Task-based Information Searching: Research Methods

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Abstract

It is widely agreed that searching is a part of a larger task performance, and searching should be studied in this context. To be able to reveal the process nature of searching, the task-based approach can be used. This entry discusses task-based approach and its use as a framework for field studies, discusses relevant task features and presents some of the typical methods for studying task-based information interaction in real-world context.

Introduction

This entry provides an overview for studying task-based information searching in the real world context. In order to understand which methods to use in a task-based field study, one has to consider several aspects of the complex task-based setting. Since so little is known about the relations of searching and the underlying tasks, the study of information-intensive task performance requires research methods that are mostly exploratory and descriptive real-world studies. This allows reporting actual behavior with the contextual aspect. By using the task-based approach, the actions of the searcher with both the cognitive and affective aspects can be studied.
People search for information in order to better accomplish tasks at hand (1). Task trigger information needs (2), or anomalous state of knowledge (3), that lead to various information interactions, including searching. Task-based information searching entails a task that is conducted. When people perform information-intensive tasks they tend to use the whole information environment available, including various types of information, search tools and data repositories. During task performance processes people use several tools in an integrated way to access various types of information. Typically, information-searching studies view at a small piece of the process at time or use only one search tool in a test situation, which lead to narrow understanding of the holistic process of searching. By using too narrow research setting it is not possible to study the heterogeneous nature of the information source use or the task-related characteristics that affect the search situation. This complexity and the process nature of searching necessitate task-based fieldwork studies in real-life context.

Task-based information searching is a complex phenomenon influenced by contextual characteristics, searcher's personal traits and the prevailing information environment (1). Contextual characteristics include the organization, its culture, and its information environment; the task performer’s traits searcher's previous knowledge, experience with similar tasks. One should not forget the varying tasks themselves that affect information behavior. Learning from the experiences of the searchers requires data collection based on multiple methods and triangulation of the findings because no single method is reliable and sufficient in order to study the complexity of real world searching. Further, there is not a common understanding what are the characteristics of tasks that actually affect the searching. If we understood better the tasks and their intrinsic search tasks, it would not only increase understanding of this important area but also bring more power to experimental test design or even user simulations.

This entry provides a short background, discusses tasks, task complexity and task-based approach, and lastly, gives an overview of some research methods, such as questionnaires, interviews and shadowing, which are used in fieldwork in task-based information searching.
**Background**

Nowadays information access is ubiquitous and happens continuously – inseparable from the work task in many cases. In a matter of fact, information is searched in order to fulfill an information need, which is triggered by problems, situations and daily activities people are in (1,4-7). Information searching does not occur in a vacuum but is an inseparable part of the surrounding activities, situations and contexts (8). The situations people are in may call just some very timely information – such as a bus schedule – or aimlessly passing time, or they may require learning of new skills and knowledge creation in order to accomplish a larger goal. One way to frame the situations for research purposes is to use the task-based approach. Instead of looking at search tasks – querying one information system – task-based approach to information searching is taking the underlying larger task as a starting point to examine the information searching. During the task performance people may need some additional information that cannot be remembered or created with the existing knowledge. This need, which is also called anomalous state of knowledge, ASK (9), prompts information seeking. This might include asking a colleague, checking one’s own notes or searching an information repository.

Since the information searching occurs during a task, the searching should be studied, and evaluated, in relation to the task performance process (7,10,11). The focus is on the information interaction that happens during that process. A related term, information retrieval, has been defined as the study of how the system replies to a request, or as how humans interact with a system. The task-based approach adopts the latter view, but in a larger context. There has been a turn in information interaction studies from a search task setting into a wider perspective, taking the whole work task as a context of searching. In studying the searching in the context of a task, task-based information searching takes a cognitive viewpoint on information retrieval and human information activities (1). This viewpoint entails the idea that personal information needs should be treated as potentially dynamic contrary to the static view in traditional information retrieval research.
Searching, even when studied during work task performance, is tightly coupled with the use of information systems, or search tools. These tools are used in order to get to the contents, not just to interact with the system interface. Information searching entails the whole cycle from the searcher’s cognitive state to the representation of the information itself. While much is known about how systems work in retrieving documents, there is lack of knowledge on the user side and of how searching relates to task performance, how people use the information tools available to them and where the tools fail to meet their needs (12,13). Understanding and exploiting contextual information may transform how people perform information discovery, analysis and synthesis tasks (1). In order to build better tools, our understanding about searchers, underlying information environments and tasks and their interrelations is crucial. In case of studying interactive information systems, in order to know the “goodness” of a system, their ability to advance the underlying task should be tested (10).

