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Foregrounding the "I" in IS Research - A Plea for Research on Computer-mediated Human Information Behaviour

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Introduction

Starting in the mid of the 20th century, the emergence of contemporary information technologies has dramatically changed the way information is disseminated and absorbed in organizational and private contexts. Recent advances in information technology make information ubiquitously available with the help of novel hardware and software, like mobile devices, corporate social networks or microblogging services. They enable organizational actors and private users to access information from multiple sources across a multitude of different computer-based channels.

However, today's abundance of information does not only result in higher organizational productivity and an enrichment of its recipients' lives in general. It also introduces new challenges as the mental information processing capabilities of human IS users improve not at the same speed as hardware and software technologies do, being constrained by cognitive limitations and evolutionary-shaped behavioural patterns guiding the absorption and use of information. Hence, it appears to be paramount to consider the aforementioned limitations as one important facet of human information behaviour with respect to a more human-centric use and design of information systems. Faster and more intelligent data processing capabilities, which recently have often been expressed with the term "big data", does not automatically lead to a better understanding of mental information processing capabilities of humans. Thus, we propose to focus on the processes and states that occur when humans process information in their brain as well.

The entity "information" is a constituent of the *Information Systems* discipline, thus underlining the field's focus on the development and use of technologies that support humans in gathering and processing information that are required in various business and private contexts. Unfortunately, however, the analysis and explanation of the relationship between human technology users and the entity information has never been the discipline's core research in-

terest. In fact, research on the behaviour of human beings when interacting with information in computer-based contexts is largely fragmented and frequently generates conflicting results.

Consequently, the goal of this paper is twofold. First, it reviews existing research with respect to information or information related behaviours. Second, based on the findings of the review, it intend to demonstrate how the research on computer-mediated information behaviours could significantly enrich IS research. Thus, we provide a profound and structured overview of extant research on the relationship between human beings and the entity information in the IS domain. Then, the article aims at creating intertextual coherence by harmonizing fragmented pieces of research as well as to identify fundamental research gaps that motivate promising future research trajectories. The latter will be exemplified with the yet under-researched phenomena of channel-dependent information seeking, information stopping, and information avoidance behaviour. Toward this end, the IS literature on information behaviours is analyzed using a conceptual framework developed based upon a synthesis and extenbsion of previous work on human information behaviour. Where appropriate, articles from non-IS journals are integrated into the analysis to complement and extend the findings. The result is a review article centred around organizing our existing knowledge of human behaviour in relation to the entity information in computer-based contexts with the overarching goal of advancing theory development [54, 110].

The Concept of Human Computer-Based Information Behaviour

Even though the term “information” represents one major constituent of our discipline’s name, past research in the IS field largely fails to clearly define its meaning in the respective research contexts {McKinney Jr., 2010 #262;Lee, 2010 #434}. McKinney and Yoos developed a taxonomy of four different views on information ranging from a token view over a syntax and representation view to an adaptation view {McKinney Jr., 2010 #262}. While the

former conceptualization regards information as atomic data entities that can be manipulated easily, the latter view assumes that information is equivalent to any change in an observer's environment that matters to the observer.

This review article acknowledges the aforementioned taxonomy and the resulting pluralistic use of the term *information* in past IS research. Consequently, the article is broad-minded since it does not specify requirements with regard to a dedicated view on information taken by the publications included in the review. Hence, it is possible to provide a broad and multi-perspective overview of literature published on phenomena concerning human beings' interaction with the entity information.

This interaction has been initiated in the *Information Science* field and resulted in the development of a new research stream called "Human Information Behaviour". Drawing on the notion of "Human Information Behaviour" as it is used in this field, we refer to "Human Computer-based Information Behaviour" (HCIB) as "the totality of human activities and non-activities (e. g. avoidance) in relation to computer-mediated channels of information, including both information seeking and information use" [adapted from 108, p. 49].

Related research has not only been conducted in the field of Information Science, but also in the Human Computer Interaction. However, the focus has not been set on the behaviours concerning the access and use of information from computer-based sources. The Information Science discipline, for example, recognizes the importance of technological artefacts for explaining information-directed human behaviour, but technology itself is not a mandatory part of corresponding research models. Consequently, Information Science also examines information behaviour in scenarios in which information technology is absent, e. g. information acquisition from traditional offline media. In contrast, the Human Computer Interaction focuses explicitly on the interplay between humans and computers. This research is interested less in the human interaction with information from computer-based sources and more in the

interaction between the individual and the technology. In this realm, the entity information is not necessarily part of the research programs, i. e. also the design of computer hardware, for example, is of interest for the community's members. Both streams offer valuable insights into information-directed human behaviour, but neither deals specifically with the information-related behaviours of organizational actors as they interact with computerized information systems. Thus, Information Systems discipline seems to be a promising source of knowledge when it comes to the examination of human information seeking and processing activities since it explicitly looks at information, artificial "systems", and the users who are supported in business contexts.

Research Methodology

Webster and Watson [103] provide the fundamental guidelines for structuring the first part of this review article. A literature review requires (1) the definition of a search scope, (2) a strategy for identifying relevant publications, and (3) the definition of guidelines for analyzing and clustering the selected articles.

Consequently, in a first step, following the recommendations of the "AIS Senior Scholars' Basket of Journals", the search was restricted to publications in the six major top-ranked IS outlets and covered all issues before 2011 accessible via ABI/INFORM and Business Source Premier (Table 1). The goal was to realize a maximum coverage of the most relevant and influential IS literature.

In a second step, we screened the relevant journals based on a list of suitable key words. Therefore, a top-down approach was combined with a bottom-up approach, i. e. potential key words were deduced from existing information behaviour models and compared with the terms used in the IS domain. For that reason, a software tool was developed containing all articles that appeared in the journal MIS Quarterly as it is the journal in the sample with the longest tradition. Every word of all articles was classified with computer-linguistic methods

as noun, verb, and adjective. In a last step, ranked lists of the different types of words occurring next to the term "information" were generated and analyzed. Following this approach, it was possible to amend and extend the key word list by synonyms which had not been identified before and which significantly improve the coverage of the literature review. Finally, the following key words were employed to identify relevant articles: "information behaviour", "information gathering", "information overload", "information processing", "information requirement", "information retrieval", "information sharing", "information need", "information seeking" and "information acquisition". In total, 131 publications were retrieved after searching titles and abstracts. Upon reading the abstracts and performing backward and forward searches based on the corresponding bibliographies, 64 articles were included into the final set of publications. The main criterion for exclusion was the absence of a clear focus on human behaviour. The coding of the various studies investigated in this literature review followed the logic of the framework proposed in the next chapter. Therefore, the framework can be regarded as an instrument for structuring this review article.

