

Dynamic Analysis of Factors Influencing Researchers' Information Encountering from a Process Perspective: Postprint

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Abstract

[Purpose/Significance] Information encountering constitutes a special pathway of information acquisition behavior. Investigating the influencing mechanisms underlying the occurrence of information encountering can provide theoretical references for designing the internal and external environments that facilitate information encountering among researchers, thereby enriching research on information behavior.

[Method/Process] This study first analyzes the model of influencing factors of information encountering from a process perspective. It then employs system dynamics modeling to analyze the causal relationships among these influencing factors, constructing a corresponding stock-and-flow diagram model. Finally, through simulation analysis, the functional relationships between various influencing factors and the occurrence of information encountering are investigated in quantitative terms.

[Results/Conclusions] From a process perspective, the researcher information encountering system is primarily composed of three subsystems: user, information, and context. Among these, personality traits, information quality level, and behavioral context significantly promote the occurrence of information encountering, whereas task context significantly inhibits it.

Full Text

Preamble

Title: A Dynamic Analysis of Factors Influencing Researchers' Information Encountering from a Process Perspective

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Abstract: [Purpose/Significance] Information encountering represents a special pathway for information acquisition behavior. Investigating the influencing mechanisms of information encountering can provide theoretical references for designing the internal and external environments that facilitate such encounters among researchers, thereby enriching related research on information behavior. [Method/Process] This study first analyzes the influencing factors model of information encountering from a process perspective, then employs system dynamics to examine the causal relationships among these factors, constructs a corresponding flow graph model, and finally explores the relationships between various influencing factors and the occurrence of information encountering through simulation analysis in quantitative form. [Result/Conclusion] The researcher information encountering system from a process perspective primarily consists of three subsystems: user, information, and context. Among these, personality characteristics, information quality levels, and behavioral contexts significantly promote information encountering, while task contexts significantly inhibit it.

Keywords: researchers; information encountering; influence mechanism; system dynamics

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In mobile internet environments, the ubiquitous information landscape and user behaviors characterized by increased network dependency, frequent online usage, and behavioral “fragmentation” have collectively transformed information encountering into an important mode of information seeking and discovery [?]. As a special pathway for information acquisition behavior, this “incidental information gathering” effectively matches information resources with users. Researchers require substantial professional information and data during scientific research processes, obtained not only through active information searching but also through incidental collection—data that holds significant value for research activities [?]. Studying researcher information encountering can provide theoretical guidance for alleviating information overload [?] and offer new perspectives for university libraries and other research information service institutions to achieve smart services.

Current domestic research on information encountering influencing factors primarily focuses on conceptual definitions, process models [?], and information encountering in specific contexts [?], with limited quantitative research analyzing influencing factors from a process perspective or promoting researcher information encountering. Influencing factors are more controllable from this viewpoint, making serendipitous discovery that meets researcher needs or inspires users no longer “unpredictable.” Building on this foundation, this paper adopts system dynamics analysis to establish causal relationships and flow models among influencing factors, quantitatively examining their effects on researcher information

encountering through simulation to identify key factors and provide guidance for human intervention in the encountering process.

1 Literature Review

1.1 Concept and Development of Information Encountering

Early scholarly conceptualizations of information encountering can be traced to C. L. Bernier's [?] notion of "serendipity." Subsequent research gradually transitioned to library and information science domains. B. Wilson [?] defined it as "incidental information acquisition," while J. Krikelas [?] viewed it as "casual information gathering." Later scholars employed similar concepts including "nonconscious acquisition of information" [?], "incidental discovery" [?], "opportunistic acquisition" [?], and "nonlinear search behavior" [?]. The formal definition was established by S. Erdelez [?] through systematic empirical research, defining information encountering as the phenomenon where individuals unintentionally obtain information relevant to their interests or problems in unexpected situations. Domestic research began in 2009 when Pan Shuguang [?] introduced the concept to China, defining it as unplanned information acquisition behavior.

