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The diary method and analysis of student's mental representations of information spaces as the research approach in information behaviour research

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Introduction. This paper focuses on a research strategy combining the concept of mental models, diary method, drawings technique and thematic analysis to study individual information spaces. The possibility of implementing such approach was tested on a case study of personal information spaces of undergraduate information management students.

Method. Methods of critical literature review and case study were used. Empirical data were gathered by means of the diary technique in its verbal, written and open form and by participant-generated drawings, and analysed with thematic analysis.

Analysis. The analysis allowed to: (1) elicit selected components of individual information spaces as represented in their mental models, such as information activities, sources, people, places, affective and socio-cultural factors, and (2) to capture the main features of mental models, i.e. themes (cross-data patterns).

Results. The pursuit of positive emotions, comfort, peace and safety is the dominant force shaping information behaviour and personalized information spaces.

Conclusions. Triangulation of concepts of mental models, diary method, drawings technique and thematic analysis proved to be a fruitful study approach, not only offering holistic insight into personal information spaces but also opening new research questions.

Introduction

The present technological development with the expansion of new forms of communication, the intensification of personalization of available applications, information systems, websites, etc. has an impact on the diverse cognitive states of people, as well as the whole human information behaviour. Functioning in a specific information environment, locating objects, proper reaction to events and situations that occur in it depend not only on the user's experience and knowledge, but also on imaginations and mental representations of the real world, that everybody creates individually in their minds. As a result, recognition and exploration of subjective mental models of individual information spaces makes an important and interesting scholarly endeavour. In the contemporary diverse, dynamic and often uncertain information ecosystem holistic research and interpretation of problems related to personalized information spaces is needed. It may encompass identification of key factors shaping such environments, emotional, motivational, socio-cultural and other ones, different interactions undertaken by individual users, as well as elements building such spaces.

On the other hand, discussion and reflection on methodology, theoretical frameworks and epistemological stances has a long tradition in information behaviour research. Concise reviews of such problems may be found, inter alia, in two well-known publications: *An introduction to metatheories, theories and models* ([Bates, 2005](#)) and *Looking for information: a survey of research on information seeking, needs, and behavior, 4th ed.* ([Case and Given, 2016](#), Parts 3 and 4).

In the outlined context, the research reported in this paper had two goals. The main one was of methodological nature. We intended to check whether four methodological and theoretical elements, that is the concept of mental models (representations), the diary method enriched by the drawings technique along with the thematic analysis, made together a fruitful research strategy to study personalized information spaces. In other words, we were interested what were scholarly advantages and methodological or executional challenges of the abovementioned combination of qualitative data and procedures. We also wanted to know if such an approach allowed capturing complicated, multi-faceted, rich nature of individual information spaces, including identification of

their components of presumably different ontological status as well as their main features or recurring motives (patterns). The possibility of implementing that strategy was tested on a case study of personal information spaces of undergraduate information management students in the academic year 2018/2019. Of course, we were not the first to employ diaries in information behaviour research or to explore broadly understood information environments. In consequence, despite the fact that our investigation has been qualitative and therefore exposing the participants feelings and views rather than the researchers' presuppositions, we used selected relevant information behaviour theories, in particular for the thematic analysis.

The second, additional goal was to discover what were the main components and features of the personalized information spaces of our participants as represented in their mental models. As for that goal, our research has not been as fully developed as it could be, mainly because of the great richness of the gathered empirical material. Therefore, it makes only an introduction to further, in-depth investigations, which would be more explanatory and interpretative. In general, in this paper we rather raise questions, in our view – the interesting ones, than give ultimate answers.

A terminological note must be added, related to an ongoing debate on meaning and relations between terms "information behaviour", "information practice", "information activity", "human beings dealing with information" and the like in information science (Hartel, 2014b; Savolainen, 2007). However, our paper is not of terminological nature, therefore such discussion is outside of the scope of this study. We use "information behaviour" as an umbrella name, embracing various information actions or activities, e.g., information avoiding, creating, monitoring, seeking, sharing, using, etc. Terms "individual information spaces", "personal information spaces" and "personalized information spaces" are used interchangeably.

Conceptual framework

In this chapter, basing on the available subject literature, we discuss the key elements of our approach, that is the concepts of information spaces and mental models, along with two methods – diaries and drawings. The thematic analysis as such is depicted in the "Analysis of empirical material" section underneath.

