Association Model Between Health Risk Perception and Information Interaction Behavior: Postprint

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Abstract

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Full Text

Preamble

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Research on the Correlation Model of Health Risk Perception and Information Interaction Behavior*
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Abstract

[**Purpose/Significance**] Exploring the relationship between health risk perception and information interaction behavior is of great significance for accurately grasping information needs and supply methods in the context of health risk perception, thereby enhancing public risk perception levels. [**Method/Process**] This study systematically reviews existing theories on risk information seeking and information interaction, theoretically explores the relevant factors and their interrelationships of information interaction behavior in the context of health risk perception, constructs a correlation model of health risk perception and information interaction behavior, and proposes corresponding research variables. [**Result/Conclusion**] Users' health risk information interaction behavior is influenced by individual characteristics, health risk perception, emotion, information adequacy, perceived information gathering capacity, and information characteristics. The correlation model constructed from these factors reveals the dynamic interaction and iteration process between users and information systems from the surface, cognitive, and contextual layers.

Keywords: information interaction; risk perception; query reformulation; health risk
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Studying user information behavior from a contextual perspective is a key viewpoint emphasized by the cognitive paradigm in information science. Context refers to the specific environment and state in which cognitive actors are situated during information seeking and retrieval processes [1]. Based on this, many researchers have begun to focus on factors influencing information behavior, such as individual characteristics, knowledge structure, cognition, emotion, and motivation. However, there remains considerable room for research grounded in socially relevant problem contexts. For instance, under the current national health development strategic goals, citizens' awareness of health risk perception has strengthened. When individuals perceive uncertainty about risks, they often proactively search for and query information via the internet or mobile devices. This phenomenon has attracted attention in relevant research fields. Existing studies have shown that information behavior such as search frequency [2], information seeking intention [3], information format characteristics [4], search time, and webpage browsing [5] correlates with health risk perception. However, current research rarely examines the deep interactive relationship between health risk perception and information behavior. This research topic is particularly important in today's ubiquitous information environment, as people's health risk information seeking increasingly relies on various information service platforms such as search engines, professional websites, and knowledge-based databases. The interaction data between users and these information systems can provide

support for analyzing risk perception intentions, motivations, and emotions, thereby revealing the dynamic interaction and iteration process between users and information systems and offering references for user-information system interaction research at the cognitive level.

Building on existing theories and research, this study incorporates information interaction behavior into the health risk perception framework to deeply explore the motivations and behavioral characteristics of information interaction triggered by this context. The aim is to more fully understand user needs within the original general consistency model, better grasp the interaction between users' surface-level information seeking behavior and deeper contextual factors, and provide references for personalized user services.

1. Theories on Risk-Cognition-Oriented Information Behavior

1.1 Risk Perception Characteristics

Risk specifically refers to a potentially damaging relational state that may arise from all natural and social existence relative to human survival and development [6]. It reflects a state of uncertain possibility and constitutes a relational category composed of a series of factors. Risk perception is a subjective perception of risk, representing subjective feelings and integration of risk information based on various objective factors [7]. Some researchers thus consider risk perception as a phenomenon associated with information activities, viewing it as a process of collecting, selecting, understanding risk information, and responding to it [8].

The subjectivity of risk perception determines the role of individual perceiver factors in cognition. Individuals primarily experience and judge risk from a subjective perspective; therefore, factors such as background, feelings, and cognitive abilities affect risk perception, resulting in individual differences. Moreover, individuals' risk perception continuously changes as they obtain more risk information, with the goal of improving risk perception levels. Thus, risk perception is a dynamic, iterative process of repeated information feedback.

Risk perception, as a subjective perception and judgment based on various objective factors, also possesses relative stability and measurability [9]. Psychologist P. Slovic proposed that an individual's risk assessment is a linear function of several psychological dimensions [10]. He introduced the famous psychometric paradigm, suggesting that individuals judge current and potential risks based on this paradigm. Slovic divided risk perception into two basic dimensions: unknown and dread. Subsequent research expanded these dimensions, dividing unknown into risk visibility, scientific understanding, familiarity, and impact delay, while dividing dread into risk controllability, consequence fatality, and potential catastrophic nature [11]. Individuals' cognitive structures differ when facing different types of risk. The psychometric paradigm reveals the dimensions (also called risk perception structures) that individuals rely on when judging and

perceiving risk and provides measurement methods for risk perception research.

