12. Individual Differences

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12.1. Introduction

In an increasingly complex world where people routinely handle large amounts of information, individuals are constantly challenged to manage and effectively use the information that they are responsible for. While email is the canonical example of an information overloading application, other well known PIM applications and tasks cited in earlier chapters of this book include maintaining addresses and contacts, scheduling, and organizing the various documents and bookmarks that one is interested in. Not surprisingly, there are individual differences (ID) in how, and how well, people cope with the challenge of personal information management. This greatly complicates any scientific analysis of PIM behavior. Thus, in addition to the evaluation methods discussed in the previous chapter, researchers and designers need to consider when and how individual differences should be included within parsimonious interpretations and explanations of PIM behavior. In this chapter we propose an approach where differences between individuals are considered last, after the influences of the environment and the task context have first been considered, and after group difference (e.g., between job classifications) have been investigated. We believe that this is a logical way to proceed, since like observing an ant walking over sand-dunes (cf. Simon, 1996) we should not ascribe complexities to an individual if they can instead be explained as due to properties of the environment.

The goal of this chapter will be to review and synthesize some of the key findings in how PIM behavior differs between individuals. Some of the reasons why these differences occur and what can be done about them will also be discussed.

12.1.1. Scenario

Alex is very well organized with respect to his work-related information and immediately files (or labels) all documents and correspondence, incoming and outgoing, including email. He also files relevant web-pages immediately as he encounters them. Every time he meets a new person he puts their contact information in his PDA. The costs of not having the information when needed are extremely high, and he is willing to invest the extra time and effort to keep his

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information organization up-to-date. However, he is much less organized with his non-work-related information. In particular, his tax-related information, mostly still paper-based, is in one big pile in a corner of his home office. His family pictures are in envelopes piled in another office corner. Brooke, on the other hand, is a piler both at work and at home. Her job is much more fluid and she does not rely on information as much as Alex does. She does not like to file anything, electronic or paper, and sees little value in keeping "old stuff". In her work office and at home, we find a relatively small number of piles. Connie, in turn, has an elaborate paper-based filing system. She prints out web pages and even email messages that she wishes to keep and then files these away into her filing system, where she also keeps documents and correspondence which she receives on paper. She claims she can find any piece of information from the past 10 years in the matter of a few minutes. She admits however that to keep up with the growing amount of collected information, she needs to add each month a set of additional drawers for her hanging folders.

Clearly, the members of the family that we met earlier in this book represent different types, and at the same time may exhibit somewhat unique coping behaviors and strategies. Alex, Brooke, and Connie differ in terms of their PIM behavior. Alex, Brooke, and Connie have different job requirements; they also have a different age, gender and an educational background. Connie for instance, was influenced to change her behavior based on a friend's visit (which inspired some spring cleaning in an earlier chapter), while people similar to Brooke will tend to rely on people like Alex and Connie to help her remember information that is relevant to the family as a whole. Brooke will need to remember information differently if she is the only one that cares or knows about it and if she cannot rely on others to store and retrieve it for her.

The unique factors and situations of different people influence their PIM needs and practices, and which PIM tools might suit them best. But even people who have quite similar profiles with respect to job and demographics can exhibit huge observable differences in PIM-related behaviors, their choices of strategy, and their preferences in tools. These differences apply both with respect to paper-based information management and to the management of electronic information.

PIM behavior plays a central role in personal cognition and life performance and is affected by many factors, internal and external. For instance, the organization of personal information involves psychological processes (Landsdale, 1988) which are sensitive to both cognitive differences, and to the amplifying effect of age on those differences (e.g. Salthouse, 1991). Given the variety of factors involved, it is not surprising that there are frequently observed individual differences in PIM performance and strategies.

Understanding the individual differences that underlie PIM behavior may be difficult, since PIM is a complex topic where observed behavior has a multiplicity of causes from both inside and outside the person. So why should we be interested in individual differences in PIM? This question will be addressed in the next section, focusing both on the importance of PIM as an activity and on the necessity of considering and attending to the considerable individual differences that exist.