Information spaces

As Bawden and Robinson write, '*we must now think of information spaces (…) as comprising both physical and virtual parts, within which individual information users operate and with which they interact*' (Bawden and Robinson, 2012, 224). Generally speaking, an information space is understood here as an area with physical, temporal and virtual dimensions, embracing abstract or symbolic resources (digital or traditional), as well as information activities, agents, events, objects and processes taking place within it. It may have affective, cognitive, information-related (access, available sources, barriers, intermediaries, etc.), political, socio-cultural, technological and other aspects.

Information science has been interested in information spaces, often differently comprehended, since the early 1990's, when the idea that human information behaviour should be studied in *context* started to prevail (Courtright, 2007; Greyson, O'Brien and Shoveller, 2017, p. 150; Savolainen, 2009, p. 39). The researchers have taken various approaches and used different spatial metaphors when referring to it, including conceptual geographies (Greyson, O'Brien and Shoveller, 2017), immediate information spaces or personal information environments (Hartel and Thomson, 2011), information fields (Johnson, 2003), information grounds (Fisher and Naumer, 2006), information horizons (Sonnenwald, 2005), information use environments (Taylor, 1991), information worlds (Burnett and Jaeger, 2011), small worlds (Chatman, 1991; Savolainen, 2009), and other. In this paper we focus solely on individual or personal information spaces, not considering possible group-based or domain information spaces, e.g., as suggested by the domain-analytic approach of Hjørland and Albrechtsen (1995).

The information space has been conceptualized as a specific human environment in which various responses to external and internal stimuli occur, and where the user undertakes a variety of information actions (Burnett and Jaeger, 2011; Yu, 2011). In such a space, different cognitive processes take place, including inferencing and creating mental models, thanks to which a person "gives sense" to reality, understands the environment, reacts to it and engage in information activities. Also, there are many dynamic relationships in the information space, where the surroundings are subjected to a continuous interpretation and provoke emotional reactions, related to human information behaviour (Savolainen, 2009). Personal information spaces may be analysed from several perspectives, stemming from the existing information behaviour models and theories, and therefore allowing capturing different determinants, elements and layers of these spaces. The concepts of information grounds (Fisher and Naumer, 2006), information horizons (Sonnenwald, 1999; 2005) and small worlds (Chatman, 1991) are particularly interesting in that context, because they draw attention to, broadly understood, affective and socio-cultural dimensions of information spaces.

Social factors are fundamental to Fisher's idea of information grounds, founded on the trichotomy people-places-information. Attention is paid to physical environment fostering spontaneous and dynamic information behaviour in temporal settings, where different users are engaged by social and affective determinants in serendipitous, voluntary and impulsive information seeking, gathering, disseminating and sharing (Savolainen, 2009). Information grounds may be perceived as bridges between different social small worlds. The notion of information horizons (Sonnenwald, 1999; 2005) offers a theoretical framework of a specific human habitat in where exist selected information resources. It is possible to identify users' various interactions with their environment, communication channels and social networks, as well as to diagnose determinants affecting information behaviour (Sinn, Kim and Syn, 2019). The main assumption on which this theory is built is information behaviour in context, what contributes to the concept of individual information spaces. All information activities are implemented in social networks, where communication processes stem from familiar, learned rules and schemes, and furthermore, take place in specific situations (Tsai, 2012). Any information space consists of numerous interrelated elements, including established expectations, norms, values, roles, social networks and ties, and information culture. In addition, it often appears as a closed area of information transfer and habitual

information behaviour (Burnett and Jaeger, 2008; 2011). Also, social relations of people sharing normative rules, similar activities and creating alike information environments are important (Chatman, 1991; Savolainen, 2009). As a result, a personal information space may be understood as an "intersection" of various social (small) worlds, in which an individual participates, undertaking different information activities in accordance to the existing habits, norms and rules.

Information spaces of *students*, with focus on social networks and ties, were studied, among others, by Holman (2011), Sonnenwald and co-researchers (Sonnenwald, Wildemuth and Harmon, 2001), Tsai (2012), Sinn, Kim and Syn (2019) and Zhang (2008).

Mental models

The idea of mental models or representations is not a simple one, in opposite, it has its various cognitive, psychological and philosophical dimension (Pitt, 2012). It functions in various scholarly fields, including library and information science (Chen and Ke, 2014). But as Pisanski and Zumer observe:

> the two things one notices when researching mental models are a great variety of – sometimes mutually exclusive – definitions of the term and a great number of authors (…) discussing this phenomenon of multiple definitions (Pisanski and Zumer, 2010, p. 646).