In addition to the aforementioned clustering, the reviewed articles were divided according to their underlying research approaches. Following the understanding of Dibbern et al. [17], we interpret the term "research approach" in a general sense consisting of several dimensions. Consequently, we analyzed if the articles belong to an empirical or a non-empirical stream of research and subsequently differentiated between the epistemological foundations interpretive and positivist. The non-empirical articles were classified as conceptual or mathematical / axiomatic [21]. In order to get a better understanding of the predominant research methods employed in past information behaviour research, the papers' techniques for acquiring empirical data were further qualified as survey / interview, case study and laboratory experiment. Thereby, the full range of the knowledge-accrual triangle proposed by Bonoma [6] is covered, which groups those methods according to their internal and external validity. Finally, the level of analysis was extracted ranging from individual over group to organization.

In order to get an impression of the relevance of the analyzed articles for the IS community, an impact analysis was conducted. Therefore, the h index was calculated based on citation data published in Thomson Reuters' Web of Knowledge as the most renowned source for citation data [57]. In its traditional form, a researcher has an index h, if h of his papers are cited at least h times each and the remaining papers of this author have less citations [37]. In this article, the above-mentioned logic is transferred to the articles published in various IS outlets in order to get an h index for every journal on a yearly basis. This allows for the judgment of an article's relevance by comparing its total number of citations with the publishing journal's h index in the specific year.

Table 1. Reviewed IS top journals and number of articles selected

Title of journal	Abbreviation	Coverage	# of selected articles
European Journal of Information Systems	EJIS	1993 – 2010	6
Information Systems Journal	ISJ	1998 – 2010	2
Information Systems Research	ISR	1990 – 2010	17
Journal of AIS	JAIS	2003 – 2010	3
Journal of MIS	JMIS	1984 – 2010	13
MIS Quarterly	MISQ	1977 – 2010	23
		Sum	**64**

Development of a Conceptual Framework

As outlined by Webster and Watson [103], it is essential for a literature review to cluster the identified literature so that common themes and research directions can be identified and ex-

plained. Thus, a literature review is usually concept-centric. In addition to letting these concepts emerge from the analyzed articles, it is possible to create a logical structure ex ante which serves as the underlying framework of the review. For this reason, the general literature on Human Information Behaviour outside the IS discipline was analyzed first, setting a focus on research in Information Science as well as Library Science. For several decades, researchers from this discipline have developed and refined models describing various behavioural steps in information acquisition and use activities. The corresponding researchers primarily try to explain how people search for information in libraries but also in "everyday situations" [79] with and without the support of a computer. Case [10] and Wilson [107] provide an overview over the historical developments in the field and compare the most important models created in the past. A common denominator of these models is the fact that they split up information seeking and use into various steps. Adopting this accepted view in the present literature review allows for elaborating on varying interactions between human beings, information and technology depending on the progress being made by a human information seeker when fulfilling organizational tasks. In addition, many models mentioned by Case [10] and Wilson [107] postulate high numbers of context variables influencing the interaction between human beings and the entity information. These variables were not considered in the process of developing a conceptual framework for this literature review because they are conflicting with the need for a parsimonious model, showing the "sequence of behaviour" [10, p. 122].

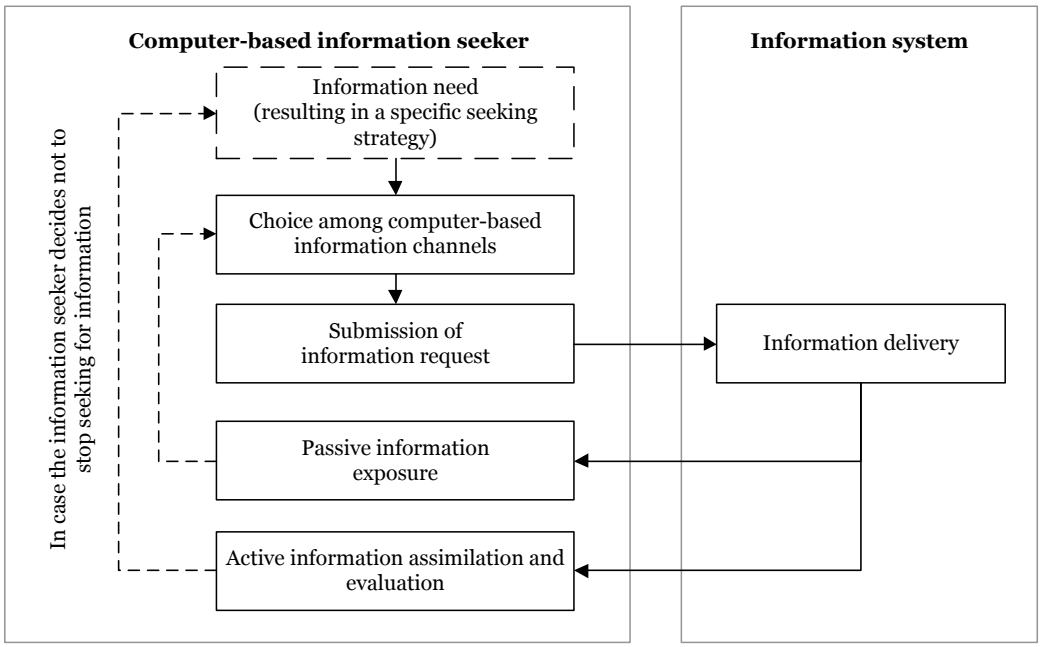

Figure 1. Conceptual framework based on Gemünden [30], Wilson [107], Vandenbosch and Huff [96]

In order to create the conceptual model for structuring the literature analysis in the IS domain, "Wilson's model of Information Behaviour" [107, p. 251] was integrated into a model proposed by Gemünden [30, p. 848]. Both models distinguish between different steps in information acquisition as well as use scenarios and have been widely applied and discussed in past research. While Wilson explicitly mentions an information system as one source of information, Gemünden's provides a complementary, more generic and thus, more generalizable perspective. The aforementioned models are extended by Vandenboschs and Huffs [96] differentiation between focused search and scanning for information resulting in the conceptual framework presented in Figure 1. The framework describes behavioural activities in computer-mediated, both goal-driven (active) search and interest-driven (passive) scanning scenarios.

According to the model, a sequence of goal-driven information-seeking activities is initiated by the awareness of a problem that requires the acquisition of information from the problem domain. Based on this ex ante information need and the emerging information seeking strategy, an adequate information channel is selected, i. e. the question of where to get the information is answered. Restricted by the specific properties of the chosen information channel, the information need is amended resulting in an actual, i. e. "realized" information request. After this interaction with the information system, the human information seeker has to decide on how to actively process and evaluate the resulting information. Therefore, the seeker has to choose from various cognitive strategies culminating in the termination of the process or a reiteration.