12.1.2.   Practical Relevance

We increasingly rely on on-line information in conducting our everyday lives. From accessing movie listings and saving product comparisons, to communicating with grandmother Edna through email or accessing health information, it is becoming difficult to find any parts of our lives that do not involve PIM skills.

As if dealing with personal information such as financial and legal records were not enough, people also need to deal with their personal views of collaborative information. Within large corporate networks, each worker must maintain a personal view of his or her area of responsibility through the various information clients that they interact with (whether it be a desktop computer, a PDA, or some other tool or device). Thus individual differences in the desktop computing setup are critical in designing collaborative work systems, as noted by Bentley and Appelt (1997) with respect to their discussion of the development of the BSCW collaborative software system: "Many of the problems we encountered concerned users with different requirements for the arrangement and level of detail of the displayed information due to different screen sizes, network connectivity and so on."

For many individuals, email is a canonical example of an information tool that spans both personal and organizational boundaries (see Chapter 11 of this book). The same email account may hold private and personally meaningful messages, along with other messages and attachments that are "owned" by a workgroup or corporation. As noted in chapter 11 there are interesting biases in email handling with people tending to receive more messages than they send, and tending to reply more quickly to social messages. This leads to an interesting strategy where social greetings and content are embedded within work-related messages to make them more "sticky" and selectable, but presumably this strategy will be more successful with some personality types (e.g., extraverts) then with others.

For many knowledge workers, a clear distinction between PIM on the one hand, and corporate or collaborative information management on the other, may not be possible, even in principle. A single email message may contain a draft contract, salutations to the family, and an invitation to lunch. Sometimes even the participants in a mixed work and social interaction would be hard pressed to identify exactly which parts of the interaction are work-related and which are personal. Thus, a broad population of individuals is engaged in PIM activities, at home and at work and the nature of those activities is constantly shifting as people move though the information space handling it with (sometimes) continuously varying perspectives and motivations. Personal inclinations and abilities, corporate tools, policies, and training, all interact with each other in determining how PIM is actually carried out. For instance, some people will continue to use Microsoft Outlook for their personal email because it is mandated for use at the office, while others may use Outlook when they have to but use Gmail otherwise.

Individuals perform PIM activities using a variety of tools in both paper and electronic environments, including a variety of desktop applications and mobile devices; PIM activities are performed in a variety of contexts (situations): at work; at home; on-the-run. The combination of the four factors: people, tasks, tools, and context creates a huge diversity in PIM behavior with considerable scope for individual differences to express themselves in how work gets performed

in various circumstances. At the same time the sheer complexity of these interactions (with all the potential causal factors involved) makes the isolation of the individual differences extremely difficult. One approach to reducing some of this complexity in the case of email is to use reference tasks (as explained in chapter 11) that create a basis for comparing findings between different studies.

Competing explanations are not the only reason why individual differences may get under-reported. In the laudable push for equal opportunity and recognition, individual differences in performance and ability tend not to be emphasized. Yet in cases where differences exist, people will not be well-served by tools and systems that fail to recognize their abilities and preferences. However, mismatches between individual needs and the tools provided are most likely under-reported. Workers may often displace negative feelings about poorly fitting tools and interfaces onto their attitudes towards the content of the work, blaming the company, the workplace, and/or management for what may be a problem concerning poor human factors. Someone who may have relatively low working memory, and who has difficulty using an email client may not be aware of why he dislikes using email so intensely, and may blame it on boring work content, or on excessive demands being made by management. Consequently, individual differences have received little research attention.

Thus while individual differences may be difficult to disentangle from other factors, and may even be ideologically unwelcome in some cases, they nevertheless exist. Yet, the mere presence of individual differences does not mean that they can or should enter into consideration as factors in design, documentation, training or personnel selection. As is always true in design, the role of individual differences needs to be established and the costs and benefits of explicating considering and designing for individual differences in particular situations needs to be assessed. Currently, we are only beginning to understand the role of individual differences in PIM. However, a number of relevant research studies have been conducted and in the next section we summarize what is known thus far about the nature of IDs in PIM behavior.

