on the impacts of electronic mail on organizational effectiveness initially took e-mail to be a rigidly constrained medium with invariant properties. Research considered how e-mail could fit into chains of business communication by substituting for other media. It is now focusing on the malleability of the medium, in terms of its features and use, for allowing appropriation for various organizational purposes. This section of the literature is essentially contained within the fields of organizational studies and information systems research.

We conclude our article with a description of how the aforementioned survey of the literature influenced our own thinking about reinventing e-mail. In particular, we propose a possible design framework cutting across the three levels of analysis reflected in our metaphors: individual, communicative, and socioorganizational. Far from being a definitive answer, it simply highlights how our survey could be used to inform the design of future e-mail clients.

We begin with the first e-mail metaphor: e-mail as a file cabinet.

2. E-MAIL AS A FILE CABINET

2.1. Human Cognition and Message Handling

Many e-mail studies have focused on the way e-mail users store and organize the messages they receive over time. This is due in great part to the strong influence of cognitive science and psychology on the design of human–computer interfaces. The concept of cognition concerns the set of men-

tal processes responsible for the acquisition, storage, retrieval, and use of information. Consequently, it has been a topic of enquiry that encompasses perception, learning, memory, and reasoning. It is premised on the idea that these processes are fundamental and universal to all people (Neisser, 1976). They are the result of an evolutionary, species-wide set of influences that have defined an information processing architecture for dealing with the environments that people encounter. Based on this premise and drawing on early studies of information organization in the office (Kidd, 1994; Landsdale, 1988; Malone, 1983), a line of research portrayed e-mail as a file cabinet: It is a means of storage for individuals to use, organize, and manipulate messages in terms of their informative content. Its effectiveness depends on its compliance with the constraints of human learning, reasoning, and memory.

2.2. Early Studies of Information Organization in the Office

For Malone (1983), who studied how office workers organize their desks, people who had neat offices and used structured filing systems had fewer difficulties in information retrieval, overlooked fewer things they had to do, and were better at finding specific documents than those who had messier offices. Many of Malone's interviewees arranged information in piles on their desks. The purpose of these piles was not only to store information for later retrieval but also to remind the individuals that they had something to do. Malone saw the latter as a crucial feature of desk organization and suggested that failure to support this function may seriously impair the usefulness of "electronic office systems" (such as e-mail), whereas explicitly facilitating it may provide an important advantage for automated office systems over their nonautomated predecessors.

Another important point in this study is that the cognitive difficulty of categorizing information is an important factor in explaining how people organize their desks. Therefore, it is suggested that computer-based systems may help with this difficulty by doing as much automatic classification as possible and including untitled "piles" of information arranged by physical location as well as explicitly titled and logically arranged "files." Following the first of these principles (facilitate and automate classification as much as possible), Malone, Grant, and Turbak (1986) later developed the Information Lens, a system to help people share and filter information communicated by computer-based messaging systems. It provides users with a set of semistructured message templates, used by the senders of these messages to facilitate their composition. This later helps people filter, sort, and prioritize messages that are addressed to them and it also helps them find useful messages they would not otherwise have received by searching for certain key words in a central repository of messages. A subsequent 18-month investigation of the use of In-

formation Lens (Mackay et al., 1989) revealed that people without significant computer experience were able to effectively create and use the sorting, prioritizing, and deleting rules offered by the system. As we see in the remainder of this section, the Information Lens's early emphasis on rules and classification of electronic messages is still prevalent in e-mail research.

Landsdale (1988) also emphasized the cognitive difficulty of categorizing items. This task is doubly difficult, first in determining which categories to use and second in remembering these categories later, at the time of retrieval. Consequently, people are reluctant to file information away either because they cannot decide how to categorize it or because they are not confident in their ability to retrieve it later. Moreover, we remember far more about documents such as e-mail messages than is evident in retrieval facilities. Information is committed to memory through a selective encoding process, connecting it with a number of associative networks. Networks can be conceptual, historical, or story-based (episodic memory), built around narrative constructs. This process is heavily constrained by the active mental models of the person who is committing information to memory. Later retrieval of information can depend on the circumstances in which people find themselves, because they can embed cues that reflect the original encoding strategy. So there is good reason to believe that what is remembered about e-mail messages includes a number of potentially helpful attributes: the meaning of their content, contextual information such as what they look like, what one was doing at the time, associated concurrent events, and the time of message receipt or composition in terms of message chains or "transactions" (see Section 3.1.). E-mail systems have not exploited this rich web of cues, instead relying on the user recalling filenames and categorization information unprompted. Landsdale argued that the sort of thing people were best at was being ignored in systems design. Information which is logically related to the required memory will not succeed in eliciting recall unless it is also related to the way in which that information was interpreted: we need a richer set of metadata.

Landsdale (1988) concluded that every attempt to retrieve information is based on two different psychological processes: (a) recall-directed search followed by (b) recognition-based scanning. Information retrieval systems should provide support for multiple categorizations and be sensitive to synonyms. Storing or categorizing information leads to a dilemma: the more time a user has to spend to categorize an item, the less likely it is that the categorization will be done at all. Moreover, the more we automate this process, the less the user will be able to recall due to fewer associative links in memory. Associations between items of information are constructed by active involvement on the part of the person for whom the e-mail has significance. This suggests that automatic filing and message folders, two ubiquitous features in

contemporary e-mail software intended to help rationalize the information overload problem, do not match human cognitive processes very well.

In a study of 12 knowledge workers, Kidd (1994) reported the same "piling" phenomenon as Malone's but offered an alternative explanation. Kidd found the knowledge workers' desks to be cluttered and to seemingly function as a spatial holding pattern for current input and ideas. These workers, however, are changed by the information they process: once informed by some written material, they have no particular need to retain a copy of the informing source (e.g., they take a lot of notes but then discard them: the act of writing is more important than an external memory store). However, if a piece of written material has not yet informed them, then they cannot sensibly file it away because its subsequent use or role in their world is still undetermined, which is why they use piles and a spatial information organization scheme. Kidd concluded that computer support for knowledge work might be better targeted at the act of informing rather than on passively filing large quantities of information in a disembodied form.

2.3. Adapting E-Mail Systems to Users' Cognitive Processes

Moving from the physical desk to the virtual, Barreau and Nardi (1995) conducted two studies of the ways users organize and find files on their computers (including their e-mail). They found that users preferred location-based finding because of its crucial reminding function. Users were seen placing files in locations where they were likely to notice them (e.g., inbox, upper-level directory). Users preferred browsing lists of files rather than using the search feature. They avoided elaborate filing schemes and archived relatively little information. Every user indicated that their attempts to establish elaborate filing schemes for archived information failed because they required more time and effort than the information was worth. Finding and reminding are intimately linked in the practice of e-mail use and should always be considered together.

Barreau and Nardi's (1995) findings generated a debate within the HCI community about the adequacy of current interfaces for information organization and retrieval. Fertig, Freeman, and Gelernter (1996) believed that Barreau and Nardi's users preferred a location-based search because it is the lesser of evils: If other search methods had been available, they would have been used. They thought that a location-based search is only possible when users don't archive or give up using archived information. They argued that it is a "cart and horse" problem: If archiving were better supported, users would archive. In short, they saw the use of location for reminding as a simple coping strategy for lack of anything better and pointed to alternative solutions: dynamic queries, semantic file system, or Lifestreams (Fertig, Freeman, &

Gelernter, 1995), a system they developed shortly before Barreau and Nardi's study.