1.2 Risk Information Seeking and Processing Models

Risk perception represents subjective feelings and integration of risk information. From this perspective, researchers have conducted a series of studies, forming relevant theories and models. These existing achievements provide initial support for the hypotheses proposed in this study.

(1) Risk Information Seeking and Processing Model. In their 1999 study, R. Griffin et al. integrated psychological and information communication theories—the Heuristic-Systematic Model (HSM) and the Theory of Planned Behavior (TPB)—to propose the Risk Information Seeking and Processing model (RISP) [12]. The RISP model categorizes influencing factors of risk information seeking and processing into seven aspects: individual factors; perceived risk characteristics; emotional response; information subjective norms; information adequacy; perceived information gathering capacity; and relevant channel beliefs. Based on the relationships among these seven factors, the RISP model was constructed, as shown in Figure 1 [Figure 1: see original paper] (Liu Jing's Chinese translation version [13]). This model reveals various factors influencing individual risk information seeking and processing patterns and their interrelationships, while also presenting types of risk information seeking and processing behavior, including heuristic processing, systematic processing, routine channel seeking, and non-routine channel seeking. Heuristic processing is a limited information processing mode requiring less cognitive effort and fewer cognitive resources, representing a preliminary information processing method. Systematic processing, by contrast, requires more cognitive effort and additional motivation to comprehensively analyze and process relevant information. Researchers believe that most individuals tend toward heuristic processing when processing information, and additional motivation is needed to prompt systematic processing.

The RISP model's proposed interaction paths between individual psychological variables and social factors, and their influence on individuals' approaches to seeking and processing risk information, provide a theoretical foundation for contextualized research on health information user behavior. Notably, "Information Seeking" in the RISP model differs from the "information seeking" research scope defined in information science. In the RISP model, individual information seeking methods are explained as routine channel seeking and non-routine channel seeking. Routine channel seeking refers to accidentally encountering risk information through habitually used media, such as watching television; non-routine channel seeking refers to actively seeking risk information from other channels, such as collecting information online [12]. L. Kahlor et al. summarized these concepts as "active seeking" and "passive seeking" based on their connotations [14]. As subsequent research progressed, R. Griffin et al. added information avoidance when reorganizing the RISP model, dividing information seeking into two variables: information seeking and information avoidance [15].

This demonstrates that research on risk information seeking behavior needs further deepening and expansion, for which existing information science user behavior research theories can provide strong support.

(2) Planned Risk Information Seeking Model. L. Kahlor proposed the Planned Risk Information Seeking Model (PRISM) based on the RISP model [16]. PRISM views risk information seeking as a carefully planned behavior, believing it is closely related to individual emotional states (including attitudes toward information seeking, subjective norms, and emotional responses triggered by risk events) and cognition and evaluation of one's own capabilities (including information seeking behavior, existing knowledge level, and behavioral control), rather than information source channel beliefs affecting processing methods. The PRISM model can explain 59% of the variation in health risk seeking intentions, showing better performance than RISP.

In summary, the RISP and PRISM models have solid theoretical support and practical significance, providing a basis for understanding and grasping information users' seeking motivations. Due to their setting of predictive variables for individual information behavior and good general applicability to risk contexts, these models have received widespread attention and application abroad, such as in research on health risk issues like cancer prevention and treatment [17].

2. Information Interaction Process and Related Factors Based on User Cognitive Context

2.1 Cognitive-Interaction-Oriented Information Behavior Models

B. Dervin views information seeking as a context-sensitive sense-making process, focusing on constructive and active information seeking rather than passively accepting information from systems [18]. Dervin's sense-making theory constructs a process model based on situation, information gaps, and bridges, including four elements: situation, gap, outcome, and bridge, where the bridge that resolves the cognitive gap is information seeking. From a cognitive perspective, sense-making focuses on individuals' meaning construction (problem solving) in different contexts, explaining the diversity in information behavior. The holistic view is the core idea of sense-making theory, advocating consideration of prior events/behaviors and subsequent information system applications. Thus, the RISP and PRISM models align with sense-making theory and are suitable for information user research in the information science domain. Moreover, in practical application research oriented toward problems, the RISP and PRISM models are more operational, allowing for the proposal of analyzable variables and relationships and testable hypotheses, particularly for variables in risk perception contexts, enabling more concrete application of the general (abstract) sense-making model.

