

# Shaken, Not Steered: The Value of Shaking Up the Search Process

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## ABSTRACT

The search engines of our times have brought ubiquitous access to information into the reach of nearly everyone. A wealth of information is just one click away, and streamlined search engines have become increasingly efficient at looking up information. However, the fact that it is simple to look up information does not necessarily mean that it is easy to find the material one really needs, especially in the context of complex tasks. At the early stages of the search process a novice searcher has to create a focus in order to succeed in the task at hand, requiring deep exploration and an understanding of the involved topic. However, these novices may perform only superficial searches; worse still, they do not even realize it. Therefore, we argue that shallow information seeking needs a “shake-up”: shallow information seeking ventures should be deepened by ‘disrupting’ the search process, especially of inexperienced users. This paper discusses the potential value of shaking up the search process, and aims to stimulate discussion about the level of support a searcher needs.

## Categories and Subject Descriptors

H.3.3 [Information Search and Retrieval]: Search process; H.5.2 [User Interfaces]: User-centered design; H.1.2 [User/Machine Systems]: Human information processing

## General Terms

Design, Human Factors

## Keywords

Information seeking, search process, stages, search systems

## 1. INTRODUCTION

In our daily lives, studies and work, information acquired from the Internet plays a pivotal role. We carry out tasks, ranging from simple lookup tasks to complex and advanced tasks, by using omnipresent search engines. The more complex tasks are performed in stages in which thoughts, feelings and actions evolve. For instance, university students working on a research assignment might perform unfocused searches at the beginning of their search process, while at some point they may formulate a focus, and perform more targeted searches [17, 24]. The students’ understanding of a topic evolves from vague to clear during the task process [24].

However, the formulation of this *focus* does not always take place.

In a large-scale study in a library context, Kuhlthau [17, p.68] found that half of the observed students “did not show evidence of reaching a focused perspective on their topic at any time during their search process.” The formulation of a focus is dependent on several factors. Focus formulation can only take place if people have built up enough background knowledge on a topic [24]. The exploratory pre-focus and focus formulation stages of search are therefore essential for developing rich knowledge.

Employing interventions in the information seeking process is one way to stimulate the critical exploration and use of information in educational settings. Different types of interventions are possible, ranging from group-based (information literacy) instructional sessions to counseling at the process level of an individual. In this paper, we focus on interventions in the information seeking process of individuals. These interventions should only be done when necessary, and at the “right” moment called a “Zone of Intervention”, which is a moment of increased uncertainty [17]. We distinguish between two different aims of interventions. One aim may be to *reduce* the uncertainty of a searcher. As Kuhlthau’s model indicates, in moments of increased uncertainty and doubt, careful intervention can improve a searcher’s performance, by providing thoughtful feedback and guidance in the process. In some cases, however, a searcher may be *too* certain. In those situations, an intervention could be aimed at *increasing* uncertainty. This type of intervention is inspired by the finding that many novice searchers regard themselves as highly competent searchers, while their search strategies are poor [11]. This is only exacerbated by the fact that current search systems generally offer focused results without requiring much effort from a searcher. Hence, searchers might experience an information seeking process that is *too* straightforward, needing some “shaking up”.

This position paper takes the idea of the potentially shallow search process of particularly novice searchers as its basis, and looks at ways to “shake-up” their search process. In the following section, we discuss information seeking in the context of complex tasks. Next, we define the concept of “a searcher in need”, before elaborating on tentative ways to disrupt searchers experiencing a too limited search process, in order to improve their task outcomes.

## 2. THE EVOLVING INFORMATION SEEKING PROCESS IN COMPLEX TASKS

*Complex tasks* are tasks in which the actor lacks understanding on the information needed, the task process and of the goals of the tasks [7]. In complex task accomplishment “understanding, sense-making and problem formulation” are essential. Complex tasks require more complex types of information, involve learning and their goals and processes are vague [18]. Novices are in this paper such actors that have not conducted the same task previously and have low domain knowledge level.

Information seeking is not a one-shot querying and retrieval of satisfying results but rather an evolving process including learning. According to Toms [23] the *process* delineates the success of the outcome, and therefore research should focus on the process and the sets of human actions. Kuhlthau’s [17] Information Search Process Model (ISP) examined the process and is based on a series of field studies. The ISP model consists of six task stages. Each of these stages produces varying information needs and searching. At the start of ISP the actors’ understanding of the task is vague, their information needs are unclear, and information searching is exploratory. After finding a focus, their notion of the task becomes clearer, information needs more articulated and information searching more directed. Vakkari [24] adapted this model to study students during an essay-writing task. His model consists of *pre-focus*, *formulation* and *post-focus* phases. He found, that at the end phase *almost* all the students in his study were able to construct a focus. The successful formulation of a focus also facilitates a transition from the mere ability to identify facts to the ability to perform more abstract and deep analyses [21].