Lifestreams is an approach to organizing a user's personal files. It uses a simple metaphor, a time-ordered stream of documents, to replace conventional files and directories. Every document a user creates is stored in his or her lifestream, as are all the documents other people send him or her. Moving beyond the present and into the future, the stream also contains documents the user will need: reminders, meeting schedules, and to-do lists. The stream stores everything the user touches electronically and can even be extended with phone call logs and URLs. The interest of the whole approach is to allow retrieval in context, because resources are surrounded by other resources accessed at the time. Fertig et al. (1995) saw their system as the perfect counterexample to Barreau and Nardi's (1995) theory but both pointed to Landsdale's (1988) argument about the value of richly associated sets.

Another way to address the cognitive difficulty associated with information organization and retrieval in e-mail is to automate the process. Using mostly techniques from natural language processing, some systems have followed this approach. One example is Re:Agent (Boone, 1998). Using a variant of automatic feature extraction, Re:Agent groups similar e-mails and combines their common information into a feature. This is called the concept feature approach. To automatically define features, the user directs the agent to use the task training examples as feature examples (e.g., if you want to sort all messages for Nicolas into a folder called Nicolas, you first train the program on the content of the "Nicolas" folder). Alternatively, the user can aid the agent by providing key words and example messages that define concepts present in the e-mail. Another system tries to automatically identify the speech-acts associated with a given message (Khosravi & Wilks, 1999). This could prove useful in certain contexts where roles and responsibilities are clearly defined and actions are unambiguous.

It is worth noting, however, that users show little confidence in learned rules for text classification (Pazzani, 2000), which directly questions the validity of a completely automated approach to e-mail filing. Taking a more moderate stance, MailCat (Segal & Kephart, 1999) encourages users to file their mail by simplifying the task but not completely automating it. Using an adaptive classifier, the system predicts and proposes the three existing folders that are most likely to be appropriate for a given message.

Finally, the Information Tapestry (Terry, 1993) is an experimental system that combines a variant of collaborative filtering with content-based filtering and automatic appraising and highlighting. The intention of this battery of techniques is to tailor the delivery and presentation of information to each user's personal interests according to a network of relevance criteria. In this

way, users should be able to cope with ever-increasing volumes of incoming electronic mail. Rather than automatically file a message, the Tapestry system uses "appraisers" to assign it a priority ranging from 1 to 100. An appraiser is a predicate or query that is applied to each new message received (e.g., if it contains "St Marcellin," give it 100; if it contains "Monterey Jack," give it 5). Collaborative filtering is also implemented: A user can rate each message as "Like It" or "Hate It;" he or she can then write an appraiser saying, for instance, "send me all the messages that X liked." The user can then sort his or her messages in decreasing priority, processing only the most important ones. More recently, researchers have been applying techniques from the field of AI to tackle the same problem. The Priorities system from Microsoft Research (Horvitz, Jacobs, & Hovel, 1999), for instance, infers the criticality of e-mail messages using Bayesian networks.

2.4. Empirical Studies of E-Mail Use

Relatively few studies have investigated the specific strategies that e-mail users have developed to handle their e-mail in practice. The earliest is probably Mackay (1988): She interviewed 23 experienced e-mail users at a research laboratory and concluded her study with two principal claims. First, e-mail is more than just a point-to-point communication system. It supports a variety of time and task management activities. The second claim is that use of e-mail is strikingly diverse, suggesting that e-mail designers should define flexible primitives that can be employed to various degrees by a wide range of users.

Whittaker and Sidner (1996) were also interested in e-mail users' message management practices. They interviewed and logged the e-mail traffic of 20 Lotus Notes™ users in several departments at Lotus Corporation. They reiterated one of Mackay's (1988) conclusions: Although e-mail was originally designed as a communication application, it is now being used for additional functions that it was not designed to support, such as task management and scheduling as well as personal archiving. E-mail is a good candidate for schedule reminders because it has become an ever-present resource in the workspace (Ducheneaut & Bellotti, 2001). Strategies for managing e-mail frequently leverage its salience and surfacing properties.

Whittaker and Sidner (1996) noted that e-mail's success could very easily prove its own undoing. E-mail overload clutters inboxes with hundreds or thousands of messages, including outstanding tasks, partially read documents, and conversational threads. The inbox operates as a kind of task manager, where people are reminded of current tasks and where they can keep information relevant to those tasks accessible. Whittaker and Sidner emphasized the importance of a visual reminding function: Users who tried to

create dedicated "action" folders abandoned the strategy, because they had to explicitly remember to go to it and view its content, rather than being reminded by working with the whole set of messages. In this regard, Landsdale's (1988) and Malone's (1983) claims are confirmed: It is clear that successful filing is highly dependent on being able to imagine future retrieval requirements, and that it requires considerable effort. It is a cognitively involved task, and, as a consequence, users either forget outstanding actions or create failed folders. Whittaker and Sidner also found striking individual differences in e-mail management strategies. They divided their users into no filers, frequent filers, and spring cleaners depending on their usage of folders and frequency of cleaning. Frequent filers use folders and clean often, whereas spring cleaners use folders but clean only occasionally. Bälter (1998) later expanded this taxonomy in his PhD thesis, adding a fourth type: the folderless cleaners, characterized by their active deletion of messages from their inbox and an absence of folders. Although in principle there may be an optimal strategy, in practice, management of messages and tasks varies considerably with experience and numbers of folders (Ducheneaut & Bellotti, 2001).

Takkinen and Shahmehri (1998a, 1998b, 1999) argued that users' construal of e-mail is primarily as a task management tool rather than as a messaging system. They reached this conclusion on the basis of two studies of high-mail-traffic professionals who need to manage e-mail in different organizational roles. The authors reported that the advanced formatting features in e-mail systems (e.g., using extrabold type, HTML, etc.) are rarely used because it takes time and because the messages are mostly short, and also because the receiving side cannot be presupposed to see the same layout; instead, documents are created in a word processor and attached to the message. Templates, other than signature files, are not widely employed because they are a hindrance and because most messages are short. Confirming the delivery of messages is generally cumbersome with Internet e-mail and typically the telephone is used to confirm important messages. Furthermore, accessing one's e-mail is often done from different computers using different e-mail clients and from the perspective of different roles depending on the communication context (social, work, educational, etc.). Forwarding, in contrast, is very common as is the use of aliases and the address book. Messages can gather momentum in terms of those who are subject to their circulation. New recipients can be added to an unfolding messaging thread so that groups of recipients can grow and become defined as a new receipt entity in a kind of "snowball" effect.

Takkinen and Shahmehri (1998a, 1999) went on to examine three structural representations intended to help encapsulate the spontaneous organization of messages. Their findings highlight the inappropriateness of the general

uniformity of facilities for the organization of messages and visualization of collections in contemporary e-mail clients. Filtering, transfer to folders, and two- or three-paned displays are not adequate to support classification, organization, and getting an overview of a set of messages, because the strategies for sorting and searching are not all covered. Takkinen and Shahmehri (1998a, 1999) have extended their Categorization Assistant For E-mail system (CAFE) by defining three modes of usage: the busy mode for intermittent use at times of high stress, the cool mode for continuous use at the computer, and the curious mode for sporadic use when exploring and (re)organizing messages when more time is at hand. Bellotti, Ducheneaut, Howard, Smith, and Grinter (2005, this issue) are also addressing the e-mail overload problem with the TaskMaster system by moving away from the file cabinet metaphor to an activity-centered view of e-mail.

