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Conceptualization and Typology of Guidance in Information Systems

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Abstract

Organizations use intelligent systems, a special kind of information system, to provide knowledge and guidance for their employees in their daily work. Concepts of guidance have been researched in the Information Systems community and related communities for decades. But due to the missing of a common concept and typology of guidance it is hard to compare the findings of the existing research streams. This paper extensively reviews and analyses the work on decisional guidance, explanations and on decision aids conducted in the last 20 years of research. Building on and grounded by the analyzed literature, a conceptualization and typology of guidance is proposed and discussed. In addition, the findings on positive and negative effects of guidance are outlined. This research contributes to both, research and practice. Researchers' will be enabled (1) to describe their own work on guidance by using a set of terms predefined for the Information Systems research community and (2) to compare various research on guidance. Practitioners will be provided with a set of design guidelines in order to implement intelligent systems using various guidance effects in order to improve their processes and systems.

1 Introduction

Organizational environments are getting more and more complex (Riemer et al., 2009). Therefore, organizations tend to introduce information systems (IS) that allow for codifying organizational knowledge and expertise in order to make them available for employees (Lado and Zhang, 1998) and to manage such complex environments. For example, there exists a class of IS specifically aiming to support humans in decision making. One representative of this class are Decision Support Systems (DSS) that aim to provide decisional advice (Turban and Aronson, 2001) in order to make decisions faster, better and easier. DSS have been used, for example, in practice for medical diagnosis (Buchanan and Shortliffe, 1984) or supervising a nuclear power plant (Mosier and Skitka, 1996). They provide decisional guidance by explaining to the user why the system performs a certain action, suggests a certain decision, or outputs a certain result. Similar to DSS, another representative of the class supporting humans in decision making are Expert Systems (XPS). XPS represents a specific type of IS that focus on emulating the decision-making ability of a human expert (Jackson, 1998) and guide humans through complex decision problems using an integrated knowledge base (also referred to as Knowledge-Based Systems (KBS)). A key feature of XPS is the additional provision of explanations on recommendations (Richards, 2003) by providing knowledge on what the systems knows, how it works and why actions are appropriate (Swartout, 1987). With such explanations, the decisions or results of the system are more likely to be accepted by the user (Ye and Johnson, 1995). All these systems focus on supporting decision making processes by providing either decisional guidance (cf. Silver, 1991), explanations (cf. Gregor and Benbasat, 1999), or decision aids (cf. Todd and Benbasat, 1991). As a result, research on such systems results in three separate streams. However, we argue that a combined consideration of all three kinds of guidance is appropriate not only to support users in making proper decisions but also in executing complex processes and in using IS efficiently and effectively. Thus, guidance is of value for all kinds of IS (Silver, 2006) as well as all types of processes. Our research aims to address all concepts of guiding humans in process execution and IS usage. We summarize all IS using one or more concepts of guidance into **intelligent systems**, defined as *"…class of systems providing advice to a decision maker and includes XPS and DSS"* (Gönül *et al.*, 2006, p. 1482). By conducting an intensive literature review on intelligent systems, we aim to extend the body of existing knowledge by developing an integrated typology of guidance. Such a typology supports researchers to (1) describe their own work on guidance by using a set of terms predefined for the IS research community and (2) enable the comparison of various research on guidance. Our research investigates the following research question:

> *How can existing guidance concepts in IS research be conceptualized in order to develop an integrated typology of guidance?*

In the subsequent section, we introduce the three research streams of guidance in IS research in more detail. Our research methodology is outlined in section 3, followed by a conceptualization of guidance and typology of guidance in section 4. Next, section 5 discusses effects of guidance, before we conclude the paper.

2 Three Streams of Guidance

We identified three research streams focusing on guidance mechanisms. The first stream is research on **decisional guidance,** often studied in the context of DSS. Silver (1991) introduces in his studies decisional guidance as the design features of DSS. He differentiates between two fundamental forms of deliberate guidance: decisional guidance and mechanical guidance. In his rephrased definition of deliberate decisional guidance, Silver (1991) describes guidance as "*the design features of an interactive computer-based system that have, or are intended to have, the effect of enlightening, swaying or directing its users as those users exercise the discretion the system grants them to choose among and use its functional capabilities*" (Silver, 2006, p. 105). Silver (2006) demonstrates the wide range of the concept of decisional guidance and discusses the applicability across different kinds of IS. He broadens the scope of guidance from a design feature for DSS to design features for IS in general. By reviewing existing literature, he modifies his original classification, which included targets, forms and modes (Silver, 1991) as categories of decisional guidance, to the categories targets, directivity, modes, invocation style and timing (Silver, 2006).