In passive information scanning scenarios, however, information is acquired independent of clearly defined problems the information seeker tries to solve. Thus, scanning is exercised when people "browse through information without a particular problem to solve or question to answer" [96, p. 83].The information seeker also chooses a computer-based information channel and requests information from an information system. However, he is not necessarily guided by a clear information need and resulting information seeking strategy (indicated by the dotted line around the "Information need" box). As a consequence, at the end of the information acquisition process, the information seeker is passively exposed to a set of information provided by a computer-based system and has to generate ideas how this information can be used, e. g. to improve organizational effectiveness by fostering creativity and supporting the formulation of new problems [96].

The objective of this framework is *not* to present a complete model in the sense of comprising all independent variables influencing Human Computer-based Information Behaviour but to provide an adequate means for analyzing and categorizing the existing body of knowledge, taking well-accepted definitions of the term "Human Information Behaviour" into considera-

tion. In addition, concepts and topics that emerged from the analysis of the selected IS articles are mentioned subsequently to complement the framework.

Literature Review and Analysis

Following the framework outlined in Figure 1, we assigned the selected articles to the corresponding steps in the information acquisition process they mainly contribute to (Table 2). In the next paragraphs, the major streams of research are presented in a concise way.

Information Need

"Information Need" refers to a gap between the quantity and quality of information available to an individual or an organization and the quantity and quality of information required in a specific scenario, for example in a decision-making process or sense-making situation. Generally speaking, an "anomalous state of knowledge" [4], i. e. the awareness of a lack of information triggers the formation of an information need as a means for adapting to a complex environment [85, 107]. The literature considers various aspects of information needs, ranging from the impact of task characteristics on different degrees of information needs over problems of and solutions for determining information needs to artificially influencing information needs in e-commerce settings.

A large share of articles dealing with differences in information needs is task-centric in a way that an organizational task is conceptualized as an independent variable influencing the seeker's perception of which information might be required (ex ante) to fulfil the given task [58, 86, 105]. Especially the importance of task complexity is stressed by several authors, though it is operationalized in different ways: Specht [86] investigates task analyzability and states that tasks with a low degree of analyzability require less precise but more information than simple tasks. Also Melville and Ramirez [58] regard analyzability as an important characteristic of task complexity. According to them, the latter can either be reduced by increasing information processing capabilities or by decreasing information needs. Browne et al. [9] argue

in a similar way but use the term "task structure" as an indicator for task complexity and hypothesize a positive impact of task complexity on the amount of information required to solve the task and the strategy employed to find the relevant information. Sviokla [91] additionally investigates the reciprocities between task complexity and information needs by concluding that sophisticated information technology does not necessarily help to satisfy information needs. On the opposite, they state that the underlying tasks can quickly mutate in the presence of information technology (in this case, an expert systems) and produce completely new information needs. This topic is closely related to a theme addressed by Wetherbe [105] as well as Mendelson and Pillai [59], namely the accelerating pace of business, constantly increasing information needs and information processing capabilities on an organizational level. While Wetherbe [105] proposes various guidelines for determining information needs in a quickly changing world and translating them into the design of appropriate information systems, Mendelson and Pillai [59] suggest to regard this problem from the opposite perspective: They propose to artificially reduce organizational information needs, arguing that information supply will exceed human information processing capabilities in the sense of humans' bounded rationality otherwise.

Besides explaining the genesis of information needs and describing mechanisms for identifying them, recent IS literature also covers exogenous factors triggering and guiding information processing. Dou et al. [22] build on the schema theory from the field of cognitive psychology in order to show that by priming users of e-commerce websites, the operators of such platforms can indirectly influence the way users navigate through the web page and how intensively they seek for information. Similar studies can be found in the marketing literature with respect to the effect of advertisements on the willingness of its viewers to gather more information about the advertised product or service [55, 61]. The authors base their assumptions on dual-processing theories and argue that specific characteristics of an advertisement such as information density and the size of pictures result in varying degrees of information

needs and finally activate different information processing strategies such as systematic as opposed to heuristic seeking.

In summary, from an IS perspective, it is essential to understand the antecedents of information needs in order to be able to develop information systems that meet these requirements and, thus, allow for efficient decision-making and problem-solving without overwhelming the users with information exceeding the specific needs. Technologies like recommendation engines try to fulfil this demand by matching information needs and information delivered to the information seeker and are presented in more detail below.

Choice among Computer-based Information Channels

Advances in modern information technology result in an increasing number of different ways for acquiring information in organizational contexts. Especially the internet evolved to a valuable source of information created and maintained by its users. The corresponding information is accessible via channels as diverse as e-commerce websites (customer reviews), social networks (user posts), or microblogging applications (tweets). These channels can be differentiated according to dimensions such as accessibility, channel restrictiveness, information volume, transmission velocity etc. [20, 44]. Consequently, some information channels are more attractive than others in information seeking scenarios depending on the task which has to be fulfilled. Interestingly, only a very small number of papers analyzed in this review addressed some specific aspects influencing choices among computer-based information channels.

Jones et al. [44] concentrate on managers' choice behaviour depending on the velocity of information acquisition stating that the managers prefer written information in low-velocity situations, but acquire information from other persons via channels with high information richness (which provide immediate feedback) in high-velocity situations. Other authors emphasize information channels' propensity to reduce the effort in information acquisition tasks.

Wang and Benbasat [100] extend the effort-accuracy framework of cognition [68], holding that information seekers minimize their effort while simultaneously getting as accurate information as possible. Wang and Benbasat show that especially the degree of restrictiveness of decision aids has an impact on the choice of these systems that can be regarded as information channels supporting information seekers in purchasing decisions. In this terminology, a decision aid is restrictive when the decision processes or strategies desired by the decision-maker, are not supported. Thus, an increased perceived restrictiveness of the decision aid leads to a decreasing intention to use this tool since humans generally prefer information channels that are in line with their mental problem representations. Similarly, Jones et al. [45] find that users show a higher tendency to stop using online community websites when the amount of information they can acquire in such an environment, exceeds specific thresholds. Hence, information intensity also has an impact on channel choice, especially on the decision to stop using specific channels in the future.

While the aforementioned articles on choice of computer-based information channels focus on various characteristics of information channels and how these characteristics influence choice, some research considers other aspects of the channel such as the difference between internal and external information (from the perspective of a person within an organization, Jones et al. [44]). Krishnan et al. [48] even take a more technical perspective when designing an information-retrieval agent that is capable of automatically identifying appropriate information channels for solving an organizational task. Thus, they derive design implications from the observation of human problem-solvers while retrieving information from heterogeneous databases.

In the marketing domain, Murray [65] analyzes the differences in consumer behaviour depending on the type of decision the consumer has to make and concludes that subjects have more confidence in personal sources of information when making decisions on services com-

pared to goods. This finding is justified by the idea of services being perceived as riskier than goods and, thereby, directly influencing the choice of appropriate information channels.