12.2. Research Overview

In this section we will review relevant research on PIM to illustrate the progress that has been made and the key issues that have been identified. This research will be interpreted in terms of the selection and use of PIM and information handling strategies, either within or between individuals. We will begin this review with a discussion of what strategies have been discovered, and how they relate to other factors that govern PIM behavior.

Dillon and Watson (1996) reviewed the large body of literature on individual differences in psychology. They argued that "a core number of basic abilities (such as cognitive speed, perceptual speed, short-term memory, spatial ability, visual ability, to name just a few[3]) seem to have been reliably and validly identified" and that appropriate user analysis ought to lead to

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[3] These factors are part of Carroll's (1993) three-stratum model of human cognitive abilities.

better systems design and more appropriate training. Egan (1988) reviewed differences in performance in human-computer interaction, focusing on common computing tasks, such as text editing, information search and programming, and concluded that differences between individuals (whatever their cause) typically explain a high proportion of the variability in performance with ratios of 20 to 1 sometimes observed between best and worst performance.

The remainder of this section will be organized according to the strategy outlined earlier in this chapter, where internal differences between individuals are considered only after various external aspects of the context of PIM usage (environment and task), and then any group differences that may pertain, have first been considered. We begin by considering task management, which is a major contextual factor in many situations.

## 12.2.1.	Task Management

Variations in PIM behavior are situated in the variations that occur within task environments, corporate policies, and the current situations that people find themselves in. New tasks may inherit structures from old tasks or may require new structures. For instance, there may be a fixed folder structure reflecting tasks associated with conference travel. Two instances of conference travel may have very similar structure (e.g., plane schedule, hotel reservations, rental car booking, conference registration) and thus folders can be re-used from other projects (conferences). In contrast a new project may require dynamic assignment of information categories, placing more emphasis on categorization decisions. Similarly, information handling strategies will likely change in an environment where there is a history of hardware or disk failures and where there is a need to backup information or to store it in multiple locations. Frequently, there is no clean separation between PIM and task management, and users do not manage information simply to retrieve it later - they also store items as reminders of the tasks they have to perform. For instance, people frequently (Whittaker and Sidner, 1996; Duchenaut and Bellotti; 2001; Bellotti et.al., 2005; Gwizdka, 2004b) use email messages as task reminders and may even send themselves email messages as additional reminders.

In general, we can expect that, in terms of information handling, people will respond rationally to the demands placed on them, within the constraints of their abilities, and the characteristics of their task environments. Yet, given the natural variability of human behavior, IDs can be expected to remain even when other factors such as the properties of the task and its environment have been accounted for. For instance, a waiter may have a highly structured task that involves activities such as taking orders, serving food, taking away used dishes, bringing the bill, and responding to various requests made during the meal. Yet casual observation of waiters quickly shows wide variations of strategy and style even at the same establishment. Some waiters may use mnemonics and trust to their memory, while others may take quick notes (if they are allowed) to jog their memories. Some waiters may simplify the PIM task by ordering only part of a meal at a time (e.g., appetizers) while others with better memories may be able to take orders for entire meals or even collect orders for multiple tables before passing them on to the kitchen. Task requirements, and work constraints are important, but it is together with internal individual

differences and with other external factors that they jointly determine PIM performance and behavior.

12.2.2. External influences on strategy selection and use

Job requirements, information tools, and work structure may each influence and constrain the way that information is handled and managed. For example (Table 1), Jones et al. (2002) found that job position was related to email use – managers used email much more than other workers. Other external factors, such as the type of PIM environment (e.g., paper vs. digital) and kind of PIM tool may also be important. External factors can have a combined effect, for example, many Information Technology (IT) departments enforce a company-wide information retention policy where all messages older than a certain amount (e.g., 45 days) are deleted; inevitably, employees' PIM behavior will be affected by such choice, making it harder to observe how their PIM behavior and performance is driven by internal factors.