Research on **explanations** forms the second stream we identified. In this stream, Gregor and Benbasat (1999) research "*information systems with an 'intelligent' […] component*" (Gregor and Benbasat, 1999, p. 497). They describe them as computer-based systems that have a built-in knowledge database, enabling them to provide users explanations for the outputs of the system. They state that "*explanations serve to clarify and make something understandable, or are a 'declaration of the meaning of words spoken, actions, motives, etc., with a view to adjusting a misunderstanding or reconciling differences'*" (Gregor and Benbasat, 1999, p. 498). They review existing work on the nature and use of explanations and propose the classification of explanations according to the content type, presentation format and provision mechanism (Gregor and Benbasat, 1999). The content type describes the explanation itself. The authors provide four types of explanations: trace / reasoning, justification / support, control / strategic, and terminological. These explanation types are further characterized by the presentation format, text-based or multimedia, and the provision mechanism, automatic, user invoked or intelligent.

The third stream addresses studies on **decision aids.** Here, Todd and Benbasat (1991) examine the impact of decision aids on decision making strategies. They state that decision aids do not restrict users by guiding them through the usage of the system, instead they are supported in selecting the proper system functionalities (Todd and Benbasat, 1991). The researchers do not define the term decision aid in greater detail. Arnold *et al.* (2004b) define decision aids as "*software intensive systems that integrate the expertise of one or more experts in a given decision domain*" (Arnold *et al.*, 2004b, p. 2). According to these authors, the purpose of decision aids are to provide recommended solutions to a problem or provide assistance in making a decision. Many types of decision aids exist ranging from simple or deterministic models to decision support systems (DSS) to intelligent systems (Messier, 1995).

In summary, there are similarities and contradictions among the three concepts which need to be investigated rigorously. How are the three research streams interrelated? What are the differences in the research streams? Are three streams needed or do they describe the same concept and could be combined? There is a need for an integrated picture of research on guidance in IS. Thus, in order to develop a clear typology that helps in analyzing and classifying the existing and future research, we need to conduct an extensive literature review following the review methodology outlined below.

3 Review Methodology

The literature review is conducted following the guidelines by Webster and Watson (2002) and vom Brocke *et al.* (2009). According the recommendations of vom Brocke *et al.* (2009), in a first step we used the taxonomy by Cooper (1988), who categorizes reviews according to six categories: (1) focus, (2) goal, (3) perspective, (4) organization, (5) coverage, and (6) audience. Table 1 summarizes our review intention based on Cooper's (1988) categories.

Having a clear scope of the literature review, we started the literature review with the conception of the topic and the definition of search terms. The seminal papers discussed in the previous section are utilized for the definition of the search parameters. The search query was iteratively tested and extended. In addition, we had to adapt the following queries to the technical specifications of the different databases:

("guidance" OR "decisional guidance" OR "explanations" OR "decision aids") AND ("decision support systems" OR "DSS" OR "expert systems" OR "intelligent systems" OR "information systems")

Category	Description
Focus	Research outcomes of application of guidance in the IS research community
Goal	Integrate and synthesize existing literature related to the concept of guidance
Perspective	Objective, neutral perspective
Organization	Results organized in the form of a taxonomy
Coverage	By using databases containing the leading IS journals and conference publications
Audience	IS research community and practice

Table 1: Categorization of literature review (based on Cooper, 1988)

In order to guide our evaluation procedures during the literature search process, we derived explicit inclusion and exclusion criteria in accordance with our research goal, providing additional transparency for the search and the literature evaluation procedures. With respect to the time frame, we anchored our study using the paper by Silver (1991). Thus, we focused on research performed after 1991, and furthermore, publications had to be peer reviewed and written in English. We excluded research which was solely about the implementation, usage and evaluation of intelligent and related systems without addressing guidance.