Information searching has been both studied with experimental settings in laboratory conditions and as natural settings in the real world. These branches of research differ from their research goals and methods. Both are needed and the first approach seems more common at this point of time (11). Although these branches have different goals, there are some connections in between: real world studies may reveal something that can be further tested in laboratory conditions. In order to test something relevant, one should know first what to test. This knowledge is gathered by fieldwork in real life situations and exploratory and descriptive studies of this kind may inform hypothesis formation to be further tested in controlled experimental settings.

Experimental settings usually entail researcher involvement and controlled environments, and report quantitative results. Some of these elements may be included in field studies as well, but usually fieldwork occurs in natural environments without any excessive researcher involvement. Moreover, usually in experimental interactive information retrieval and search studies tasks are seen as a vehicle for research (14), whereas in fieldwork tasks are regarded as inherent part of human daily performance. In controlled settings it is very demanding to create long lasting task processes with assigned tasks and therefore experimental studies commonly use more limited search tasks.
Fieldwork studies are intended to observe how real people search in order to complete real tasks. However, experimental studies in information searching are intended to study particular effects of the selected variables on human or system behaviors. This requires control over the situation. In experimental research designs assigned tasks help with controlling the setting. Assigned tasks are hard to design and they may lack contextual features or personal aspects such as motivational or affective triggers that in real world are present in search processes. Borlund (15) and Wildemuth and Freund (16) provide recommendations on how to design assigned tasks. Despite the challenges in designing tasks, there are experimental studies that have incorporated exquisitely real world features (17,18). In these studies assigned tasks are designed to reflect real world situations.

The present entry focuses on fieldwork methods. The aims of fieldwork lie on understanding how people behave with the tools they are used to work with, and during the tasks they are doing. Nevertheless, for those more interested in experimental settings, Kelly (14) provides a broad overview on how to study interactive information retrieval and evaluate systems with users, Kelly and Sugimoto (19) a recent review on interactive evaluation research and Wildemuth, Freund and Toms (20) a review on assigned task difficulty and complexity in experimental settings.

**Tasks in task-based information searching**

A task is an activity to be performed in order to accomplish a goal (6). Task-based information searching is interested in the information interaction related to the task performance. A task at hand may be either a leisure or work-related task. It is seen as a triggering force behind the information needs (21), or anomalous state of knowledge (ASK) (9), possibly leading to information searching. According to Järvelin and others (11) it is a part of a larger task performance process, which can be cut down into activities searching being one of them. Searching is one small part of the larger task, among other activities that are all aiming at task fulfillment (11,22).
Task granularity

Human task performance and searching may be examined in different context and on different levels of abstraction (1). Tasks are interpreted at multiple levels of granularity and this is related to one’s understanding about the task (22). Task doer needs to understand the preconditions and goals for performance. As her understanding about the task increases, and if the focus is formulated, she is more capable of decomposing the task into smaller pieces. These pieces are conceptualized as stages (23,24), during which the cognitive and affective states evolve, or as successive sub-tasks or actions (11), which advance the fulfillment of the task.

Byström and Hansen (22) look at the task granularity as a hierarchical structure, where information-seeking tasks are part of a larger (work) task, and search tasks are part of an information-seeking task. They also discuss information use as an essential part of a larger task and as a contributing factor in task accomplishment. Järvelin and others (11) decompose a (learning) task into five cognitive and behavioral activities, which are task planning, searching information items, selecting between them, working with them, and synthesizing and reporting.