2.5. Managing Messages in the E-Mail File Cabinet

A large number of e-mail studies and proposals for technical improvement have been focused on techniques for message organization and retrieval. This viewpoint on e-mail can be described as a file cabinet. According to the analysis presented in this section, all e-mail activities can be thought of on one hand as primarily matters of storage or learning and on the other as matters of retrieval or memory.

As such, the debate around e-mail in this research cluster is fundamentally divided by different conceptions of human memory and cognition, rather than a strong view of the dedicated functionalities e-mail should provide. In fact, many of the findings reported in this section of the literature apply equally well to the design of other computer technologies where the management of personal information is prevalent. As a consequence, few of the systems based on the file cabinet metaphor differ strongly from the common e-mail interface, itself an extension of the desktop metaphor (e.g., inbox, outbox, folders). Most of the advances have been around ways of making interaction with such an interface easier but do not really challenge its basic design. Moreover, most of this literature focuses on the individual use of e-mail at work. There is little or no mention of the larger context in which filing and sending messages takes place. More recent research within the storage and retrieval tradition has shifted the argument toward messaging that subserves task management. The cognitive demands of such work thus revolve around group-defined task-level operations and not individual-created message-level operations.

As a summary, Figure 1 outlines the existing research body that is consistent with the file cabinet theme.

Figure 1. **The file cabinet theme and its associated literature**

Issues	Approaches	References
Information organization in offices	Importance of piles and spatial arrangement	Malone (1983)
	Cognitive difficulties in classification and retrieval	Landsdale (1988)
	Importance of context for recall	Kidd (1994)
	Automation and its pitfalls	
Systems to alleviate cognitive difficulties in email management	Spatial organization vs. queries	Barreau & Nardi (1995), Fertig et al. (1996)
	Automatic classification of messages	Boone (1998), Khosravi & Wilks (1999)
	Assisting the user rather than automating	Malone et al. (1986), Terry (1993), Fertig et al. (1995), Segal & Kephart (1999), Horvitz et al. (1999)
	From messages to tasks	Takkinen & Shahmehri (1998), Takkinen & Shahmehri (1999), Bellotti et al. (2003)
Empirical studies of email use	Email as more than a communication medium	Mackay (1988), Whittaker & Sidner (1996), Takkinen & Shahmehri (1998), Ducheneaut & Bellotti (2001)
	Taxonomies of filing behaviors	Mackay (1988), Whittaker & Sidner (1996), Takkinen & Shahmehri (1998), Balter (1998, 2000)
	Filtering and automation	Pazzani (2000)

3. STRUCTURED MESSAGING SYSTEMS AND THE E-MAIL PRODUCTION LINE

3.1. E-Mail and Collaboration

In the previous section, we characterized the file cabinet theme for e-mail research as, in effect, revolving around operations carried out by a single user sitting at a terminal, at some remove from the social and organizational world around him or her. This is quite surprising considering that e-mail is, first and foremost, a communication technology used to support interaction and coordination between groups of people. Another line of research, typically in the CSCW mold, has placed this consideration at the heart of its concerns. It proposes ways to support and improve e-mail's role in collaboration.

Generally speaking, debates on the role and use of electronic communication technologies in collaboration have been characterized by a dialectic of two strategies. On the one hand, research has aimed at devising strategies for building coordination support to reduce the complexity of coordination through technologies for intragroup regulation. On the other hand, efforts have been made to devise strategies that aim at flexible means of interaction which do not regulate interaction but rather leave it to the users to cope with the complexity of coordinating their activities (Bernstein, 2000; Schmidt & Simone, 2000). The importance of wider and unregulated articulation cues is firmly established in the field, evidenced by, for example, the growth in awareness technology. These wider concerns, however, must all be related somehow to cooperative effort: They "refer to actors' taking heed of the context of their joint effort." (Schmidt, 2002, p. 280). This workflow-and-coordination approach has led to the emergence of another theme: e-mail as a *production line*. The emphasis here began with concerns about discipline and control over the flow of communication. The most influential and controversial example of such work is certainly The Coordinator (Flores, Graves, Hartfield, & Winograd, 1988), although the COSMOS system followed a similar design philosophy (Bowers & Churcher, 1988).

3.2. Making Sense of Group Transactions Through Linguistic Structures

Winograd and Flores (Flores et al., 1988; Winograd & Flores, 1987) proposed that the design of a tool for communication and management in an organization should embody an orientation toward the management of action. They suggested that this ought to be done by understanding the role of background and language in setting the dimensions of the space in which people interpret and generate their possibilities for action. Language, providing the coordination between actions, is central: Human beings are fundamentally linguistic beings and action happens in language in a world constituted through language. This approach to the design of coordination technologies is known as the Language-Action Perspective. The subject of heated criticism (Suchman, 1994), The Coordinator served as the focus for an entire issue in the *Computer Supported Cooperative Work* (Bannon, 1995). However, the Language-Action Perspective is coevolving with two other "postcognitive" perspectives (Kaptelinin & Nardi, 2003), activity theory (Nardi, 1996) and Distributed Cognition (Hutchins, 1994), and so deserves special attention in this article.

Winograd and Flores (1987) found in Speech Act Theory (Searle, 1969) a unified foundation for designing the support of interactive work in organizations. Speech Act Theory came about as a result of dissatisfaction with the log-

ical positivistic view of language, which dealt with the meaning of a sentence just in terms of its internal verifiability. That is, language use was considered without external reference. Speech acts represent a "commonsense" approach to language that extends beyond the making of statements and they assert that, for the most part, utterances cannot be said to be true or false. They underscore the importance of the distinction between language use and linguistic meaning.

Words can be used to accomplish many things, not only conveying information, and when information is conveyed it is often more than is directly encoded in words alone. A speech act consists of three elements: the speaker says something, the speaker signals an associated speech act, and the speech act causes an effect on the listeners or the participants. Searle (1969) called the first element a locutionary act (the act of saying something that makes sense in a language); the second, an illocutionary act (that is, the use to which language can be put in society); and the third, a perlocutionary act (concerned with what follows an utterance, the effect of an illocutionary act). So speech is performative in that it is premised on the existence of a certain communicative intention and results in effects in the world: language is, in a certain sense, intentional action.

Flores et al.'s (1988) Coordinator provided facilities for generating, transmitting, storing, retrieving, and displaying records of moves in conversations based on this language-action theory. Instead of providing a uniform command to initiate a new message (as in standard e-mail), the Coordinator required its users to select from among a predefined and notionally objective set of linguistic actions. For example, a user could explicitly label his or her message as a request or an acknowledgement. A key design issue is that the content of the messages themselves is totally free-form: The designers let people interpret the natural language and let the program deal with explicit declarations of structure. The Coordinator therefore applied a theory of language without attempting to automate language understanding. During later exchanges, a conversational state interpreter kept track of the current sate of the conversation and automatically generated a list of those actions that could sensibly be taken by the next speaker.

A key premise of Flores et al.'s (1988) design was that by interpreting a situation as a network of requests and promises with certain logical and temporal structures, they could help bring order to an otherwise chaotic process. The Coordinator gave managers tools for anticipating and identifying breakdowns on the way to the completion of actions, simply because the kind of mechanisms identified in Speech Act Theory are made visible and explicit to the users. The nature of action itself is not intrinsically changed but a tool for diagnosis is now available. This is especially important because electronic communication systems can struggle to convey the social context people nor-

mally rely on to detect and address collaboration difficulties (see Section 4). The Coordinator aimed at reconstructing some social commonality and providing shared interpretations albeit within organizations characterized by stable roles, obligations, and collaboration patterns.

