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Conceptual growth in integrated models for information behaviour

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Abstract

Purpose – The purpose of this paper is to elaborate the picture of the nature of integrated models for information behaviour from the perspective of conceptual growth in this field of study.

Design/methodology/approach – Conceptual analysis focusing on the ways in which the researchers have developed integrated models. The study concentrates on seven key models proposed by Bates, Choo and associates, Godbold, Robson and Robinson, and Wilson.

Findings – Researchers have employed four main approaches to develop integrated models. First, such frameworks are based on the juxtaposition of individual models. Second, integrated models are built by cross-tabulating the components of diverse models. Third, such models are constructed by relating similar components of individual models. Finally, integrated models are built by incorporating components taken from diverse frameworks. The integrated models have contributed to conceptual growth in three major ways: first, by integrating formerly separate parts of knowledge; second, by generalizing and explaining lower abstraction-level knowledge through higher level constructs; and third, by expanding knowledge by identifying new characteristics of the object of study.

Research limitations/implications – The findings are based on the comparison of seven models only. The integrated frameworks of information retrieval were excluded from the study.

Originality/value – The study pioneers by providing an in-depth analysis the nature of integrated models for information behaviour. The findings contribute to the identification of the key factors of information behaviour.

Keywords Research, Models, Searching, Information, Modelling, Information operations

Paper type Research paper

Introduction

Since the 1960s, researchers have developed a number of models for information behaviour (for an overview, see Case, 2012, pp. 133-198; Wilson, 2010). Classic frameworks include, for example, Wilson's (1981) model of information-seeking behaviour, Dervin's (1983) sense-making theory, Ellis's (1989) behavioural model of information seeking, and Kuhlthau's (1993) Information Search Process (ISP) model. More recently, the repertoire of models has been enriched by novel constructs such as the nonlinear model of information seeking developed by Foster (2004), and the integrated research framework for information seeking and retrieval elaborated by Ingwersen and Järvelin (2005).

The present study was inspired by the problems caused by the abundance of models for information seeking and searching. The profusion of such models is perhaps best exemplified by the book titled *Theories of Information Behaviour* (Fisher *et al.*, 2005); it introduces no less than 72 diverse theories, models or conceptual frameworks. Even though the proliferation of models and theories suggests that research on information behaviour is evolving dynamically, the abundance of frameworks has a downside manifesting itself in an "increasing chaos and overload condition", as Dervin (2003) put it. Therefore, "researchers are drowning in concepts, variables, methods, theories; and in an avalanche of contradictory findings" (Dervin, 2003). Overall, information researchers seem to be inclined to add diversity by developing their own models rather than integrating existing ideas. This preference makes it difficult to cumulate a body of

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theory that may serve as a starting point for further research (Wilson, 1999). Another downside of the increasing diversity in model building is that it becomes more difficult to compare individual research approaches and identify their common elements.

However, there are a few examples of the attempts to fight the above trend. On the one hand, researchers have tried to cumulate knowledge by elaborating existing models instead of proposing still another framework. For instance, Meho and Tibbo (2003) and Makri *et al.* (2008) have refined Ellis's (1989) classic model by incorporating novel components into it or restructured the existing elements in a new way. On the other hand, researches have made attempts to develop integrated models for information behaviour by bringing together ideas presented in diverse frameworks. Different from the incremental enhancement of individual frameworks such as Ellis's (1989) model, the development of integrated models tends to result in more complex constructs because the researcher combines elements from several models. In this context, the explication of the meaning of the adjective of integrated is illuminating because it derives from the word of integration. It can be generally referred to as "The making up or composition of a whole by adding together or combining the separate parts or elements; combination into an integral whole: a making whole or entire" (Oxford English Dictionary). Consequently, the adjective integrated can be generally defined to mean "combined into a whole" (Oxford English Dictionary).

The present study focuses on integrated models of information behaviour for two major reasons. First, there is a dearth of analytical studies examining the nature of such frameworks. Second and more importantly, integrated models are particularly interesting from the perspective of theoretical growth in information research. Spink and Cole (2006, p. 26) provide support for this assumption by emphasizing that for a field to move forward scientifically, it is important to examine the strengths and weaknesses of various models, theories or approaches, and move towards a more integrated perspective – a necessary pre-condition for theoretical growth. According to Vakkari (1998), theoretical growth refers to the growth of unit (or substantial) theories. As suggested by the present investigation, this assumption can be expanded to involve scientific models as well. Similar to unit theories, such models consist of a set of concepts and a set of relations interconnecting concepts in an account of some phenomenon. Growth can be assessed by observing the empirical support gained by the theories and by analysing the conceptual growth of the theories or models. The present study focuses on the aspect of conceptual growth. Overall, conceptual growth means that a new theory or model is conceptually more specific, more general or more comprehensive than its earlier variants (Vakkari, 1998).

To examine this issue in greater detail, an attempt was made to find out how the integrated models for information behaviour exhibit conceptual growth. To this end, a conceptual analysis was made by concentrating on seven key models discussed in greater depth in the forthcoming sections. The paper is structured as follows. First, to provide background, the nature of scientific models is characterized, followed by the specification of the research setting. The next section reports the findings. The final sections discuss the study findings and draws conclusions of their significance.

The nature and aims of scientific models

There is no consensus among researchers about the definition of the concepts of theory and model However, theory can be generally understood as a set of statements presenting a systematic view of a phenomenon with the purpose of explanation or prediction (Frigg and Hartmann, 2012). Models tend to focus on more specific problems

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than do theories, typically making their content more concrete. Models represent a phenomenon, covering all relatively stable and general features of the world that are interesting from a scientific point of view (Frigg and Hartmann, 2012). Models therefore simplify complex reality in order to make it understandable. Nevertheless, models represent a way of organizing a body of knowledge to pave the way towards theories. From this perspective, a model can be conceived as an interim stage in a research discipline, before a theory can be established, serving as a "working strategy" for hypothesis testing (Järvelin and Wilson, 2003).

Models may be textual, mathematical, or graphic constructs (Wilson, 2010, p. 2392). A model can simply be described in words by presenting a set of theoretical propositions (e.g. Ellis, 1989). Mathematical models can take many forms, for example, differential equations. Models can also express the relationships of concepts in graphic form by means of diagrams or flow charts describing actions in a sequential or cyclic fashion (e.g. Meho and Tibbo, 2003). Many models of information behaviour include both a textual and graphic representation so that diagrams are used to express actual or theoretical relationships, or ideal processes of interaction with information (Wilson, 2010, p. 2393). The components of such models may include, for example, the information user and her context, and the information resources available to the user.

Scientific models can be evaluated by diverse criteria. While comparing competing models, attention may be devoted to their accuracy, clarity, conceptual coherence, scope, and explanatory power, for example (Pluta *et al.*, 2011, p. 486). Models can also be evaluated by devoting attention to their functions or basic aims (Järvelin and Wilson, 2003). As the present investigation is mainly interested in the conceptual growth exhibited by integrated models, the following aims of scientific theories and models identified by Bunge (1967, p. 383) are particularly relevant:

- integrating formerly separate parts of knowledge;
- generalizing and explaining lower abstraction-level knowledge (or observations, data) through higher level constructs; and
- expanding knowledge by deducing new propositions based on selected starting points and collected information.

The above list is not exhaustive. Scientific models can also serve more practical ends such as providing a working strategy for a research project (Järvelin and Wilson, 2003). This aim refers to the possibilities for further inquiry arising from the contributions made through the use of the model in research and practice. As the present study concentrates on the aims dealing with conceptual growth, the practical ends of this type will not be discussed in greater detail.

Research setting and research questions

Drawing on Wilson's (1999) ideas, Jansen and Rieh (2010, p. 1518) have specified three main levels of generality for the study of information behaviour. At the highest level of generality, human information behaviour is the broadest domain, addressing all aspects of human information interactions with various forms of information. At a middle level, a subset is information-seeking behaviour, which encompasses the range of information seeking employed in discovering and accessing information resources (both humans and systems) in response to goals and intentions. Finally, at the micro level, information searching behaviour is a subset of information seeking, referring to the actions involved in interacting with an information search system, including information retrieval (IR).