Similarly to Byströms and Hansen’s levels in their task hierarchy, Kekäläinen and Järvelin (25) present a nested model of context to evaluate information searching (1,25). They separated socio-cultural, organizational, the work task, the information-seeking task and the information retrieval levels. Tasks may be analyzed on these levels as task descriptions or goals. All these levels are present in a task performance process and the phenomena during task performance may belong to varying contextual levels (26). The contextual levels also outline the methods and the participants in the study to some extent. On the socio-organizational level, research interest may lie on decomposing networked phenomena and identifying its actors (27,28). On the organizational level, one may be interested in task flows in the organization and of division of labor etc. (29), or studying on the high-level task context in collaborative information searching during teamwork (30,31). This entry, however takes the view of studying one individual at time, but similar settings may also be applicable to groups of people.
Typically studies on information searching take the search task level as a starting point. However, in real-world the goals and constraints of the tasks are derived from higher-level tasks (1,24,32). Taking the higher-level context into account, the missing links between larger tasks and search tasks may be found. The larger, motivating task is binding the sub-actions together, which might seem atomistic if separated from each other. If just the single search task is taken as a starting point, one system setting might seem reasonable. However, if the scope is broadened towards a larger task, one may have to accept the whole information environment composed of multiple types of information systems providing heterogeneous data or information, such as audio, pictorial, numerical or text data. The actual information is created during the process, collected piece by piece from various sources and finally interpreted and used in knowledge creation (33). The task has several features additional to the granularity one being the task complexity, which is discussed next.

**Task complexity**

Task complexity and difficulty are very commonly integrated in information searching research (20). Research in information searching has discussed task complexity from both objective and subjective perspectives. These two perspectives have different background. Objective task complexity supposes "an objective task external to and independent on task performers" (34). In the objective task complexity, the structure of the task and aspects related to the task are used in assessing the task complexity. The increasing number of choices (paths) leading to the desired outcome increases task complexity. Objective task complexity is the complexity of the prescribed task seen by the person prescribing the task, and subjective task complexity is the complexity of the actual task for the task performer executing it (34).

Tasks may be difficult to perform by many factors; e.g., there might be too many alternatives to consider, imprecise or missing raw data, a great deal of irrelevant information, lack of ideas, or insufficient methods (1,35). This characterization, which considers the features of the task, treats complexity as a function of objective task characteristics (36).

Further, Cambell (36) and Liu and Li (34) consider task complexity as composed of number of subtasks. Albertson and Meadows (37) use similar construction: complex search tasks contain multiple subtopics.
Objective task complexity may be defined also as the number of steps required in order to reach the completion. Li and Belkin’s (38) comprehensive task categorisation uses both objective and subjective characteristics. It is based on earlier categorisations in information research literature and includes a number of dimensions, which may be divided into objective and subjective parts. Objectivity here means the number of paths between which the task performer has to choose during the task. The subjective aspect in the categorisation is called difficulty.

An example of more subjective approach is a priori task complexity. Byström and Järvelin’s (39) approach to task complexity is an intersection between the task and actor characteristics: It evaluates task complexity on the basis of the actor’s a priori understanding about the features of tasks – namely, the information needed, the process, and the outcome. If all the aspects are known the task is routine and if none, the task is considered as complex (39,40). There are different levels in between. In complex tasks, the actor lacks a mental model sufficient for enabling him or her to assess what needs to be done. The a priori task complexity has been used in field studies, because it does not require subject expertise. In a priori task complexity, the task performer’s previous knowledge on similar tasks affects the complexity assessment, because the more experience the person has with similar tasks, the more focused the conceptual structure of the task (41). Byström and Järvelin’s (39) a priori task complexity has been applied also to some extent by Bell and Ruthven (42), Kumpulainen (40,43) and Kumpulainen & Järvelin (26,33).

Both objective and subjective views on task complexity may be employed in fieldwork. However, if a person does not know what the outcome is or cannot describe the possible paths, it is very hard to count or consider the different aspects or the paths to the completion. In fieldwork, the task complexity can be assessed only after the task performance, when all the queries and needed steps or subtasks are already conducted.

However, researcher cannot be sure during fieldwork that the participant is actually going to end the task during the research time period. Therefore, the a priori task complexity may more useful in real life studies. This way a task complexity assessment can be collected for all task performance sequences even if the task processes do not reach the completion. One should keep in mind that natural research settings include always
some compromises and instability. Therefore, because of the (possibly) uncompleted and incomplete tasks, it is hard to compare different task performance sessions with another ones, if one uses the objective complexity and the numbers of subtask constructs, or the total number of paths, are needed.