3.3. The Problem of Tools That Embody Coordination Structure

Researchers have been polarized over the role of structures for articulation work as they are embodied in tools, in relation to the structure of work in practice. Suchman (1994) denounced the "hidden agenda" embedded in technologies such as The Coordinator, arguing that "the adoption of speech act theory as a foundation for system design carries with it an agenda of discipline and control over organization members' actions" (p. 178). All organizations exert control over their members but do so to differing degrees. Extreme examples are given by command and control structure of military groups, at one end of the spectrum, and artists' cooperatives at the other. Responsibilities, roles, accountability, and freedom in decision making are always at stake, as is discussed in Section 4. The objection has not concerned explicit organizational control structures per se so much as those control structures that become embedded in tools. When protocols are embedded in technologies, they can assume the guise of impartial mediators in the functioning of groups, where they could formerly be challenged and changed to meet situational demands.

Flores et al. (1988) argued that the typical office comprises a structure of recurrent conversation patterns associated with formally declared roles: group manager, assistant, programmer, and so forth. The role structure is assumed to be stable and not under negotiation or change. Positions and power relations among the users are also assumed to be stable. Moreover, the customer–supplier metaphor, reified and objectified to a remarkable extent in the literature on business process reengineering (Hammer & Champy, 1993), is also prevalent in the Coordinator. Problems arise when this basic conceptualization is applied to any kind of role-declared activity because it does not permit changes in response to the influences that are exerted on a functional group that carries out the activity. Consequently, the view of work embedded in the Coordinator leads us to notions such as bureaucratization and control and away from the more powerful view of organizations as networks of commitments. For example, Schäl (1996, p. 388) found that the Coordinator can be problematic for relations among persons at different levels in the organizational hierarchy (e.g., one participant said, "I try to avoid to make requests, especially for conversations with directors"). Carasik and Grantham (1988) showed early on that, by being overly restrictive, the Coordinator simply im-

poverished interactions or, in certain circumstances, forced violation of established norms of interaction. Other reasons advanced to explain the Coodinator's lack of success is that users are unwilling or unable to make structure, content, or procedures explicit (Shipman & Marshall, 1999). This is because the use of formal representations can serve to hinder articulation work by adding to its overhead of effort. Formalization also requires introspection to make tacit knowledge visible and this process interrupts the task at hand and changes it.

Flores et al. (1988) understood the notion of role change within a group and role combination, depending on circumstance and membership changes. However, in devising the Coordinator, they seemed unprepared for the extent to which the structuring of exchanges in electronic conversation could propagate up to the political lives of the groups who used it. This could be an instance of a problem that will arise any time one imports a passive descriptive theory from another discipline for use as a basis for prescriptive design (Ljungberg & Holm, 1997).

3.4. Structural Support for Managing Workflow

Numerous other attempts have been made in the past decade to develop message-based tools to support collaborative work activities and correct some of the flaws of the Coordinator. They include Strudel (Shepherd, Niels, & Kuchinsky, 1990), another example of a conversation-based model on top of e-mail; and Conversation Builder (Kaplan, Carroll, & MacGregor, 1991; Kaplan, Tolone, Bogia, & Bignoli, 1992), an attempt at a more flexible variant of Winograd and Flores's (1988) model. Other moves toward structural flexibility to improve the applicability of the Language Action Perspective for the design of communication systems include the Structure Definition Language from the COSMOS project (Bowers & Churcher, 1988) and the Milan Conversation Model (De Michelis & Grasso, 1994). From a more commercial groupware perspective, Lotus Notes (Lotus, 1996) integrates a database and platform for developing e-mail-based workflow systems of a similar nature. In all of this work, there is a persistent view of e-mail as an unruly flow that would benefit from the inclusion of structural support for conversations.

3.5. Other Structured E-mail Systems

Soon after the inception of e-mail, and in parallel to the efforts outlined earlier, other researchers started to wonder about the various technical improvements one could make to the system. These people, mostly with a technocentric view of e-mail, started experimenting with the capabilities of e-mail and extended them to support new functionalities. These

functionalities provided new opportunities for group collaboration which, one way or another, were also based on a structuring of the flow of e-mail messages. Their mechanisms take two forms, following on from the collaborative nature of messaging: (a) establishing and defining the evolving conversational structure and (b) tracking and modifying the content of the conversational record.

The earliest suggestion for technical improvement is probably computational mail (Anderson & Gillogly, 1976), in which programs are embedded in each message. When the message is opened, the program is executed. One frequently-cited application of these embedded programs is collaborative decision making, such as asking a set of recipients questions about suitable times for a meeting and centrally collecting them.

Collaborative decision making through e-mail places great strain on the participants' ability to maintain the thread of their arguments. In this respect, the use of quoting of prior messages and threading by sorting on subject or sender is a critical process for nearly all e-mail users (Eklundh & Macdonald, 1994). Active Mail was devised to address the collaborative nature of e-mail by supporting consistency between versions of messages and maintaining dialogue continuity (Goldberg, Safran, & Shapiro, 1992). It treated messages as a shared space that participants in a discussion can edit from within their own e-mail client. MONA used a hypertext representation to try to maintain threading, inferring conversational context from message headers (Cockburn & Thimbleby, 1993). However, as Cockburn and Thimbleby (1993) themselves pointed out, participants' investment of meaning into their exchanges, and the evolution of a conversational thread, limit such attempts at automatic conversational structure extraction to the level of guidance at best.

Envoys (Gold, 1986) addressed the joint and consequential nature of messaging by actively automating the routing of messages in a round trip from message senders. Observations about quoting in e-mail exchanges make clear that, unlike many other forms of communication, e-mail conversations keep statements alive and subject to continual modification. It included relevant recipients that were not specified, allowed modification as messages moved from mailer to mailer, and returned messages to the original sender to inform him or her what actions had been taken. Borenstein's (1992) Atomicmail allowed its users to build collaborative applications on top of e-mail with a scripting language. Atomicmail extended some ideas already present in an earlier multimedia-enabled system: the Andrew Message System (AMS) from Carnegie Mellon University (Borenstein & Thyberg, 1988). In AMS, users could already send voting messages, return receipt requests, enclosures, or subscription invitations.

According to Milewski and Smith (1997), transactions are "a series of activities between two or more parties that follows through to the completion of

some planned goal" (p. 325). They proposed that two key characteristics of traditional electronic messaging are antithetical to transaction support. First, messages are traditionally treated as independent objects: There is no simple way of bundling together messages that are part of the same transaction. Second, once a message is sent, there is traditionally little or no control over its content, in the event, for example, that the sender wishes to change it. Consequently, they implemented in their Action Mail system an approach toward structuring messages that is intended to help users carry out some of these transactions. Their approach has been to make message structure both general-purpose and optional. The message composition screen proposes a list of possible responses to each message received. The message itself is not sent, only a pointer to the message. The recipient sees the original message, with a list of interface elements (checkboxes) allowing easy reply to the options included in the original message.

3.6. E-Mail As Production Through Transaction

The functionality for sending and receiving electronic messages, available in many groupware products, has been shown to be by far the most heavily used and is universally acknowledged as the most critical facility (Bullen & Bennett, 1990; Farshchian & Divitini, 1999). It is no wonder then that some of the earliest work on electronic collaboration, such as the Coordinator, tried to build on this success. But widely deployed systems attempting to structure e-mail exchanges to improve workflow have so far proved unsuccessful; other prototypes have not been deployed widely enough to get meaningful results.