For finding relevant data sources, we queried scientific databases containing journals and conference publications (Webster and Watson, 2002). We performed searches on the following databases: EBSCSOhost, ProQuest, ACM Digital Library, IEEE Xplore Digital Library and AIS Electronic Library. The databases were selected in order to include the basket of six and most important conferences in the IS field. In addition, we did not filter to specific journals or outlets in order to include research from information systems, business, and computer science research being also relevant for our studies. Within the databases, we searched by title and abstract, and when possible, by author.

The results were categorized according to their contribution: Do they **conceptualize** guidance and/or **use** guidance? Literature addressing the conceptualization of guidance formulates new concepts of guidance or modifies existing concepts. Articles addressing the use of guidance describe the realization of guiding concepts to solve certain issues. These categories are not mutually exclusive and a paper could be assigned to one or both categories. In addition, we sorted the papers according to the used guidance streams introduced in section 2.

In total, we identified 63 papers after executing the analysis and backward search. Due to the limited space in this publication, we do not publish the full list of papers. Table 2 depicts the number of found literature arranged by its contribution, guidance stream and search phases.

Phase	Total					Conceptualizing					Using					Both				
	#	DG	EX	DA	NA	#	DG	EX	DA	NA	#	DG	EX	DA	NA	#	DG	EX	DA	NA
Keyword	**2128**																			
Abstract	**101**																			
Full text	**53**	11	26	11	5	**4**	1	3	0	0	**45**	10	19	11	5	**4**	0	4	0	0
Backward	**10**	5	3	2	0	**1**	1	0	0	0	**8**	4	2	2	0	**1**	0	1	0	0
Result	**63**	16	29	13	5	**5**	2	3	0	0	**53**	14	21	13	5	**5**	0	5	0	0

Table 2. Paper count sorted by contribution (conceptualizing guidance, using guidance and both), used guidance stream (decisional guidance (DG), explanations (EX), decision aids (DA) or (NA) if none of the streams was applicable), and phase (keyword search, abstract and title analysis, full text analysis, backward search and the final result)

Out of 63 papers, we identified five articles which conceptualize guidance, 53 articles using guidance, and five articles addressing both categories. Based on the various types of guidance, we found 16 papers referring to decisional guidance, 13 papers referring to decision aids, 29 papers referring to explanations and five papers referring to the concept of guidance not covered by the three streams. When considering the identified articles in the course of time, we notice that until the year 2000 all three streams of guidance were discussed at nearly the same rate and explanations addressed the most. In more recent years, the research interest seemed to focus more on explanations, based on the count of found papers in this literature review. A possible reason for this distribution could be the interrelation of the three guidance concepts and how the concepts are used in the existing research. The following section 4.1 discusses the concepts and outlines the interrelation among them.

4 Conceptualization and Typology of Guidance

As stated in the introduction and the discussion of the three research streams, there is a need to analyze the existing research and to provide a conceptualization of guidance in IS research. Before presenting and discussing the main contribution of our research, the typology of guidance, we provide our conceptualization and a definition of guidance based on the literature found.

4.1 Conceptualization of Guidance

Decisional guidance originally describes design features of DSS supporting users in the usage of the system (Silver, 1991). The broader concept of decisional guidance as stated by Silver (2006) (Silver,È can be used for more than DSS, as it can also be adapted to IS in general. We interpret decisional guidance as an abstract concept, describing how to support users in the usage of IS.

Explanations are a guidance concept, supporting users in the usage of systems and in the understanding of the system results. The found literature discussing the concept of explanations shows how the notion of explanations is extended and improved over time. Dhaliwal and Benbasat (1996) defined an extensive framework for the evaluation of explanation usage, and building on that framework, other researchers (e.g. Gregor and Benbasat, 1999; Arnold *et al.*, 2004a; Gönül *et al.*, 2006) modified and extended the concept of explanations.

Decision aids can be seen as an umbrella term of guidance concepts and also as systems supporting users in their decision process. Decision aids include systems such as DSS and XPS (Arnold *et al.*, 2004a) as well as its overarching systems: the **intelligent systems** (Gönül *et al.*, 2006).