Whether the task is self-formulated or assigned, it is the perceived task that is performed after all. The perceived task is the task performer’s current understanding about the task goals and the suitable path(s) leading to that goal. This means, that people who have the same assigned task, treat it according to their understanding. This perception may change during the task performance due to learning about the task itself. Perception of the task and possible solutions are evolving and getting clearer towards the end of the process. One critical point is the focus formulation phase, during which the actor creates a clear understanding what the task is about (23,41). Focus formulation allows the searcher to make pertinent judgments about the retrieved items. Without this formulation, a task can be performed, but the outcome might not be good (44).

The Process nature of searching

Task performance and searching are evolving, iterative processes. According to Toms (32), the process of achieving the task outcome determines the success in task performance. Therefore, tasks and search tasks internal to them should be studied as processes. The processes may be decomposed into smaller events. There are models that look task performance in stages (23,24), and models that decompose tasks into sub-tasks, which are performed as series of actions (11,43,45,46).

One of the early stage models was the Kuhlthau’s ISP model (23). The ISP model consists of six stages, during which the information search process evolves and the searcher formulates a focused understanding about the topic. According to the model, this point is critical since the focus formulation enables the searcher to assess the relevance of information items. Kuhlthau’s model examines the searching process at levels of physical actions, cognitive and affective aspect, and it was developed to inform librarians. Vakkari’s (24) task-based information search model was based on the ISP and it consisted of three stages. Both models used stages, and the searcher moved from a stage to another in the course of searching. Models in information
searching research that decompose task processes into sub-tasks are not very common. A very recent model of Järvelin and colleagues (11) decomposes a learning task into five subtasks, and discusses program theories (47) of these sub-tasks as a tool for information retrieval evaluation.

The berry-picking model by Bates was one of the first models that described searching and exploration task performance as a process (48). It was developed in an OPAC (online public access catalog) environment, which included references to full texts. Bates’ berry-picking model is based on the idea that pieces of information are collected from separate documents or information objects during the search, and the understanding about the task was created during the berry-picking episodes. This is a natural way humans explore their information environments, and this applies also to web environment.

The study of task-based searching as a process entails that the sub-tasks, the search stage or phase should be taken into account. The process of searching affects the searchers understanding about the task itself, the perceived utility of information and what will be the next step in the process. Together with the procedural approach, task features such as complexity and granularity are worth consideration in research setting. Due to their complexity, these task-related phenomena often require multi-method research. In the next section, we discuss some of the methods that may be used in task-based field studies.

**Studying task-based information searching in the field**

Due to the complexities of studying information searching during tasks in their context, it requires multiple and often tedious means of data collection. The traditional means of data collection for studying human actions include questionnaires, interviews, diaries, and observation (1). The quality of results obtained from field research depends greatly on the data gathered in the field.

There are some field studies that relate searching to larger tasks. Typically, the type of task-based research uses multiple methods. To review a few, Byström and Järvelin (39) studied information seeking related to tasks in municipal administration through diaries and questionnaires. Saastamoinen and others (49) revisited this study and studied how task complexity was related to the information types in municipal administration
by using task shadowing and questionnaires. Kumpulainen and colleagues (33,40,50), Huuskonen and Vakkari (51,52), Freund and colleagues (53) and Markkula and Sormunen (54) used shadowing combined with some other method. Kumpulainen and colleagues (33,40,50) examined how query types and the use of various systems varied according to task complexity in molecular medicine. They used shadowing, interviews, logging and photographs. Huuskonen and Vakkari (51) studied by using worksite observations and interviews, how social workers record and use information in a client information system during various tasks. Freund and colleagues (53) used a multi-method approach using focus groups, interviews, shadowing and resource audits in their study on software engineers’ task-based information behavior. Markkula and Sormunen (54) used interviews and task observations to study the work processes of journalists, which included various stages and these stages shaped information access and interaction.