With the development of cognitive science and the formation of information interaction environments, information seeking models have gradually transformed

into user-cognition-oriented cognitive interaction models. Representative models include P. Ingwersen's information search interaction model [19], N. Belkin's information interaction support model [20], and T. Saracevic's stratified interaction model [21]. Among these, Saracevic's model emphasizes the dynamic interaction and iteration process between users and information systems, making it more suitable for the characteristics of health risk perception in this study.

T. Saracevic believes that interaction between users and information systems occurs through three levels: surface, cognitive, and contextual. Users first interact with the system interface by issuing query commands (surface interaction), then interact with the information content fed back by the system, and finally interact the results with the context of information needs or problems. Thus, surface interaction between users and information systems actually implies deeper interaction at the cognitive and contextual levels [22]. During the interaction process between surface and deeper levels, there are interrelationships. S. Rieh et al. point out that this interaction is manifested through query reformulation, which is a product of user interaction at the cognitive, emotional, and contextual levels [23], leading to the proposal of the web query reformulation model. These theories and models deeply expand the framework structure of the information seeking and processing components of the RISP and PRISM models, compensating for the models' insufficient explanation of information behavior and lack of interaction behavior. Correspondingly, the RISP and PRISM models provide theoretically grounded contextual analysis support for information interaction models.

2.2 Information Interaction Behavior Related Factors

Search queries are currently the primary form of Web search or database search for most users. Generally, users interact with systems through a series of processes including inputting query commands, interpreting system feedback results, reformulating query strategies, and deciding information utilization to ultimately complete search objectives. Analysis shows that query reformulation is a key element of information interaction. Through query construction and reformulation, surface-level and deeper-level cognition, emotion, and context are connected, serving as a bridge. The mechanism works as follows: users construct initial query terms based on knowledge structures at the cognitive level, query intentions at the emotional level, and query tasks at the contextual level; they then input query terms into the search box, wait for system query result feedback after interaction to complete surface interaction; based on system feedback results, users engage in self-interaction again at the cognitive, emotional, and contextual levels, modifying queries to complete cognitive changes. This process repeats cyclically until users achieve their final information query goals.

Thus, related factors of problem-oriented information interaction behavior include not only cognitive, emotional, and contextual factors but also query behavior-related factors occurring during interaction, such as query terms, query paths, query frequency, and query reformulation patterns. Examining the rela-

tionships and linkage mechanisms of these factors helps identify user query intentions, reveal the interaction relationships between query surfaces and deeper-level user (cognition), intention (emotion), and task (context), and thereby provide a basis for improving personalized query system services and enhancing user query experience.

3. Relationship Between Health Risk Perception and Information Interaction Behavior

3.1 Model Structure Foundation

This study uses B. Dervin's sense-making theory as the model foundation, viewing health information interaction behavior as a sense-making process, focusing on individuals' meaning construction (problem solving) in health risk perception contexts, from front-end health information perception states and emotional responses to information needs (information adequacy), and finally to information system application behavior. Based on this foundation and existing models and health risk perception theories, this study establishes a relational model oriented toward health risk perception and information interaction behavior and examines research variables in the model.

3.2 Personal Characteristic Variables

The personal characteristic influencing factors in the RISP model mainly include demographic characteristics (gender, age, education level, etc.), risk-related experience, and political ideology. R. Griffin believes that non-personal risk political ideology affects individuals' trust in risk management institutions. Since this study focuses on personal health risk, the political ideology variable will be excluded. The RISP model was primarily validated in non-personal risk contexts, which have different characteristics from personal risk contexts, so political ideology will not be included when discussing personal health risk characteristics.

This study adds health level and lifestyle related to risk experience in the personal characteristic variables. The impact of risk experience on risk perception mainly refers to public risk event contexts, such as S. Parry et al.'s finding that consumers who experienced food poisoning had higher food safety risk perception than those without such experience [24]. In individual health risk perception contexts, health level and lifestyle are the main personal characteristics affecting health risk perception [25]. Therefore, personal characteristics in this study include three variables: demographic characteristics (gender, age, education level), health level, and lifestyle.