Information Request

The category "Information Request" contains all articles which are concerned with the actual act of acquiring information from a specific information system. Therefore, it is significantly different from the information need concept since the latter comprises ex ante assumptions about required information based on a given problem description before the information acquisition process has been started.

Two common themes emerge from the literature review with respect to this category: One group of articles discusses the immediate interaction between the user and the information system, e. g. in the form of user-centered information retrieval systems, while the second group deals with broader concepts such as the amount or quality of information requested in order to fulfill a certain task [70, 94]. With regard to the first group, Gordon and Moore [33] concentrate on the problem of document retrieval and propose a formal language for describing documents. Also in the realm of document retrieval, Stenmark [89] conducted a case study to evaluate an agent-based retrieval prototype putting a link between Information Behaviour research and knowledge management literature: The author shows that organizational IS users stick to established ways of searching when locating information in a knowledge management system. In the specific scenario the users had the chance to search for information by either entering key words or by uploading a document with similar content. Although the latter variant is trivial, a large portion of the users favored the key word search that "requires a (nontrivial) translation to explicit knowledge" (p. 20). Another stream of research addresses semantics and linguistic methods to develop more accurate retrieval mechanisms matching the users' natural language use, e.g. by building so-called "collocation indexes", i. e. groups of words carrying a distinct meaning and therefore reducing ambiguities [1, 90].

Taking a broader perspective on the phenomenon of requesting information from computer-based systems, several authors try to explain why human information seekers deviate from ex ante defined information needs and solve tasks in a less effective way by not considering available, relevant information. The major reason for this behaviour is rooted in the information seekers' limited mental capacities resulting in an information overload if a specific, individual threshold is exceeded [27]. Beyond this point, the information seeker's task performance is reported to decline significantly [13]. Even though this topic has been addressed at least marginally in about ten articles – e. g. Jones et al. [45] and Liang et al. [51] – the overall share of articles dealing with information overload is rather small. This finding is further supported by a comprehensive study on the concept of information overload in organization science, accounting, marketing, and IS, in which the authors conclude: "Surprisingly, MIS has not been the discipline that has dealt with information overload in the most extensive manner" [27]. Current tendencies towards increasingly larger amounts of information being available to decision makers via mobile devices and, thus, ubiquitous accessibility of information, might even aggravate the aforementioned problem. Pitts and Browne [70] and Browne et al. [9] address this trend by investigating human stopping behaviour in information systems design and online search scenarios, i. e. they explain why and when human beings stop seeking for information in computer-mediated contexts. They show that the application of various cognitive stopping rules determines they quantity of information actually retrieved depending on characteristics such as task complexity and former task experience. Prabha et al. [71] provide an extensive overview of stopping rule-related literature in the Information Science domain and conclude that also in this discipline "[it has been] neglected to study how individuals decide what and how much information is enough to meet their [the information seekers'] needs or goals" (p. 75). Economics complement this literature by research relying on expected-utility maximization assuming that humans behave rationally during information seeking in that they are able to quantify the cost of getting additional information and com-

pare it with the expected value of this information in decision tasks [83]. A similar stance is taken by marketing researchers trying to explain consumer search behaviour in sequential search processes [113].

IS-enabled Information Delivery

The two major topics which emerge when looking at the role of information systems in the information delivery process comprise (1) the visualization of the information, e.g. how the information is presented and (2) the personalization of the information to the individual's specific context.

The differing impacts of various forms of information visualization on the efficiency and effectiveness of information systems use have been broadly and extensively analyzed in the past, especially with regard to decision support systems. Starting with the effect of numerical, textual, and relational representations [77], the field matured and intensified the research beyond the classical graph versus table discussions of the past. Vessey and Galletta [98] formalize the concept of cognitive fit by including the human information seeker and calling for an adequate support of human information seeking and problem-solving strategies. Based on the information processing theory, they assume that only a fit between problem solving task and problem representation leads to a consistent mental representation which is the prerequisite for reducing the effort in acquiring information. Lin et al. [53] complement these findings by measuring improvements in human recall and precision when information is visualized in self-organizing maps. Such maps cluster terms of a specific domain such that the size of a cluster correlates with its relative importance. In more recent research, Hong et al. [38] examine the effect of flash animations on online users' performance in search scenarios drawing on theories from cognitive psychology, the central capacity theory, and the associative network model. Chung et al. [15] eventually develop new web visualization methods for facilitating mental model building in exploratory information-seeking processes. Dudezert and Leidner

[23] go into a similar direction by visualizing a company's knowledge assets in knowledge maps.

Starting in 2005, significantly more articles elaborate on the personalization aspect especially in web environments. They cover various topics such as trust in recommendation agents conceptualized as "social actors" with human characteristics [99], or the effect of personalization on user satisfaction and perceived information overload [51]. The reduction of information load in organizational settings by presenting customized content is also addressed [80] as well as users' perceptions of personalized information in decision-making contexts [92].

In the early 1980ies, Ives [42] as well as Robey and Taggart [77] tried to promote another field of research, namely the amalgamation of brain sciences with IS. They claimed that it is required to have a better understanding of the human brain in order to be able to design information systems addressing both functionally different brain hemispheres. This aspect, however, was largely neglected in the following three decades. Riedl et al. [75] use modern brain imaging techniques for the first time in the IS domain in a laboratory experiment. Thus, they advance the field by introducing new approaches for measuring complex cognitive reactions induced by the quality and format of information transmitted to the information seeker. Thus, it is possible to deduce valuable design recommendations for future information systems that provide information in a way that is congruent with processes triggered on a neural basis [74].

Passive Information Exposure

The behaviour humans exhibit "when they browse through information without a particular problem to solve or question to answer" [96, p. 83] is regarded as a mode of passive information acquisition. Thus, this category describes articles dealing with information retrieved from an information system without having a clearly stated problem in mind. Examples of such behaviours are manifold and were investigated from different perspectives in past IS

research. Until the 1990ies, several articles were published addressing strategic scanning behaviour on a managers' level. Then, the research focus has shifted in the last ten years. The recent three publications in IS top journals are exclusively centred around private end users' behaviour dependent on various design aspects of web sites.

El Sawy [26] and Chen [12] present attempts to adapt Executive Information Systems (EIS) in order to reduce the amount of reports, managers have to scan on a daily basis and thus, cope with information overload. El Sawy's research project was motivated by the perception that a huge amount of managers spends a significant amount of time scanning information and that these tasks are regularly not delegated to employees. Descriptive evidence is presented, supporting managers' preference for personal information, orally transmitted to the CEO, finally leading to high-level design recommendations with regard to future EIS. Chen's work on the other hand is primarily problem-centered in that he proposes an EIS solution that structures information along organization models and, thus, delivers additional contextual information that help the managers in fitting the received information into their own mental models. The authors base their assumptions on findings in cognitive sciences as well as managerial thought processes and conclude that the combination of various information sources and organization models will lead to improved organizational learning, arguing that managers browsing through the structured set of information will better understand the shared visions and processes of the company. From today's perspective, the authors' vision reminds of what is today known as "Business Intelligence" as a comprehensive and integrative approach for delivering organizational information to members of the company in a structured way. Watson [102] has a narrow focus on IS managers and describes their scanning behaviour with regard to key issues in the IS area, conceptualizing "scanning" as "the first stage of a response mechanism that leads to an organization adapting to its environment" (p. 218).