In the pre-focus phase, where exploration takes place, berry-picking information behavior occurs, which is an iterative and adaptive search process that also incorporates the idea of collecting information objects as the search progresses over time. This explorative stage is needed in order to build an understanding of the task, task domain and the task goals.

Contrary to the common point of view that information reduces uncertainty, Kuhlthau indicates that information may actually *increase* uncertainty. Uncertainty is a necessary critical element in any process of knowledge construction [17]. The comprehension of the problem at hand is supposed to be changed and evolving during the process and learning from the retrieved documents is to occur. In case the information seeking process is too shallow, intervention might be necessary in order to make people realize that they need to gain greater understanding. [17, p. 114]. Kuhlthau defines a “Zone of Intervention” as “that area in which a user can do with guidance and assistance what he or she cannot do alone or can do only with difficulty” [17, p.129]. However, interventions are not always necessary: if an individual is “self-sufficient”, interventions may even have adverse effects, as they can be intrusive and annoying [17].

## 3. DEFINING “A SEARCHER IN NEED”

A searcher on the right path needs to be separated from “a searcher in need” to avoid unnecessary interventions. Here, we define a searcher in need as a novice searcher whose focus is not formulated, and does not realize that is critical. A novice searcher does not have a sufficient level of subject knowledge or search experience [13]. According to Holliday & Li [12] and Vakkari [24], many students skip focus formulation entirely.

They might be overconfident and resistant to take any help. Focus formulation enables assessing relevance, pertinence and what is enough to accomplish the task [11, 14]. Therefore, the searchers are neither able to assess relevance or usefulness of the retrieved items nor when to stop the searching. They might be happy just with few information items at hand that are “somewhat relevant” to their topic and terminate searching [12]. We claim that these searchers without any feelings of uncertainty and with overconfidence are the searchers in need.

Overconfidence leads to straightforward workflows, following a predefined pattern and little exploration. The searcher is not actually looking for evidence to back up her ideas, but for a – possibly non-existing – correct answer using search engines. This kind of behavior leads to shallow use of information instead of deep learning. This might be further strengthened by cognitive biases, namely the use of heuristics and *anchoring* [16]. In anchoring the searcher sticks to the first idea found and does not accept any opposite views. People also tend to avoid information that is against their attitudes and beliefs [9]. Interacting with information might be unpleasant and too hard work and therefore a searcher might terminate the information seeking too early. Thus, they might arrive to conclusions based on limited information, and feel satisfied with that. Most current search engines may even increase cognitive biases by the employed personalization, leading to “filter bubbles”. Moreover, search systems may encourage overconfidence [16].

There might be an inverse relation between confidence and the correctness of solutions: Davidson, Deuser, Sternberg [8] showed that persons with high feelings of confidence tended to arrive at incorrect solutions whereas individuals who felt they were far from solving the problems tended to give correct solutions. This supports our central thesis that if we “shake” the searchers out of their confidence and comfort zone, they may achieve better results. In the next section we explore whether there are ways to do this shake-up in actual search systems.

## 4. SHAKING UP “A SEARCHER IN NEED”

Current search engines support searchers quite effectively in locating sources. However, the “searcher in need” is not able to assess if the located source is a correct one. Therefore, search engines should also take “process problems” [17] into account, i.e. the stage of a user in the information seeking process. These process problems are currently not identified nor ameliorated by search systems. One way to do this is to support the search process of a user and possibly intervene.

First of all, a search system should roughly be aware of the current search stage of a user. To do so, it could actively *monitor* a user’s progress in complex information seeking tasks [4]. For linear tasks with a closed set of answers, a system could know related concepts, associated sources and the “right” answers, and actively monitor if a user touches upon them in their information searches. For complex tasks involving knowledge construction, intervening can be harder, however. Vakkari [24] provides some indications of searchers’ behavior, stating that pre-focus searches are more precision-oriented, while searches in post-focus stages are more recall-oriented. Conceptual constructs evolve from vague to precise. At the pre-focus stage a user is satisfied with any piece of information that is even remotely relevant to the topic, since they are trying to gather understanding on it. This kind of “shooting blind” behavior might be detected by monitoring search sessions.