The *e-mail as a production line* theme examines messaging technology as a facility for work production within groups, across individuals in terms of their role as members of the group. This approach seems to be particularly useful in contexts where activities are fairly repetitive and well-defined but it breaks down easily when more flexibility is required. As discussed earlier, the polymorphous nature of e-mail (Ducheneaut & Bellotti, 2001; Whittaker & Sidner, 1996) only adds to the difficulty, as this communication technology is constantly repurposed for the needs of its users (see also Section 4). This casts serious doubt on the feasibility of developing a truly generic, structured e-mail infrastructure and, in fact, research efforts in this direction seem to have been greatly reduced in recent years. It does, however, leave open the need for appropriate mechanisms for revealing and working with the structure of e-mail message collections and for treating the dual nature of e-mail messages as both matters of record and as collaborative work in progress.

To summarize, Figure 2 outlines the main contributors to this body of e-mail research.

Figure 2. **The production line theme and its associated literature**

Issues	Approaches	References
Structuring e-mail: The language-action debate and its follow-ups	Speech-acts theory	Austin (1962), Searle (1969)
	The role of language in application design	Winograd & Flores (1987)
	The Coordinator	Flores et al. (1988), Winograd (1988)
	Case studies of the system	Carasik & Grantham (1988), Schäl (1996)
	Critiques of the system and its hidden assumptions	Suchman (1994), Ljundberg & Holm (1997), Shipman & Marshall (1999)
	Later attempts at improved systems	Bowers & Churcher (1988), Shepherd et al. (1990), Kaplan et al. (1991, 1992), De Michelis & Grasso (1994)
	Continuation of the debate: Workflow versus ad-hoc resources	Schmidt & Simone (2000), Bernstein (2000)
Other experimental systems	Computational mail	Anderson & Gillogly (1976), Gold (1986), Borenstein (1992), Bellotti et al. (2002)
	The Andrew Mail System	Borenstein & Thyberg (1988)
	Tracking conversations and transactions	Goldberg et al. (1992), Cockburn & Thimbleby (1993), Milewski (1997)

4. E-MAIL AS A COMMUNICATION GENRE

4.1. E-Mail and Organizations

Communication and organization have a lot in common. Very early on, seminal works in organization theory recognized that communication was an essential ingredient in the creation and long-term survival of organizations. Barnard, for instance, proposed that "*an organization is born when there are individuals who are able to communicate,* and who are determined to engage in actions oriented toward a common goal" (1938, emphasis added). E-mail being a communication technology, it is therefore not surprising that its effects in organizations have been the subject of much scrutiny. Researchers have, for example, examined the relation between electronic media, organizational behaviors, and outcomes, such as intragroup interaction (Finholt & Sproull, 1990), communication patterns (Eveland & Bikson, 1988; Feldman, 1987), group decision behavior (e.g., Kiesler, Siegel, & McGuire, 1984; Kiesler & Sproull, 1992),

socioemotional discourse (Haythornthwaite & Wellman, 1998; Sproull & Kiesler, 1986; Walther, 1995), and managerial effectiveness (e.g., Daft & Lengel, 1986; Schmitz & Fulk, 1991; Trevino, Daft, & Lengel, 1990; Zack, 1994).

The view of e-mail emerging from these studies has shifted dramatically over time. Initially, e-mail was assumed to be a communication medium with well defined properties, leading to predictable effects. But research progressively recognized the malleability of e-mail and this medium is now described more in terms of its local meaning, contingent on how users appropriate it and renegotiate the value of its features in the context of their organization. As such, we identify the third theme of e-mail research cluster as *communication genre*. We begin with the earliest research on e-mail use in organizations.

4.2. Organizational Communication

Discussions of media choice within organizations began by treating media choice as an objective, individual, and voluntary act of matching tasks to media. It was assumed that inherent properties of media leant themselves to certain kinds of organizational function and that the goal of research was to show which media went with which organizational tasks. This idea is extensively articulated in Short, Williams, and Christie's "Social Psychology of Telecommunications," a synthesis of work carried out by the Long Range Research Group of the British Post Office in the early 1970s, and formalized as Reid's "Telecommunications Impact Model" (described in Chapter 3, Short, Williams, & Christie, 1976). The idea of inherent properties is also evident in Media Richness or Information Richness Theory (IRT), which proposes that the sum of the observable attributes (e.g., speed of transmission, range of transmissible cues) gives a net effect of information provision (Daft & Lengel, 1984, 1986). Depending on the degree of equivocality or ambiguity of a task, users can then select the most appropriate medium. Equivocality is an extremely important issue in organizational decision making, because it identifies the need for judgment in the face of uncertainty and implies the need for consensus or clear authority to carry through from decision to action. Organizations, as collections of individuals, require a balance between autonomy to allow uncertain decisions to be made and accountability to contain their risk. E-mail, because of its textual and asynchronous nature, is placed at the lower extreme of the richness scale and is said to be inappropriate for highly equivocal or ambiguous activities.

Researchers following this information-theoretic, rationalist approach paid less attention to the influence of organizational power, group perceptions, and social network relations on media adoption (see Rice & Shook, 1990). As telecommunications became ingrained in organizational processes (Sproull & Kiesler, 1991), studies began to expose the overriding role of these factors. Social networks, social influence, interpersonal relationships, and organizational

power structures all affect how groups and individuals use e-mail (Garton & Wellman, 1995). For instance, El-Shinnawy and Markus (1998) found that users generally preferred electronic mail over voice mail for most communication purposes. These results do not support a hypothesis derived from IRT that technologies such as voice mail would be preferred to e-mail for ambiguous and socially significant situations because they are intrinsically "richer."

As a result, social influence theories have gained considerable ground in the past years, at the expense of rational theories such as IRT. Interpretivism is one of these more recent attempts at understanding e-mail adoption. From an hermeneutic perspective, Lee (1994) argued that richness or leanness is not an inherent property of the electronic mail medium but rather an emergent property of the interaction of this medium with its organizational context, where the interaction is described in terms of distanciation, autonomization, social construction, appropriation, and enactment. In another study, Markus (1994) examined the literal and interpreted content of messages to examine what some managers themselves meant in the e-mail messages they sent to one another. Managers were found to perceive various media in ways that were relatively consistent with information richness theory but to use e-mail more and differently than the theory predicted. In particular, effective senior managers were found to use e-mail heavily and for precisely the kind of judgment-intensive, equivocal communications tasks that e-mail was supposed to be poor at supporting. Through collective behaviors like answering messages as they arrived, e-mail senders invested this medium with the speed and richness usually associated with the phone. It suggests that the adoption, use, and consequence of media in organizations can be powerfully shaped by social processes such as sponsorship, socialization, and social control, which require social perspectives to understand them.

Ngwenyama and Lee (1997) later reinterpreted Markus's (1994) data from the perspective of Habermas's (1979) critical social theory. People, as actors in a social or organizational context, themselves "process" data into information and hence richness dimensions of e-mail arise in association with the organizational processing units that are instituted over time, not just in the raw-data bandwidth terms of IRT. They clearly show that organizational members are more than just passive receptacles for data or meanings that are somehow transported or downloaded to them. When people communicate, they perform social acts that are regulated by organizational norms and thereby come to have meaning within their organizational context. Thus they simultaneously enact existing and new relationships with one another as they communicate over e-mail, a phenomenon completely overlooked by theories such as IRT.

