Managing References by Filing and Tagging

An Exploratory Study of Personal Information Management by Social Scientists

Pierre Fastrez(✉) and Jerry Jacques

Center for Research in Communication, Université catholique de Louvain, Louvain-la-Neuve, Belgium
{pierre.fastrez, jerry.jacques}@uclouvain.be

Abstract. This paper presents the preliminary results of a cognitive ethnography of the personal information management (PIM) practices of five social science researchers. Based on video-recorded interviews involving guided tours of our informants' personal digital spaces of information, we study how they create digital workspaces that support their informational activity. We introduce a semio-cognitive theoretical framework to elucidate the relationships between the users' informational activity, the technical and semiotic properties of the software tools they use, and their conceptual models of these tools. Based on this framework, our analyses of PIM practices highlight how conceptual models play a mediation role between the affordances of the tools and the activities that they support.

Keywords: Personal information management · Folders · Tags · Cognitive semiotics · Conceptual models · Conceptual metaphors

1 Introduction

Contemporary information workers face the challenge of managing personal and shared information collections (documents, emails, bookmarks, pictures, videos) that constantly grow in size. These collections can be accessed through a multiplicity of devices and services, in an increasing number of mobile and sedentary contexts. When they are shared, they often support complex collaborative activities. This paper presents the theoretical framework and methodological protocol, as well as the preliminary results, of an ongoing research program focused on the personal information management (or PIM) practices of scientific researchers.

2 Personal Information Management (PIM)

PIM can be defined as "the practice and the study of activities a person performs in order to acquire or create, store, organize, maintain, retrieve, use and distribute the information needed to meet life's many goals (everyday and long-term, work-related

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and not) and to fulfill life's many roles and responsibilities (as parent, spouse, friend, employee, member of community, etc.)" [1].

PIM research has dedicated a fair amount of effort to documenting the practices of individuals organizing digital collections of information, in the prospect of formulating recommendations for the design of future PIM software applications. These studies have generally focused on how individuals organize a specific type of digital resources, such as files [2–5], emails [6–9], photographs [10], web bookmarks [11], or, in a minority of cases, several types of resources [12]. Twenty years ago, initial studies in this field have highlighted how users sorted their digital information based on a limited number of categories, organized at the same level (e.g. a distinction between ephemeral, working and archived files, with no or few sub-categories) [2]. More recent studies have shown a greater variety in the organizations produced by users, especially regarding the number of folders or the complexity of folder hierarchies they created [4, 12], in a context where information workers have to deal with increasing loads of information to be processed [3, 8].

Several studies have described the different types of strategies adopted by users to organize their personal information. These strategies differ in terms of the nature of the categories used to group resources (e.g. by level of priority in their expected processing, or by subject [6]), or based on the frequency of sorting, or the proportion of sorted resources [4, 8, 9, 12]. Some of these studies have shown that the same users can adopt different strategies both within the same application and between different applications (file managers vs. email clients vs. bookmark managers) [12].

As of today, the description of the cognitive functions fulfilled by the personal organization of information collections is still shaped by the seminal distinction introduced by Malone [13], deriving from his observation of desk organization practices, between *filing* documents into named folders (within cabinets), which affords *(re) finding* them later, and *piling* documents in sight, which *reminds* the office occupant what needs to be done.

In the context of the descriptive studies of PIM practices presented above, the research presented in this paper focuses on a specific set of practices: the categorization of digital resources using either folders or tags. Our perspective is a comprehensive one: we examine how the kinds of organization produced by users with these two types of functionalities support their activities as they are situated in their natural contexts of use.

3 Cognitive Semiotics of PIM

We consider PIM practices as a semio-cognitive activity. PIM tools can be viewed as cognitive artifacts "designed to maintain, display, or operate upon information in order to serve a representational function" [14]. We use the concept of *techno-semiotic affordances* to describe how each tool offers specific means of action on ("techno-") and representation of ("semiotic") the information items it helps organize.