For the remainder of the paper, we use following terms: **Decisional guidance** or **guidance** in general to describe the concept of supporting users in their processes and system usage, **explanations** as an instantiation of guidance describing in detail the characteristics of this provided guidance and **intelligent systems** to describe systems or components providing guidance to the user.

Based on the definitions of the main concepts on guidance (decisional guidance (Silver, 2006, p. 105), explanations (Gregor and Benbasat, 1999, p. 498), decision aids (Arnold *et al.*, 2004b, p. 2) and intelligent systems (Gönül *et al.*, 2006, p. 1482)), we formulate an integrated definition as follows:

> *The design features of an intelligent system that have, or are intended to have, the effect of enlightening, swaying, clarifying or directing its users by utilizing the expertise of one or more experts of the domain.*

4.2 Typology of Guidance

The main goal of this research is to create a typology of guidance based on the findings of the literature review. In order to have a starting point, we used the existing categories of the seminal papers from section 2 to create an initial typology. The typology include categories of decisional guidance by Silver (2006), *target, directivity, modes, invocation styles and timing,* and the categories of explanations by Gregor and Benbasat (1999), *content type, presentation format and provision mechanism.* The main goal of the typology is to provide a common set of characteristics to describe types of guidance applicable for all, excluding the content of the described guidance. We argue that content types as a category of guidance (as proposed by Gregor and Benbasat, 1999) is too specific for the typology of guidance. Therefore we exclude the content type in order to provide a common and generally applicable typology of guidance.

Building on these categories, we analyzed the found literature, searched for further categories and examined characteristics of guidance. Figure 1 depicts the result of this analysis. The first six categories represent the initial typology taken from the seminal papers. We added two additional categories, namely intention of guidance and the audience of guidance, while analyzing the found literature. The footnotes in the figure indicate the primary sources for the categories and characteristics. Characteristics having no footnote are added by us based on indicators discussed in several articles. Below, we describe the characteristics in more detail as well as reasoning the inclusion of additional characteristics.

The category **target** is taken from Silver's (2006) decisional guidance. In contrast to his original DSS-related definition from 1991, he generalized the two characteristics to choosing functional capabilities and using functional capabilities of a system. Decisional guidance may support users as they interact with the system and are confronted with its complexities. It helps users choosing between and interacting with a system's capabilities (Mahoney *et al.*, 2003). Mahoney *et al.* (2003) used suggestive guidance to support users in the choice of the display format in their research about tasks involving uncertainty data. They found that decision makers were more accurate and responded faster when symbolic tasks were matched with tabular displays and spatial tasks were matched with graphical displays (Mahoney *et al.*, 2003).

categories	characteristics			
target(1)	choosing functional capabilities(1)	using functional capabilities(1)		
directivity(1)	suggestive(1)	quasi-suggestive(1)	informative(1)	
mode(2)	predefined(2)	dynamic(2)	participative(2)	
invocation(1)	automatic(3)	user-invoked(3)	intelligent(3)	
timing(1)	prospective(1)	concurrent(1)	retrospective(1)	
format(3)	text(3)	image	animation	audio
intention(4)	clarification(4)	knowledge(4)	learning(4)	recommending
audience(3)	novices	experts		

(1) (Silver, 2006) (2) (Silver, 1991) (3) (Gregor and Benbasat, 1999)
(4) (Gönül *et al.*, 2006)

Figure 1. Typology of Guidance

In terms of guidance **directivity,** Silver (2006) distinguishes three types of directivity. First, informative guidance "*provides pertinent information that enlightens the user's choice without suggesting or implying how to act*" (Silver, 2006, p. 109). Opposing that, suggestive guidance "*makes explicit recommendations to the user on how to exercise his or her discretion*" (Silver, 2006, p. 109). In addition, Silver (2006) added a mix of both types: the quasi-suggestive guidance "*that does not explicitly make a recommendation but from which one can directly infer a recommendation or direction*" (Silver, 2006, p. 109). Montazemi *et al.* (1996) found that suggestive guidance enabled the subjects to perform better than informative guidance(Montazemietal.,Ç. In addition, they found that for less complex tasks suggestive guidance outperformed informative guidance, but for more complex tasks informative guidance outperformed suggestive guidance (Montazemi *et al.*, 1996). Parikh *et al.* (2001) found that suggestive guidance was more effective in improving the decision quality, increasing the user satisfaction and reducing decision time, whereas informative guidance was more effective in user learning about the problem domain. Parkes (2013) demonstrates that suggestive guidance is a significant predictor of reliance, and therefore, the persuasiveness of the decision aid. In contrast, informative or no guidance do no significantly affect reliance, and therefore have a limit effect on persuasiveness. This finding establishes the importance of carefully considering the design of guidance offered by a decision aid (Parkes, 2013).