Individuals also differ with respect to their preference of information presentation. For example, Krishnan & Jones (2005) found that some people preferred to access files via folders shown in a spatial representation, while others preferred textual keyword-based search to access their files.

Table 1. Selected research on external influences on PIM strategies (Inter-Individual differences).

Factors	Reference	PIM tool / environment	PIM activity	Key findings
job requirements	Jones et al., 2002	email	all	job role affects email use: managers vs. others
information-presentation	Krishnan & Jones, 2005	files	finding & managing	preference for external information representation: a) spatial layout (recognition) or b) filename patterns (recall).

12.2.3. Differences in PIM strategies between groups of users

With respect to grouping users, early studies tended to categorize individuals engaged in PIM at the extremes of a continuum. Malone (1983) classified individuals into filers and pilers. Filers' information organization is well-structured and neat. In contrast, pilers' information organization is unstructured and messy. Further examples include MacKay's (1988) email prioritizers vs. archivers distinction, and Whittaker and Sidner's (1996) tripartite grouping of email users into frequent filers vs. spring cleaners vs. no filers. Abrams et. al., (1998) divided web-users with respect to their keeping behavior (bookmarking) into four groups: creation-time filer, end-of-session filer, sporadic filer, no-filer. These empirically established strategies have retained many similarities despite being observed with respect to a range of different PIM tools.

Table 2 summarizes some of the key early findings that have been obtained on individual differences in PIM.

Table 2. Selected research on PIM strategies between groups of users.

Reference	PIM tool / environment	PIM activity	Key findings
Malone, 1983	office environment	keeping & managing	filers, pilers
MacKay, 1988	email	managing	prioritizers, archivers
Whittaker & Sidner, 1996	email	keeping & managing	frequent filer, spring cleaner, no filer
Abrams et al., 1998	web	keeping	creation-time filer, end-of-session filer, sporadic filer, no-filer

12.2.4.   Differences in PIM strategies across PIM activities

Personal information processing strategies are influenced by the type of PIM activity being carried out and by strategies that were used in other PIM activities (Table 3). Information organization strategies appear to be related to the user's retrieval preferences and style (Boardman & Sasse, 2004; Teevan et. al., 2004). Filers used keyword search about as frequently as pilers. However, they did it in different contexts. Filers were found to use keyword search in their file systems and on the global web, while pilers used keyword search on particular websites. Strategies in one activity were found to affect how other activities were carried out. For instance, keeping strategy affected re-finding. Pilers, who did not use meta-data, and did not impose information structures at the time of filing, tended to perform local steps (navigate/browse around) before performing keyword search. In contrast, filers who used meta-data in their filing process tended to use this meta-data at the time of retrieval.

The relation between keeping and finding (in the context of the Web) was further explored by Jones et. al., (2002, 2003) and Bruce et. al. (2004). Participants in their studies used more than one keeping method. Although the choice of the keeping method was influenced by reasons for keeping (sharing, reminding) and by preferred re-finding methods, a high proportion of re-finding methods did not rely on keeping at all. Examples of re-finding methods independent from keeping included, direct entry of URL, search, and access via another web site.

Table 3. Selected research on PIM strategies across PIM activities.

Reference	PIM tool / environment	PIM activity	Key findings
Teevan et. al, 2004	cross-tool (bookmarks, email, files)	managing vs. finding	search behavior of filers vs. pilers key findings: 1) filers search more for files than pilers; 2) filers rely more on keyword search than pilers
Jones et. al., 2002, 2003; Bruce et. al., 2004	web / bookmarks	keeping vs. re-finding methods	key findings: each participant used more than one method; re-finding affected by keeping methods, however most re-finding methods did not rely on keeping

12.2.5. Differences in PIM strategies within users

We conclude this presentation of related work on differences in PIM behavior with a review of how PIM strategies differ within users. Relevant research on this topic is summarized in   For instance, Jones et al., (2002) found differences in strategies within the same individual between paper and electronic information environments. Similarly, Boardman & Sasse (2004) found that people change strategies between different computer-based PIM tools. They found that files tended to be organized more extensively than emails or bookmarks. This may arise because files are more externally constrained documents than are messages. Thus while files are often subject to audit, inspection, or use by others, messages are generally considered to be more private and only subject to audit or inspection in special cases.