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To strengthen the focus of the study, the present investigation concentrates on integrated models for information behaviour at the levels of human information behaviour and information-seeking behaviour. However, as the boundary between the levels of information seeking and information searching has been blurred due to the increasing popularity of the networked sources, the present study looked at integrated models that are hospitable to information searching, too (e.g. Choo *et al.*, 2000). However, models primarily focusing on IR were excluded (e.g. Ingwersen, 1996; Marchionini, 1995; Saracevic, 1997).

The present study makes an attempt to find out how the elaboration of integrated models exhibits the conceptual growth, if it is looked at from the perspective of the basic aims of scientific models reviewed above. More specifically, the study focuses on three aims identified by Bunge (1967, p. 383): (i) integrating formerly separate parts of knowledge; (ii) generalizing and explaining lower abstraction-level knowledge through higher level constructs; and (iii) expanding knowledge by deducing new propositions based on selected starting points and collected information. However, since the integrated models reviewed in the current study do not necessarily deduce "propositions" understood as true statements of the properties of objects, a broader view was taken. The expression of "deducing new propositions" was replaced by "identifying new characteristics of the object of study". Therefore, the last-mentioned aim was rephrased as (iii) expanding knowledge by identifying new characteristics of the object of study based on selected starting points and collected information.

Drawing on the above specifications, the present study addresses two research questions:

RQ1. In which ways have researchers developed integrated models for human information behaviour, information-seeking behaviour and information searching behaviour?

RQ2. How have such models contributed to conceptual growth in information behaviour research?

Method

The research material was identified by searching main databases such as EBSCO and LISA. The keywords used in the search included, for example, information behaviour, information seeking, information searching, model, and theory. In addition, major review articles focusing on information needs, seeking and use were consulted; these articles were mainly published in the volumes of the Annual Review of Information Science and Technology. Moreover, review articles and book chapters focusing on this topic were scrutinized (e.g. Case, 2012; Wilson, 1999, 2010). The searches resulted in the identification of 125 articles, book chapters, and conference papers pertaining to the research topic. Of these investigations, 22 items were directly relevant for the analysis of the integrated models in that they proposed or commented on such frameworks.

The major criterion used for the identification of an integrated model was that it should be based on the incorporation of elements obtained from two or fewer frameworks, for example, Ellis's (1989) behavioural model, Kuhlthau's (1993) ISP model and Wilson's (1981) model for information-seeking behaviour. To strengthen the focus of the study, further limitations appeared to be necessary. To this end, studies taking a general-level approach to the development of integrated models were excluded because such studies tend to focus on metatheoretical issues rather than proposing detailed

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models. For example, Spink and Cole (2006) have made an ambitious attempt to create an integrated framework by comparing four main approaches to information behaviour research. These approaches encompass the problem-solving approach, everyday life information seeking – sense-making approach, foraging approach, and modular thinking. Spink and Cole (2006, p. 33) admitted, however, that their study provides only an initial attempt to associate the above four approaches in order to pave the way for the development of an integrated model for information behaviour. As their study mainly operates at the level of research approaches and thus is not sufficiently comparable to more detailed models reviewed in the present study, Spink and Cole's (2006) framework will not be discussed in greater detail.

Given these limitations, the present study concentrates on seven integrated models developed by Bates (2002), Choo *et al.* (2000), Godbold (2006), Robson and Robinson (2013, 2015), and Wilson (1994, 1997, 1999). Of the above authors, Bates (2002) and Choo *et al.* (2000) explicitly refer to their frameworks as "integrated models", while Godbold (2006) and Wilson (1997) prefers the term "general model". Robson and Robinson (2013) characterize their model as a framework "linking information seeking and communication". Despite different terminology, all seven models referred to above have in fact incorporated elements from diverse frameworks and can therefore be regarded as integrated models.

The above models were scrutinized by means of conceptual analysis. Drawing on Furner (2004), this method can be generally defined as an approach that treats the components of the study objects as classes of objects, events, properties, or relationships. Conceptual analysis involves defining the meaning of a given component and its attributes by identifying and specifying the contexts in which it is classified under the concept in question. The analysis also focuses on the relationships between the attributes.

To conduct the conceptual analysis, relevant text portions (paragraphs and sentences) characterizing the integrated models were first identified from research literature. This material was then read several times in order to identify individual characterizations of the components, and their relationships. More specifically, the studies characterizing integrated models were scrutinized by devoting attention to how researchers have characterized the components and their attributes, as well as the relationships between the attributes. The components include, for example, information-seeking behaviour, and the context of information seeking, while the attributes of the latter component entail, for example, environmental and personal factors. This analysis served the end of identifying the components that are employed in the building of integrated models.

In the following phase, the research material was scrutinized by focusing on the ways in which researchers have built integrated models by making use of diverse components and their attributes. The approaches employed in model building were identified inductively from the research material. As discussed in the following section, four such approaches were identified, for example, relating similar components of individual models Second, to examine the contributions of integrated models to conceptual growth, the three aims of scientific research identified by Bunge (1967, p. 383) reviewed above were used as a point of departure. However, the analysis was not restricted to these categories in order to allow for other categories to emerge. However, no such categories describing conceptual growth were identified. The contributions to conceptual growth per aims defined by Bunge (1967, p. 383) were identified by scrutinizing the diagrams presenting integrated models, as well as their

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textual explanations. This was achieved by asking: first, what kind of formerly separate parts of knowledge do the proposed model integrate; second, what kind of higher level constructs are developed in order to generalize and explain lower abstraction level knowledge; and third, what kind of new characteristics of information behaviour, seeking and searching are introduced in order to expand knowledge?

All in all, the conceptual analysis was based on the identification of similarities and differences between the ways in which integrated models are constructed and how they contribute to conceptual growth. The analysis was continued until no new categories were identified. The next section reports the research findings by discussing the four main approaches to the construction of integrated models. The review mainly proceeds chronologically because conceptual growth in science is often based on the elaboration of ideas presented in earlier studies.

Findings

Integration by juxtaposing models

The conceptual analysis revealed that the simplest way to develop an integrated model is to juxtapose two frameworks. The first attempt of this kind was made by Tom Wilson (1994, p. 33). The point of departure was the model of information-seeking behaviour proposed by Wilson (1981). It is a classic model that has significantly affected the elaboration of information-seeking frameworks since that time. Wilson's (1981) pioneering model consists of three diagrams specifying the interrelationships among areas in the field of user studies, information-seeking paths, and factors influencing needs and information-seeking behaviour. Of these, the latter diagram is most widely known, and it presents a holistic view on individual, group-level, organizational, social and cultural factors affecting information seeking. In the model, contextual factors are placed in nested boxes so that those having an indirect impact on information seeking are placed in the outer layers, that is, physical environment, politico-economic environment, and socio-cultural environment. Person-level factors, that is, physiological, affective, and cognitive needs are placed in the innermost sphere, while role-related factors are located between the micro- and macro-level items. Wilson also identified personal, role-related and environmental barriers as contextual factors affecting the attempts to seek information.

Wilson (1994, p. 33) suggested that his 1981 model could be enhanced by incorporating the framework of information seeking developed by Ellis *et al.* (1993). The integration would be reasonable, because Ellis's model is concerned solely with the information-seeking process, rather than with the information needs that motivate search behaviour. Ellis's (1989) original model identified six characteristics of information-seeking behaviour, i.e., starting, chaining, browsing, differentiating, monitoring, and extracting. The enhanced framework proposed by Ellis *et al.* (1993) incorporated two new components, that is, verifying and ending. The integrated model proposed by Wilson has been presented by using slightly different diagrams (Wilson, 1994, p. 33; 1997, p. 552; 1999, p. 252). Figure 1 presents the newest version of the model.