Hong et al. [39] investigate a question close to marketing research. In a 2x2 research design, they examine the effects of two different types of information presentation, namely list versus matrix in two shopping tasks and goal-directed search versus experiential browsing. The authors conclude with the observation that information seekers experience lower degrees of mental effort when being exposed to information in a list format when experientially browsing for information. A similar question is addressed by Nadkarni and Gupta [66] however, in a broader context. The authors hypothesize a correlation between a website's complexity and the user experience on this website and assume that this relationship is moderated by the user's task goal, i. e. if he is performing a goal-directed search or if he is browsing. In the latter scenarios, users are intrinsically motivated to process challenging information. According to the authors, this results in an inverse U-shaped curve, i. e. optimal user satisfaction can be observed when the scanning person is exposed to information nested on a website with medium complexity. Liang et al. [51] also confirm this effect in a slightly different scenario: The authors draw on least effort theories in order to explain the impact of personalized web services on user satisfaction depending on scanning versus target search. They conclude that personalized content recommendation systems can reduce information overload and, hence, are preferred when users experientially retrieved information from general purpose websites.

Active Information Assimilation and Appraisal

After the previous section summarized the literature on humans who are passively exposed to information in browsing tasks, this category contains all articles dealing with behavioural and mental processes taking part after the act of requesting specific information in a goal-directed way from an information system. In this context, literature in the IS domain is mainly concerned with (1) the integration of information into mental models and – with a strong focus – (2) the analysis of effort minimization in information-acquisition scenarios.

Vandenbosch and Higgins [95] take a cognitive learning perspective to investigate the relationship between information acquisition and learning in the context of executive support systems. They primarily differentiate between mental model building and mental model maintenance. While the former is conceptualized as a change of an existing mental model in order to integrate new information, the latter represents a confirmation mechanism in which new information fits into the prevalent mental model. The organizational impact of these differing behavioural patterns is illustrated by the assumption that executives, who are scanning information, challenge fundamental assumptions and, therefore, build new mental models while executives who are answering specific questions verify assumptions and, hence, maintain existing mental models [96]. Dou et al. [22] extend this research and show – drawing on the schema theory – that information, evaluated as being incongruent with the searcher's basic assumptions about how the world works, is more memorable and, thereby, make recommendations for the design of search engine marketing campaigns.

While some authors draw on effort-accuracy trade-offs to explain information channel choice phenomena, others refer to it in late phases of information acquisition, before the seeking process is terminated because of the limited information processing capabilities of human problem-solvers [51, 59]. Hong et al. [38] focus on active suppression of information following the central capacity theory, while Browne et al. [9] take the opposite stance and analyze various mechanisms that help to judge the sufficiency of information consumption based on cognitive heuristics. The phenomenon of sacrificing information quality for the sake of reduced effort in acquiring that information is brought up by Liang et al. [51] and Wang and Benbasat [100], albeit without setting a focus on the exploration of that phenomenon.

Findings from Citation Analysis

In addition to the content analysis presented, a citation analysis was conducted. The objective of this analysis is to create an overview of the most influential papers in the context of Human

Computer-based Information Behaviour and to identify trends with regard to the popularity and diffusion of corresponding papers.

In a first step, cross references between the 64 papers were analyzed: In total, only 17 papers were referenced by other publications in the set of 64 papers. Figure 2 shows the four "hub papers" [26, 62, 96, 105] that were referenced (indicated by arrows) by at least three publications. It becomes obvious that the density of cross references is rather low. Although this literature review comprises 64 papers which are related to each other as they deal with the relationship between human beings and the entity information, only a small fraction of these papers is connected to the others via literature references. This leads to the following conclusions: IS top journal publications in the context of Human Computer-based Information Behaviour are largely fragmented. Although many different aspects of Human Computer-based Information Behaviour were researched in the past, a cumulative research strategy seems to be absent. As a consequence, research results concerning these specific questions were not contributing to each other in a cumulative but in a rather isolated way.

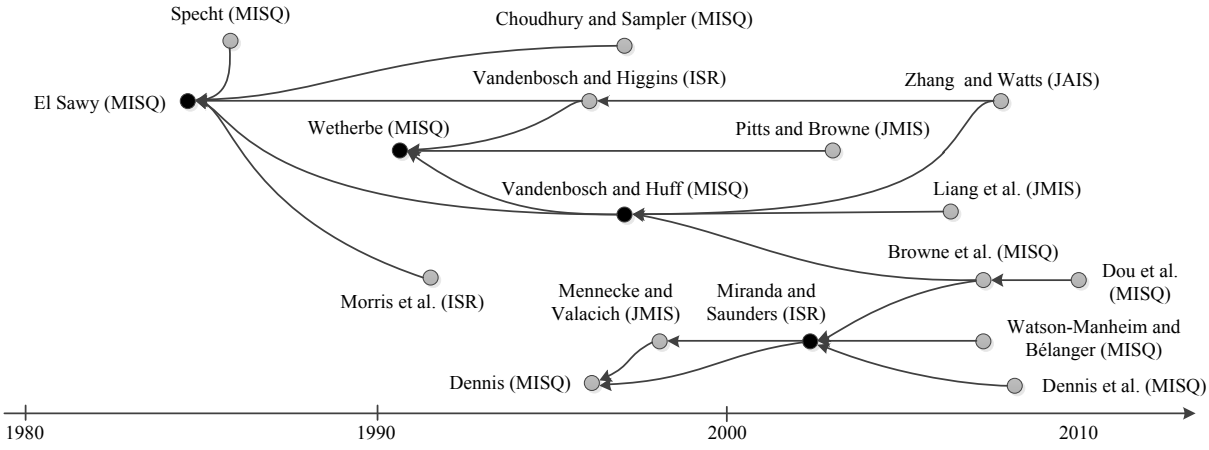

Figure 2: Cross references between publications reviewed in this article (around "hub" articles)

In a second step, the journals' h index was calculated on a yearly basis, following the logic introduced in the method part of this paper. When comparing these figures with the total number of citations for each article, it becomes obvious that most articles published before about 2005 show citation counts that are significantly higher than the corresponding journal's h index in the specific year. After 2005, this rate is much lower, which indicates that research articles in the realm of Human Computer-based Information Behaviour might require some notable amount of time before they advance from a niche article to one that is intensively cited also by many authors outside the IS discipline (the numbers in the column "# of citations" in Table 2 represent all references recorded by Thomson Reuters' Web of Knowledge from various scientific fields). Furthermore, the results suggest that the overall topic of Human Information Behaviour is highly relevant within and outside the IS domain, especially among psychologists. One unanswered questions remains why the intertextual coherence is on a low level within the outlets of the basket of six. This is a rather counter-intuitive finding since the authors of these outlets usually intensively cite articles that were published in the corresponding journals in the past.