These kinds of differences may be habitual; PIM users may have learned (acquired) contextually-conditioned PIM behavior and formed different "PIM-personalities", which are then triggered by different PIM contexts. The primacy of hierarchical file systems in desktop computing and in handling of papers within businesses may predispose people to filing strategies more than they would do so by natural inclination. Individual differences, as suggested by Boardman & Sasse (2004), may also be influenced by a range of factors related to PIM tools. Higher perceived value and ownership of information, as well as higher likelihood of information re-use encourage people to invest more effort in information organization.

PIM strategies may also change within users in the absence of marked external changes (e.g., in terms of PIM tool, information environment, or job position). Bälter (1997) found that users may switch between (and/or gradually change) different information organization strategies within one PIM tool. He suggested that there are two competing trends, one towards more organization, and the other an "anti-organization" set of transitions that may be precipitated by information overload (amount of email messages) and time pressure. Similarly, Whittaker & Hirshberg (2001) found that people employed a combination of different PIM strategies (filing and piling) within the same environment (paper archives).

Barreau & Nardi (1995) studied behavior related to three information types: ephemeral, working, and archived. They suggested that people prefer to access ephemeral and working information by location-based browsing, while accessing archived information by keyword-based search. In practice, specific behavior is likely to be influenced by both specific dispositions of the individual, and properties of the task environment within which PIM is carried out.

Gwizdka (2004a) and Boardman & Sasse (2004) found that specific behaviors depend on the perceived importance and value of information (in email messages). For instance, in Gwizdka's study, participants were observed to re-email important messages to themselves.

Table 4. Selected Research on PIM strategies within users (intra-individual differences).

Factors	Reference	PIM tool / environment	PIM activity	Key findings
information-environment	Jones et. al. (2002)	web	all	differences in strategies in different environments influencing factors: information environment: paper vs. digital
multiple strategies	Whittaker & Hirshberg, 2001	paper documents	keeping & managing	filers, pilers key finding: combination of strategies filing and piling within paper archives
	Boardman and Sasse, 2004	cross-tool (files, emails, bookmarks)	keeping, finding & managing	frequent filers, file some now & spring clean rest, no filers key findings: multiple PIM strategies within specific collections; PIM strategies vary between tools (files organized more extensively than emails or bookmarks) influencing factors: 1) (perceived) value and ownership of information; 2) likelihood of re-use ; 3) degree of control over information creation
	Gwizdka, 2004a	email	keeping, finding & managing	email inbox processing: 1) immediate processing; 2) limiting; 3) encoding additional information; and 4) accumulation.
information type	Barreau & Nardi, 1995	files (primarily)	keeping, finding & managing	influencing factors: information type (ephemeral, working, archived) relationships: preferred access to 1) ephemeral & working info by location-based browsing; 2) archived info by search (keywords)
adaptive strategy change	Bälter, 1997	email	keeping & managing	frequent filer, spring cleaner, folderless cleaner, folderless spring cleaner influencing factors: 1) information overload & time pressure; 2) willingness to expend increased organization effort

12.2.6.   Internal influences on strategy selection

There have been empirically-motivated attempts to link observed differences in behavior to internal differences (e.g., in cognitive ability) between individuals (Table 5). For instance, based on empirical evidence Gwizdka (2004) suggested flexibility of closure[4] as a possible internal source of influence on personal information management behavior.

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[4] Flexibility of closure is the ability to hold a given visual percept or configuration in mind so as to disembed it from other well defined perceptual material (Ekstrom, 1976).