One way to find the users in need is that the system could build its identification of 'user stage' on search characteristics reflecting different types of search tactics [3, 19], information needs [5] or different types of search goals [23] and prompt its support when needed. However, there is need for more research in which stages of ISP these occur.

Systems would support searchers in need in various ways. Here, a paradox emerges: excellent search tools providing a user with perfectly tailored results might not necessarily be desirable. With this kind of tool, a searcher does not need to put in the effort necessary for focus formulation. However, increasing search effort has been shown to decrease perceived precision, but to lead to better outcomes [24]. Hence, we need more blurred set of search results for better task results.

One way to support searchers in need would be to provide high-quality search tools with the ability to introduce interventions, or "disruptions" in the search process. We want to stimulate the user to reflect and possibly change her search tactics. Motivation for changing tactics may be triggered by providing interesting new angles towards topics or problems, showing violations of previous expectations requiring further investigation, and creating sudden awareness of inconsistencies and gaps in understanding [20]. If information environments are normally orderly, it is the disorder that catches our attention, and this causes cognitive reactions [6]. In effect, interventions in the search process should provide new insights to searchers in need.

At system level, users should be stimulated to investigate matters more deeply. This may be done by providing surprising search results, by asking the searcher to reflect on the search results and with specific support tools at suitable points of the search process. Firstly, a search system could change the ranking algorithms and suddenly provide different results to queries. For instance, a system could promote diversity ranking and reduce redundancy to invite searchers to explore more diverse information sources. Further, systems could even stimulate serendipity, thereby promoting chance encounters [22] and "intellectual leaps of understanding" [1] or even *eureka* moments [26]. However, any piece of information must be related to the actor's prior experiences and to be exposed to the actor in order to be found serendipitously [22].

Hence, a search system would move away from considering the algorithmic relevance of retrieved results to a certain *query*, but provide results relevant at a certain point of the search *process* of a user. Moreover, a highly coherent information source may increase learning for searchers with low knowledge, but not offer enough diversity and challenge for a high knowledge searcher [9]. Consequently different kinds of sources may be useful in different situations, and the provided information should match with searchers' cognitive and affective states [17].

Secondly, shake-ups in the search process could also be provided using applied instructional interventions, which are stimulating reflection. For example, at an appropriate point, a system could provide instructional guidance by providing guiding instructions based on established information literacy models. Also, a system could interactively ask questions to make the searcher reflect on the found information sources (for instance about content and authority of sources<sup>1</sup>), or even provide search dashboards providing feedback on personal search behavior [2].

Thirdly, the provision of additional search support features at moments when a searcher is "in need" may disrupt the shallow information seeking process. Various categories of search features could support search in different stages [15]. For example, a searcher in need could be offered explicit query suggestions promoting diversity ("did you try ...") at strategic moments, or word clouds showing explored and unexplored concepts to promote exploratory browsing of material.

However, the searcher may be unwilling to accept the "shaking" due to the cognitive biases. Some solutions to solve this grand challenge may include persuasive techniques and gamification. Deep learning might be helped with the emergence of a prepared mind, motivation and curiosity.

## 5. LIMITATIONS AND FUTURE WORK

This position paper presented an idealistic approach to user stimulation in order to improve task outcome. At this point of time shallow information processing is acceptable, both in practice and in research. Maybe the biggest challenge to applying more deep information processing is the persuasion of people to change their behavior and habits. However, regardless the state of the art, this "shaking approach" might be one way to support the complex task processes.

The posited "shaking approach" needs to be studied in order to prove its usefulness. The improvement that instructions and other interventions can provide to actual learning outcomes might be further studied and tested with students, both in the type of instruction or tool support and in the timing of the intervention. One challenge is to find the possibly overconfident searchers, and to observe the kinds of behaviors described here during their information search processes.

## 6. CONCLUSION

This paper aims at stimulating discussion about the level of support a searcher needs during a search process. At the early stages of the search process, a novice searcher needs to create a focus in order to succeed in the task at hand. Sometimes this does not happen, and we suggest that by shaking the user a bit, they might reach the focus formulation phase and ultimately a better task outcome. This shaking may be done by providing surprising but at the same time coherent search results, instructional ways and by reflecting on the search process and tactics, and by stage-specific support tools. However, the searcher needs to be motivated, and therefore some persuasion is needed. It is commonly agreed, that without any cognitive effort in task performance, the level of outcome may remain low. In order to trigger critical thinking and knowledge creation, searchers need to be shaken to realize that there might be other ways to solve their problem, if the search route they follow seems too obvious to them.

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<sup>1</sup> <http://library.sasaustin.org/webEvaluationTraining.php>

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