Domestic scholars have offered various interpretations: Ma Cuichang and Cao Shujin [?] considered it an essential component of information discovery and knowledge innovation in distributed information contexts, referring primarily to finding needed information during non-purposeful information seeking. Wang Wentao and Xie Yangqun [?] viewed it as possibly purposeful or non-purposeful non-active information seeking behavior, while Jiang Tingting et al. [?] argued it occurs without information needs as a prerequisite, essentially being accidental information discovery and possession.

While scholarly consensus on the conceptual connotation remains elusive, early research emphasized the 偶然性 (contingency) of information acquisition, whereas later work described both this contingency and the encountering context and user search states. Most studies support information encountering as a special and important form of information seeking behavior, essentially characterized by low participation and low expectation during information acquisition. Therefore, this paper defines researcher information encountering as: the process where researchers, in states of low participation and low expectation, encounter information resources that can resolve academic confusion, stimulate research interest, or promote scientific innovation.

1.2 Related Research on Information Encountering Influencing Factors

In digital environments, users driven by personal interests capture external contextual stimuli, connecting their domain knowledge structures with encountered information objects to bridge the "gap" between cognitive awareness and evolv-

ing needs. Current research has shifted from single-factor analysis to multi-dimensional perspectives, primarily focusing on three fundamental levels: user, context, and information.

User-level factors significantly influence information encountering, including personality traits, emotional states, information literacy, and encountering experience. K. Williamson [?] found user characteristic differences (observation, curiosity, mental activity, breadth of interests, information sensitivity) to be primary factors. J. H. Austin et al. [?] identified emotional states as important influences, with positive, relaxed, and excited states increasing encountering probability. J. E. Nutfall et al. [?] noted that information literacy differences arising from varying domain knowledge structures affect encountering. S. Erdelez [?] discovered that users' three encountering states (non-encounterers, occasional encounterers, and super-encounterers) differentially impact future encounters, with frequent encounterers more likely to experience subsequent encounters.

Contextual factors are also crucial, particularly social network contexts [?], where encountering frequency is higher [?]. X. Sun et al. [?] found behavioral contexts interactively influence encountering occurrence. L. Mccay-Peet et al. [?] identified five digital environmental features, finding that three (rich trigger points, helping users make connections, providing unexpected interaction opportunities) promote encountering. Regarding task contexts, S. Webber [?] and T. Jiang et al. [?] found relaxed environments facilitate encountering. Physical contexts, including location and duration, also affect occurrence [?].

Since information encountering lacks foreground problems and differs from purposeful behaviors like information searching [?], scholars have examined information-level factors through characteristics like expected value, problem relevance, and interest relevance [?]. Online digital environments, particularly social media [?], provide rich information supporting social navigation and exploration [?]. T. Jiang et al. [?] identified information type, relevance, quality, visibility, and source as influencing factors. L. Mccay-Peet et al. [?] found spatial positioning of encountered information significantly stimulates users. Yang Yuxuan et al. [?] confirmed that higher information salience increases encountering probability.

Information encountering models have been extensively studied from process and conceptual feature perspectives. Process-based models include Erdelez's [?] closed information encountering process model, the open information encountering process model [?], the nonlinear information seeking behavior model [?], and the information encountering perception model [?]. Feature-based models include the information encountering organization model [?], the information encountering knowledge discovery model [?], the information encountering mechanism model [?], and the information encountering characteristics model [?]. Erdelez's closed model, which dominates user information needs and describes five stages (noticing, stopping, examining, capturing, and returning) from conscious and subconscious perspectives, serves as the foundation for this study's process perspective analysis incorporating user, information, and context levels,

as shown in Figure 1 [Figure 1: see original paper].

Despite comprehensive research, most studies remain theoretical with limited quantitative, structured analysis. This paper addresses two questions: (1) What factors influence researcher information encountering based on specific theoretical models? (2) How do these factors mechanismally affect encountering, and which are key influences?

2 Process Perspective Model and Causal Relationships

2.1 Process Perspective Influencing Factors Model

Current information encountering models primarily adopt process or conceptual feature perspectives to describe this passive, non-purposeful information seeking behavior. The process perspective examines encountering as a series of stages.