So e-mail often serves to support socially loaded decision making, where processes that convey authority, autonomy, and accountability all need to be supported. The degree to which each of these is exploited in practice will de-

pend on a combination of factors within the organization, including the various organizational functions into which it is recruited.

4.3. E-Mail and Participation in Group Work

Another issue addressed in great length by the organizational literature on e-mail is that this technology provides fewer cues than face-to-face communication about interactions, physical context, or social roles. Because most of the early research on the effects of e-mail in organizations was conducted by people with a strong background in social psychology, this particular emphasis on the role of cues to support social attribution in electronic group work is not surprising. The results coming out of this "cues filtered out" approach are, however, less than conclusive.

E-mail's lack of cues can make it easier for group members to contribute to group discussions. As "status equalization" (Dubrovsky, Kiesler, & Sethna, 1991), the reduction of information about group members' expertise, organizational niche and power, and characteristics, such as age and gender, can change interpersonal perception and, with it, feelings about ability to participate. It can encourage contributions from those who would normally wish to remain silent and reduce the ability of those who would normally dominate from disproportionate contribution. However, status differentials seem to be much more robust than initially thought when electronic tools are used in organizations (Saunders, Robey, & Vaverek, 1994; Sherblom, 1988). It is very difficult to draw conclusions about communications shared between people who have no relationship outside the medium and then to apply these conclusions to those whose relationships span media and map onto identified, persistent, organizational roles.

Many studies have also found that, as a corollary of the equalization effect, people can be less inhibited, nonconformist, and combative when using e-mail (Adrianson & Hjelmquist, 1991; Hiltz, Johnson, & Turoff, 1986; Kiesler & Sproull, 1992; Kiesler, Zubrow, Moses, & Geller, 1985; Siegal, Dubrovsky, Kiesler, & McGuire, 1986). It has been suggested that because it is more difficult to interpret the intentions of the sender, misunderstandings are more likely to emerge and will be more difficult to resolve. E-mail groups tend to be more polarized and are slower to develop leaders and reach consensus (see, for instance, Kiesler & Sproull, 1992), which is somewhat balanced by the fact that their greater range of ideas may also produce more innovative and better decisions (Valacich, Paranka, George, & Nunamaker, 1993). However, meta-analyses (Walther, 1992, 1995) have shown that uninhibited behavior is quite infrequent when e-mail is used in organizations and decreases with time, group history, and anticipated future interaction. E-mail can also be used to create and maintain friendship ties at work (Haythornthwaite & Wellman,

1998), despite its low "socioemotional bandwidth." Again, this hints at the fallacy that e-mail entirely describes the social milieu within which people know one another. Although this may well be true outside of organizational relationships, for example on Newsnet bulletin boards, within organizations it is rare indeed. Even if members never meet beyond the medium, their responsibilities to one another exist within a socioeconomic world that requires them to understand the consequences of their dealings through e-mail.

Overall it seems much attention has been focused on incidents and the problematic nature of e-mail for decision making in organizations, rather than the countless rewarding and routine nonproblematic interactions also happening (Baym, 1995). One simply cannot discount the organizational context in which the technology is used, the history of past interactions built over time and anticipations of consequences for future interactions. This does not mean that such effects as have been noted are spurious; rather that they should be taken within the wider context of the social networks to which they refer. Indeed, the anonymity effects of e-mail that underlie deindividuation and polarization (Spears, Lee, & Lea, 1990) seem to be among the most powerful within groups compared to other media (Baltes, Dickson, Sherman, Bauer, & LaGanke, 2002). Social Identity Theory places them into just such a framework of social relations, whereby group members reflect on their group membership, its values, and their simultaneous and competitive relationship with other groups (Tajfel & Turner, 1986). Applied to e-mail, Social Identity Theory suggests that it is the relative balance of individual and group information in evidence at the interface that governs such effects but always against the backdrop of persistent relations (Spears, Lea, & Postmes, 2000; Watts, Nugroho, & Lea, 2003).

4.4. E-Mail in Formal and Informal Structural Relationships

At the very least, the structure of an organization is the embodiment of its functional constitution, chains of command, and interfunctional interaction. E-mail has the potential to allow various strategic and political manipulations of information in organizations, thereby affecting the organization's structure in terms of power and control (for analysis of the problem dealing with more technologies than simply e-mail, see Zmud, 1990). Zuboff (1988), for instance, reported early on the case of a manager spying on e-mail exchanges in his company. Other studies have shown that some managers distrust e-mail because they cannot control communication channels as easily as before (Perrin, 1991). Using e-mail, employees could discover more about their company than their management would like them to know and subvert controls for their own individual benefit (Sproull & Kiesler, 1991), threatening traditional pyramidal control structures. Although e-mail can be used to give a large group of people access to quality information, this potential can backfire

and e-mail can as easily become a rumor mill (Finholt & Sproull, 1990). Illustrating the applicability of these concepts, Romm (1999) showed, in a series of case studies, how e-mail has been used to organize concerted political actions against a variety of organizational groups or members.

Most of the work on e-mail's impact on organizational structure has examined the tension between the value of being informed and the threat to authority posed by underlings having possession of too much information. The threat side of the equation has been in terms of dilution of boundaries set in place by management through the new cross-functional and cross-organizational linkages created by electronic communication tools. It has been proposed that e-mail creates new connections between individuals and that its users can therefore get access to information they would not have received otherwise (Finholt, Sproull, & Kiesler, 1990); for instance, by finding organizationally-distant people with whom they have shared interests (Feldman, 1987). The value side of the equation resides in cost, speed, and flexibility. E-mail reduces the cost of communicating with a large number of people, some of whom are completely unknown. Therefore, e-mail serves as a vehicle for broadening the process of socialization in an organization by facilitating the creation of weak ties. In other studies, e-mail users have also reported a better sense of connection to others after using the tool, as well as a feeling of getting better quality information than before (Rice & Steinfeld, 1994). In fact, some users join a great number of e-mail lists just because they don't want to miss anything (Finholt & Sproull, 1990; Rice & Steinfeld, 1994).

By facilitating informal interactions, e-mail also reinforces the linkages between core and periphery in organizations (Eveland & Bikson, 1988; Huff, Sproull, & Kiesler, 1989; Sproull & Kiesler, 1991). Peripheral workers can increase their participation in the organization and, in return, feel more positively oriented toward the group. Low status individuals can use e-mail to gain more information and power. By being a potential source of emotional support, e-mail can also reinforce the cohesion of a group, especially during times of crisis (Haythornthwaite & Wellman, 1998; Steinfield, 1985). The traditional frontiers between these groups, however, are blurred by e-mail (Bikson & Eveland, 1990; Eveland & Bikson, 1988), because e-mail can support in-groups without out-groups: Expertise in-groups can form via one-to-one computer mail but that expertise can be shared via all-group mail (Finholt et al., 1990).