Interestingly, Wilson (1994, pp. 33-34; 1997, p. 552; 1999, pp. 252-253) did not detail the nature and the potential of the integrated model; the reader was just provided with the diagram that simply juxtaposes the two models. Nor did Wilson explain how the characteristics identified by Ellis would substantiate the approach to information-seeking behaviour and how strongly could the novel components be integrated into his 1981 model. Thus, the question of how the integrated model would contribute to the conceptual growth in information behaviour research remains partly open.

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Nevertheless, the above model implicitly serves the aim of integrating knowledge because it raises relevant questions about how the two frameworks may supplement each other in order to elaborate the picture of information-seeking behaviour. It is evident, however, that the integrated model does not contribute to conceptual growth by expanding knowledge because no new components are introduced. Moreover, due to the descriptive approach, the model does not generalize and explain lower abstraction-level knowledge through higher level constructs.

Integration by cross-tabulating the components of models

Another fairly straightforward way to develop an integrated model is based on the cross-tabulation of the key components of individual models. In general, cross-tabulation is a display of data that shows how many cases in each category of one variable are divided among the categories of one or more additional variables. In a cross-tabulation, a cell is a combination of two or more characteristics, one from each variable. In the simplest case, two variables have two categories, yielding $2 \times 2 = 4$ cells. As demonstrated by Bates's (2002) study discussed below, cross-tabulation can provide a powerful way to develop typologies. Further, as shown by Choo *et al.* (2000), cross-tabulation can be used to identify the components of a model by examining the co-occurrences of two categories.

Bates (2002). Bates (2002) developed an integrated model of information seeking and searching by drawing on a 2×2 cross-tabulation approach. By making use of the berrypicking model of information searching (Bates, 1989) and studies characterizing the "information foraging" approach (e.g. Sandstrom, 1994), Bates (2002) identified four modes of information seeking and searching. The model is based on the cross-tabulation of two variables: active vs passive; and directed vs undirected information seeking and searching (Figure 2).

The model depicted in Figure 2 is very general in nature. In fact, the diagram just identifies four ideal typical modes of information seeking and searching. However, the textual explanation of the diagram digs deeper and the main characteristics of the modes are depicted in detail. According to Bates (2002, pp. 4-7), an enormous part of all we know and learn comes to us through passive undirected behaviour, or simply being aware (cell (d) of Figure 2). Monitoring and browsing are complementary to each other, and opposites, in a way. Monitoring is directed and passive, while browsing is undirected and active. In monitoring (cell (b) of Figure 2), people maintain a back-of-the-mind alertness

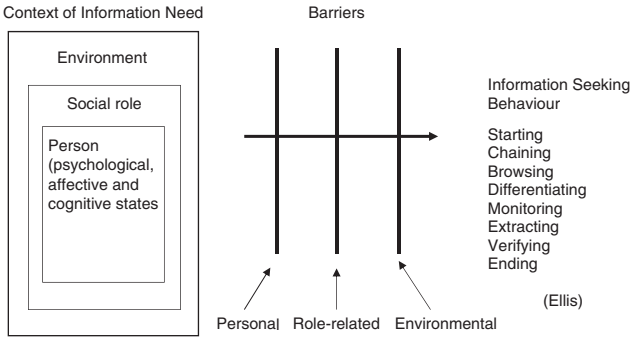

Figure 1.
Wilson's (1981) model of information-seeking behaviour juxtaposing Ellis's framework

Source: Wilson (1999, p. 232),

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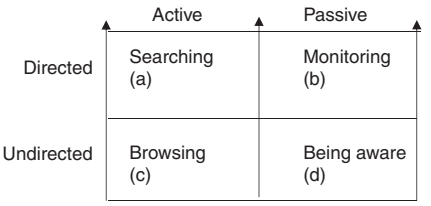
for things that interest them, and for answers to questions they have. While browsing, people have no special information need or interest, but actively expose themselves to possibly novel information (cell (c), Figure 2). According to Bates (2002, p. 6), monitoring and directed searching are ways we find information that we know we need to know, and browsing and being aware are ways we find information that we do not know we need to know. Thus, curiosity may lead to browsing behaviour. In contrast, directed search represents active attempts to answer questions or develop understanding around a particular question or topic area (cell (a), Figure 2).

Bates's (2002) model contributes to conceptual growth in information behaviour research in three ways. First, the four-part model integrates knowledge by bringing together formerly separate components of being aware, monitoring, browsing, and searching. Second, the model expands knowledge by identifying a new component, that is, being aware. Finally, the model generalizes and explains lower abstraction-level knowledge through higher level constructs. In her earlier model Bates (1989) suggested that "berrypicking" is a common and natural way people actually engaged in active directed searching. In the more comprehensive context of the integrated model, both browsing and berrypicking can be conceived as types of sampling and selecting. Browsing is an undirected, while berrypicking is a directed mode of searching (Bates, 2002, p. 10). Thus, in terms of information seeking and searching as behaviour, people operate in two general modes: sampling and selecting (cells (a) and (c), Figure 2) or passive absorption (cells (b) and (d)). When people know what information they want, people generally either actively search for it (a), or monitor environmental information for it (b). When they do not know what they want, people browse (c) or remain passively aware (d).

The integrated model serves the aim of generalizing and explaining lower level knowledge through higher level constructs also in that human information seeking is reviewed in the broader context of information foraging. Bates (2002, p. 14) claimed that a more complete understanding of information-seeking behaviour requires attention to the several levels of human existence. Both social or individual as well as biological and anthropological levels should be taken into account while explaining the modes of information seeking and searching. In the integrated model, information seeking has been conceptualized in terms of all the ways in which information comes to people, including much that is absorbed passively. Bates (2002, p. 14) speculates that more active efforts to acquire information, such as browsing and berrypicking, are probably applications of a generic human behaviour known as sampling and selecting. Sampling and selecting, in turn, may be an exception from original animal food foraging and mating behaviour. Searching thus becomes one behaviour within a general model of human information-related behaviours.



Source: Bates (2002, p. 4)

Figure 2.
Modes of information seeking

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Choo et al. (2000). Choo *et al.* (2000) provide another example of use of the cross-tabulation approach to the development of an integrated model for information searching. Different from Bates's (2002) general-level framework reviewed above, they focused on browsing and searching on the World Wide Web. A framework was developed to describe the common repertoires of information searching that were observed empirically. On one axis of the model, episodes of web searching were plotted according to the four environmental scanning modes identified by Aguilar (1967): undirected viewing, conditioned viewing, informal search, and formal search. Each mode was characterized by its own information needs and information-seeking strategies. On the other axis of the model, episodes of web searching were plotted according to the occurrence of one or more of the six characteristics of information-seeking behaviour identified by Ellis (1989). The key idea of the integrated model is that relating the components identified by Aguilar and Ellis may be helpful in analysing patterns of web-based information seeking. Table I presents the integrated framework.

The model depicted in Table I indicates how the modes of scanning identified by Aguilar are likely to occur with the characteristics of information seeking specified by Ellis. Out of the $4 \times 6 = 24$ cells, only ten appeared to be relevant in this regard. The high share of empty cells suggests that the cross-tabulation approach becomes less useful when the number of categories per variable increases.