Mental models (or mental representations), named also knowledge structures, knowledge states, cognitive structures or cognitive states (Chen and Ke, 2014), are fundamental cognitive tools and intentional carriers used to represent and respond to stimuli. They make sense of external world, surrounding reality, objects, phenomena, processes and systems (Johnson-Laird, 2010; Rieh, Yang, Yakel and Markey, 2010; Zhang, 2010). One of the cognitive mechanisms of the individual is metaphorization and constructing cognitive metaphors. In the process of reasoning, users create abstract concepts that are the result of analysis and interpretation in the mind of various specific concepts, objects. They are a pattern expressing spatial relations, rooted directly in internal patterns, on the basis of which people undertake interaction with the surrounding environment (Bergen, 2015).

Mental models are the result of cognitive mechanisms, they are a coherent and predictable combination of individual experiences, memory and knowledge. They are the basis of reasoning processes and even activators of various processes, therefore mental models are understood as organised knowledge structures and inner representations of the human coping and problem solving pattern (Rapp, 2005). Through these constructs, people undertake a variety of cognitive processes, and build mental models trying to understand the information world, establishing certain patterns of reaction to various stimuli (Savolainen, 1995). Therefore, mental models are abstract mental structure, impermanent linguistic and pictorial forms, relating to specific objects, phenomena and situations, arising in the course of imagining, metaphorization and reasoning. These are internal representations, images, phrases and sentences, through which people not only understand their world, but also give it a better sense, understand various relations and activate perceptual and motor knowledge. On these mental patterns, they shape and embed any variety of behaviours, including informational, as well as biological, cognitive, emotional and social activities. (Bergen, 2015; Chen and Ke, 2014; Kerkhofs and Haselager, 2006). At the same time, these structures are subjective and dependent of individual experience and knowledge.

Research on mental models as cognitive, iconic imitations of systems, environments or information are conducted in information science since the 1980s. The mental imaging analyses most often concerned the structure of information systems, including digital libraries (Makri, Blandford, Gow, Rimmer, Warwick and Buchanan, 2007; Rahrovani, Mirzabeigi and Abbaspour, 2017; Westbrook 2006) and information retrieval processes (Holman, 2011; Hsu 2011; Khoo and Hall, 2012; Zhang, 2008; Zhang, 2010; Zhang and Chignell, 2001). Researchers also studied mental representations of search processes in databases (Bussert, 2011; Holman, 2011), user interface design (Mohamed, Chakraborty and Dehlinger 2017; Norman, 2014), interface visualisation (Roth, 2010), information world mapping (Greyson, O'Brien, Shankar, 2019) and visualizing concepts in the mind, e.g., information (Hartel and Savolainen, 2016). Diagnosis of mental models was also associated with valuation of anomalous state of knowledge (Belkin and Kwasnik, 1986; Cole, Leide, Beheshti, Large and Brooks, 2005; Zhang, 2012).

Mental models are unique; hence their identification is complicated. It requires adequate research procedures for discovering, mapping and representing mental models, among which most often the drawings technique has appeared (Efthimiadis and Hendry, 2008; Hartel and Savolainen, 2016; Kodama, St. Jean, Subramaniam and Taylor, 2017; Zhang, 2010; Zhang, 2013). Drawings were used exclusively or combined with other techniques, like semi-structured interviews (Li, 2007; Sonnenwald, Wildemuth, and Harmon, 2001; Wilson and Given, 2014), surveys and think-aloud protocols while interacting with a system (Zhang, 2010), performing simple or complex search tasks (DeRosa 2013; Zhang, 2012) and observation (Holman, 2011). More often, however, methods such as interviews (Lewis and Contrino, 2016) or a combination of interviews and observations (Makri, Blandford, Gow, Rimmer, Warwick and Buchanan, 2007; Willson and Given, 2014) were used to characterize and categorize mental models. At the same time, many attempts to classify mental representations have been made in the information behaviour field, e.g., by Cole and co-researchers (Cole and Leide, 2003; Cole, Lin, Leide, Large and Beheshti, 2007), Hartel and Savolainen (2016), Holman (2011) and Zhang (2008).

Diaries

Diaries are narrative, respondent-generated, first-person chronological records, '*generally used to track participants' daily activities and (…) experiences*' (Smith-Sullivan, 2008, p. 213). The diary method (or technique), as Case and Given write, '*tries to use sampling of time in the lives of individuals to overcome part of artificiality problems associated with questionnaires, interviews and other retrospective methods of data collection*' (Case & Given, 2016, p. 247). It offers a multi-dimensional, participant-generated, qualitative content, frequently of private nature. Diaries as research tools have many variations. Some of