Regarding the guidance **mode**, Silver (1991) proposes pre-defined, dynamic, and participative guidance. In contrast to the category target, he does not generalize the original DSS-related definitions (Silver, 1991). Therefore, we generalize his original definitions to the following: predefined guidance is defined as guidance that is prepared by the system designer and is static in its form. In contrast to this, dynamic guidance is not prepared upfront, and instead the systems "learns" from the user and generates the guidance on demand. The third type, participative guidance, depends on the users' input for the received guidance, in contrast to the other modes which do not need user input. Participative guidance enables the user to actively decide which information is needed and/or desired. Parikh *et al.* (2001) found that dynamic guidance was more effective than predefined guidance in improving decision quality, user learning, and decision performance (Parikh *et al.*, 2001). In contrast, decision performance was not better with either dynamic or predefined guidance. Lankton *et al.* (2012) found similar results and discuss the lack of a complexity moderator. They state that participative guidance could be beneficial for highly complex tasks w.r.t. to task performance. They found that participative guidance has a lower perceived information overload and results in higher task quality than predefined guidance for high-complexity tasks. In contrast to this, predefined guidance results in a higher task quality and increased task performance (regarding the speed) than participative guidance for low-complexity tasks (Lankton *et al.*, 2012).

The guidance **invocation style** (Silver, 2006) describes how the guidance is started and delivered to the user. Gregor and Benbasat (1999) name this category provision and state three characteristics: user-invoked, automatic and intelligent. Silver (2006) also states three invocation styles: on-demand, automatic and hybrid. We combine both categories into one. According to the descriptions of the authors, user-invoked and on-demand describe a similar characteristic. The same holds true for automatic. Silver (2006) does not provide a definition for the hybrid style, but we conclude from the differentiation of guidance directivity that the hybrid style is a mixture of the other two invocation styles he proposes. Gregor and Benbasat (1999) describe their third characteristic intelligent provision as explanations which are provided based on user behavior monitored by the system. Therefore, we decided to combine the category title of Silver (2006) and the characteristics proposed by Gregor and Benbasat (1999). Arnold *et al.* (2004a) discuss the difference between automatic and user-invoked provision of guidance in relation to the interface design of their decisional aid. The automatic provision of explanations requires the computer screen to be partitioned leading to reduced space for the presentation of questions and answers by their decisional aid.

Silver (2006) defines three characteristics of **timing** in his 2006 classification of guidance: prospective, concurrent and retrospective. They are defined according to their name: prospective guidance is provided before a certain activity, concurrent guidance is provided timely with the activity and retrospective guidance is provided after an activity. Furthermore, Silver (2006) discusses the similarities between his terminology and the research on feedback and feedforward guidance. Dhaliwal and Benbasat (1996) discuss the difference between cognitive feedback and feedforward: cognitive feedback provides information that clarifies case specific outcome feedback, improving the decision maker's understanding of the task. Feed forward is not related to the outcomes of the specific case being considered but focuses rather on the input cues of the task (Dhaliwal and Benbasat, 1996). We resonate with Silver (2006), as the formal definition of feedback and feed forward are more than just describing the timing of guidance. Hence, we use the characteristics defined by Silver (2006) for the typology of guidance. Shen *et al.* (2012) conducted an experiment supporting decision makers in emergency management with guidance to support the proper display format. They find that decision makers performance increases when given prospective guidance (Shen *et al.*, 2012).