The integrated model proposes that in the undirected viewing mode on the web, there may be many instances of starting and chaining, while other characteristics identified by Ellis are unlikely to occur with this mode of scanning. For example, starting occurs when viewers begin their web use on pre-selected default home pages (Choo *et al.*, 2000). Chaining may take place when viewers notice items of interest,

	Starting	Chaining	Browsing	Differentiating	Monitoring	Extracting
Undirected viewing	Identifying, selecting, starting pages and sites	Following links on initial pages				
Conditioned viewing			Browsing entry pages, headings, site maps	Bookmarking, printing, copying; going directly to known site	Revisiting "favourite" or bookmarked sites for new information	
Informal search				Bookmarking, printing, copying; going directly to known site	Revisiting "favourite" or bookmarked sites for new information	Using (local) search engines to extract information
Formal search					Revisiting "favourite" or bookmarked sites for new information	Using search engines to extract information

Source: Choo *et al.* (2000)

Table I.
The integration of the models of Aguilar and Ellis

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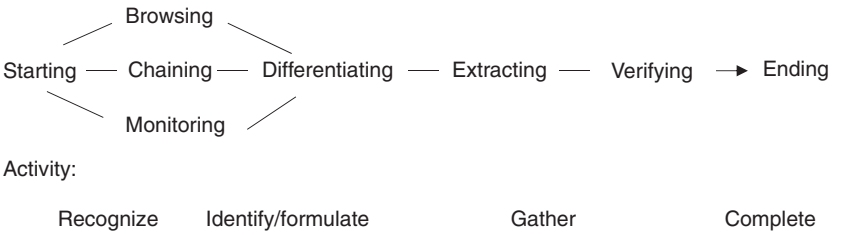
and then follow hypertext links to obtain more information on those items. In the conditioned viewing mode on the web, browsing, differentiating, and monitoring are expected to be common activities. Differentiating occurs when viewers select web pages that they expect to provide relevant information. Viewers may also monitor highly differentiated sites by returning regularly to browse, or by keeping abreast of new content.

During informal search on the web, differentiating, extracting, and monitoring are typical activities of information seeking. Again, informal search is likely to be attempted on a small number of websites that have been differentiated by the individual. According to Choo *et al.* (2000), extracting is relatively "informal" in the sense that searching would be localized to looking for information within the selected site(s). Extracting is also likely to make use of the basic, "simple" search features or commands of the local search engine, in order to get the most important information, without attempting to be comprehensive. Monitoring becomes more proactive if the individual sets up software agents that automatically deliver information based on keywords or subject headings. Finally, during formal search on the web, there may be primarily extracting activities, with some complementary monitoring activity (Choo *et al.*, 2000). Formal search makes use of search engines and may be two-staged: multi-site searching that identifies significant sources is then followed by within-site searching that may involve fairly intensive foraging. Extracting may be supported by monitoring activity through services such as website alerts, in order to keep up with late-breaking information.

Overall, the above model provides a detailed picture of the ways in which modes of environmental scanning occur with the characteristics of web searching. The cross-tabulation of these factors systematically brings together formerly separate parts of knowledge about information seeking and searching. At the same time, the integrated model serves the aim of generalizing and explaining lower level knowledge through higher level constructs. The nature of web searching (lower level knowledge) is characterized as a specific instance of higher level constructs, that is, environmental scanning and information-seeking behaviour. However, as Figure 3 indicates, the integrated model does not much expand knowledge of the web searching process consisting of well-known activities such as using search engines and following links.

Integration by relating similar components of models

Even though the cross-tabulation approach may be an effective method to identify ideal typical modes of information searching (Bates, 2002) or the interrelationships between the components of two models (Choo *et al.*, 2000), the above approach has its



Source: Wilson (1999, p. 256)

Figure 3.
Relating the components of Ellis's and Kuhlthau's models

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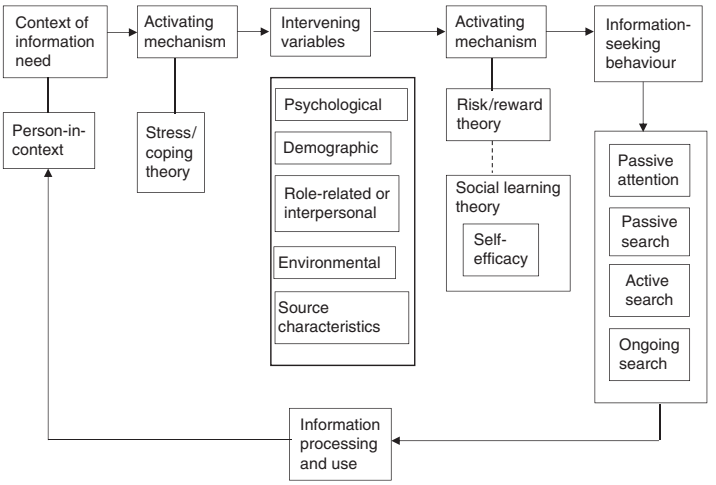
limitations because it is confined to the two-dimensional categorization of phenomena into discrete and static boxes. Therefore, researchers have sought for more flexible approaches that allow better the characterization of the dynamic relationships between multiple elements of information behaviour. Common to such attempts is that they identify similar components of two diverse models, based on the comparison of such components.

Early attempts to develop integrated models of this type include Wilson's (1994, pp. 33-34) idea to relate the models developed by Ellis and Kuhlthau. Inspired by Kuhlthau's (1993) ISP model, Wilson suggested that the enhanced framework proposed by Ellis *et al.* (1993) could be elaborated further by conceptualizing the characteristics of information seeking as components of a staged process. Interestingly, this idea is contrary to Ellis's (1989, p. 238) proposition that characteristics such as browsing, monitoring, and extracting do not represent a set of stages or phases that any or all researchers follow when seeking information. Thus, Ellis's model is not meant to indicate sequences of events, but instead, the order of actions might vary and be iterative as well. Nevertheless, Wilson (1994, pp. 33-34) elaborated his idea further by approaching information seeking as a process that proceeds from starting and chaining to browsing and differentiating, followed by monitoring, extracting, verifying, and ending. Wilson suggested that despite different terminology, Ellis's framework shares some fundamental elements with Kuhlthau's ISP model. There is a question of a loose association in that Ellis's characteristics can be depicted similar to Kuhlthau's categories. The integrated model is presented in Figure 3.

The integrated model suggests that starting stands for a logical point of departure of the information-seeking process and that ending is its logical final point. According to Wilson (1999, p. 254), it is equally logical to assume that extracting follows from a specific search behaviour such as browsing. From the temporal perspective, extracting would not be an information behaviour of the same kind as browsing, or chaining or monitoring because the latter can be perceived as antecedents of extracting behaviour. Furthermore, extracting is more closely related to information use than information searching. In a similar vein, Wilson (1999, p. 254) suggests that differentiating is a different kind of behaviour: browsing, chaining and monitoring are search procedures, whereas differentiating is a filtering process. The remaining behaviours do not necessarily take place in a specific sequence and may be initiated in different sequences at different times in the overall search process.

Wilson believed that the relating of key components such as these would pave the way towards the development of a general model of information-seeking. Although Ellis's and Kuhlthau's models do not map directly on to one another, Wilson (1999, p. 256) saw important similarities between them. Figure 4 suggests that in effect, Ellis's "staged characteristics" are an elaboration of the activities described by Kuhlthau. The activities related to recognizing of information sources are closely associated with Ellis's starting phase, while identifying and formulating the focus of searching are associated with Ellis's characteristics of chaining, browsing, differentiating, and monitoring. Gathering information is closely related to extracting and verifying, while search closure is equivalent to verifying and ending in Ellis's enhanced model.

The model depicted in Figure 3 contributes to conceptual growth by generalizing and explaining lower level knowledge (Ellis's characteristics) through higher level constructs, i.e., the assumption that ultimately, information seeking is a staged process. However, similar to the integrated model of web searching proposed by Choo *et al.* (2000) above, Wilson's (1999) integrated model does not add much to the knowledge about the nature of



Source: Wilson (1997, p. 569)

Figure 4.
A revised general model of information behaviour

information seeking characterized in the original frameworks (Ellis *et al.*, 1993; Kuhlthau, 1993). Thus, as a whole, integration by relating similar components of diverse models provides only a modest contribution to conceptual growth.

Integration by incorporating components of diverse models

Wilson (1997). Finally, researchers have developed integrated models by incorporating components of two or fewer frameworks. Different from the three approaches discussed above, this strategy aims at a deeper integration of components with respect to their content. Again, Tom Wilson (1997) pioneered in the development of models of this type. Drawing on an extensive literature review of studies conducted in diverse fields such as communication, consumer research, health communication, and psychology, Wilson revised his 1981 model of information-seeking behaviour. To this end, he drew ideas from a number of research approaches such as stress/coping theory and risk/reward theory. Wilson (1997) pointed out that the other disciplines offered many analytical concept, models and theories that had been ignored by information scientists and urgently need to be incorporated into information science.