As the initial stage, noticing functions as a triggering mechanism. During research activities, researchers shift from initial task states due to personality traits and information literacy, driven by task contexts, gradually focusing on the interaction between encountered information and flow experiences. This interaction intensity and transient memory strength vary with encountering experience. When researchers' cognitive structures form associative intersections with encountered information (strong interaction experience), they actively suspend and shift behavioral contexts, cognitively connecting background information across different task contexts with encountered information, attempting to predict needs across research lifecycle stages to achieve new cognitive balance. The second stage, stopping, emerges based on interaction strength during noticing, combined with information stimuli, acquisition levels, and quality attributes. Researchers then preliminarily evaluate encountered information attributes through perceived control mechanisms (the examining stage) to prepare for capturing. The "stopping, examining, and capturing" stages essentially bridge cognitive gaps for returning to initial search tasks.

Researchers' overall attitudes significantly influence encountering occurrence and processing [?]. Strong curiosity and thirst for knowledge increase encountering probability, enabling positive post-encounter processing.

2.2 Causal Relationship Analysis in Researcher Information Encountering

System dynamics combines systems theory with computer simulation, employing qualitative and quantitative methods to address complex dynamic systems [?]. It models multiple interacting elements and quantifies relationships among them [?]. Research objects are viewed as dynamic systems with multiple components and feedback loops, with causal diagrams describing complex causal relationships and feedback mechanisms.

The researcher information encountering system exhibits systematic, nonlinear, and dynamic characteristics with frequent interactions and feedback, forming

a “spiral of silence” upward trend. System dynamics addresses the challenge of numerous, difficult-to-quantify factors. The system divides into three subsystems (user, information, context) with complex dynamic causal relationships among elements. Causal diagrams reveal interdependent driving structures and multiple feedback characteristics.

2.2.1 User Subsystem Most process models emphasize establishing “new conscious connections” along user cognitive paradigms. As the key subject, users include information literacy, personality traits, and encountering experience dimensions. In academic media environments, information-literate researchers easily discover useful information for resolving academic confusion or stimulating interest. Information need states significantly affect encountering motivation intensity, with latent needs becoming explicit through encountering. Encountering experience represents connection frequency between cognition and encountered information, generally quantified by encountering frequency. Frequent encounterers form more complex connection touchpoints, stimulating subsequent encounters and creating long-term positive feedback loops. S. Erdelez [?] categorized users into non-encounterers, occasional encounterers, encounterers, and super-encounterers. Under flow experience, researchers’ attitudes significantly influence encountering and processing [?]. The user subsystem causal relationships are shown in Figure 2 [Figure 2: see original paper].

2.2.2 Information Subsystem As an unexpected passive information behavior, encountering connects user and context levels through problem-solving or interest-driven academic information [?], facilitating passive-to-active transitions and returning to initial tasks to achieve “useful information discovery.” Progress through encountering stages closely relates to 预判 (prediction) of research information value, which fundamentally drives the transition from information needs to behavior.

In the information subsystem, information content attributes, quality attributes, and acquisition levels significantly impact value judgments. Information content and quality reflect actual academic value. In low-participation states, researchers discover problem-solving or interest-driven academic information influenced by source credibility, timeliness, salience, and type diversity. Information relevance affects attitudes toward recommended information on academic platforms [?]. Information novelty and salience reflect research hotspots and future directions, positively correlating with encountering probability. Usefulness, credibility, and timeliness significantly impact encountering. Information acquisition level also matters: acquisition costs (e.g., paywalls) affect processing methods and viewable ranges, while type diversity reduces time costs and increases encountering probability. Information subsystem causal relationships are shown in Figure 3 [Figure 3: see original paper].

2.2.3 Context Subsystem Zhang Min et al. categorized information encountering contexts into physical and task environments [?]. This model includes

behavioral context, task context, and physical context, which interactively influence research encountering.

Researchers typically experience “information behavior \rightarrow information acquisition \rightarrow information need” processes [?], accidentally obtaining information in behavioral contexts (browsing, searching, communicating) that generates new needs. Information browsing, with weak purpose and low expectation, aligns with encountering conditions [?], facilitating encountering. However, as session time extends and environments become familiar, encountering probability decreases, showing short-term positive feedback but long-term negative feedback. Task context effects vary individually: time pressure, a major factor [?], reduces encountering probability, while relaxed environments expand information sources [?]. Physical attributes like location and duration also affect encountering [?]. Context subsystem causal relationships are shown in Figure 4 [Figure 4: see original paper].