Gregor and Benbasat (1999) define two presentation **format**s for their explanations: text-based and multimedia. They specified types of multimedia which could be used in the guidance such as graphics, images, animations or voice synthesis (Gregor and Benbasat, 1999). We modify the original definition by splitting up the multimedia type in order to be more precise and use the following characteristics for the presentation format of guidance: text, image, animation (including videos) and audio. These characteristics are not mutually exclusive and could be used solely or in combination. The usage of text-based guidance is most favored in the found literature. For example, Dutta *et al.* (1997) use text to explain and recommend in their system. Text-based guidance is also often used in the combination with images. Limayem and Chelbi (1997) provide instructions, explanations, tables and graphs to support groups in decision making. Al-Natour *et al.* (2006) investigate the combination of text and audio to provide guidance in online shopping. Verwey (1993) shows that guidance in the form of audio has an advantage over visual guidance when the user's visual channel is already heavily loaded. He showed it in the context of car navigation while driving (Verwey, 1993), but transferred to the IS field, we also have situations where audio guidance could be superior to non-audio guidance because the users' visual capacity is blocked by other actions. In another research Gönül *et al.* (2006) found that explanation length has an effect on user acceptance because long (and confident) explanations are found to be more effective in participants' acceptance of forecasts provided by the system.

Dhaliwal and Benbasat (1996) state that it is important to distinguish between two contexts for explanation use: instructional (explanations are used for learning) and working (explanations are used for problem solving). These two contexts are extended by Gönül *et al.* (2006). The authors state that explanations can have three possible **intention**s: the clarification of a perceived anomaly, the supply of extra knowledge and the facilitation of learning from the system (Gönül *et al.*, 2006). A fourth characteristic is motivated by the literature on recommender systems (cf. Wang and Benbasat, 2013). Guidance systems could be intended to be used for recommending decisions such as the best suited camera or how to best solve a given problem. We add the category intention with the above mentioned characteristics to the typology of guidance. Mao and Benbasat (2000) showed that explanations help users understand nonconforming advice by resolving the contraction between the users and the system (Mao and Benbasat, 2000). Gönül *et al.* (2006) state that users request extra knowledge in order to enable them to participate effectively in a problem-solving task. The learning characteristic is also mentioned by Gregor and Benbasat (1999). They state that "*experts will use explanations more for resolving anomalies and novices more for learning*" (Gregor and Benbasat, 1999, p. 512). Hornik and Ruf (1997) investigate the usage of EXS and knowledge acquisition and they also state that an EXS and its explanations improves the knowledge transfer and learning for novices (Hornik and Ruf, 1997).

Gregor and Benbasat (1999) differentiate between novices and experts using the explanations from intelligent systems. These findings are also supported by Ye and Johnson (1995). Dhaliwal and Benbasat (1996) state that the expertise of the user is a factor which influences the usage of explanations. Therefore, we add the category **audience** of guidance to the typology with the two characteristics novices and experts. Nah and Benbasat (2004) show that expertise is a key factor moderating the effectiveness of a KBS and explanations in a group decision making context. According to their findings, experts have a lower acceptance of KBS conclusions and advice from other experts when compared to novices (Nah and Benbasat, 2004). Mao and Benbasat (2000) find that novices may benefit from explanations that assist them with learning, while experts may be more interested in resolving anomalies (Mao and Benbasat, 2000). In another research, the authors find that novices are more strongly influenced by the explanations they receive from KBS than from experts (Mao and Benbasat, 2001).

5 Effects of Guidance

The usage of guidance has several effects on the user and the system. Whereas most of the effects are intended and perceived as beneficial, there are also some negative effects of guidance. The following section starts by briefly summarizing general outcomes of guidance and then discusses selected positive and negative effects of guidance in detail.

There are general effects of guidance found in the literature: guidance can have a positive impact on the user acceptance of a system (Ye and Johnson, 1995), perception of the system (Gregor and Benbasat, 1999), satisfaction (Huguenard and Frolick, 2001) and improved (decision making) effectiveness and efficiency (Singh, 1998). Guidance leads to better learning (Silver, 2006; Gregor and Benbasat, 1999), performance (Wilson and Zigurs, 1999; Huguenard and Frolick, 2001; Gregor and Benbasat, 1999) and decision quality (Silver, 2006). Guidance can support the user in interacting with a system and in dealing with its complexity (Mahoney *et al.*, 2003).