The rationale of the revised general model of information behaviour was justified by referring to the need to make it more understandable why people in certain situations make decisions to seek information. The answer of this question is the incorporation of the component of activating mechanism that was specified by drawing on the stress/coping models, for example (Wilson, 1997, p. 568). Another rationale to revise the 1981 model was the need to specify the nature of barriers to information seeking. As a result, the construct of intervening variables was introduced; these variables specified the nature demographic and psychological factors, and characteristics of information sources that may constitute a barrier (Wilson, 1997, p. 568). Third, there was need to identify a further activating mechanism between the determination of need and the initiation of action to satisfy the need. Wilson (1997, pp. 568-569) proposed that the nature of this mechanism can be elaborated by making use of risk/reward theory, social learning theory, and the concept of self-efficacy (Bandura, 1986) in particular.

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Finally, the new model should incorporate the component of information processing and information use. The revised model is presented in Figure 4.

Compared to the 1981 model, the revised framework provides a more detailed specification of the modes of information seeking or search, i.e., passive attention, passive search, active search, and ongoing search. Second, the model emphasizes the centrality of cyclic features of information seeking. In fact, Wilson's framework is one of the first cyclic models of information behaviour, similar to the model of professionals' information seeking developed by Leckie *et al.* (1996). The dynamic approach differs markedly from the somewhat static approach characteristic of the 1981 model. Wilson (2005, p. 35) reminds, however, that the general model has no pretensions to explaining everything to do with human information behaviour. The framework is hospitable to explanations set out by others and prompts the researcher to ask the question "Given my findings, what are the implications for these related areas" (Wilson, 2005, p. 35).

Different from integrated frameworks depicted in Figures 1-3 and Table I, Wilson's (1997) general model elicited more discussion and gave rise to critical comments, too. Ingwersen and Järvelin (2005, p. 67) characterized Wilson's framework as a static, fairly broad, general summary model of information behaviour. Therefore the model would need further specification if it should be used for the study of relationships between tasks, information seeking and retrieval. Another criticism levelled against the revised model is that it shows a logical, sequential process, whereas information behaviour in reality may be a back-and-forth, non-sequential process (Foster, 2004; Godbold, 2006).

Niedzwiedzka (2003) criticized Wilson's way of depicting the component of "context" by pointing out that Wilson's graphic separation of "the context" from the intervening variables and from features of the information sources does not make complete sense. This is because intervening variables form part of the context; moreover, the activating mechanisms are in operation not only at the point in which a decision is made to seek information, but also at all the other stages. On this basis, Niedzwiedzka (2003) proposed a few modifications to Wilson's model in order to apply it to the information-seeking behaviours of Polish managers. The modified diagram proposed, for example, that a phase of the need occurrence is separated from a phase of making a decision to seek information. In addition, a distinction is made between users seeking information personally, and those seeking information by making use of the help or services of other people, for example, librarians. However, as all main components of Wilson's model were preserved in Niedzwiedzka's (2003) amended diagram, it cannot be regarded as a novel integrated framework, and will therefore not be discussed in greater detail.

Interestingly, Wilson and his associates David Ellis, Nigel Ford, Allen Foster, and Amanda Spink returned to the questions of integrated frameworks in an empirical research project that aimed at the development of an integrated model of information seeking and mediated searching (Spink *et al.*, 2002). Interestingly, however, this project did not primarily draw on Wilson's (1997) general model reviewed above. Instead, Wilson's (1999) elaborated still another framework, that is, problem-solving model to explain why people engage in information seeking. Wilson (1999) proposed that information seeking is directed at the goal of the resolution of the problem and possibly the presentation of the solution. In moving through the stages of problem identification, problem definition, problem resolution, and solution presentation, uncertainty must be reduced by engaging in successive interaction episodes with information sources.

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A user's successive interactions may be analysed in terms of relevance judgements, uncertainty reduction, and the problem-solving stage.

The above project aimed at an ambitious integrated framework that would incorporate Wilson's (1999) problem-solving model, Kuhlthau's (1993) ISP model and Ellis's (1989) behavioural characteristics (Spink *et al.*, 2002). Wilson and his associates believed that a key strength of the theoretical framework would be the focus on the larger picture that embraces information seeking and information searching, and the drawing together of major concepts: situated actions, relevance, IR interaction and time, as well as feedback, representation, information problem, and context (Spink *et al.*, 2002, p. 701). The theoretical framework could integrate existing and future research and models from IR and information seeking.

However, it turned out that the ambitious plan could not be realized. Even though the components derived from the models developed by Ellis (1989), Kuhlthau (1993), Saracevic (1997), and Wilson (1999) provided a useful framework for the empirical study, no integrated model for information behaviour was presented in the form of a diagram. Instead, in a table titled as "General model information seeking and search process", the authors provided a specification of events constitutive of information seeking and searching, for example, "information seeking process related to information problem" and variables needed to examine such events, for example, "information-seeking behaviours" and "information seeking models" (Spink *et al.*, 2002, p. 700). All in all, the above table serves the general ends of identifying and grouping key variables of information seeking and searching. However, it cannot be regarded as a genuine integrated model. Further support for this conclusion can be found in Wilson's (2005, 2010) recent writings reviewing the models for information behaviour; no reference is made to the above specification even though it was referred to as a "general model".

Godbold (2006). So far, perhaps the most ambitious attempt to develop an integrated general model of information-seeking behaviour was made by Natalya Godbold (2006). To this end, she brought together a range of frameworks in order to elucidate the multi-directional nature of information seeking. As a point of departure, Godbold drew on the main ideas of Dervin's (1992) sense-making methodology. It suggests that information seeking is not necessarily a linear process; it may also entail dead-ends, changes of direction, iteration, abandonment and beginning again. On the other hand, Godbold drew on Wilson's (1981, 1997) models suggesting that in addition to information-seeking, information behaviour can entail information transfer, exchange and use. Similar to Wilson (1981), Godbold (2006) emphasized the contextual nature of information behaviour.

The integrated model proposed by Godbold (2006) is a multi-faceted construct because it also incorporates Ellis's (1989) characteristics, categories of the ISP model (Kuhlthau, 1993; Wilson's, 1999 problem-solving model of information seeking). In addition, Godbold made use of Brookes's (1980, p. 131) Fundamental Equation $K[S]+\Delta I = K[S+\Delta S]$ suggesting that the knowledge structure $K[S]$ is changed to the new modified structure $K[S+\Delta S]$ by the information ΔI, the ΔS indicating the effect of the modification. Finally, the model was substantiated by incorporating the construct of gap proposed by Dervin (1992) in order to indicate the multi-directionality of human information behaviour. To achieve this, Godbold made use of the idea of navigating the gap. The incorporation of multiple components resulted in the model of information behaviour depicted in Figure 5.