them are, to a greater or lesser extent, pre-structured, meaning that the respondents are expected to follow a given pattern of reporting, other ones are completely "open". Also, they may take different forms, such as: the literary form – purely verbal, audio journals (Agosto and Hughes-Hassell, 2005), online diaries (Pellegrino, 2014), as well as photo or video diaries (Shankar, O'Brien and Absar, 2018). In the human information behaviour area, the diary method has been used frequently, in many contexts and to investigate various information-related problems. For instance, Agosto and Hughes-Hassel (2005) employed it to study teens' information seeking, Sligo, Massey and Lewis (2005) – to discover information environments of farmers in New Zealand, Hyldegard (2006) – to obtain empirical material on individual and group-based information behaviour, Du, Liu, Zhu and Chen (2013) – to investigate marketing professionals' information behaviour in the workplace, Xie, Joo and Bennett-Kapusniak (2017) – to collect data on students' search tactics, and Shankar, O'Brien and Absar (2018) – in the context of everyday life mobile information seeking, to give but few examples. In today's information behaviour research diaries usually are not a solely data gathering technique, in opposite – they are augmented by interviews or arts-based approaches (Shankar, O'Brien and Absar, 2018).

Drawings

Gathering and analysing qualitative visual data for information behaviour research, including participant-generated drawings, belong to the area called arts-based methods or research (Cox and Benson, 2017), arts-informed studies (Hartel, 2014a), picturing research (Mitchell, Theron, Stuart, Smith and Campbell, 2011), visual approach (Hartel and Thomson, 2011), visual methodology (Hartel, 2017), visual methods (Hicks and Lloyd, 2018) or visual research (Hartel, 2014b). Visual empirical material is commonly named visual data, but also graphic elicitation (Hicks and Lloyd, 2018, p. 230), images (Hartel and Thomson, 2011), imagery (Pollak, 2017), visual representations (Hartel, 2017) or pictorial metaphors or representations (Hartel and Savolainen, 2016). Visual material may be participant-generated, researcher-generated or basing on already existing content, e.g., photos or videos shared on the social media. Visual data take forms of cartoons, collages, diagrams, drawings, films, mental maps (catching spatial conceptualizations), photography, pictures, schemes, sketches, sculpture and timelines (capturing temporal experience) (Hartel and Thomson, 2011; Hicks and Lloyd, 2018; Pollak, 2017; Zhang, 2008). Among these, as already mentioned, drawings in particular are perceived as an effective technique to elicit information users' mental models (Kodama, St. Jean, Subramaniam and Taylor, 2017). Extensive use of drawings or draw-and-write technique to study information behaviour and related issues is seen particularly in works of Hartel and co-researchers (Hartel 2014a; 2014b; Hartel and Savolainen, 2017). This author also relates visual research to the concept of information horizon (Hartel, 2017). Another arts-based method employed to obtain empirical material on users' individual social information worlds is information worlds mapping, a draw-and-talk technique, as described in (Greyson, O'Brien, Shoveller, 2017) and (Greyson, O'Brien and Shankar, 2019). As for qualitative analysis of visual data, within human information behaviour field there exist at least six approaches: compositional interpretation, constructivist grounded theory analysis, conceptual analysis, pictorial metaphor analysis, thematic analysis and visual discourse analysis (Hartel, 2014b; Hartel and Savolainen, 2016; Hicks, 2018; Greyson, O'Brien and Shankar, 2019). The literature reviews of visual approaches in general, in library and information science and in information behaviour research in particular are included, inter alia, in (Hartel and Thomson, 2011), (Pollak, 2017) and (Hicks and Lloyd, 2018).

Research approach and methods

Our research has been multi-method and qualitative. We employed methods of critical literature review (Cisek, 2009) and case study (Blatter, 2008). The empirical data were gathered by means of the diary technique in its verbal, written and open form as well as by the participant-generated drawings, and analysed with thematic analysis. We adopted a realist epistemological stance, meaning that the content of diaries and drawings was '*seen in a realist (…) manner that embraced their surface reality, rather than their socially constructed, latent or metaphorical meanings*' (Hartel, 2014b).

Empirical data collection

We used a case study approach and a convenience sample. The first-year full-time undergraduate students of information management at the Institute of Information Studies of the Jagiellonian University in Krakow formed a group of our research participants. Most of them were about twenty years old. The students were informed about our intent to use both forms of collected data, that is the anonymised diaries and drawings for the research on individual information spaces. None of them objected to the study.

The empirical data collection took place between October 2018 and mid-January 2019 and had two stages, within which two different data gathering techniques were employed. First, in October 2018, at the beginning of the information behaviour course and without any prior theoretical introduction, students were asked to draw on a piece of paper their own, personalized information spaces. The task was anonymous, non-mandatory and spontaneous, but limited to 30 minutes. The way of presenting individual information environments was also not imposed, participants were free to use pictures, text or to mix both, as several students reported lack of drawing skills. Thus, during the class, 63 students created (participant-generated) visual representations of their individual information spaces, covering also the crucial or relevant components of those spaces.