With these tools, users construct actionable representations (folder hierarchical trees, item lists, collections of dynamic tags, etc.) which make the conceptual categories underlying their activity perceptible and manipulable.

Our analyses of PIM practices emphasize the role of conceptual models of technology constructed by users. A conceptual model corresponds to the representation a given user holds of the functioning of a tool or system, and of how to interact with it [15]. When constructing a conceptual model for a system, users rely on the system image [16], i.e. the way it presents itself through its interface, its documentation, etc. We study how conceptual models can play a mediating role between the actual affordances and constraints of the tool for the user, and the user's activity it is meant to support.

These models can be described in terms of the conceptual metaphors they involve. Conceptual metaphor theory [17] considers metaphors as cognitive tools that are essential and ubiquitous to the way humans understand their experiences. As human beings, we understand most of our abstract concepts (time, love, causality, money, the self, etc.) by using what we know of more concrete conceptual domains (space, heat, physical forces, inanimate objects, etc.). A conceptual metaphor is the cognitive operation through which the conceptual structure of a source domain (e.g. heat) is projected onto a target domain (e.g. love) to provide an understanding of the target in terms of the source (e.g. yielding linguistic expressions such as "he was in a *heated* relationship").

In this theoretical perspective, the conceptual model of an interactive system (as constructed by its user) is structured by multiple layers of conceptual metaphors [18] that call upon the user's knowledge and experience in various (source) conceptual domains. Higher-level metaphorical projections inherit and build upon the conceptual structure established by lower-level projections [19]. In the case of PIM software applications, folders and tags share the low-level metaphor of DIRECT MANIPULATION [20], in which a system corresponds to a model-world composed of objects the user can act on "directly" [21]. The user' bodily experience of objects in physical space are projected onto their experience of the system, so that they understand it in terms of direct manipulation of computer objects [22] (see top portion of Fig. 1). Although computer folders and tags fulfil a common categorization function, they correspond to two distinct conceptual models, relying on different metaphors that build upon the common primary metaphor of object manipulation. Folders rely on the CONTAINER metaphor, in which the act of categorizing an item corresponds to the act of placing it into a folder that contains it (see middle portion of Fig. 1, left). Tags rely on the TAGGING metaphor, in which the act of categorizing an item corresponds to the act of attaching a descriptive label to this item (see middle portion of Fig. 1, right).

The implementation of folders and tags into a particular software application further specifies these metaphors, each application adding its own conceptual structure to the conceptual model (see bottom portion of Fig. 1). In some cases, these specifications can contradict the lower-level metaphors that underlie them. For instance, folders can, depending on their implementation in different applications, contain only categorized items (in conformity with the source domain of physical folders), or contain an undetermined number of levels of subfolders (in contradiction with the source). Similarly, a folder can be the exclusive storage location of the items it contains (conformity), or contain items that also reside in other folders (contradiction). The techno-semiotic affordances of each application act as material anchors [23] for the user's conceptual model of the system and its functionalities: the material structure of