Attfield and Dowell also studied journalists, but they used interviews and grounded theory for analysis (55). Bartlett and Toms (56) also used interviews as a data collection method in their study of biotechnology experts work tasks and made a detailed task analysis showing each subtask in the workflow. Vakkari and Huuskonen (44) used questionnaires, search logs and expert outcome evaluations in their study, which analyzed which aspects of search process and search output were associated with the task outcome in medical students essay writing assignment.

Consequently, it seems that multiple methods are used in studying task-based information searching. In the following, we discuss the typical methods used and data triangulation, which facilitates the in-depth study of complex task performance sessions.

**Questionnaires**

Questionnaires are a very economic way to collect data and are typically used to study topics that are already known to some extend. However, like all the methods represented in the article, questionnaires can be used in different types of research settings (57). Firstly, exploratory research questionnaires benefit from open-ended questions, which allow deep understanding and some unexpected findings. Second type is descriptive survey, that may be used, e.g., in collecting opinions about some issue, and typically includes multiple
choices and predefined categories. This type is considered as conclusive due to its quantitative nature.

Thirdly, one may use questionnaires in explanatory studies in order to study the causality. In explanatory research careful preplanning of the questions is required. The aim is to explaining the cause and effect relationship between variables. Causality may be studied to reveal which variables are the cause and which are the effect and to study what is the type of the relationship between the causal variables and the effect to be predicted.

Questionnaires are usually understood as a means of quantitative research, but they can be also used as a qualitative manner with open-ended questions in an exploratory research setting. The questionnaires in information searching and seeking studies are typically circulated among some social group or staff in an organization, so everyone in the target group is included. Therefore no actual sampling method is used.

The value of collected data completely depends upon how well respondents answer on questionnaires, and on the other hand, how good the wording in the questionnaire is. Usually, an explanatory survey is based on a theory from which a hypothesis is derived and the concepts are operationalized. However, in task-based approaches one useful way is just to survey in a exploratory or descriptive manner e.g. what is the perceived information environment like, what are the populations preferences for suitable information tools and to survey what kinds of tasks they perceive doing (58,59). This kind of research is typical of task-based searching studies. There is no attempt to explore why a phenomenon occurs, but just to state that it does. This is the case if very little is known about e.g. the tools people use in their daily activities. However, since the control over how people respond to a questionnaire is low, questionnaires also benefit if used in combination with some other methods.

Nowadays questionnaire studies are typically published in web form and a link to the form is distributed via web home page or email. Via web questionnaires researchers are able to reach large groups of people quickly and simultaneously, they are easy to handle, the data are already structured and in suitable form for further analysis (e.g. a spreadsheet form). However, web questionnaires may be subject to a bias towards certain groups (active, willing to answer, tech savvy etc.) and they typically suffer from low response rates. Web
questionnaires also suffer from the same deficiencies as the paper form questionnaires: it is hard to capture the meaningful aspects of human actions, and to place the actions or phenomena that are captured in any context in which they occur – not to mention the process nature of searching. Further, questionnaires have been criticized to block creative thinking and imagination beyond the research setting (60). However, despite the criticism, open-ended qualitative style questionnaire studies are very useful in the case the researcher does not know much about the field and needs to get a quick overview of the information environment the people are engaged with and their opinions about it.

**Interviews**

Interview is one of the major approaches of data collection in qualitative research. Interviews are the best way to collect in depth data on how people understand or feel about phenomena in their everyday lives (51). It is a means to uncover their experiences and the meaning of these experiences. Interviewing is a good method of studying the “why” questions, and interviewing is focused in comparison with shadowing; one does not have to see everything. During the interview, the researcher creates a personal contact but access to the field is easier than when observing (50).

Maybe the most used type of interview in task-based studies is a semi-structured interview. In this type of interview, the interviewer has broad themes and topics, that are discussed, and the interviewer steers the situation towards the central topics. Preparation is important to be able to steer, and the interviewer should make an interview guide, which includes all the topics that should be covered. In semi-structured interviews, the interview guide keeps one on track but still allows her to collect unlimited qualitative data.