Secondly, between mid-December 2018 and mid-January 2019 students were requested to provide verbal diaries on their information behaviour in everyday life, covering 7 full days, and to write about all observed and recognised personal information activities. Also, they were asked to consider various factors affecting information spaces, e.g., the cognitive, emotional and social components shaping those environments. That task was compulsory and carried out at the end of the course on information behaviour, when most of the concepts and theoretical frameworks were already discussed during our classes. Nevertheless, the primary goal of that assignment was not to check the students' newly acquired knowledge, but to inspire them to analyse their own information behaviour, spaces, their components and interrelations in more systematic manner. We intended to engage

students in conducting their own "research": observation of information behaviour in context, collecting experiences and keeping written notes. In addition, we decided to employ an open form of diary to capture the participants' own voices rather than the researchers' presumption, what is characteristic to the qualitative approach. The respondents were given full autonomy in executing the task, no software or pattern were suggested, because the freely chosen schema of diary might itself indicate a type of mental representation. Thus, the fact that the diaries were created along with their personal, information-related content and forms were important, rather than the professional knowledge or terminology implemented in them. As a result, the following qualitative analysis did not concern achieving learning outcomes of the course or its evaluation, but the mental models of individual information spaces.

Eventually, we obtained 131 items, including 63 pictorial representations of information spaces and 68 personal diaries. The verbal content of all but one of the collected items has been in Polish, because it is the language of our study participants (with just one exception). The drawings were anonymous from the beginning, the diaries have been anonymized for the purpose of this research, and both were given consecutive numbers. Such gathered material was subsequently examined by means of thematic analysis (see below for details). Of course, our empirical material, as any participant generated qualitative data, has its limitations and associated methodological problems. There is always a possibility of "cheating" and manipulation, presenting themselves by participants in unreal contexts, changing their images, etc. Nevertheless, we have assumed that the students had not deceived deliberately or "invented" individual information spaces and their components as well as personal information activities. The non-restrictive and open design of both tasks, as described above, prevented a formal pressure and allowed the participants to freely express their feelings and thoughts about information behaviour and its context. What is more, the respondents did not have any copies of their drawings and could not use them for preparation of diaries. The reliability of the two sets of empirical data (drawings and diaries) has been also confirmed by the final research results, as the thematic analysis indicated many similarities in both the drawn and verbally described information spaces, despite the distance in time of creation of their visual and textual representations. A triangulation of qualitative data gathering techniques supports reliability and validity of the empirical material (Rothbauer, 2008).

Analysis of empirical material

The collected diaries and pictures have made a great set of rich, multifaceted empirical material, that may be analysed and interpreted in different ways and, as a result, answer various research questions. Nonetheless, as previously stated, in this paper we concentrate on mental models of individual information spaces, elicited from the participant-generated diaries and drawings. However, we additionally examined the obtained pictorial material in the light of existing categorizations of mental models elaborated within the information behaviour area, including those by Cole et al. (2007), Engelhardt (2002), Hartel and Savolainen (2016), and Zhang (2008), but the results of that analysis are presented in our other paper (Cisek and Krakowska, in press).

To capture mental models of individual information spaces, in particular their components and common patterns across the data, we conducted thematic analysis of the gathered qualitative, verbal and visual material. We decided to employ that technique because of two reasons. First, thematic analysis is a flexible procedure, applicable within various metatheoretical frames or epistemological positions (Braun and Clarke, 2006, p. 76). Secondly, it has already been successfully used in contemporary information behaviour research, for example in (Hartel, 2014b).

Thematic analysis as such is not, as Braun and co-authors write, '*a single qualitative analytic approach. It is better understood as an umbrella term, designating sometimes quite different approaches aimed at identifying patterns ("themes") across qualitative datasets*' (Braun, Clarke, Hayfield and Terry, 2019, p. 844). There are three major types of thematic analysis: codebook, coding reliability and reflexive. The main difference between them lies in how a theme is understood, how the coding process is conducted and in a priori or a posteriori nature of the resulting themes. In the reflexive thematic analysis, as Braun et al. emphasize:

> themes are conceptualized as meaning-based patterns, evident in explicit (semantic) or conceptual (latent) ways, and as the output of coding – themes result from considerable analytic work on the part of the researcher to explore and develop an understanding of patterned meaning across the dataset. Coding is an organic and open iterative process; it is not "fixed" at the start of the process (e.g., through the use of a codebook or coding frame) (Braun, Clarke, Hayfield and Terry, 2019, p. 848).