Table 5. Selected research on internal factors (cognitive and affective) and PIM Strategies.

Reference	PIM tool / environment	PIM activity	Individual differences and influencing factors
Gwizdka, 2004a, 2004b	email	keeping & managing	keepers (pilers) and cleaners (filers) influencing factors: flexibility of closure, email experience
Gwizdka & Chignell, 2004	email	finding	influencing factors: working memory
Modjeska & Chignell, 2003	2.5D / 3D info-landscape	finding	influencing factors: spatial ability
Allen, 2001	database	finding	influencing factors: spatial scanning
Kim & Allen, 2002	web	finding	influencing factors: field dependence/independence, experience
Ford, et. al., 2005	web	finding	Preference for Boolean vs. best-match web search influencing factors: verbalizer-/ wholist-imager cognitive style, cognitive complexity
Nahl, 2005	web	finding	influencing factors: affective

In a study of information finding in email inboxes, Gwizdka & Chignell (2004) linked differences in efficiency to cognitive abilities. Working memory (WM) was found to be related with performance time (users who scored higher on a WM test, were faster), while visual memory was related to user interaction with the inbox (the amount of scrolling and sorting).

Modjeska & Chignell (2003) examined the effect of spatial ability on searching for information in a hierarchy that was visualized using the "information islands" metaphor (Waterworth and Singh, 1994). They found that individuals with relatively low spatial ability were significantly less successful in finding information in the information hierarchy (finding only about half as many of the targets in the timed task that was used).

Researchers in related areas (such as information searching on the web) have also discovered relationships between user behavior and cognitive abilities and styles. For example, Kim & Allen (2002) found that field dependence and experience affect information searching behavior on web search tasks. Allen (2001) found that users with high spatial scanning ability performed better on an information retrieval task using a novel Boolean browsing interface. However, the advantage was found only for certain information retrieval tasks (low-recall tasks).

Other internal factors are also implicated. For example, affect and emotions associated with information also influence how an individual handles personal information. For example, affective factors (e.g., optimism, self-efficacy) have been shown to influence web search behavior (Nahl, 2005). Thus some differences in PIM behavior may be transient and attributable to mood or emotions.

12.2.7.   Summary

As can be inferred from the preceding discussion and literature review, IDs are contextually dependent, and they respond to changing situations and task demands dynamically. People may exhibit different "PIM-personality" in different environments, and when dealing with different

information types (e.g. paper vs. electronic; email vs. files). PIM personality may be thought of as the style of PIM use that people exhibit. It will presumably be influenced by context and by a variety of internal and external influences, and yet may be recognizable to others as a consistent style of behavior.

People may be neat/organized with in one context (using one PIM tool, one environment such as paper) while being messy in others. For instance, a neat office at work may not necessarily mean that an employee has a correspondingly neat home office. Thus variations in PIM behavior are contextualized.