In addition to these general effects, there are various positive effects reported in detail in literature. For example, the task complexity can be used to determine which characteristics of guidance should be used. Lankton *et al.* (2012) discovered that high-complexity tasks are supported by participative guidance and in addition Montazemi *et al.* (1996) noticed that informative guidance is also supportive. In contrast to this, Montazemi *et al.* (1996) reported that low complexity tasks are supported by suggestive guidance. Hornik and Ruf (1997) stated that explanations improve the knowledge transfer and learning for novices. Mao and Benbasat (2000) found that novices may benefit from explanations that assist them with learning. Glover *et al.* (1997) discovered that people learn more effectively using concurrent and participative guidance because they are actively participating in the concepts underlying a task, working through the processes involved in the task, rather than simply operating a structured aid and receiving outcome feedback. Arnold *et al.* (2004a), based on the research by Dhaliwal and Benbasat (1996), investigated the effect of prospective (feedforward) and retrospective (feedback) guidance in the form of explanations on learning. They use the Adaptive Character Though-Rational theory by Anderson (1993) to explain the different types of understanding addressed by the guidance: declarative phase (novice user) is enhanced by prospective guidance, knowledge compilation phase (experienced user) and the procedural phase (expert user) benefits from retrospective guidance. The referenced literature shows that guidance, especially prospective and participative, improves learning. Another positive effect is the increase of accuracy and response time. Mahoney *et al.* (2003) and Shen *et al.* (2012) noticed that decision-makers were more accurate and responded faster when the task requirements where matched with the display style by using suggestive guidance. The combination of suggestive and dynamic guidance increases the (decision) quality and shortens the decision time (Parikh *et al.*, 2001). In addition, guidance may help users to understand nonconforming results of a system by verifying that the result matches the user’s expectation or tries to resolve the contradiction between the user and the system (Gönül *et al.*, 2006). Guidance supports individuals in problem solving by externalizing relevant information. The required information could be provided by suggestive or informative guidance in prospective or concurrent timing. By externalizing information, the working memory of the user is relived, which is useful for cognitive tasks (van Nimwegen *et al.*, 2006).

There are also unintended or undesired effects which need to be taken into account when using guidance. Limayem *et al.* (2006) found that groups given decisional guidance required significantly more time to complete their tasks than groups without guidance. Using guidance increases the total time required for a task because users need to cope with the guidance (Parikh *et al.*, 2001; Limayem and DeSanctis, 2000). Therefore, users, managers or system designers need to decide if the additional time requirements are worth the increased result quality for a certain task. Another consideration for the system designer is the design of the intelligent system itself. Users tend to refuse applying the intelligent system if they have to exert too much effort to utilize the guidance (Gregor and Benbasat, 1999). Again, those responsible should consider if the guidance is needed to fulfill the task, the effort to create guidance and the additional time required are worth the intended positive effects of guidance. The usage of guidance, in contrast to the findings above, can also reduce the quality of results. Todd and Benbasat (1991) showed that users will try to reduce their effort by using decision aids, even if this reduces the quality of their work. Especially suggestive guidance, directing the user through their work, can have the effect that the user blindly accepts the systems guidance due to its persuasiveness (Parkes, 2013), and as a result, present the possibility of failures. In addition, this externalization of relevant information can have the outcome that the user will not learn how to solve the task the next time (van Nimwegen *et al.*, 2006).

6 Conclusion and Future Work

This paper presents an extensive literature review on the existing work on guidance in IS research and related communities. We introduce three guidance concepts from the IS community and discuss the interrelation of decisional guidance, explanations, and decision aids. Building on the found literature we create a conceptualization and typology of guidance supporting researchers and practitioners in formulating and classifying guidance. We discuss the several positive and negative effects of guidance by summarizing existing research findings. We strongly believe our research results contribute to future research and practice. Researchers' will be enabled (1) to describe their own work on guidance by using a set of terms predefined for the IS research community and (2) to compare various research on guidance. Practitioners will be provided with a set of design guidelines in order to implement intelligent systems using various guidance effects in order to improve their processes and systems.

We are aware that our work comes with some limitations. Although our literature review is conducted following established guidelines from the IS community, executed rigorously and comprehensively documented, there might be work on guidance which is not included in this review. We invite the research community to use, prove and extend our typology of guidance.

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