3 Model Experiment and Simulation

3.1 System Boundary Determination

System boundary definition is critical for successful modeling, focusing on core issues while excluding non-important factors. This study examines the researcher information encountering system from a process perspective, comprising user, information, and context subsystems with elements listed in Table 1 . Rate variables are determined based on prior research: browsing speed negatively correlates with encountering ease (personality trait reduction), acquisition costs reduce acquisition levels, and environmental familiarity reduces physical context levels.

3.2 Basic Assumptions

To standardize the research, based on the process perspective model, this paper proposes:

H1: The information encountering system is a continuously interacting feedback system without external boundary factors.

H2: Factors like information literacy and personality traits change over time.

H3: Encountering occurrence can be quantified through encountering ease.

3.3 Model Construction

System dynamics models are simulation models that identify causal relationships and construct calculation formulas. Based on the three subsystems' causal diagrams, the flow graph model (Figure 5 [Figure 5: see original paper]) contains 52 variables: 9 level variables, 12 rate variables, and 31 constant variables.

3.4 Parameter Settings and Calculation Formulas

- (1) **Data Collection:** Questionnaires using 10-point Likert scales (1 = strongly disagree to 10 = strongly agree) collected data on 31 indicator variables from 128 valid respondents (42.19% male, 57.81% female; ages 22-50; diverse disciplines). Average scores calculated indicator weights. Following H1, gender, age, and discipline differences are excluded from system boundaries.
- (2) **Simulation Settings:** Step length = 1 month; duration = 6 months. Variable equations are designed as shown in Table 2 .

4 Simulation Results and Analysis

Using Vensim PLE software, the model simulates factor effects on encountering. Each subsystem's elements differentially impact encountering occurrence.

4.1 Variable Effects on Information Encountering

To observe effects of 9 level variables' indicators, each constant was increased by 500 units while holding others constant, running 31 simulations. Results are shown in Figures 6-8, where curves represent encountering ease changes after indicator modification (e.g., "browsing speed: current" shows the curve after increasing browsing speed by 500 units).

4.1.1 User Subsystem Simulation Except browsing speed, all factor increases raised encountering ease. Personality traits showed the strongest promotion effect, followed by encountering experience, with information literacy showing the weakest effect.

Among personality trait indicators (Figure 6 Figure 6: see original paper), curiosity and thirst for knowledge significantly increased encountering ease, with knowledge having greater impact. Browsing speed negatively correlated with encountering ease. Among encountering experience indicators (Figure 6(b)), content familiarity showed stronger positive effects than emotional states, indicating familiarity with encountered content better facilitates encountering than positive emotions. Among information literacy indicators (Figure 6(c)), encountering ease only began increasing from month 2 due to cumulative effects, with academic research experience showing the strongest impact, followed by social media experience and information needs. Information ability and awareness also promoted encountering.

4.1.2 Information Subsystem Simulation All factor increases raised encountering ease, with information quality showing the strongest effect, followed by acquisition level and content attributes.

Among information quality indicators (Figure 7 Figure 7: see original paper), encountering ease was most sensitive to usefulness, least to timeliness, indicating

usefulness improvements most effectively promote encountering. Among acquisition level indicators (Figure 7(b)), database resources showed greater impact than type diversity, suggesting richer resources better facilitate encountering. Among content attribute indicators (Figure 7(c)), interactivity and interest relevance showed the most significant effects, with other factors also increasing encountering ease but showing differential effects after month 1.

4.1.3 Context Subsystem Simulation Physical context generally inhibited encountering, with task context showing stronger negative effects than behavioral context's positive effects.