3.3 Perceived Risk Characteristics and Emotional Response Variables

(1) Perceived Risk Characteristics. Since most research following the RISP model's proposal has concentrated on non-personal risk contexts, it is necessary to deeply explore personal risk perception contexts.

The first component of the RISP model is perceived risk characteristics. R. Griffin et al. decompose the process by which individuals measure the relationship between relevant events and their own interests through information content into cognitive and emotional stages. Different individuals often make vastly different risk perceptions and assessments when facing the same risk event, and this personal estimation and evaluation of risk states is called perceived risk characteristics in the RISP model. Perceived risk characteristics are divided into perceived risk likelihood, perceived risk severity, trust in relevant risk control organizations, and self-assessment of risk control.

Combining the special context of health risk perception and based on P. Slovic's psychometric paradigm and existing research [26-27], this study redefines health risk perception structure as research variables. The final health risk perception structure includes four dimensions: likelihood, severity, familiarity, and controllability. Additionally, trust in relevant risk control organizations mainly addresses non-personal risk perception characteristics at the public risk level and will not be included when discussing personal health risk characteristics.

(2) Emotional Response. The RISP model posits that emotional responses generated by risk perception can prompt individuals to judge information as insufficient, forming information needs. This relationship has been confirmed in many subsequent studies. Extensive research demonstrates that individuals' risk-related emotional responses significantly influence their subsequent risk information processing methods, particularly that negative emotions are typically positively correlated with systematic processing [28]. R. Griffin focused on three emotional experiences: worry, anger, and uncertainty. Since uncertainty is not typically considered an emotional state, subsequent research has mainly focused on examining negative emotions such as worry and anger and their impact on information adequacy. Anger primarily reflects emotional responses to environmental safety and public safety 等非个人风险, and thus will not be considered. P. Slovic believes that fear-based risks include worry and concern about future risks. Therefore, fear is used as the primary emotional factor, including worry and concern about future risks as two variables.

3.4 Information Adequacy

The RISP model suggests that emotional responses generated by risk perception prompt individuals to judge information as insufficient, forming information needs. Although different individuals have different information adequacy thresholds, they all attempt to satisfy their subjective information needs. R. Griffin believes that individuals' efforts to overcome information inadequacy serve as additional motivation for more active and systematic information seeking and processing. Some subsequent studies have also supported the positive relationship between information adequacy and systematic processing to some extent. According to the HSM model, the subjective gap between individuals' current knowledge and information adequacy threshold (information need) will ultimately affect information seeking and processing methods.

Individuals' existing knowledge influences their willingness and choices to seek and process information, but it is not necessarily true that the less existing knowledge individuals have, the more actively and systematically they seek and process information. Individuals' confidence in their own information collection abilities also affects whether they ultimately take actual action to seek and process information. In the health risk perception process, the relationships among these factors need further verification.

3.5 Perceived Information Gathering Capacity

The variable of perceived information gathering capacity aims to measure individuals' perceived level of ability to collect risk-related information. When individuals face risk situations requiring more information to adequately respond, especially those requiring more effort and cognitive resources and the use of non-routine channels to collect information, this factor can reflect individuals' confidence in their own information collection ability level. R. Griffin introduced the concept of self-efficacy into the information seeking and processing process and defined it as perceived information gathering capacity, believing it to be an embodiment of individuals' self-efficacy in information collection ability. When individuals' perceived information gathering capacity is stronger, they are more inclined toward non-routine channel risk information seeking and systematic information processing methods. The correlation between information gathering capacity and information behavior has been confirmed in many studies, but the relationship between individuals' self-perception and interaction behavior in health risk perception contexts needs further in-depth exploration.

3.6 Information Characteristic Variables

In T. Wilson's information behavior model, the mediating variable of information resource characteristics is emphasized as also influencing information behavior in specific contexts [29]. Therefore, this study also includes this factor as an influence on health risk information behavior.