We chose the reflexive type of thematic analysis because of its flexibility, non-idiographic approach and "pure" qualitative nature, which meant that both data collection and analysis were underpinned by the qualitative paradigm. Such kind of thematic analysis consists of the following phases: familiarization with the data; generating codes – inductively, deductively (theoretically) or by combination of both strategies; constructing themes (eliciting patterns across the data set); revising and defining themes; and producing the report (Braun and Clarke, 2006; Braun, Clarke, Hayfield and Terry, 2019). In our research, we applied a mixture of inductive and deductive approaches. Therefore, coding was based not only on the collected verbal and visual data as such but also on the existing theoretical achievements from the information behaviour field. Among those were, already mentioned (see chapter "Information spaces" above), concepts of information grounds, in particular the trichotomy people-places-information (Fisher and Naumer, 2006), information horizons (Sonnenwald, 1999; 2005) and small worlds (Chatman, 1991; Savolainen, 2009), which we employed to identify components and features of the participants' information spaces as represented in their mental models. As for categories of information activities (types of information behaviour), we used the works of Godbold (2006) and Savolainen (2016). As a result, our codes concerned the following dimensions of personal information spaces: information activities, information sources, people, places, as well as affective and socio-cultural factors, including emotions, norms, values and social ties. But it has to be underlined, that the abovementioned theories made only a loose framework for our coding, a conceptual inspiration, and not the pre-defined themes. In addition, some students in their diaries provided themselves a kind of participant-generated coding, e.g., by bolding or colouring selected fragments of their texts. We took those ideas into account in our analysis,

as well as the participants' own wordings of components of their information spaces, in particular the names of the experienced feelings.

Results and discussion

Among the 63 drawings collected, 9 are pure graphic items, 21 – prevailing text – verbal mental maps, and 33 – mixed text and graphic representations. In addition, within all the pictures there are 10 mostly abstract representations, such as a futuristic head resembling a spaceship, a café or an idyllic landscape. The diaries have also occurred to be diverse. Some are highly organized, give dates and even hours of particular information actions (e.g., diaries 2 and 57), accompanying emotion are graphically emphasized by different colours (e.g., diaries 12 and 19), or even use Excel or Word tables to precisely separate different components of their information spaces – time, places, information activities, information barriers, as well as affective and cognitive reactions (e.g., diaries 16, 28, 29, 66); other resemble unstructured streams of consciousness (e.g., diaries 1, 24, 62). Also, most of the participants have been very open in their diaries. They frequently gave many details of their private lives, revealed deep emotions, including the negative ones (e.g., diary 30), described social relations (all diaries), health and beauty treatments (e.g., diaries 4, 27 and 36), eating and shopping habits (e.g., diaries 5, 6 and 21), and even own political views and religious attitudes (e.g., diaries 10, 17 and 23). Roughly in a two third of diaries influence of the learnt information behaviour models and theories seem obvious. They include a kind of a proto-scholarly reflection on own information activities and spaces, like in diaries number 8, 43, 64 and 66, which authors have explicitly used professional terminology and written about directed information seeking, information avoiding, monitoring, noise, processing, routine, sharing, sense making, and the like.

During the processes of familiarization with the content of diaries and drawings, generating codes and their revising and grouping it became clear that the same basic elements as well as common patterns appear in both sets of our empirical material, although sometimes with different frequency, deepness and intensity.

In perspective of the information dimension of individual information spaces, the students identified in their own behaviour, in many cases explicitly and quite meticulously, all possible information activities as mentioned in Godbold (2006) and Savolainen (2016). Among these have been information creation, directed or undirected, active or passive modes of information gathering (active searching and seeking, browsing and scanning, glimpsing, incidental acquisition of information, passive monitoring, routine information gathering), information evaluation, exchange, giving, sharing and transfer, information filtering or selection, processing and use for private, study and job purposes. Also, other activities, like berrypicking, information avoiding, disbelieving and ignoring, sense-making, taking mental notes and personal information management have been named. Information sources and their content, what is not surprising, are addressed in each diary and drawing, including both documentary and human, online and traditional resources of different kind. Interestingly, the students still use "old" media, i.e. radio and television news programmes and even printed books and magazines. However, detailed analysis of information sources used by the students is beyond the scope of this paper, despite the fact that the gathered empirical material offers such a possibility. That we leave for our future research.