Among behavioral context indicators (Figure 8 Figure 8: see original paper), browsing, searching, and communication all increased encountering ease, with browsing being more conducive than purposeful searching or communication [?]. Among task context indicators (Figure 8(b)), time pressure showed the strongest negative effect, followed by task clarity and complexity, indicating that greater time pressure, clearer and more complex tasks inhibit encountering. Among physical context indicators (Figure 8(c)), familiar environments reduced encountering probability, while friendly interfaces increased it.

5 Discussion

Based on theoretical foundations and system dynamics simulation of 9 level variables across three subsystems, results show that at simulation end, curiosity approached 250 units and knowledge exceeded 250 units in personality traits. Timeliness, usefulness, and credibility in information quality exceeded 250 units, higher than other dimensions. Behavioral context indicators (browsing, searching, communication) also exceeded 250 units, while task clarity and time pressure fell below -250 units. Thus, key promoting factors are personality traits, information quality, and behavioral context; the main inhibiting factor is task context.

5.1 Information Factor Level

Embedding researchers' disciplinary backgrounds and interest profiles can provide richer, targeted free resources, expanding browsable ranges and reducing time/financial costs. Optimizing information reorganization reduces overload and fragmentation, earning user recognition through high-quality content. Database navigation should update promptly, highlighting new information through diverse formats (images, charts, audio/video) and interactive approaches.

5.2 User Factor Level

Researchers should strengthen information acquisition and utilization capabilities, cultivate awareness of connecting discovered information with their knowledge structures, and develop academic literacy for tacit need mining and knowl-

edge creation. Institutions should address researchers' psychological pressure and emotional states by providing hardware/software support, comfortable environments, and counseling services to maintain relaxed, positive states. Research should explore mechanisms triggering curiosity and knowledge to increase matches between useful information and user needs.

5.3 Context Factor Level

Beyond clear, complex tasks, researchers can increase encountering experiences through more non-purposeful browsing and interactive behaviors. Regular interface redesigns can break 固化 (solidified) usage patterns, facilitating unexpected discoveries during adaptation. Optimizing human-computer interfaces can alleviate time pressure through proactive pop-ups of relevant content, personalized push services, and information filtering, creating conditions for encountering.

6 Conclusion

This study applies system dynamics to researcher information encountering process models, analyzing relationships among influencing factors from a systems perspective. The encountering system comprises three subsystems (user, information, context) with nine variables whose interrelated feedback mechanisms easily form. Predictive simulations from three levels provide effective modeling for environmental design promoting researcher encountering. Results visually demonstrate each factor's promotional effect on encountering ease, identifying key factors: personality traits, information quality, behavioral context, and task context. Measures such as enhancing researchers' knowledge thirst, stimulating research interest, strictly controlling academic information quality, and optimizing interfaces and knowledge services positively impact information resource utilization and encountering promotion.

The findings demonstrate the feasibility of system dynamics modeling for information encountering, enriching research methods and providing new approaches for measuring factor relationships and effects. Results also offer insights for information service institutions to improve service levels and proactivity by embedding themselves in research and innovation processes to stimulate and guide information needs, thereby increasing encountering probability and promoting scientific innovation.

Limitations include limited data sources, idealized equation design, and incomplete consideration of factor relationships. Future research will expand data collection, refine nonlinear equation relationships, and conduct follow-up investigations and validation with specific researchers.

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Research on Factors Affecting Scientific Researchers' Information Encountering Based on System Dynamics: Under the Process Perspective

Abstract: [Purpose/significance] As a special way of information acquisition behavior, researching the mechanism of information encountering can provide theoretical reference for the internal and external environment design that effectively promotes information encountering among research users, and enrich information behavior research. [Method/process] This paper firstly analyzes the influencing factors model of information encountering under the process perspective, and then comprehends the causal relationship among factors affecting information encountering by means of system dynamics model. Also, this paper constructs the corresponding flow graph model, and explores the role of various influencing factors in the occurrence of information encountering through simulation analysis and quantitative form finally. [Result/conclusion] The scientific researchers' information encountering system under the process perspective mainly consists of three subsystems: user, information and context. Among them, personality characteristics, information quality levels and behavioral contexts can significantly promote information encountering, while mission context significantly inhibits the occurrence of information encountering.

Keywords: scientific researchers; information encountering; influence mechanism; system dynamics

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

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