Information resource characteristics include both information content and information format features. Information content is the main aspect by which users judge whether queried information can meet their information adequacy needs, which has been fully considered and studied in the RISP model. Users judge the information content they query, and when not very satisfied with query results, interaction behavior changes, such as adjusting or modifying queries. Additionally, information format features (such as information presentation methods and description methods) also have an impact. The same information content, if described using positive and negative formats, produces different individual feelings and cognitions, leading to different behavioral decisions. When cognizing the same health risk issue, users' risk perception levels differ due to different risk information description methods. Research has found that negative information description methods more easily induce high risk perception [30-31]. Users' risk perception levels are also influenced by information presentation methods

(such as sound, pictures, text, etc.). For example, N. Stefan et al. [32] found that information in numerical and chart formats more easily induces high risk perception. Thus, format features such as information description methods and presentation methods may influence health risk perception levels together with information content, subsequently affecting information seeking and processing behavior.

Based on the above analysis, this study treats information resource characteristics as a variable for further investigation.

3.7 Information Interaction Behavior Variables

The RISP model considers heuristic processing as "a limited information processing state requiring less cognitive effort and fewer cognitive resources than systematic processing." In contrast, the latter requires not only more cognitive effort but also additional motivation. However, the RISP model does not further interpret the processing process. This study comprehensively analyzes and systematically explores the information seeking and processing process in specific contexts from an information science perspective, combined with previous theories and research findings.

Users' information seeking and processing behavior is manifested on the internet as interaction behavior between users and retrieval systems. Users continuously interact with retrieval systems by constructing queries and modifying query expressions, expressing their information needs. Query construction and query reformulation are important elements for understanding interaction between users and retrieval systems. E. Efthimiadis collectively refers to the two stages of query construction and query reformulation as query reformulation [33].

N. Wacholder points out that query reformulation is a cognitive processing and processing procedure [34]. External observers cannot see users' cognitive processes in building queries and reformulating queries, including the mental representation of information needs and the process of converting information needs into queries. These can only be indirectly analyzed and studied through query types and patterns and other query characteristics. Therefore, this study analyzes query reformulation as a concrete manifestation of the information seeking and processing process in interaction behavior.

Query reformulation is divided into two stages: users constructing initial queries and modifying and adjusting queries based on query result lists. Related variables in these two stages include: Query construction: In the query construction stage, characteristics such as query construction time, query length, and query method are mainly considered; Query reformulation: Query reformulation type refers to the classification of query reformulation strategies, while query reformulation pattern refers to the sequence of user query reformulation, i.e., changes in query reformulation strategies. C. Liu et al. divided query reformulation types into five categories: generalization, specification, word replacement, word repetition, and new word addition [38]. Sun Li et al. believe

this classification can comprehensively cover various situations of users' query reformulation for health information [39]. S. Rieh identified three query reformulation patterns: dynamic, multitasking, and periodic. Dynamic refers to users presenting multiple query reformulation types in a query sequence; multitasking refers to users conducting information queries for two or more tasks simultaneously; periodic refers to users re-querying by inputting the same query expression or query words as before. Subsequent research will comprehensively examine the main factors of query behavior based on the above factors.

3.8 Health Risk Perception and Information Interaction Behavior Correlation Model

Individual characteristics, health risk perception, emotional response, and information characteristic variables jointly influence information adequacy, while perceived information gathering capacity and information adequacy jointly determine individuals' information query behavior. Based on the above variables and variable relationships, the health risk perception and information interaction behavior correlation model is constructed, as shown in Figure 2 [Figure 2: see original paper].

4. Discussion on the Correlation Model of Health Risk Perception and Information Interaction Behavior

(1) On Information Subjective Norms. Information subjective norms refer to the social pressure individuals feel regarding whether to adopt a specific behavior. L. Kahlor points out that subjective norms play a significant role in non-personal risk information seeking and processing. When risk directly threatens individuals, they focus more on the personal level than the social level. R. Griffin also notes that subjective norms are important motivations for seeking and processing non-personal risk. In health risk directly related to personal interests, subjective norms may not necessarily be a major factor. S. Hovick et al. [25] and B. Johnson [35] did not adopt the subjective norm variable when applying the RISP model to health risk information seeking research. Therefore, information subjective norms will not be included in this study's context.