Summary of the Research to Date

The articles analyzed follow the common objective of increasing organizational performance by aligning behavioural patterns in the realm of information acquisition and use with the amount, quality, and nature of information provided by technical systems. This can be interpreted as a clear indication for the topic's general importance in IS research that also manifests in the high impact of the corresponding articles in terms of the number of citations they received compared to the journal's h-index in the given year. The existing literature is multifaceted and illuminates various sub-dimensions of Information Behaviour such as information visualization, mental model building and information-seeking stopping behaviour to name a

few. At the same time, there is evidence suggesting that the discipline partly neglects the importance of the entity "information", especially in relation to human behaviour [56], resulting in a list of several topics that have not been addressed intensely by IS researchers in the past:

(1) Impact of information technology on information pathologies

Information pathologies represent deficiencies and inadequacies in the production, transmission, acquisition and use of information and have a significant impact on individual and organizational performance [81, 106]. Literature distinguishes between two major antecedents of information pathologies. On the one hand, power exerted by influential persons in organizations is believed to restrict the amount and the quality of information produced and distributed within the company. On the other hand, limitations with regard to the information receiver's cognitive capacities [85] result in sub-optimal information acquisition and processing strategies and related phenomena such as information avoidance, information overload or the use of over-simplified heuristics [81]. At the same time, information and communication technologies are used intensively in today's organizations and play an important role in supporting the employees in fulfilling their tasks. Thus, it is essential to understand the impact of these technologies on information pathologies in order to avoid the latter by applying appropriate IS design concepts.

However, even though this literature review focuses on information acquisition and use, only a small number of papers address specific categories of information pathologies, e. g. cognitive biases such as terminating information seeking processes too early [9] or the problem of information overload in general [12, 34, 51, 53, 59]. The relative negligence of the information overload problem by IS researchers has already been criticized by Eppler and Mengis [27] because information technology is one of its major drivers by making huge amounts of information easily accessible.

In summary, more research is required to create a broader knowledge base of technology-induced information pathologies, i. e. dysfunctional Human Computer-based Information Behaviour and possible ways of how information technology can help to reduce information pathologies. IS researchers should put more effort in shaping corresponding research programs as our discipline integrates the necessary knowledge about both human behaviour and technology in the context of organizational tasks.

(2) Interdependencies between the various steps in information acquisition processes

The literature review reveals that there is no publication integrating all stages of an information acquisition process and, thereby, covering the topic in a comprehensive way. Especially remarkable is the fact that a systematic examination of the differences between a priori defined subjective information needs, information actually requested from an information system, and information finally assimilated by the human seeker is not existent. It seems reasonable to assume that an initial information need explicated by the seeker will not translate identically into the set of information finally used by the person to make a decision or to solve a problem. This is because the seeker can usually (in non-routine tasks) not determine a priori if the available information channels will provide information in the quantity, quality, and nature (e.g. form of presentation) in which he expects them to appear.

(3) Determinants of information channel choice

From our synopsis we found that there is a lack of literature addressing both determinants of information channel choice and the consequences with regard to subsequent behavioural patterns such as information seeking stopping behaviour [9]. Possible characteristics of the computer-based information channels, influencing its choice, could be properties of the information delivered, such as personalized information versus generic information, internal information versus external information or real-time versus historical in-

formation. Moreover, given the ever-increasing sources of information, including blogs, tweets, and social media, it is important to consider which channels are trusted for what types of information.

To summarize, the primary goal of information systems consists in providing information that supports its users in fulfilling (organizational) tasks in the most effective and efficient way. Therefore, building information systems that fulfil the aforementioned goal necessarily have to take complex reciprocities between the entity information and its use by human beings into account. Thus, the fact that there is only a small amount of literature in the IS domain decidedly dealing with aspects of Human Computer-based Information Behaviour might either be a result of other topics being more important to IS researchers in the past or of reference theories not being sufficiently utilized.

We argue that more siginificant research endeavours are needed in our discipline with respect to the interaction between human beings and the entity information in computer-mediated scenarios because no other scientific community can be perceived as equally interested in the interaction effects between technology characteristics and human behaviour as the IS discipline. After there has been a long and very fertile research trajectory on the acceptance of information technology, the next step should be taken by explaining the actual use of the information provided by the myriad of information systems available to organizational actors today [5].

Potential Avenues for Future Research

The gaps outlined above reveal a significant potential for future research and, in particular, theory development and theory refinement. We argue that advances in theory development and refinement in the field of Human Computer-based Information Behaviour are missing, but a crucial element for explaining the use and informing the design of information systems. Thus, this section intends to exemplify certain paths for developing and refining theory in

Human Computer-based Information Behaviour combining various aspects of information acquisition and use identified. The focus is set on the explanation of technology-induced information pathologies since it constitutes a promising research trajectory identified in the previous chapter.

As explained above, the growing number of articles dealing with Information Behaviour in online settings during the last decade is a clear indicator of the novelty of phenomena arising in web environments, not covered by existing socio-technical theories [80, 92, 99]. Kuruzovich et al. [50] argue that information available online can be accessed more easily compared to offline information, i. e. the cost for acquiring information on the web in terms of the effort the information seeker has to exert, is very low, potentially resulting in information overload [15, 51] due to limited information processing capabilities. Consequently, the information seeker has to make a decision – either consciously or subconsciously – when to stop acquiring information and proceed to the next step in a given task [9, 67].

However, not only the quantity of information is growing but also the number of various technologies (information channels) for accessing this information is rising: As shown in the review above, e. g. shopping websites try to implement recommendation agents with human features [99] and, thus, are in line with companies such as Twitter or Facebook to provide "social content" created by other internet users [28]. Little is known, however, about the interplay between the use of specific information channels, the induced stopping behaviour and the consequences on task performance. This gap is addressed by proposing avenues of research which we consider promising in the future. Theses avenues of research will be subsequently developed.