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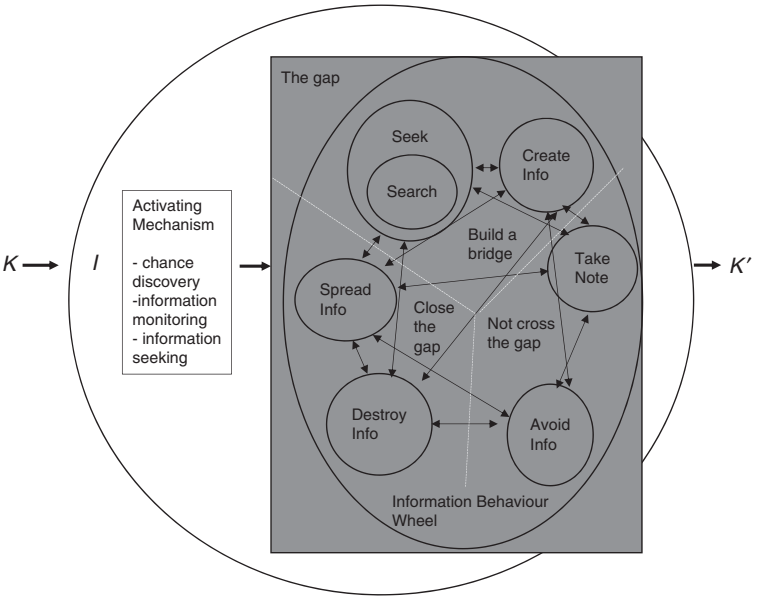

Figure 5.
An integrated model of information behaviour

Source: Godbold (2006)

The model suggests that an individual can make use of three strategies for navigating the gap: build a bridge, close the gap, or take a different path, that is, not cross the gap. The factors constitutive of Wilson's (1997) activating mechanism drive information seeking. In Godbold's model, the barriers to information seeking identified by Wilson (1981) are depicted by the category of gap. The gap also incorporates the components of intervening variables, stress/coping theory, risk/reward theory and social learning presented in Wilson's (1997) general model. Further, throughout the information behaviour wheel, the gap is repeatedly encountered and measured. Information strategies undertaken may have made the gap appear larger or smaller. The person remains in this phase of navigation until the point where they have "built a bridge", or decide that the gap is now either too big to navigate or small enough to ignore. At that point they leave the information behaviour wheel with knowledge state K', as suggested by Brookes's Fundamental Equation.

It is evident that Godbold's (2006) model serves the aim of conceptual growth by means of integrating knowledge. To this end, the model brings together formerly separate elements such as information creation, information avoidance, and exchange of information. The model also expands knowledge by introducing a new construct, that is, information behaviour wheel. However, due to the proliferation of the components there is a question about the coherence of the integrated model: how well do the individual constituents work together? The components operate at different levels of abstraction and they originate from diverse theoretical traditions such as sense-making methodology (Dervin, 1992), problem-solving (Wilson, 1999) and task-based information seeking (Kuhlthau, 1993). Similarly, it is not clear how well the model would serve the aim of generalizing and explaining lower level knowledge through higher level constructs because the nature of higher level constructs is not

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explicated. In this regard, for example, Brookes's pseudo-mathematical Fundamental Equation operates on too abstract a level in order to provide a meaningful basis for the generalizations about the nature of information behaviour.

Robson and Robinson (2013, 2015). Most recently, based on Andrew Robson's (2013) PhD thesis, Robson and Robinson (2013, 2015) proposed a model for information seeking and communication (ISCM) that can be regarded as an integrated framework of information behaviour. Similar to Wilson's (1997) general model of information behaviour, this framework makes use of interdisciplinary elements. Different from Wilson's framework, Robson and Robinson drew more broadly on models for information seeking and searching developed in the field of information science, while the interdisciplinary components were obtained from communication studies only. However, these components are important because they enable the integration of the viewpoint of information provision with the perspective of information seeking.

Similar to Godbold's (2006) integrated model, the framework proposed by Robson and Robinson exemplifies an ambitious attempt since it aims at enhancing Wilson's (1997) general model for information behaviour by making use of ideas obtained from multiple frameworks of information seeking and communication. The frameworks include the comprehensive model of information seeking (CMIS) developed by Johnson (1996). The most important components of the CMIS model incorporated into the ISCM framework are beliefs and salience: if an information user believes that a source will provide useful information, he or she is likely to be motivated to use it. Further, from the model of professionals' information seeking proposed by Leckie *et al.* (1996), Robson and Robinson captured components related to work role, work task and resulting information needs, for example. Moreover, Gorman's (1999) taxonomy of information needs of physicians was used to characterize recognized and unrecognized information needs, while the frameworks proposed by Ingwersen and Järvelin (2005) and Wilson (1981) appeared to be useful for the identification of contextual factors of information seeking. Finally, Wilson's (1997) general model of information behaviour provided significant components describing many of the activating mechanisms and intervening variables affecting information behaviour.

As to the components of communication process, Robson and Robinson mainly drew on the framework proposed by Maletzke (1963). This model was chosen because it considers contextual factors for the author and the information seeker (Robson and Robinson, 2013, p. 183). Maletzke's key idea is that the communicator's self-image, personality, working and social environment and image of the receiver affect the communications produced, which may reflect the aims and views of the communicator and his/her organization rather than the needs of the receiver. The receiver, on the other hand, reacts to and interprets communications according to his or her own context, self-image, personality, and environment.

Robson and Robinson (2013, pp. 184-185) identified a host of factors that were used in the development of the ISCM model. Context is a key factor because it stands for the environment in which any of the parties involved in information or communication behaviour operates. More specifically, context includes location, social influences, culture, activity- and work-related factors, finances and technology. Demographic factors such as age and socio-economic status may occupy a significant role. Expertise such as an information actor's knowledge and experience relevant to a subject area may have an effect on the information-seeking process. Similarly, psychological factors such as an individual's personality, and perceived self-efficacy, and thoughts and

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feelings can occupy a significant role while searching for information. Information user's needs, wants and goals, prompting the user to seek information are significant drivers for information seeking. Moreover, an information provider's needs, wants and goals, prompting the provider to communicate information may have an effect on the information-seeking process. In addition, there may be other motivating and inhibiting factors affecting the information-seeking process. Furthermore, features of the information-seeking process can be important in this respect. They deal with activities, feelings, and thoughts experienced by an individual when looking for information. Finally, the characteristics of information and sources may have an effect on information seeking. Such characteristics can include, for example, utility. It entails factors such as the accessibility and ease-of-use of information or of a source. Moreover, credibility may be an important characteristic of information and sources.

The validity of the original model (Robson and Robinson, 2013) was tested by reviewing literature on physicians' information behaviour and by making an interview study focusing on health professionals acting as information providers (Robson and Robinson, 2015). The findings endorsed the validity of the model, with minor modifications dealing with ways in which users share information in collaborative settings and how they assess, use or dismiss information. The revised model is presented in Figure 6.

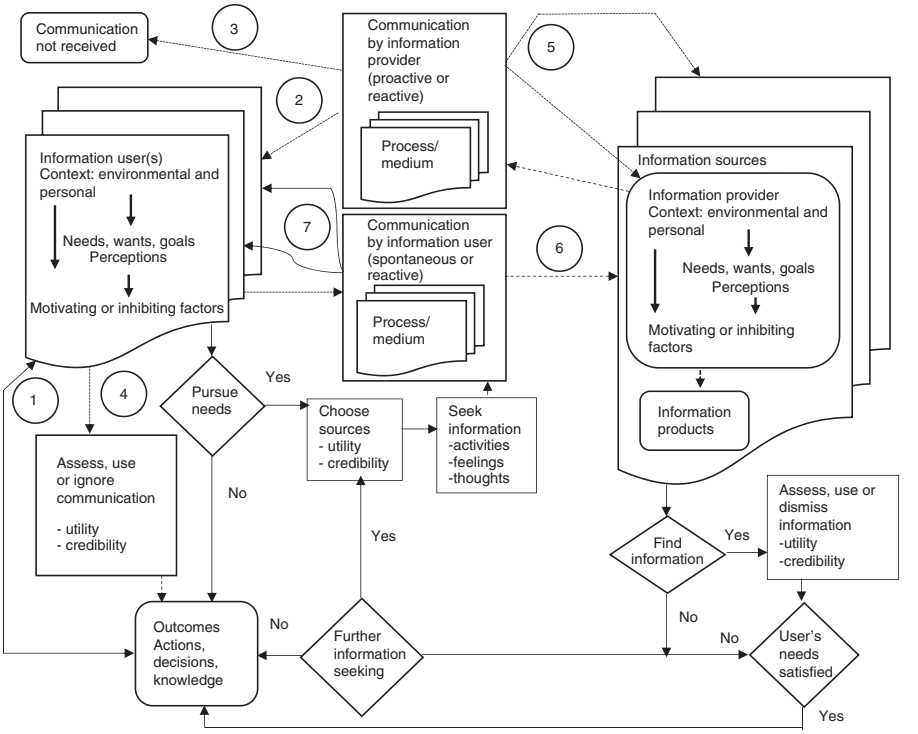

Figure 6.
Revised information seeking and communication model (ISCM)

Source: Robson and Robinson (2015, p. 1056)

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As Figure 6 indicates, the ISCM model is fairly complex, and it consists of a number of components and their relationships. The diagram makes use of a cyclic flowchart suggesting that information seeking and communication progresses from one stage to another and that there are several instances of feedback (Robson and Robinson, 2013, pp. 185-187). In Figure 6, the continuous arrows show information seeking and related activities, and the dashed arrows show communication and related activities. Information users include those who seek information, those who have information needs, whether they pursue them or not and whether the needs are recognized or unrecognized; and receivers of information, and whether or not they actively use it. Information sources may be information products or the providers of those products. Information providers are individuals, groups and organizations who produce, supply or communicate information, or who facilitate or control access to it.