Figure 1 summarizes the various influences on PIM behavior described earlier. The main point of the figure is that strategies lie at the heart of the malleability of PIM behavior as people respond to a wide range of internal and external factors in dealing with information.
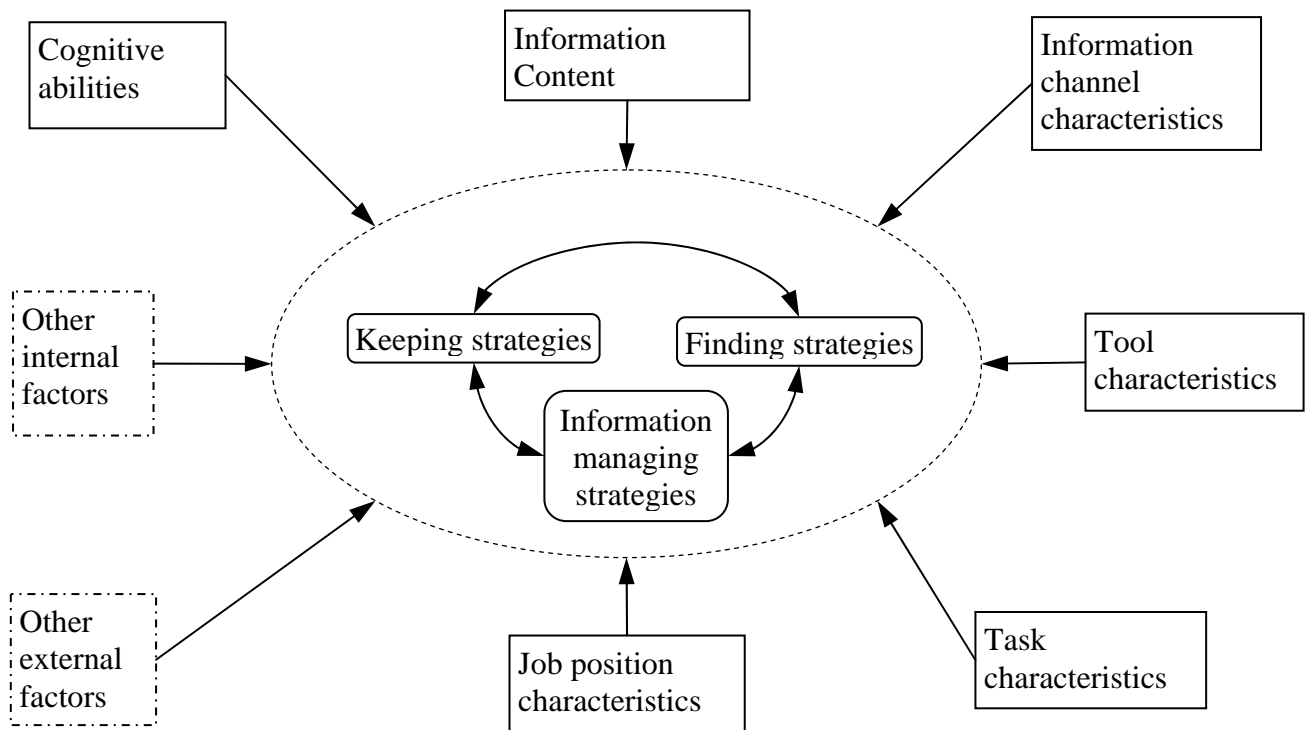
Figure 1. Individual differences in PIM.
(PIM strategies are represented by rounded rectangles, empirically established influencing factors are represented by solid-edge rectangles, while other, unknown yet, factors are represented by dashed-edge rectangles).

In Chapter 2 Jones proposed "keeping", "finding", and "information managing" (or more generally "meta-level" activities) as three main types of PIM activities. The detailed interaction of the characteristics and factors (shown in the outer part of the Figure 1) with those types of strategies is not yet known. In the following section we suggest some research and design approaches that may help to elucidate the relationships shown in Figure 1, eventually leading to design guidance concerning more personalized and customized PIM tools and interfaces.

12.3. Looking Forward

Personal information management is a relatively young field. Given the youth of the discipline and the complexities of the phenomena to be studied, it is not surprising that research paradigms and methodologies are only beginning to emerge. This is especially true for research on IDs in PIM behavior, where previous findings have predominantly applied to differences in broadly defined strategies that differ between groups of people. In the following subsections we will examine a number of promising future directions, first in terms of research challenges, and then in terms of design challenges.

12.3.1. Research Challenges

Individual differences tend to be difficult to study because they interact with a variety of other factors in determining performance. Teasing out the precise effect of individual differences may not always be possible. Results of fieldwork investigation of PIM may be very specific to the participants under study and their current situation. Generalizations are risky for many types of research, but even more so given the richness and complexity of real-word environments of PIM.

Yet personalized and customized solutions require an understanding of the mappings between the properties of the individual and the requirements of the application or tool. This in turn requires a more systematic approach to the study of individual differences. One of the major challenges for research in this area is to provide a consistent framework for ID studies and to elucidate the relationships between various internal and external factors on the one hand, and differences in PIM strategies and behavior on the other.