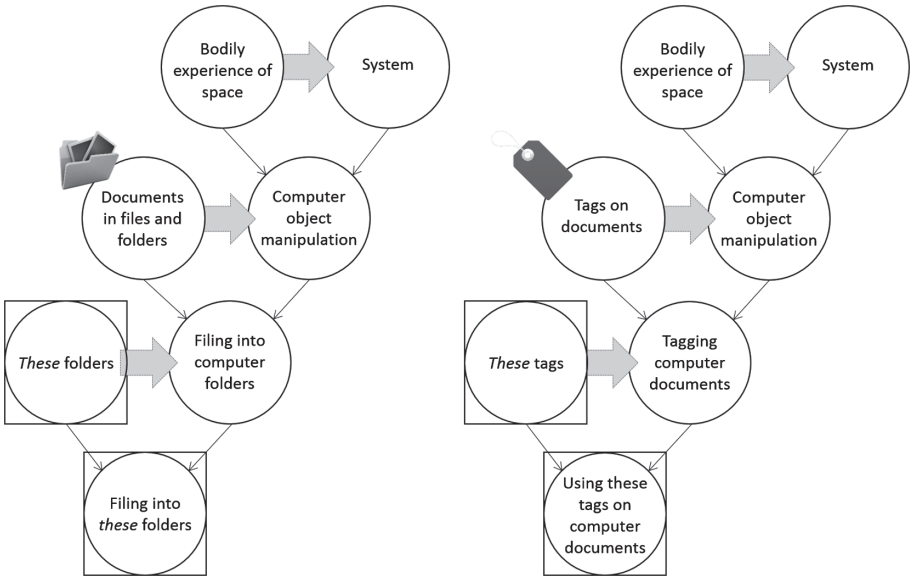


Fig. 1. Layers of metaphors in the conceptual models of folders (left) and tags (right)

the system's interface is mapped onto the conceptual structure of the model, thereby providing stability to the conceptual model (the material structure of each application is represented as a square around the source domain in Fig. 1).

Our analyses also rely on the tenets of distributed cognition theory [24], which defines cognitive activity as the creation, transformation and propagation of representational states through (internal or external) representational media brought into coordination. We examine how the conceptual structure of the informational activity is brought into coordination with the techno-semiotic structure of the technological tool used to support it, through the mediation of the user's conceptual model of this tool.

4 Method

We conducted a series of ten semi-structured interviews with five social science researchers active in the same scientific domain, representing a variety of profiles in the advancement of the academic career. Each informant was interviewed twice, three years apart. At the time of the second interviews, Laurent was halfway through his PhD thesis, Thomas was finishing writing his Ph.D. dissertation, Benoît had recently defended it, Patrick had been an Associate Professor for five years, and Michel was a Full Professor, three years away from retirement.[1] The interviews were video-recorded, and took the form of a guided tour of their personal digital workspaces.

[1] The informants' names were modified.

5 Preliminary Results

The preliminary results presented in this section focus on the analysis of the PIM practices of our five informants involving the use of their bibliographical reference manager of choice (Zotero[2] or Mendeley[3]), which affords the categorization of references and texts both with folders and with tags. Despite the limited number of informants, our observations reveal an important variety in the practices involving these functionalities, as well as in the practices dedicated to coordinating the resources contained in the reference managers with those stored in the folders of their operating system (Windows or MacOS). In this paper, we will focus on the practices developed within the reference managers, as well as on their diachronic evolution.

5.1 Folders and Tags in Zotero and Mendeley

Categorizing Texts… The folders and tags of reference managers are used by our informants to map sets of conceptual categories related to their professional activities onto a representational structure, and to determine which texts[4] are part of which categories. Three types of categories are reified by folders or tags: (1) categories related to the subjects or concepts detailed in the categorized texts, (2) categories related to the user's projects (or, more generally, their activity domains) involving the sorted texts (e.g. the user's Ph.D. thesis, an article he wrote, a class he is in charge of, etc.), and (3) categories related to the processing of the texts (e.g. "need to borrow", "need to read", "can be read in the evening", etc.).

In Zotero as in Medeley, the same document can be placed into multiple folders, and the same tag can be applied to multiple documents. Folders and tags act as filters on the complete list of texts encoded by the user: selecting a folder and/or one or several tags limits the list of displayed texts to those corresponding to the cumulated selection criteria.

Among the five researchers we interviewed, all use folders, but only the two youngest (Laurent and Thomas) use tags. All of them make use of the possibility of placing texts in multiple folders, but neither Laurent nor Thomas filters his bibliographic list by selecting multiple tags. Therefore, folders and tags are put to use by our informants in functionally equivalent ways, despite their different affordances. They are used to sort texts into multiple categories (i.e. placing one text into multiple folders, applying multiple tags to one text), and to generate text lists based on their belonging to a single category (i.e. selecting a single folder or tag, whereas tags afford to generate lists from the selection of multiple tags).

