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Query strategies during information searching: Effects of prior domain knowledge and complexity of the information problems to be solved



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ABSTRACT

This study addresses the impact of domain expertise (i.e. of prior knowledge of the domain) on the performance and query strategies used by users while searching for information. Twenty-four experts (psychology students) and 24 non-experts (students from other disciplines) had to search for psychology information from the Universalis website in order to perform six information problems of varying complexity: two simple problems (the keywords required to complete the task were provided in the problem statement), two more difficult problems (the keywords required had to be inferred) and two impossible problems (no answer was provided by the website). The results showed that participants with prior knowledge in the domain (experts in psychology) performed better (i.e. reached more correct answers after shorter search times) than non-experts. This difference was stronger as the complexity of the problems increased. This study also showed that experts and non-experts displayed different query strategies. Experts reformulated the impossible problems more often than non-experts, because they produced new queries with psychology-related keywords. The participants rarely used thematic category tool and when they did so this did not enhance their performance.

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1. Introduction

Searching for information in e-documents is now commonly used for professional, educational, and personal purposes. Among these e-documents, the Internet both provides a large environment within which users can search for information and also offers many different tools for accessing information (such as search engines). Search engines can be general (e.g. Google, Yahoo), in which case they can be used to search a huge number of documents throughout the Internet, or they can be part of a website (such as the search engine of Amazon.com). In both cases, the use of search engines and the way of carrying out a search for information depend on various characteristics, such as those of the individual (e.g., experience in using the Internet, level of domain knowledge), those of the interface (e.g., layout organization) and/or those of the task (e.g., complexity of the information problem to be performed, nature of the problem).

Among the factors underlying the information searching task, many studies have reported that prior domain knowledge is a major predictor of performance in information searching (e.g. Hsieh-Yee, 1993; Hölscher & Strube, 2000; Ihadjadene &

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Martins, 2004; Marchionini, 1995; Wildemuth, 2004; Willoughby, Anderson, Wood, Mueller, & Ross, 2009). These studies showed that experts formulated appropriate queries, their searches were successful and they were faster than non-experts (e.g. Dillon & Song, 1997; Downing, Moore, & Brown, 2005; Hölscher & Strube, 2000). On the other hand, some studies found that users tended to bypass complex information channels and advanced techniques in favor of 'simpler' web search and search engines (George et al., 2006; Makani & WooShue, 2006; Vezzosi, 2009). The level of expertise is particularly important in the educational field, since students are increasingly searching for information on the Internet to do their homework and/or to deepen their knowledge of an academic topic. Students with greater knowledge will use various and more efficient strategies than students with little or no existing knowledge. In addition, various studies have provided evidence that information searching performance depends on the level of complexity of the problem to be performed (Barsky & Bar-Ilan, 2012; Chevalier, Dommès, & Marquié, 2011; Dommès, Chevalier, & Lia, 2011; Dommès, Chevalier, & Rossetti, 2010).

Consequently, what will happen if we manipulate the level of prior domain knowledge and the complexity of the information problems to be solved? Would a high level of domain knowledge allow the user to overcome difficulties in searching for information by reformulating unsuccessful queries? Would it increase accuracy? In order to provide some answers, this experimental study set out to investigate the impact of prior domain knowledge (i.e., the level of expertise of the participants) and the complexity of the information problems to be performed on the efficiency and the strategies used by the participants. We describe these two points in greater detail in Section 1.1. The objectives and hypotheses underlying the study are presented in Section 1.2. The method and results are described in Sections 2 and 3. The article ends with the discussion of the results we obtained (Section 4) and we present limitations as well as further insights (Section 5).

1.1. Prior domain knowledge and the complexity of the information problems

Information searching activity can be defined as a complex cognitive activity involving problem solving, decision-making, and text comprehension processes. Several models have been developed (e.g., CoLiDeS developed by Kitajima, Blackmon, & Polson, 2000; Marchionini's model, 1995; for an overview see Dinet, Chevalier, & Tricot, 2012). More precisely, with regard to information searching using search engines, Sharit, Hernandez, Czaja, and Pirolli (2008) developed a cognitive model, which involves three main stages:

- Stage 1, planning and formulating the query. An individual has to produce keywords relevant to the objective of the search.
- Stage 2, evaluating and selecting the information provided by the search engine. An individual has to check and evaluate the relevance of the information provided by the search engine with regard to the keywords used. If the results do not match the objectives, the individual has to reformulate her/his query (and goes back to stage 1).
- Stage 3, processing information. If the results provided by the search engine seem to be relevant to the proposed objectives, the individual selects and then processes them at a deeper level.

As an individual progresses in her/his search, s/he has to keep the search goal in his/her working memory, and compare it to the information provided by the search in order to obtain the information that is expected to solve the current information problem.

In this study we focused on Stages 1 and 2, i.e. on the formulation and reformulation of queries. Stage 2 may be iterative if the individual does not find the expected information, and so it may be repeated throughout search activity.

Various factors are involved in information searching, especially prior domain knowledge. Indeed, many authors have found that prior domain knowledge supported better search performance (e.g. more correct answers), higher search efficiency (e.g. fast search and more oriented by opening fewer pages) and more search flexibility (e.g. formulated more queries) (e.g., Ihadjadene, Chaudiron, & Martins, 2003; Ihadjadene & Martins, 2004; Sihvonen & Vakkari, 2004; Wildemuth, 2004). Ihadjadene and Martins (2004) and Ihadjadene et al. (2003) observed that only experts used thematic categories (provided by a search engine, such as sport, news) but they did so in an inefficient way that did not enhance their performance. Participants found that the category labels were not meaningful, they were also confused by the heading "categories", and did not understand the difference between "keywords" and "categories". Although prior domain knowledge is a relevant factor predicting search performance with search engines, Hölscher and Strube (2000) observed that only people with dual expertise (domain and web experts) modified their search strategies to develop a better one (by changing search engine) when faced with an impasse.

In addition to prior domain knowledge, the complexity of the information problems to be solved also impacts searching performance and the strategies used. The definitions and viewpoints of task complexity are numerous (for a review see Liu & Li, 2012). In psychology, Campbell (1988) defined two dimensions of task complexity: (a) objective task complexity is characteristic of a task and independent of the individual and (b) subjective task complexity is a psychological experience or perception of a task by the individual who performs the task. Campbell (1988) also identified four complexity attributes: (1) multiple paths to achieve targeted outcomes; (2) multiple acceptable solutions may be provided to solve the task; (3) conflicting interdependence among paths and targeted outcomes; and (4) uncertain links among paths and targeted outcomes to solve the task.

Hence, in the research field of information searching, problem complexity can be measured in different ways. For instance, Barsky and Bar-Ilan (2012) as well as Chevalier, Maury, and Fouquereau (2014) provided information problems

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