The model depicted in Figure 6 provides a detailed picture of the complex interplay of information seeking and communication (or information provision). According to Robson and Robinson (2013, pp. 188-189), information seeking includes both active searching and Wilson's (1997) concepts of ongoing and passive searching. Searching can be broken down if necessary into individual activities, as in the Ellis (1989) and Kuhlthau (1993) models, and the thoughts and feelings associated with those activities may be described as in the Kuhlthau model (arrow 1 in Figure 6). If users find information from a source, they can assess it based on its characteristics such as utility and credibility and, if it meets their needs, use it to make decisions and take action. Alternatively they may dismiss the information if it has poor utility or is not perceived as credible. If users find no adequate information they can undertake further information seeking, or they can make decisions and take action (or decide to take no action) on the basis of their existing knowledge. Again, the situation may subsequently be reviewed depending on changes in needs, perceptions, motivating or inhibiting factors. Further, as indicated by arrow 2, providers of information, for example, speakers making presentations at meetings, may communicate directly with users. However, as indicated by arrow 3, communication may also be reactive, for example, when the provider makes information available through a website. A user who has received a communication (arrow 4) may assess the information, use it or ignore it, depending on its perceived utility and credibility. If used, the information may lead to actions or decisions and these may subsequently be reviewed depending on changes in needs, perceptions, motivating or inhibiting factors (arrow 1). In addition, as indicated by arrow 5, information providers may communicate with each other. An information user may also communicate with an information provider, for example, librarian (arrow 6). This may be done proactively, for example when a user asks for information. Alternatively it may be done reactively such as when a provider requests feedback on an information service. Finally, as indicated by a two-way arrow 7, there may be collaboration between users such as members of a work team, and they may communicate with each other while sharing information.

Figure 6 also demonstrates that both information users and providers operate within their own contexts, which affect their needs, wants, goals and perceptions and thus their information behaviour. The model shows two main types of context: environmental and personal. The environmental context is the living or working environment of the information user or provider. It includes location, culture and social influences, including friends, colleagues, professional and organizational culture, activity- or work-related factors, including role, objectives, tasks and time constraints;

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financial constraints; and technology – for example, an information user's access to the internet, and the communication systems available to an information provider. The personal context can include an information actor's demographics, expertise, and host of psychological factors such as self-perception, perceptions of others, including an information user's perception of a source and an information provider's perception of a user, and thoughts and feelings while searching for information.

To investigate the model's application to information users, Robson and Robinson (2015) studied findings from published literature on physicians' information behaviour. In addition, to investigate its application to information providers, interviews were carried out with staff working for the UK National Institute for Health and Care Excellence and with employees of pharmaceutical companies. The empirical findings provided support for the fundamental proposition of the ISCM model that information user acts within a context which affects the user's needs, wants, goals, perceptions and information behaviour (Robson and Robinson, 2015, p. 1059). Similarly, the results confirmed the assumption that contextual factors have a fundamental influence on a provider's information behaviour. Such factors include the environment and culture in which the provider operates. Related to the context are the provider's needs, wants, goals, perceptions and motivating and inhibiting factors. The model also indicates that the success of information providers in their communication activities and in achieving their goals depends significantly on the credibility and utility of the information they provide (Robson and Robinson, 2015, p. 1059). However, as the authors aptly point out, the ISCM model is not intended to give a detailed representation of every aspect of information behaviour; the framework highlights important elements of the process being modelled and the factors affecting them (Robson and Robinson, 2015, p. 1064). Due to such limitations, the model does not, for example, describe the steps involved when a user assesses and processes information or when a provider produces information products.

The main strength of the ISCM model is that it provides a comprehensive contextual picture of the dynamic interplay of information seeking and communication. The model serves the aim of integrating knowledge created in the fields of information science and communication research. Even though multiple elements are incorporated into the ISCM model, the logic of the ISCM diagram is easier to follow compared to Godbold's (2006) overarching framework. This is due to the fact that the ISCM components are specified in greater detail and their relationships are described more systematically. The ISCM model expands knowledge of information behaviour by explicating the mutual relationships between information seeking and communication. The model also generalizes and explains lower level knowledge (e.g. information needs) by explaining it by means of higher level constructs (e.g. contextual factors functioning as drivers for information seeking). From the viewpoint of this aim it is important that the ISCM model is adaptable to different environments. As Robson (2013, p. 249) points out, the this is due to the fact that generic terms such as "context", "needs, wants, goals", "perceptions" and "motivating or inhibiting factors" will all be determined with reference to the particular information users or providers being studied and the environments in which they operate.

Discussion

The present investigation examined the ways in which researchers have developed integrated models for information behaviour, information seeking, and information searching. The study also examined how such efforts have contributed to conceptual growth. The findings are summarized in Table II.

Reference(s)	The sources of components used in integrated models	Approach used to develop an integrated model	Contribution to conceptual growth
Wilson (1994, 1997)	Wilson (1981) and Ellis (1989)	Juxtaposing two individual models	Integrating knowledge
Bates (2002)	Bates (1989) and Sandstrom (1994)	Cross-tabulating the components of diverse models	Integrating knowledge; expanding knowledge; generalizing and explaining knowledge
Choo *et al.* (2000)	Aguilar (1967) and Ellis (1989)	Cross-tabulating the components of two models	Integrating knowledge; generalizing and explaining knowledge
Wilson (1997, 1999)	Ellis *et al.* (1993) and Kuhlthau (1993)	Relating similar components of individual models	Integrating knowledge
Wilson (1997)	Wilson (1981); diverse constructs originating from the studies of health communication and psychology, for example	Incorporating components of diverse models	Integrating knowledge; expanding knowledge
Godbold (2006)	Brookes (1980), Dervin (1992), Ellis (1989), Kuhlthau (1993) and Wilson (1981, 1994, 1997, 1999)	Incorporating components of diverse models	Integrating knowledge; expanding knowledge
Robson and Robinson (2013, 2015)	Ellis (1989), Gorman (1999), Ingwersen and Järvelin (2005), Johnson (1996), Kuhlthau (1993), Leckie *et al.* (1996), Maletzke (1963) and Wilson (1981, 1997)	Incorporating components of diverse models	Integrating knowledge; expanding knowledge; generalizing and explaining knowledge

Table II. Summary of research findings

The first research question dealt with the ways in which researchers have developed integrated models. Table II suggests that with time, the attempts to develop such frameworks have become more sophisticated. Four main approaches to create integrated models were identified. Early attempts exemplified by Wilson's (1994, 1997) studies simply juxtaposed two models without reflecting the added value brought by such efforts. Second, integrated models have been created by cross-tabulating two or fewer models (Bates, 2002; Choo *et al.*, 2000). This approach is somewhat more sophisticated and it enables the identification of types or modes of information seeking or searching. However, the cross-tabulation approach has its limitations due to its static nature and it is less suitable for the characterization of the dynamic features of information behaviour. These problems can be avoided by relating similar diverse components of individual models, as exemplified by Wilson's (1997, 1999) idea to parallel the characteristics of information seeking identified by Ellis *et al.* (1993) and the components of the ISP model (Kuhlthau, 1993). Most recent approaches are based on the incorporation of components of diverse frameworks into an integrated model (Godbold, 2006; Robson and Robinson, 2013, 2015; Wilson, 1997). This approach is more sophisticated than the other methods, but it tends to result in complex diagrams, as exemplified the models developed by Godbold (2006), and Robson and Robinson (2015).