The places category, elicited from the diaries, comprises both real and virtual elements and locales. In the first group there have been the students' own, their family members' and friends' homes, university settings, including libraries, shops, galleries and malls, sports and cultural facilities, cafes, pubs and restaurants, streets and means of transport, health centres and hospitals. The second group embraces, inter alia, social media (Facebook, Instagram, Pinterest, YouTube, Twitter), specialized discussion fora and websites (e.g., Filmweb.pl, Jakdojade.pl) and the university online management and learning systems. In the drawings we also noticed references to landscape, architecture and nature (mountains, pond, parks, forest, and even the beach), to home (family, house architecture, idyllic image of the house, rooms), and to specific names of places (e.g., United States of America, Krakow or Bieszczady).

Regarding people playing various roles in the individual information spaces, our participants referred in the first place to members of their families (parents, siblings, grandparents, aunts and uncles, cousins, nieces and nephews), partners, as well as to friends and acquaintances, colleague students and roommates. Other humans, e.g., bus and taxi drivers, co-workers, beauty, fitness and health professionals (dentists, hairdressers, nurses, physicians, trainers), neighbours, random people met on the street, in trams, etc., shop-assistants, the university faculty and vets were also mentioned. In addition, what is especially visible in the drawings, the participants frequently referred to "I", the first person singular, often figured as an individual and lonely being located in the centre of an information space.

In addition, and quite surprisingly, the participants referred also to animals both in the diaries and drawings. In other words, their mental representations of personal information spaces embrace cats, dogs, horses and even gecko (diary 47), with whom they build strong emotional relationships. Taking care of animals trigger various information activities.

Numerous elements related to affective and social factors, as suggested by the theories of information grounds, information horizons and small worlds, have been easily seen in the gathered verbal and visual empirical data. Among reported emotions, feelings, psychophysical states and thoughts shaping the mental models both positive and negative ones occurred, including amazement, attention, care, curiosity, enthusiasm, euphoria, happiness, hope, interest, pleasure, pride in a job well done, relief, reflection, relaxation, satisfaction, but also – aggression, anger, annoyance, anxiety, boredom, dissatisfaction, distraction, embarrassment, fatigue, fear of failure, grief, helplessness, melancholy, outrage, panic, shock and uncertainty. Striving for emotional well-being, identified with a sense of comfort, happiness, joy and love has been manifested by almost all the students. The avoidance of negative emotions, as well as absence of fear and aggression, further characterizes information behaviour and relations within the personalized information spaces.

As for the socio-cultural dimension of personal information spaces, the students referred to social norms as well as important beliefs and values held by them, influencing information behaviour and shaping information environments. Standards and values such as beauty, decisiveness, entrepreneurship, family, freedom, friendship, honesty, independence, religious guidelines, self-reliance, sense of life, sense of security, support, understanding were explicitly named or implicitly suggested.

Generally speaking, the identified components of mental models of personal information spaces listed above, might – to some extent – had been expected. Many of them appeared in previous information behaviour research, e.g., cited in this paper works of Fisher and Naumer (2006), Savolainen (2009; 2016), Sinn, Kim and Syn (2019), Tsai (2012), Zhang (2012) and many more. What occurred new to us was, firstly, that the students, young people, still quite frequently have used traditional media in their everyday life. Secondly, most participants demonstrated really strong ties with their family members, correlating them with undertaken various affective, cognitive and information activities, and as a result making them a central category of people in individual information spaces. Thirdly, the appearance and role of animals.

On the basis of the identified components and relations, their categorization and summarization, we finally elicited several themes, reflecting the main features of the students' mental models of their personal information spaces. These themes should be treated as tentative at the present phase of our research. The central organizing concept or the main theme occurred to be the pursuit of positive emotions, comfort, peace, safety as the dominant force shaping information behaviour and personalized information spaces. That means that other components of information spaces – people, places, information activities and sources, social networks and relations, and their mutual connections are determined by this pursuit. The three sub-themes reflect the ways to achieve that affective well-being, and are as follows:

- functioning within "comfort zones" – small worlds and repeated information grounds (places),
- intense, positive relations with family and friends (and even animals),
- a full spectrum of types of information behaviour, but within the limited range of information sources and social networks, mainly the popular social media and close people.

The last theme suggests living within filter or epistemic bubbles (Cisek and Krakowska, 2018; Nguyen, 2018), what merits further research.

Conclusions and remarks for future research

Our research showed that combination of the concept of mental models, the diary method, drawings technique and thematic analysis offers a promising research strategy to investigate individual information spaces. It allows not only to identify various components, often of different ontological status of personalized information spaces, but also to make some middle-range generalizations, i.e. to capture the cross-data patterns or themes.