A systematic approach to studying ID could involve the development of a paradigm / methodology that includes formalized: a) PIM tasks, b) metrics, c) sets (repertoires) of possible PIM behaviors (discrete), d) ranges of possible behaviors (continuous), and e) mappings between contexts (conditions) and PIM strategies / behaviors.

Given the complexity associated with disentangling internal factors and their impact on PIM behavior, we suggest an approach where factors influencing PIM behavior are considered in a sequence. The initial focus may be on observable differences in broad strategies. Questions are then asked concerning how environment, task contexts, and tools influence the strategies employed by PIM users. The effects of group differences are examined next. Human abilities and personality are considered after the influences of other factors have been investigated. Once some of the relevant individual differences are understood it should then be possible to link differences between people and their task environments to resulting differences in their PIM behavior.

12.3.2. Design Challenges

Designing for PIM is a most extreme case of user-centeredness because of the intense involvement that each person has with the rich amount of information that is relevant to them. Individual differences in PIM requirements call for thoughtful user-centric design in adapting tools and their interfaces to the needs, capabilities, and circumstances of each user. Caution

however must be exercised in the design of PIM tools with respect to conclusions reached concerning their user evaluations. When people reject a tool it may not always be the fault of the tool's design per se, since other people may benefit from the tool. Instead the problem may be one of mismatch between tool and person.

In designing for PIM, there is a delicate balance between prescribing what to use PIM for and how, versus allowing people to express (and execute) their own PIM styles/habits/preferences. In practice, designers will need to handle this tradeoff carefully by judicious use of the following strategies:

- Providing customization options or settings within a single tool;

- Providing different tools for different types of user;

- Employing an adaptive approach (e.g,. Horvitz et. al., 1999) where the behavior of PIM tools is contextually dependent and sensitive to the situation.

These approaches, or their combination, can be employed in the context of designing interactive systems to support PIM activities.

12.3.3.   Conclusion

Much work remains to define the boundaries of the discipline of PIM, particularly with respect to how it relates to other information disciplines, and to which properties of individuals should be deemed relevant to determining or affecting their PIM behaviors. Detailed findings are also needed concerning the effects of different combinations of situations and settings on PIM strategies and performance.

We are, perhaps, entering an era where PIM tools need to be highly customized, and customizable, in order to succeed. While there are millions of people using PDAs of one form or another, there are billions of people using mobile phones. In terms of technology diffusion, specialized personal information tools are used largely by early adopters, and not by the general population. Of all PIM related tools, email is most widely used, but in many cases this use is driven by job requirements. Even so, many people are turning to instant messaging as a frequent alternative to email, with its much lower demands on working memory and its removal of the need to store and retrieve information. It is our belief that the current use of PIM tools is artificially constrained by inattention to the significant individual differences that drive the acceptability of PIM solutions and their adoption.

Individual differences in PIM are huge and there are a great many factors that influence the impact of IDs on PIM. The resulting behavior can be complex, idiosyncratic, and affected by context and changing situations. In spite of these problems, the research literature cited in this chapter demonstrates the existence of a healthy and growing group of pioneering researchers working on the topic of individual differences in PIM. It is possible that further progress in PIM design may require *individual-centered design* and that we are entering an era where PIM tools need to be highly customized, and customizable, in order to succeed. However, a considerable amount of work remains to be done on formalizing relevant frameworks and methodologies, and

on obtained detailed research results, before definitive guidance can be given to designers concerning when and how PIM functions and interfaces should be personalized and customized.

One of the factors not considered in this chapter is how an area of application may affect PIM behavior. While individual differences exist, PIM behavior can be quite malleable as people respond to the situations they find themselves in and the various demands that are placed on them. Healthcare is a good example of an application where there may be special rules for PIM, arising from the criticality of the information and also enhanced requirements for privacy and confidentiality. This topic will be addressed in the following chapter.

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