There should be a clear purpose for the interview. During the whole interview the interviewee must feel confident to talk freely. The flow of conversation should be kept going and the interviewer should listen actively and keep the questions simple. However, interviews are open to bias and problems. Opinions regarding behavior are not the same as actual behavior, and the respondents may not correctly remember the answers to questions or they might be unwilling to tell the flow of actual events. People are not good in recalling simple tasks that are executed on a routine basis, or exact protocols they follow. More precise
accounts of actual behavior are collected by observation, but interviews are very useful when collecting data about people's interpretations about their tasks (e.g. perceived difficulty) or opinions about the search tools they use.

**Critical incident technique**

The critical incident technique is a set of procedures used for collecting the observations of human activity and behaviors (61). Typically, the participants are asked recall a recent incident that has relevance to the research questions and it is used as a vehicle for interviews. The participants may answer the interview questions by reflecting their actions related to that recalled incident or demonstrate their behavior during that recent incident. This helps the participants to anchor their thoughts and behaviors to a certain incident, and may introduce some reality to basic interview settings. Critical incident technique is suitable for collecting data in the field and in more controlled environments. Critical incident technique is a very flexible method and helps to bind the findings to practical real-world tasks. In task-based information searching, the participants are asked to recall a recent task that included any information searching episodes. Then they are interviewed about the causes, descriptions and outcomes of the task. The actors’ feelings and perceptions of the situation are collected and the actions taken during the task are either interviewed or demonstrated. These scenarios can be presented as narratives, visualized in diagrams or as a causal model. Examples of use of the critical incident method are research by Zach (62), Auster and Choo (63), and Roos and others (58).

Critical incident method can be used also as a vehicle for observational research (51). The participants are asked to recall a recent situation or a task and to perform the task. Task may be observed at the participants’ work place, home or any other place or environment where the critical incident task has been previously conducted. Also, making people recall a recent task is a good way to bring naturalistic tasks into experimental settings.

This method is very flexible and suitable for studying everyday problem solving, but its challenges lie already in the remembering of the task. The tasks that are recalled tend to be rather simple, and the participants may remember the actual behaviors imprecisely and present idealized workflows. This method,
however, helps to bind the searching activities and the underlying task together and it may help in revealing the procedural nature of task performance.

**Diaries**

Diaries are a good way to collect data on participants’ recollections of transactions, such as tasks and used information systems. Usually, diaries are collected with structured forms and diaries are filled after a workday or task performance. People are asked to describe relevant actions and e.g. information sources they used during particular task performance processes. There might be questions about reflecting the events or their features, which relate to the research questions. Therefore, in addition to just collecting the events, diaries provide clues to the importance of events for the participants and their attitudes about those events. Diaries also provide data in textual form, which is easy to analyze compared with voice recordings, for instance, or video diaries. Diaries may be collected via web forms, so that makes the data even easier to handle. Diaries can be a useful strategy for data collection when periods of prolonged participant observation are not practical. This might be the case in order to have a rich source of data of reflections that communicate the stories of their daily lives.

Usually in task-based studies, diaries are used in combination with some other data collection method. Byström (39,64), Hansen (65) and Saastamoinen and colleagues (49) used diaries in their studies, and triangulated the data collection with some other type of data, such interviews and shadowing. They collected information about the participants’ reflections on the task complexity and use of various information resources, among other things. However, despite the usefulness of diaries in some occasions, participants may find filling in the diaries time consuming and cumbersome. If the diaries are not collected during observations, the researchers cannot know how long after the event the diary was actually made and, consequently, the events might be not remembered correctly. Processes may be collected with diaries, but as discussed previously, they are a means of collecting recollections. People do not describe sequences of actions precisely and sometimes they even tidy up their descriptions of performance. Instead, they tend to describe idealized procedures leaving out some workarounds or problems.
**Shadowing**

Shadowing is a qualitative method, which involves a researcher closely following people over a period of time to uncover the real-time actions performed in some context (66,67). It enables the study of information searching in context of real everyday practices and situations and reveals such barriers and routine like workflows that people are not actually aware of. Shadowing facilitates the study of complex tasks and task processes as they are and it is a very agile method. As it is known, people are not good in describing what really happens, but they describe their ideal ideas how things go. This is not necessarily what actually happened. Shadowing can be done over long periods of time, or applied more rapidly to gain a quick understanding about a problem.