4.5. E-Mail As a Communication Genre

As discussed in this section, studies of e-mail use in organizations have followed a historical progression that is typical of emerging technologies. Although early research was concerned with factors that contributed to or hindered the integration of the technology with existing practice, later research

looked at e-mail as a social phenomenon with much broader, transformative, organizational implications. The later research, however, still fails to show where and how, in general, e-mail will be used to good effect in organizations—if anything, it seems to imply that such guidance is impossible. Despite a great deal of published work, the breadth of the field gives it a piecemeal rather than integrated nature (Rudy, 1996). Moreover, many of the published studies are based on questionable assumptions about the limited reach of social relations among e-mail users. Most of the work has concentrated on how individual users interface with their computers, how two persons interact online, or how small groups function online (Garton & Wellman, 1995); much less attention has been devoted to the effects at a larger organizational or social level. In this respect, e-mail research in this mold could be subject to the same criticism Wellman and Gulia (1999) leveled at Computer-Mediated Communication research in general: it is often Manichean, presentist, and parochial, assuming that individuals use the electronic medium exclusively, that this is done in a social or organizational vacuum, and without consideration of one's history of past interactions.

Studies of e-mail illustrate a common problem in studies of information and communication technologies. As Markus and Robey (1988) and later Orlikowski (1992) pointed out, the state of knowledge about technology in organizations is ambiguous and conflicting. Early research assumed technology to be an objective, external force that would have determined impacts on organizational properties such as structure. Later researchers focused on the human aspect of technology, seeing it as the outcome of strategic choice and social action. Either view, however, is incomplete and e-mail studies have been no exception to this rule. As a consequence, recent developments in this area have tried to articulate a theoretical framework in which technology is presented as the product of, as well as the medium for, the interactions of its users (Orlikowski, 1992; Orlikowski & Robey, 1991). Researchers are actively trying to explain the incredible variety in the effects e-mail has in organizations depending on each organization's culture, its member's frames of reference, and structural properties of the organization (Orlikowski, 1996).

Because its meaning and use always seem to be contingent on the social and organizational factors surrounding it, the e-mail theme of this research cluster is that of a *communication genre* (Agre, 1998). This reflects the view that, when a new medium comes to be used, people will try to define its place in their relationships, to ultimately reach a "relatively stable, expectable form of communication" (Agre, 1998, p. 83). The changes "will express latent potentials in the local social system, and they will be influenced heavily by the participants' own (shared or conflicting) understandings of the situation" (Agre, 1998, p. 84). This theme can be identified in recent studies of the use of e-mail (and other communication media) in organizations (see, for instance, Ducheneaut, 2002; Orlikowski & Yates, 1994; Yates, Orlikowski, & Okamura,

Figure 3. **Email as a communication genre and its associated literature**

Issues	Approaches	References
Adoption and diffusion	Social influences	Lee (1994), Markus (1994), Lee & Ngwenyama (1997), Zack & McKenney (1995), El-Shinnawy & Markus (1998)
	Interactions	Schmitz & Fulk (1991)
	Number of users	Steinfield (1986)
	Social legitimacy	Trevino et al. (1990), Perrin (1991)
	Task–media match	Daft & Lengel (1984, 1986), Short et al. (1976)
Structural impacts	Broader communications	Feldman (1987), Finholt & Sproull (1990), Rice & Steinfield (1994)
	Informal interaction	Steinfield (1985), Eveland & Bikson (1988), Huff et al. (1989), Finholt & Sproull (1990), Sproull & Kiesler (1991), Haythornthwaite & Wellman (1998), Rice & Steinfield (1994)
	Weakening of group boundaries	Eveland & Bikson (1988), Bikson & Eveland (1990), Kiesler & Sproull (1992)
	Core-periphery links	Eveland & Bikson (1988), Huff et al. (1989), Sproull & Kiesler (1991)
	Social control and political aspects	Zuboff (1988), Finholt & Sproull (1990), Sproull & Kiesler (1991), Perrin (1991), Romm (1999)
Relational impacts	Socioemotional relations	Walther (1995), Haythornthwaite & Wellman (1998)
	Status equalization	Hiltz et al. (1986), Sherblom (1988), Dubrovsky et al. (1991), Adrianson & Hjelmquist (1991), Kiesler & Sproull (1992), Saunders et al. (1994)
	Unusual behavior	Kiesler et al. (1985), Siegal et al (1986), Dubrovsky et al. (1991), Sproull & Kiesler (1991), Adrianson & Hjelmquist (1991), Walther (1992, 1995)
	Group polarization	Kiesler et al. (1985), Spears et al. (1990), Sproull & Kiesler (1991), Kiesler & Sproull (1992), Baltes et al. (2002)
	Fragmentation of opinions	Kiesler et al. (1984), Hiltz et al. (1986), Sproull & Kiesler (1991), Adrianson & Hjelmquist (1991)
	Quality of decisions	Hiltz et al. (1986), Valacich et al. (1993)
	Social identity theory	Spears et al. (2000), Watts et al. (2003)

1999). Such studies reflect the new direction organizational research is taking with e-mail. Initially, e-mail was portrayed as a substitutable communication medium with predictable effects in relation to the various organizational functions into which it could be recruited. The variability of deployment has recast e-mail as a communication genre that is constructed and adjusted over time from the interaction between the technology and its context of organizational deployment. Figure 3 summarizes this body of research.

5. MOVING FORWARD: A POSSIBLE DESIGN FRAMEWORK

In the earlier sections, we journeyed through more than 30 years of e-mail research and proposed three metaphors that, we think, can help organize this vast and diverse body of work. It is clear that e-mail has been considered from so many different angles that researchers can be hard pressed to find any commonality between some of the existing findings. Although our survey's organization is certainly not without flaws, we think it brings a minimum of order to this body of work that makes it more tractable and, therefore, more useful as a point of departure for future research.

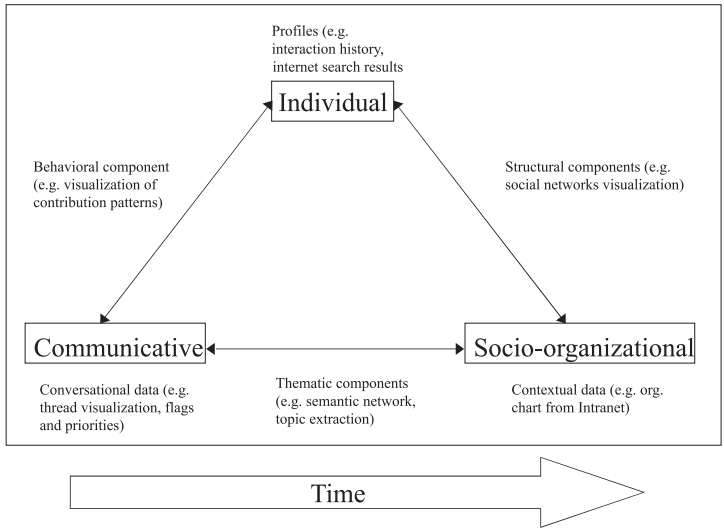
Indeed, as stated earlier, our hope with this review was to delineate what had been said about e-mail so that future researchers could use some or all of this early work as stepping-stones. In the interest of starting a debate that would be particularly appropriate to this special issue, we would now like to illustrate how previous research influenced our own thinking. Based on this discussion, we then propose one tentative avenue for reinventing e-mail.

In our view, the most problematic issue with past e-mail research is that it failed to connect the three levels at which e-mail operates: namely, the individual; communicative; and socioorganizational. Our metaphors reflect these divisions. For instance, the notion of e-mail as a file cabinet rightly draws our attention to the central role of individual users in managing their electronic communication but often forgets about the conversational and situated nature of e-mail. At the other extreme, the characterization of e-mail as a communication genre highlights the fluidity of e-mail as a medium and the importance of the socioorganizational context of its use—perhaps with a tendency to forget about the user simply manipulating an e-mail client. In the middle, the idea of e-mail as a production line emphasizes the communicative act, the exchange of information and work between several parties.