Obtaining accurate and reliable qualitative data on individual information spaces may be challenging. As previously stated, participant-generated graphic representations are frequently considered to be an effective tool to elicit mental models, to uncover their elements and relations between them, especially in the metaphorical spatial perspective. But the drawings technique, despite bringing interesting pictorial representations of mental models, produces very specific research data, often incomplete and too generalizing. Therefore, it requires clarification through use of additional methods to explore factors and processes shaping the users' imaginations of their individual information spaces. In the existing literature visual methods are frequently combined with interviews, like in the well-known Sonnenwald's information horizon interview (Sonnenwald, Wildemuth and Harmon, 2001; Hartel, 2017) or in the information world mapping approach (Greyson, O'Brien, Shoveller, 2017). As it occurred, open diaries enable the same and more, by giving deep insight into people's emotions, motivations, values, ways of thinking, as well as the temporal dimension of personal information spaces. In this paper we did not discuss the last issue, leaving it for our future research, but the collected verbal empirical data certainly allow for such an endeavour. Triangulation of two data gathering techniques helped not only to capture similarities and thus mutually check the results, but also to get more holistic picture of individual information spaces as represented in mental models, because, simply, some aspects of these spaces are easier to be drawn, other – to be described in written text.

As it occurred, diaries and drawings in the forms used in our research contributed to involvement and "openness" of most of our study participants, and therefore brought rich and valuable empirical material. They are low-barrier methods, having potential to avoid problems of face-to-face interviews, connected with making conversation, expressing oneself and articulating uneasy, often intimate, and highly emotional content. Diaries and drawings expose individual perspectives of users, "give voice" to them. They are also creative, inspire study participants to observe and think of individual information behaviour and spaces, their components and determinants, and thus provoke and emphasize deeper insight into own mental models. As a result, users are able to report more precisely and reliably their cognitive representations for a study purpose. Diaries and drawings are also accessible, they do not require any sophisticated software or technology, flexible and applicable within different groups of users.

Thematic analysis of qualitative verbal and visual data, gathered by means of diaries and drawings, has also it challenges. Among them are labour-intensiveness and time-consuming as well as need for an open mind and creativity from a researcher on the one hand, and scrupulousness, thoroughness on the other. Also, and most importantly, it is ambiguous and gives many potential options of analysis and interpretation.

Furthermore, the presented approach evokes additional, interesting research problems. One of them is connected with developing more elaborate, empirically based definition of the concept of individual information space. Another question concerns the relation between cognitive representations, i.e. mental models and "real" personal information spaces. Mental models are involved in generation of affects and reasoning processes, which in turn shape information behaviour and other components of information

spaces, but how exactly they "do" this? Would it be possible to capture precisely the steps of this process? Also, do personal information spaces exist objectively and the users' particular mental models are just better or worse in capturing them, i.e. people have more or less "correct" mental representations of their information environments? Or maybe any individual information space exists subjectively, meaning it just is as perceived by a given user. Then there are not "inaccurate" metal models. These issues may seem naïve, but in fact they are fundamental, and directly connected with the ongoing debate on philosophical positions underpinning the information science research, i.e. realism, (social) constructivism, critical theory, and other (Bawden and Robinson, 2012, p. 39-41; Talja, Tuominen and Savolainen, 2005). Additional research problem, that seems to be very interesting, is the relation between the concepts of personal information spaces, mental models and filter or epistemic bubbles. Presumably they are strongly interconnected and shaping each other.

As for our second, additional research goal, related to the case study of the students' individual information spaces as represented in their mental models, the results are only tentative and make a first step for following, more explanatory and in-depth research. Our primary goal in this paper has been meta-methodological, intended rather to check the procedure than to make genuine discoveries. We concentrated here on selected components, relations and main features of these spaces. Nonetheless, the gathered data allow for further investigations concerning other, not examined here, elements of personal information spaces, including information barriers and needs, the already mentioned time component, as well as the determinants influencing the participants' thinking of their information environment, such as hobbies, interests, part-time jobs and, of course, their information management studies. Furthermore, some components already discussed may be seen from different perspectives, e.g., the gathered material most probably enables constructing a detailed, empirically based typology of information activities undertaken within personal information spaces as well as information sources and modes of their evaluation and use.

To sum up, mental models defined as imitations of the external world, constructed by humans during their thinking processes along with affective content and transformation of the perceived reality, despite of their impermanence and limitation, could be the basis for the anticipation of stimuli, events, and information activities. Relevantly, they may reflect the important for an individual user ways of raising awareness and expressing the essence of problems and existing correlations. Therefore, they contribute to obtaining a valuable research material and can be used to analyse human information behaviour.

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