Before starting the shadowing, it is important to get to know both the organizational environment, and the information environment they work with in case of studying information searching. Without knowing what the participants refer to makes it very hard to follow the flow of actions at the start of shadowing. Also, taking some time to carefully select the participants and the venue is important: participants need to take the actions that contribute to the research questions. It is of high importance to carefully select suitable participants for the study. The investigator should be aware of the current tasks the participants are going to conduct, and the shadowing sessions should be arranged so that the kinds of actions, e.g. searching, really occur during the shadowing. One practical way is just to simply ask the participants that when they have planned to do some searching, and arrive at that point of time to collect the data.

The shadowing method does not require undistorted situations. The participants certainly are aware of being shadowed and this may have an effect on their behavior and task performance. However, nearly all participants usually become comfortable with the situation after a short while. The method is about gaining an “inside view” of the research questions. Throughout the shadowing period, be it few hours or several months, the researcher asks questions, which will prompt a commentary from the participant. Some questions will be for clarification, other questions to reveal a purpose of actions. During the shadowing, the researcher will write a continuous set of field notes. Shadowing yields data that is more detailed than data gathered through many other data collection methods. Shadowing does not collect the accounts of...
participants’ opinions but observes it directly, and gives the researcher first-hand detailed data both on aspects that are habitual or mundane, and the problematic to express, which may be otherwise difficult to collect.

A task is performed in task sessions. These task sessions are observed. During a task performance session, a person is working on a particular task. There might be several ongoing tasks over time, but just one session at the time is performed. Multitasking or parallel task performance means that people switch between the tasks. An actor starts at some point, e.g. in the morning when she comes at the working place, or just stops the previous task and changes to another. There might be interruptions during the task, but the task session may continue after the break.

One important aspect in shadowing is to build trust. If the participant does not feel comfortable, critical information could be missed. The researcher must continually work on the personal relationship throughout the shadowing period. By providing information on what purposes the collected data is used and to allow participants to discuss the suitable shadowing times might help the participants to feel they have some control. The agreement that the shadowing may be stopped or paused at any time if it gets too distressing also eases the participants’ situation.

Shadowing produces a massive detailed dataset that is rich and thick in every aspect. Also, shadowing is a physically and cognitively burdening method for the researcher. It is not easy to follow people around day after day and still trying to stay focused. One of the questions that are of main importance, is to keep the research questions in mind all the time, and not “going-native” which means adopting the views and opinions of the research participants. One of the biggest challenges in shadowing is the data handling (66). The researcher should already before the fieldwork plan how to collect the data, and how to analyze it. This also brings more focus to the fieldwork. For collecting the notes a pen and a hardback notebook are the best. The data handling might be assisted by the use of smartpens or other devises. With the handwritten notes, the researcher already creates a focused view on actions, and so a part of the first round analysis is already done.
Video recordings of several hours are hardly usable, but it can be used if one needs detailed data on a short occasion.

**Transaction logs**

A transaction log is “an electronic record of interactions that have occurred between a system and users of that system” (68). There are basically two ways to collect transaction log data, namely client-side or server-side log data. Client side data collection may be more intrusive than server-side, but it is more accurate and can reveal participant’s interactions with the whole information environment via varying channels (33) while server-side logs reveal the interactions with materials on one server. Both have their advantages providing detailed data on user behavior and they allow studying the process nature of searching. However, the log data lacks depth and are ineffective as a methods of gaining an understanding of the underlying motivations, affective characteristics, cognitive factors and contextual aspects that influence task-based information searching (68). User intent analysis based solely on transaction logs has been described as guessing (69). This is because similar queries are used for quite different search goals. Even an obvious known item search (e.g., for a homepage) may in fact be an unknown fact search (for an email address). However, this method is very valuable if used in a concerted way with some other (qualitative) method, such as shadowing or questionnaires. Despite its benefits, the biggest obstacle to successfully use client-side logging is that organizations or participants may prohibit any data collection on their computers.