In his seminal work, Wood [109] introduces a positive link between task complexity and the number of distinct information cues required for solving the task. Empirical research corroborates this assumption by showing that increasing task complexity directly and positively influ-

ences the information processing requirements [43, 112]. From a cognitive perspective, task complexity also influences the mental workload of the problem-solver which can be ascribed to the higher number of activities which have to be performed in order to gain the required information. Moreover, the transformation of the – possibly contradicting – information cues into a coherent mental model and, thus, suitable problem representation, increases mental workload [88, 109]. Since human beings' cognitive capabilities are restricted in the sense of a bounded rationality, it is not possible to process unlimited amounts of information. Therefore, simplification strategies, also known as heuristics, are applied in order to guide the process of seeking for information. The most important characteristic of the use of heuristics is the fact that not all available information is processed but only a small subset that appears to be relevant, so that cognitive effort is reduced [31]. Furthermore, complex tasks can usually not be decomposed into separate elements that would be easier to assess. As a consequence, information seekers have to employ holistic approaches for representing the task and deducing the corresponding information needs which results in the seeker acting "on his 'sense' or 'image' or 'gist' of the situation" [9, p. 93]. Dual-processing theories as mentioned in one of the reviewed articles [111], serve as a general and well researched framework for characterizing information seeking and use as either systematic or heuristic [11]. In summary, we propose:

Avenue 1: *The more complex a task is to fulfil, the higher is the propensity to use heuristic information seeking strategies. Thus, the latter should be further researched with respect to properties of a specific which an information systems is supposed to support.*

The relatively high amount of articles in our review that are related to contemporary online contexts indicates a significant research interest in behavioural patterns humans show when acquiring information in a computer-mediated, i. e. artificial but nevertheless "social" environment [28, 99, 111]. However, the articles are largely silent on the implications this "social-

ly enriched" information has on subsequent information seeking strategies. Information channels conveying additional social cues such as opinions of friends about specific topics or aggregated ratings of a large group of internet users contain information that goes beyond "objectively correct information" [16, p. 439]. Thus, they are likely to support a holistic approach for making sense of the acquired information without a thorough argument scrutiny [69]. Consequently, instead of processing discrete and individual informational elements on more cognitive basis, the problem-solver might act relying on a "sense" of the situation which is strongly influenced by affect [6, 71]. This propensity is even more present when the information seeker has to fulfil complex tasks in which social cues can help to reduce cognitive effort by providing source legitimation [16].

Avenue 2: *The more information channels are utilized that provide social cues, the more heuristic information seeking strategies are employed. Thus, we see another promising research avenue in disengtangling the social elements of new media and its impact on computer-mediated human information behaviour.*

The termination of information-seeking activities is a crucial step in the context of online environments since the amount of information accessible by the information seeker regularly exceeds his processing capabilities [9]. Several research endeavours in psychology [32], business administration [2] and economics [83, 84] conducted in the past three decades offer important insights into the reasons why and when human beings stop seeking for information. Usually, an "optimal" stopping strategy is defined in the introductory part of the corresponding papers (normative stopping rules) before these are compared with actual human behaviour exercised under laboratory conditions (descriptive stopping rules). A large proportion of the articles assumes that human information seekers try to reduce their effort of seeking information while increasing expected benefits from the information they obtain by following rules

like “search until the perceived marginal benefit of search is equal to the perceived marginal cost” [46, p. 30]. At the same time it can be stated that humans often do not acquire enough information before making decisions or giving recommendations [2, 3, 73], even though underacquisition of information usually results in a decrease in task performance [8]. One of the reasons for such an undesirable behaviour is impulsiveness guiding the information seeker by applying simplifying heuristic information seeking approaches. Since it can be assumed that there are reciprocal interdependencies between information seeking approaches and the decision to stop seeking for information [8], judgments about having obtained enough information might be undertaken more impulsively when the underlying seeking approach is following intuitive, reflexive instead of rational, reflective activities as described in dual-processing theories. We thus propose,

Avenue 3: *The more heuristic information seeking strategies are employed, the more impulsive information seeking stopping rules are used. Thus, we strongly advocate the investigation of information seeking strategies in combination with information stopping behaviours.*

As shown in the review above, research on recommendation agents in online settings has become more popular in the past few years [51, 99]. The (software) agents provide information that is aligned with the information seekers mental model as well as possible. However, there have not been any research efforts dealing with the problem of delivering contradicting information to the recipient. Cognitive dissonance theory holds that information that does not fit into the information seekers’ view of the world causes negative affective states [35]. As a consequence, the information seeker is more likely to avoid this information [29]. Since this behaviour is mainly based on affective stimuli, it can be argued – following a similar line of thought as in Avenue 3 – that the likelihood of an impulsive as opposed to rationally reflected

termination of the entire seeking process increases because of the activation of intuitive, automatic modes of information processing. Therefore, we propose

Avenue 4: *Information that is not in line with the information seeker's mental model will result in the use of impulsive information seeking stopping rules. Thus, we advocate to study the interrelationship of impulsive (affective) information behaviours and reflective (cognitive) information behaviours in the light of computer-mediated information systems.*

The theory of channel-dependent information seeking, stopping and information avoidance behaviour integrates both ideas from the reviewed articles and reference theories from neighbour disciplines. In addition to advancing and refining theory in the context of Human Computer-based Information Behaviour, it offers the potential to inform IS designers and IT managers about cognitive strategies and heuristic processing exercised by human beings who are exposed to complex tasks and information, rich in social cues. Creating a better understanding of these behavioural patterns and characteristics of underlying technologies will support employees in organizations to work more effectively and – e. g. in e-commerce environments – to guide prospective customers' informational activities.

Conclusion

Research in the IS domain has been intensely concerned with the explanation of human behaviour in the use of information technology. Initially, we assumed that there is a comprehensive body of knowledge dealing with the interrelationship between the discipline's core entity – information – and the behaviour humans exert in order to better support organizational tasks in computer-mediated business scenarios. From our perspective, more fundamental research in the field of "Human Computer-based Information Behaviour" is a key prerequisite for using and designing information systems that support the evolutionary, social, and experience-

shaped information-seeking patterns of humans [47]. Surprisingly, questions conceptualizing Human Information Behaviour in computer-mediated settings have not yet been researched explicitly and coherently in the IS domain. However, based on the articles included in our review, they provide strong evidence for the topic's importance– a fact that calls for concentrated and incremental interdisciplinary research endeavours in the future. By outline four avenues of future research, we hopefully have been able to stimulate behavioural IS scholars to further explore our discipline's core artefact: information.

Appendix

Table 2. Selected research addressing Information Behaviour-related aspects in the IS domain (due to page limitations, articles published between 2005 and 2010 are not listed. A complete list can be requested).