We think each of these themes points at several components that should all be considered for inclusion in any new e-mail interface. In other words, although many of the theoretical gaps in e-mail research probably cannot be bridged, we think this does not prevent all perspectives to simultaneously affect the design of future e-mail clients. In our scheme, each of the design components either connects two previously isolated analytical levels or offers more detailed information about a single level. Moreover, each component offers a dynamic view of the processes it relates too—in other words, it incorporates a model of time. Put together, these components are an attempt at blending together in an artifact some of the most high-level concerns of e-mail researchers over the past 3 decades.

Let us describe the components of this design framework in more detail (see Figure 4):

Figure 4. **A possible framework for reinventing e-mail.**



1. "Profiles" can offer in-depth information about each individual an e-mail user is corresponding with. For now, the only indicator of a correspondent's identity is an e-mail address and signature file but it would be possible to do more. Simple strategies, like automatically querying an Internet search engine with an unknown correspondent's name, could enrich e-mail users' understanding of who they are dealing with. Interaction histories and rhythms would also provide a useful context. Indeed e-mail, like any communication activity, is about face management (Goffman, 1959; Tyler & Tang, 2003). It is therefore quite important to have access to resources allowing an evaluation of the identity projected by someone through his or her e-mail. It is equally important to ensure that control of such profiles rests firmly in the hands of the individuals to whom the information pertains.
2. "Structural components" connect the individual and the socioorganizational levels. Up to now, there is no way to connect e-mail correspondents to the larger social and organizational structures to which they belong. Yet this information can be valuable: when it becomes visible, e-mail users can start reasoning about how they partition their social relationships and which set of identities they present to the world through their messages (Viegas, Boyd, Nguyen, Potter, & Donath, 2004); it also reveals the roles of the correspondents and the attention that should be given to them (Sack, 2001; Smith & Fiore, 2001).

Existing research proposes several social network visualization techniques that could be fruitfully imported into new e-mail interfaces.

3. "Behavioral components" connect the individual and the communicative levels. Intuitively, we all know that people do not communicate the same way over e-mail. Some are more vociferous than others; some start more conversations, whereas others are content to simply reply to contacts they have not initiated. All these factors affect the interaction strategies an e-mail user can adopt and yet none of these behavioral aspects transpire in current e-mail interface. Again, recent research has proposed some ways of making this information more accessible (Donath, Karahalios, & Viegas, 1999; Viegas & Smith, 2004) but it is clearly in its infancy. Much more could be done to give e-mail users a better sense of how to interact with their correspondents.
4. Improved "information about each individual conversation" would be greatly beneficial. At the communicative level, current e-mail interfaces mostly consider conversations as sets of atomic messages. It is only recently that some commercial e-mail clients have started offering crude threading mechanisms, in a form very similar to those available in Usenet reader for many years. Yet e-mail conversations can be quite involved and hard to track. Mechanisms to help the user deal with entire conversations are needed, to help him or her get a better sense of how conversational turns are unfolding and how they relate to each other. Efforts have been started in this direction (Bellotti, Ducheneaut, Howard, & Smith, 2003; Venolia & Neustaedter, 2003) but there is still much space left for improvements.
5. "Contextual data" could be fruitfully integrated into e-mail. The profiles we have discussed earlier help e-mail users evaluate the identity of their correspondents and to manage the basis on which they themselves are being evaluated. Contextual data offers a similar benefit but at the larger socioorganizational level. When e-mail is used in a corporation, for instance, a wealth of data is frequently available about how work is (or should be) organized. Company intranets can be repositories for organizational charts and documents. All of these could be made accessible from within one's e-mail, as a context for the interpretation of e-mail exchanges. One effort has already been made in this direction, relating e-mail conversations to the organizational chart of the corporation it is used into (Heckel & Hamann, 1997).
6. "Thematic components" connect the communicative and socioorganizational levels. Each e-mail conversation takes place in a socioorganizational context. In particular, topics and themes reflect which part of this context with which a conversation is concerned. However, there is currently no way in e-mail to get a sense of what is being

talked about. Sorting messages by subject line is crude and inefficient, because many conversations drift away from their initial subject (Ducheneaut & Bellotti, 2003). Better ways of visualizing themes of conversation could be imported into e-mail (Sack, 2001) or entirely new ones developed. Both would help contextualize conversations more easily.

7. Finally, each of these components should include "a model of time." E-mail exchanges are inherently dynamic, connecting shifting constellations of individuals depending on the purpose and context of the communication. For now, however, time is poorly represented in e-mail interfaces: Sorting by date or searching for messages over a specific date range are often the only two possibilities. This limits the potential reuse of content accumulating in one's e-mail, because the user is often constrained to focus only on the present state of his or her affairs reflected in a monolithic inbox. Time in e-mail also does not have to be only represented as present and past: Recent systems show that e-mail interfaces can also be used to project into the future, to reason about upcoming activities and commitments (Bellotti et al., 2003).

As a concluding remark for this section, note that all of the components we proposed automate very few e-mail activities. Instead, they point users at potentially interesting information patterns that they can interpret as they see fit. This is an important requirement: As we have discussed earlier, automated approaches to e-mail management have rarely been successful (see Section 2, in particular) and attempts at imposing structure have not fared much better (see Section 3). We view e-mail users as human beings able to reason about their activities, not passive recipients of preanalyzed data. E-mail interfaces should encourage active sense-making as much as possible.

6. CONCLUSION

In this article, we have surveyed a range of research carried out on e-mail over the last 30 years. Our hope is that this survey will prove useful to future researchers and help them forge their own direction of research, with knowledge of what has been attempted in the past. We found it impossible to cast e-mail research into a single mold because the idea of e-mail has manifested itself in significantly different ways in the various research communities to have tackled it. Instead, our approach has been to propose three metaphors reflecting, as best as possible, the "collective imagination" of several disciplinary fields regarding e-mail. With this we have made an attempt at answering the first question with which we started: What is e-mail research?

It is clear that we know a lot about e-mail as a communication medium, its usage and its users, the way it interacts with its social and organizational con-

texts of use. Yet e-mail remains a moving target that has evolved from a simple, electronic, letter-writing system to a business and social communication genre and keeps evolving as new generations of users adopt it. Perhaps because it is so hard to pin down, academic research has had surprisingly little effect on the design of new e-mail interfaces. We think it is time to put some of this knowledge to use and reinvent e-mail so that its interface reflects the diverse range of practices it is used to support.

Informed by our journey through the literature, we proposed a way to put theory into action by suggesting design guidelines for the reinvention of e-mail. Our view is that, despite the incommensurable theoretical gaps between most published works on e-mail, it is still possible to merge many of these seemingly incompatible ideas into a new e-mail interface. Our particular approach, meant more as an illustration of the possible avenues to explore than a definitive answer, has been to blend the three analytical levels cutting across three e-mail metaphors in one place. We therefore suggest ways for future e-mail interfaces to simultaneously support activities in three contexts: individual, communicative, and socioorganizational.

However, we are persuaded that there can be many alternative readings of e-mail research that could be as, if not more, informative for the reinvention of e-mail. Our cocontributors to this special issue will no doubt propose other challenging and exciting approaches. The second question we asked remains very much open: How can we reinvent e-mail? We look forward to the discussion generated by the possibilities described in the remaining articles.

NOTES

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