**Triangulation**

Triangulation means the use of two or more methods of data collection in the study of some aspect(s) of human behavior (70). In other words, it refers to a multi-method research. Although triangulation may be of combining theories, methods, datasets and investigators in the study of the same object (70), in this entry, however, the focus is on triangulating the methods. Triangulation advances the study of circumstances when a complex phenomenon requires analysis, when some controversial aspects needs studying, or when an established approach provides a limited and perhaps distorted picture and where a researcher is engaged in a case study. These all are conditions for a task-based information searching study.
Triangulation of methods raises the research above the possible biases related to the personality of the researcher that stem from a use of a single method (70). Using more than one method to examine the same research question enables the strengthening of the validity and confidence of the findings. However, sometimes research methods may show opposite or discrepant events. In this case, the researcher should interpret why this happened, and maybe use just one source of data in the analysis. However, there should be an understanding, which is the main data and use that in the interpretation of analysis. By the use of data triangulation, qualitative information can be added to flat quantitative data, such as questionnaire or log data, and more accurate quantitative data may increase the validity of the qualitative data.

Even before the data collection, the researcher should have some understanding about how the analysis will be done. After the triangulated data collection, data needs to be merged. By collecting various types of data during the information intensive tasks, researchers should find a way to ensure that they know which data is connected to which task in possibly separate datasets (e.g. time stamps and personal account on log data). In the task-based studies the point of departure for analysis is the task as a unit of analysis (64). One way to study the processes of tasks is to analyze the data as task performance sessions. A task performance session is the period of time, during which the participants are conducting a particular task; if the task is ended or changed, the session ends. This can be done by merging all data about each task performance session and then analyzed it together.

Figure 1 depicts an approach to frame a task session. It has been used in Kumpulainen’s (31) studies in task-based information searching in the biotechnology domain. In the procedure, every time a participant starts a task session, the participant is interviewed about what is the aim of the task, how well the participant is able to describe the task content, what information and which sources are to be used and with which procedures the task is to be performed. These questions aim at assessing the a priori task complexity. During the task performance, field notes and interaction logs were collected. When the participant indicates that the task session might be at the end, some questions take place that ensure the ending of the session. Participants may switch to another task, stop working, or just have a break and continue after a while.
After framing the task sessions other aspects related to research questions, such as task complexity, type or stage can be analyzed. Data may be analyzed using qualitative methods, e.g. by classifying, the grounded theory approach, content analysis, visualizations etc. or by quantifying it. One option to analyze the data is task-analysis, which is a way to do detailed task decomposition (56,71). If task-analysis is too fine graded, processes may be studied also by event analysis (72).

**Ethical concerns**

Always, when using humans in research, an informed consent is needed. The researcher needs to think about the confidentiality and protect the identity of the participants. Participants should be informed about the purpose of the investigation and the main features of the research design. There might be some confidential material that the researcher is exposed to during the research, and the ways how to address this kind of material should be agreed in advance. The researcher should cause as little harm to the participants and their organizations or social environments as possible.

**Conclusion**

Real world information searching is a combination of inquiry, discovery and serendipity. It is nonlinear and iterative and entails the use of various heterogeneous information types from wide ranges of sources. By task-based studies, we are able to more realistically describe the human behavior during a task performance process, and by this inform not only system design, but also other highly controlled research settings such as simulation studies. On the downside, field studies focus on a specific organizational setting or a specific domain, where limited number and type of tools and data are used in tasks typical to that domain. The specific findings cannot be generalized to other contexts. However, it is not yet clear how the searcher should be modeled or simulated, so there is a world still to discover. Fieldwork remains under pressure due to costs and resource demands, but it still is an invaluable way to study how things really happen.

The existing models of task-based information searching suggest that task performance and information searching are processes that should be studied longitudinally over several work task performance sessions and search sessions. The task-based research is still uncommon and there is still a need for investigating how
and what features of tasks affect the searching. Therefore, the task-based approach provides a useful framework to study complex situations during information intensive work tasks, and further, a means to reveal the procedural nature of searching.

Acknowledgements

The author wishes to thank Jaap Kamps for his comments on the manuscript. This research was supported by the Netherlands Organization for Scientific Research (NWO project # 640.005.001 - WebART).

References


ACM SIGIR conference on Research and development in information retrieval; Anonymous ; ACM: , 2012; 425-434.


List of figures:

Figure 1. Task session procedure for triangulation of interview data, transaction logs and shadowing fieldnotes.