Journal	Study	Stages in information acquisition process					Research approach				Research method			Level of analysis			Impact		
							Empirical		Non empirical										
		Information need	Choice among comp.-based info channel	Information request	Information delivery	Information assim. and evaluation	Interpretive	Positivist	Conceptual	Mthematical / axiomatic	Survey / interview	Case study	Lab. experiment	Individual	Group	Organization	Journal's H-Index (Y)	Average # of citations	# of article citations
MISQ	(Ives, 1982)				x				x					x			/	/	/
MISQ	(Robey and Taggart, 1982)				x	x			x					x			/	/	/
MISQ	(Huber, 1984)				x				x						x		14	34	166
MISQ	(El Sawy, 1985)	x	x		x	x		x			x			x			17	40	40
MISQ	(Specht, 1986)	x						x				x		x			14	32	8
JMIS	(Sviokla, 1989)	x					x					x				x	/	/	/
Total	**Total 1980-1989**	**3**	**1**	**0**	**4**	**2**	**1**	**2**	**3**	**0**	**1**	**2**	**0**	**4**	**1**	**1**			
MISQ	(Watson, 1990)	x	x			x		x			x			x			16	24	35
ISR	(Vessey and Galletta, 1991)				x	x		x					x	x			/	/	/
MISQ	(Wetherbe, 1991)	x			x				x					x			22	62	38
ISR	(Morris et al., 1992)				x	x		x					x	x			/	/	/
MISQ	(Todd and Benbasat, 1992)			x		x					x			x			21	52	92
ISR	(De et al., 1993)									x				x			/	/	/
EJOIS	(Hertzum et al., 1993)				x				x								/	/	/
EJOIS	(Jones et al., 1993)		x									x					/	/	/
JMIS	(Chen, 1995)				x	x			x					x			/	/	/
MISQ	(Dennis, 1996)					x		x					x		x		17	63	97
EJOIS	(Rudy, 1996)																9	12	23
ISR	(Vandenbosch and Higgins, 1996)	x				x		x			x			x			16	39	34
MISQ	(Choudhury and Sampler, 1997)			x					x							x	18	70	46

Journal	Study	Stages in information acquisition process					Research approach				Research method			Level of analysis			Impact		
							Empirical		Non empirical										
		Information need	Choice among comp.-based info channel	Information request	Information delivery	Information assim. and evaluation	Interpretive	Positivist	Conceptual	Mathematical / axiomatic	Survey / interview	Case study	Lab. experiment	Individual	Group	Organization	Journal's H-Index (Y)	Average # of citations	# of article citations
ISR	(Moore et al., 1997)					x				x				x			15	47	6
MISQ	(Vandenbosch and Huff, 1997)	x		x		x		x				x		x			18	70	47
ISR	(Mendelson and Pillai, 1998)	x				x		x			x					x	17	50	41
JMIS	(Mennecke and Valacich, 1998)		x		x			x					x		x		/	/	/
ISR	(Gordon and Moore, 1999)			x	x					x							15	42	2
JMIS	(Grisé and Gallupe, 1999)				x	x		x					x	x			11	24	21
JMIS	(Lin et al., 1999)				x								x	x			11	24	15
Total	**Total 1990-1999**	**5**	**3**	**4**	**9**	**11**	**0**	**9**	**4**	**3**	**4**	**2**	**6**	**12**	**2**	**2**			
ISR	(Bordetsky and Mark, 2000)					x			x					x			15	46	8
EJOIS	(Edwards et al., 2000)	x						x					x	x			6	17	5
ISR	(Lim et al., 2000)				x	x		x					x	x			15	46	14
ISR	(Krishnan et al., 2001)	x	x	x	x			x		x		x	x	x			16	59	8
JMIS	(Stenmark, 2001)			x	x	x	x					x		x	x		21	45	27
ISR	(Miranda and Saunders, 2003)		x		x	x	x						x	x			16	62	49
ISJ	(Rafaeli and Ravid, 2003)			x	x								x		x		10	12	12
ISR	(Hong et al., 2004a)				x	x		x					x	x			16	45	31
JMIS	(Hong et al., 2004b)	x		x	x	x		x					x	x			17	19	31
ISR	(Jones et al., 2004)		x	x		x		x				x		x			16	45	67
MISQ	(Kumar and Benbasat, 2004)				x	x		x					x	x			20	73	10
JMIS	(Browne and Pitts, 2004)			x		x		x					x	x			17	19	12
ISR	(Schultze and Orlikowski, 2004)			x	x		x					x		x			16	45	54
JMIS	(Chung et al., 2005)				x				x					x			17	17	26
ISR	(Jiang et al., 2005)			x	x				x								14	30	3
JMIS	(Nelson et al., 2005)							x			x			x			17	17	48
JAIS	(Wang and Benbasat, 2005)	x			x			x					x				/	/	/
EJOIS	(Hovorka and Larsen, 2006)	x					x					x		x			11	9	2

Journal	Study	Stages in information acquisition process					Research approach				Research method			Level of analysis			Impact		
							Empirical		Non empirical										
		Information need	Choice among comp.-based info channel	Information request	Information delivery	Information assim. and evaluation	Interpretive	Positivist	Conceptual	Mathematical / axiomatic	Survey / interview	Case study	Lab. experiment	Individual	Group	Organization	Journal's H-Index (Y)	Average # of citations	# of article citations
MISQ	(Kuechler and Vaishnavi, 2006)				x								x	x			21	31	6
JMIS	(Liang et al., 2006)	x			x	x		x					x	x			14	11	17
JAIS	(Li and Kettinger, 2006)			x		x			x								9	6	4
JMIS	(Liang et al., 2006)	x		x	x	x		x					x	x			14	11	17
EJOIS	(Scheepers, 2006)				x				x			x				x	11	9	4
MISQ	(Tam and Ho, 2006)				x	x		x				x	x	x			21	31	20
MISQ	(Arazy and Woo, 2007)			x	x			x					x				15	22	2
MISQ	(Browne et al., 2007)			x		x		x					x	x			15	22	10
MISQ	(Watson-Manheim and Bélanger, 2007)		x	x				x				x		x			15	22	28
MISQ	(Nadkarni and Gupta, 2007)	x			x	x		x					x	x			15	22	13
MISQ	(Dennis et al., 2008)		x						x					x			12	13	37
ISR	(Forman et al., 2008)				x	x		x				x		x			8	6	37
ISJ	(Melville and Ramirez, 2008)	x			x			x			x					x	8	5	4
JMIS	(Ren et al., 2008)	x					x					x			x		11	7	9
ISR	(Storey et al., 2008)			x	x				x								8	6	3
JAIS	(Zhang and Watts, 2008)					x		x			x			x			6	4	0
MISQ	(Wang and Benbasat, 2009)		x		x	x							x	x			8	4	4
MISQ	(Dou et al., 2010)	x			x	x		x					x	x			3	1	1
MISQ	(Mani and Barua, 2010)	x			x			x			x					x	3	1	2
MISQ	(Riedl et al., 2010)				x	x		x					x	x			3	1	3
Total	**Total 2000-2010**	**12**	**6**	**14**	**26**	**20**	**5**	**23**	**7**	**1**	**4**	**10**	**20**	**28**	**3**	**3**			
Sum	**Sum 1980-2010**	**20**	**10**	**18**	**39**	**33**	**6**	**34**	**14**	**4**	**9**	**14**	**26**	**44**	**6**	**6**			

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