(2) On Relevant Channel Beliefs. The RISP model considers trust in media as relevant channel beliefs, reflecting people's social trust levels. However, L. Kahlor et al. proved through research that the main influencing factor of information seeking and processing is individuals' attitudes toward risk information, not information source channel-related beliefs [36]. This study explores information interaction behavior between users and information systems, with the research scope primarily considering attitudes toward risk information, not involving information channel selection. Therefore, relevant channel beliefs will not be discussed in this study.

(3) On Health Risk Perception Dimensions. According to P. Slovic's psy-

chometric paradigm, the two dimensions of perceived likelihood and risk severity are insufficient to fully reveal health risk perception characteristics. According to existing literature, the risk unknown variable also includes understanding of risk, i.e., the familiarity variable. Individuals' familiarity with risk affects their judgment of information adequacy, generating motivation to obtain information. Therefore, the familiarity dimension is added. Personal control refers to the degree to which individuals believe they can control risk when facing it, consistent with the connotation of controllability in the psychometric paradigm. Therefore, health risk perception structure is defined as four dimensions: likelihood, severity, familiarity, and controllability.

(4) On Emotional Response. Based on the dynamics of K. Witte's Extended Parallel Process Model [37], individuals' fear of significant danger can combine with perceived risk characteristics in the RISP model to influence information seeking. Whether this dimension plays a mediating role or can work together with risk perception in health risk perception needs further verification. Research on how different emotional states and their intensities affect risk assessment formation and subsequent information seeking and processing behavior requires further testing.

(5) On Information Characteristics. After users input initial queries and click search, information systems display query results to users. After reading and understanding, users judge and absorb query results, redefining self-cognition and knowledge levels and changing individual risk perception levels. According to cognitive psychology theory, risk perception formation is a process of processing and handling risk information. Therefore, information characteristics are direct factors affecting risk perception levels, which is why this study introduces information characteristic variables. Previous studies have found that different information description methods and presentation methods affect risk perception. Whether consistent results can be obtained in health risk perception still needs verification. Whether these information characteristics further affect changes in search behavior requires more detailed research.

(6) On Query Reformulation. Query reformulation is divided into two stages: users constructing initial queries and modifying queries based on query result lists. Related variables in these two stages include: Query construction: mainly considering query construction time, query length, and query method; Query reformulation: query reformulation type refers to the classification of query reformulation strategies, while query reformulation pattern refers to the sequence of user query reformulation, i.e., changes in query reformulation strategies. Subsequent research will comprehensively examine the main factors of query behavior based on the above factors.

This study proposes a health risk perception and information interaction behavior correlation model, aiming to start from surface-level query reformulation behavior, deeply reveal deep interaction behaviors at the cognitive and contextual levels, understand user needs and intentions, better grasp information provision methods, and provide references for personalized user services. The

model constructed in this study has the following characteristics: It sets contextual presets for information seeking and querying based on real-world problems, identifying corresponding influencing factors and research variables; According to the specific context of health risk perception, it further clarifies the direct interaction between surface-level (query reformulation) interaction and deep-level (cognitive and contextual) interaction, integrating the ideas reflected in the RISP model into the information science research scope of information interaction behavior and enriching relevant information science theories. Subsequent research will further propose specific research hypotheses based on this model for empirical verification and establish corresponding predictive models.

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Author Contributions

Cao Jindan: Research framework design, paper content review, final manuscript revision;
Lan Xue: Research plan refinement, paper writing;
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English Abstract

[Purpose/significance] To discuss the relationship between health risk perception and information interaction behavior is of great significance to accurately grasp the information needs and information provision methods in the context of health risk perception, and then improve the level of public risk perception. **[Method/process]** The existing theories of risk information seeking

and information interaction were systematically reviewed, the relevant factors and their interrelationships of information interaction behavior in the context of health risk perception were theoretically explored, the correlation model of health risk perception and information interaction behavior was constructed, and the corresponding research variables were proposed. [**Result/conclusion**] Users' health risk information interaction behavior is affected by users' individual characteristics, health risk perception, emotion, information adequacy, perceived information gathering capacity and information characteristics. The correlation model constructed from these related factors reveals the dynamic interaction and iteration process between users and information systems from the surface, cognitive and contextual levels.

Keywords: information interaction; risk perception; query reformulation; health risk

Note: Figure translations are in progress. See original paper for figures.