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[2] http://www.zotero.org/.

[3] http://www.mendeley.com/.

[4] Even though one could argue that the records in a reference manager are *references*, we will refer to them as *texts*, and consider that each encoded reference ultimately refers to a text (book, article, book chapter, etc.).

Nevertheless, the ways in which our informants categorize texts using folders and tags differ, both between informants and within the practices of a given informant. For example, Michel only creates folders that correspond to his research projects and classes. Patrick and Benoît's folders include all three types of categories described above (subjects, projects, and work management). Laurent creates subject-based tags, and folders for projects and work management categories. Thomas assigns subject-based tags to the notes he writes in Zotero (which are all attached to a text, and related to one of its sections), which allows him to create ties between fragments of texts he read. He also created folders for each part of his Ph.D. dissertation, as he progressed through its writing. Hence, when tags are used by our informants, their use is exclusively associated to the contents of the texts: the distinction between the texts' subjects and the categories related to the user's activity (projects and work management) corresponds to the distinction between tags as properties of texts-objects and folders containing these texts.

Additionally, we identified two other techno-semiotic affordances of folders and tags in Zotero and Mendeley that may explain their respective adoption in a given context, although we cannot fully articulate them to the observed practices of our informants yet. On the one hand, folders (not tags) in both applications afford to be organized into hierarchical levels, without these hierarchical relationships having any incidence on the categorization of the texts contained in the folders: for example, selecting a first-level folder only makes the texts contained in that folder appear in the active list, not the texts contained in the subfolders. On the other hand, in addition to being displayed in a general list of all used tags, the tags applied to a text (contrary to the folders containing them) appear and can be edited on the text's details panel (which includes a "tags" tab).

… In Order to Produce Relevant Lists. Our informants mainly categorize texts using folders or tags to be able produce a limited list of texts corresponding to a given criterion, through the selection of a folder or a tag, or by using the search function with specific keywords (Zotero and Mendeley's search index includes tags, but also all the encoded references' metadata as well as the full-text contents of the pdf files stored inside the software database and their associated notes).

The production of such a list is essentially used as a means to two different ends by our informants: (1) re-finding a specific text (generating the list is the first step of a search task, before sorting it and identifying the searched text) or (2) "seeing what one has" on a given subject, project or domain. These two uses are reminiscent of the distinction between finding and reminding introduced by Malone [13]. The second type of use actually corresponds to two distinct contexts of use in our informants practices. In some cases, the informant "reviews" the list to improve his knowledge of the literature on the selected topic, which may lead him to further search for additional bibliographic resources (outside of the reference manager) to complement his collection. In other cases, the informant generates and goes through the list as part of the writing process of a text, typically to see what research works could or should be cited in the section being written. Between these two contexts, Thomas is the only one to adopt different practices: whereas he uses tags to "review" the contents of his collection on a specific topic, he uses folders when checking what texts to cite in his writing.

5.2 The Diachronic Dimension of PIM

Incremental Constructions. Our observations of the PIM practices of scientific researchers make the temporal distribution of the cognitive activity they involve apparent [25]. One the one hand, the products of past organization practices support future organization practices. For example, Thomas explained how he broke down the work of organizing his references into folders in Zotero, by importing the contents of each subfolder of his "sources" folder (located on his hard drive) at a time, and by frequently checking the tags he assigned to the notes associated with the references he is organizing. Both the hard drive subfolders and the note tags that were created previously act as guides for the creation of new reference manager folders.

On the other hand, the organization process itself is an activity that yields benefits for the user: Laurent and Thomas justified the utility of creating folders and tags both by mentioning the possibility they created to select relevant sets of texts for their current activity (cf. supra) and by emphasizing the better knowledge of their bibliography which resulted from the act of organizing.