The second research question dealt with the conceptual growth brought by the development of integrated models. The contributions to conceptual growth were identified by drawing on Bunge's (1967, p. 383) ideas. To this end, the judgements were

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made by drawing on three main criteria – the extent to which a model: first, integrates formerly separate parts of knowledge; second, develops higher level constructs in order to generalize and explain lower abstraction-level knowledge; and third, introduces new characteristics of information behaviour, seeking and searching in order to expand knowledge.

As the focus of the present study is placed on the integrated models, it should not come as a surprise that all four approaches have contributed to conceptual growth by bringing together formerly separate parts of knowledge. However, Wilson's (1994, 1997) early attempt to juxtapose the frameworks proposed by Wilson (1981) and Ellis (1989) contributed to this aim only implicitly. Overall, the depth of integration has varied between the models. In Figure 3, Wilson's (1999) approach to relating Ellis's characteristics with Kuhlthau's (1993) categories exemplifies a loose integration. On the other hand, Robson and Robinson's (2013, 2015) ISCM model provides an example of a relatively tight integration of components captured from diverse frameworks. The components are embedded as integral building blocks of the model and their relationships are defined exactly.

Four out of the seven models have expanded knowledge by identifying new characteristics of information behaviour. Again, there was variation between the models. For example, Bates (2002) and Godbold (2006) contributed by introducing individual constructs such as being aware and information behaviour wheel. On the other end of the continuum we find the ISCM model proposed by Robson and Robinson (2015). This framework expands more broadly knowledge about the mutual relationships between information seeking and information provision. The ISCM model also expands knowledge by introducing components such as utility and credibility that affect the selection and use of information sources.

Finally, three models out of seven contributed to conceptual growth by generalizing and explaining lower abstraction-level knowledge through higher level constructs. The low number suggests that this aim is difficult to reach in the building of integrated models. This is probably due to difficulty in identifying higher level constructs that would make the processes of information behaviour more understandable as generic human activity. For example, Bates's (2002) model suggests that such a construct can be found in the foraging approach because it explains why and how people select and sample information. The ISCM model developed by Robson and Robinson (2015) contributes to conceptual growth by demonstrating that the processes of information seeking and communication (or provision of information) are ultimately brought about by the interplay of personal and environmental factors.

The findings suggest that overall, there is no grand developmental line starting from Wilson's (1994) early framework and culminating in the ISCM model proposed by Robson and Robinson (2015). Even though the latter framework provides a detailed picture of the complex relationships between information seeking and information provision, the ISCM model should not be seen as a final word on this topic. Rather, it is best understood as a step on a long way to a truly integrated model of information behaviour.

The review of the strengths and weaknesses of the integrated models is rendered difficult due to the fact that their coverage varies considerably, ranging from web searching (Choo *et al.*, 2000) to information seeking, coupled with information provision (Robson and Robinson, 2015). Different from other frameworks, the ISCM model conceptualizes the two-way communication between information seekers and information providers. The incorporation of the communicative elements opens

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possibilities to elaborate the framework by devoting attention to the ways in which dialogue is constructed between information seekers and information providers. One of the key issues is the intentionality of communication (Bowers and Bradac, 1982, pp. 5-9). This issue can be framed differently, depending on the extent to which information providers make conscious attempts to affect information seekers' source preferences.

Despite the above differences, a few factors common to the integrated models can be found. Most of them are built by making use of components captured from the classic models developed by Ellis, Kuhlthau, and Wilson. In this regard, the models developed by Ellis and Kuhlthau are particularly important because they have been validated empirically. This implies that they are robust frameworks that can be reliably used in the building of integrated models, too. From this perspective, an integrated model would ideally combine the strongest components of diverse frameworks. Such a model would integrate, for example, Ellis's characteristics of information seeking placed in the multiple contexts described by Wilson, coupled with the idea of staged or multi-directional cyclic processes of information seeking (Kuhlthau, 1993; Godbold, 2006). From this perspective, the revised model proposed by Robson and Robinson (2015) can be regarded as the most advanced construct. However, their diagram (Figure 6) implies that the development of an overarching integrated model has its limits, due to the increasingly complex constellation of multiple factors depicting diverse attributes of information behaviour.

The findings indicate that as a whole, there is not much critical discussion between researchers about the goals and ways of developing integrated frameworks in order to systematically cumulate knowledge (see, however, Ingwersen and Järvelin, 2005, p. 67; Niedzwiedzka, 2003). Most researchers have adopted a descriptive approach to models whose components are used in the building integrated frameworks. For example, Godbold (2006) provides an informative review of Wilson's (1997, 1999) integrated models. However, there is no critical reflection about how well the components captured from frameworks such as these can be integrated in the model under construction. A more critical approach would be preferable from the perspective of the conceptual growth because it enables the evaluation of the strengths and weaknesses of the components of the existing frameworks.

Interestingly, except for the frameworks developed by Choo *et al.* (2000), and Robson and Robinson (2015), the applicability of the integrated models have not been tested empirically. This is probably due to the complex nature of integrated frameworks. However, the empirical testability of these models may vary. For example, Wilson's (1997, 1999) model relating Ellis's (1989) and Kuhlthau's (1993) frameworks seems to be amenable to operationalization because the components of the model are specified quite clearly. In contrast, Godbold's (2006) model may be beyond empirical testing due to the multiplicity of variables at various levels of abstraction. Nevertheless, integrated models need not to remain speculative constructs. For example, Robson and Robinson (2015) showed empirically that the ISCM model can be reliably applied to examine information behaviour among physicians and providers of health information.

The novelty value of the findings of the present study is difficult to evaluate due to the lack of comparable investigations. However, as an in-depth analysis of the integrated models, the findings complement the general-level reviews of models for information-seeking behaviour (e.g. Case, 2012, pp. 133-162; Wilson, 2010). The closest point of comparison is the study conducted by Järvelin and Wilson (2003). Mainly drawing on Bunge's (1967, p. 383) specification of the aims (or functions) of scientific

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theories they reviewed the features of individual models developed by Ellis (1989), Ellis *et al.* (1993), Ingwersen (1996), and Byström and Järvelin (1995). The findings confirmed Vakkari's (1998) finding that Byström and Järvelin's (1995) model meant theory growth in terms of theory precision because the model explicates dependencies (causality) between task complexity, information needed and information sources. In addition, it appeared that the strength of Byström and Järvelin's (1995) model lies in that it explicitly generates hypotheses through systematically categorizing the central concepts. However, Vakkari's (1998) findings are not directly comparable because the study concentrated on an individual model elaborated by Byström and Järvelin (1995).

Conclusion

The present study provided two main contribution, first, it identified four main approaches by which researchers have developed integrated models since the 1990s. Second, the findings demonstrate how such models have contributed to conceptual growth in information behaviour research. The findings indicate that compared to the abundance of individual models and theories, the number of integrated frameworks is still low. However, considerable progress has been made since the 1990s and the approaches to the development of integrated models have become more sophisticated. On the other hand, the attempts to validate the integrated frameworks empirically are rare indeed (e.g. Robson and Robinson, 2015).

The present investigation is limited in that it primarily focused on integrated models for information-seeking behaviour. Therefore, the findings cannot be generalized to deal with theoretical growth of information behaviour research at large. More comparative research is required to examine other frameworks with an integrative intent developed in the field of IR, for example (Spink *et al.*, 2002). Comparative studies are important because they can help to identify the elements common to individual models. Thereby, such studies can serve the ends of cumulating knowledge and fighting excessive diversity in the building of models for information behaviour.

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