The Weight of History. However, the observed PIM practices do not always evolve for the better over time. Our informants' digital workspaces are cluttered with residues of past practices. For example, Laurent pointed us to a series of subject-based folders he created in Mendeley, for which he now has equivalent tags that replace them. During our second interview, Patrick found a forgotten folder named "unread pdf files" on his hard drive. In both cases, these abandoned structures are ignored by the user, and do not seem to get in the way of their current practices. Both informants claim they could delete them, or convert them into the structures they now use.

In other cases, the products of the informant's past practices hinder his current practices. When he first started using Zotero, Patrick used its import function to recover the 560 references he had encoded in a homemade database, which he previously used as a reference manager. The import process converted the hundreds of keywords he had assigned to the encoded references into tags. The automated coordination between this set of keywords, which were initially created to be used with a search engine, and the tagging function of Zotero, generated a list of hundreds of tags, most of which were assigned to only one text. Not only were these keywords useless as tags from Patrick's standpoint, but their number made any newly created tag automatically lost among them. The impossibility to delete several tags at a time, or to merge them, prevents him from using tags altogether to organize his bibliography.

6 Discussion

We study the PIM practices of scientific researchers by studying them as the coordination (or disjunction) of three types of structure: the conceptual structure of an informational activity (e.g. managing scientific references), the techno-semiotic structure of the tools (including their affordances) that support this activity, and the structure of the conceptual models of the tools held by their users (including the conceptual metaphors they involve).

As the research presented in this paper is work in progress, the first observations we presented can only be considered as the basis for hypotheses to be validated by future analyses. For instance, we observed differences in the uses of folders *vs*. tags that correspond to conceptual distinctions related to the user's activity. Our current hypothesis is that this correspondence could be best explained by differences in the user's respective conceptual models of folders and tags, not by their respective affordances: if our informants use folders and tags differently, it is because they understand them differently, not because they function differently. Indeed, when they use either folders or tags, our informants exploit the same basic affordances: multiple categorization of texts, and selection of one unique category at a time to generate a limited list of texts. By contrast, the exclusive use of tags to categorize texts by subject (not by project) could indicate a privileged correspondence between a conceptual model relying on the LABELING metaphor and a topical categorization of texts.

Our observations also define several research directions regarding the collaboration practices anchored by shared document collections.

First, the semio-cognitive conceptual framework introduced in Sect. 3 allows for a fine-grained analysis of the coordination between internal (mental) representations and external (semiotic) representations within PIM practices. Such analyses make it possible to answer the question of what is explicitly encoded in the external representations (as opposed to being located in the user's internal representations), and hence can be shared, when these representations are resources for the coordination between individuals.

Second, taking the diachronic dimension of PIM practices into account sheds light on the benefit of organization both as a process and as a product of this process. By reifying the conceptual categories of the user's activity (subjects, projects, etc.), the work of tagging items and placing them into folders affects the way the user understands these very categories, by providing them with a deeper knowledge of their collection (in our observations: their bibliography). In the context of shared collections, this finding emphasizes the necessity of making the organization process itself visible, and in particular the part of this process operated by other users of the shared collection. Making the process of organizing a collection visible would place it in the common conceptual ground [26] of the users sharing the collection, which would support the development of a shared understanding of the organization of the knowledge domain covered by the collection. This shared understanding could, in turn, support further activities, such as the collective writing of a publication or a research proposal.

Third, in terms of recommendations for the design of PIM tools, our observations on the diachronic dimension of PIM practices also highlight the issue of transitions between successively adopted PIM tools. These observations suggest the possibility of including "negotiated" import procedures into PIM tools. Such procedures would allow the user to accommodate previous organization structures with the specific affordances of the system in which they are imported.

Finally, our analyses show how our informants explore the contents of their (folder-based or tag-based) categories in the context of a variety of activities (e.g. searching, reviewing, and writing). As such, they raise the question of the desirability of seeing PIM tools generate multiple representations of the same organizations, each tailored to a specific context of use.

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