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Diffusion and influence of theoretical models of information behaviour: the case of Sonnenwald's Information Horizon model

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Abstract

Introduction. Investigating the degree to which researchers use theory in scientific literature is essential for ensuring methodological rigour, fostering the accumulation of knowledge, and advancing a discipline. This study examines the diffusion, adoption, and influence of Diane Sonnenwald's Information Horizon model from its initial formulation to the present.

Method. This study consisted of a dual methodological approach using direct citation and context citation analysis to explore documents citing the Information Horizon model. The direct citation analysis captured the publication year, research type, and thematic focus of these citing documents, while the context citation analysis of in-text citations yielded results on the frequency, citation style, location of citations within the documents, and the specific elements of the model being referenced.

Analysis. The analysis was conducted on two datasets comprised of a total of 486 documents.

Results. The findings indicate that the Information Horizon model has been notably incorporated into research on information behaviour, particularly through the substantial and meaningful use of its theoretical concepts and methodological approaches.

Conclusion. The Information Horizon model has demonstrated sustained impact, interdisciplinary adoption, and consistent conceptual use, establishing it as one of the most functional and widely applied frameworks in information behaviour research.

Introduction

Theory in the field of information behaviour is characterised by its interdisciplinarity, frequent loans from the social sciences, and a strong tradition of developing models and theoretical frameworks based on observations of information users. Seminal models, such as those proposed by Kuhlthau, Bates, Wilson, Dervin, and Ellis, are widely cited and fundamental in the field (Lund, 2019). Despite the acknowledged importance of theory in disciplinary advancement, its actual use in information behaviour research is sometimes inconsistent (Fidel, 2012) and limited (Kumasi, et al., 2013). Only a minority of studies explicitly ground their work in theory (Julien & O'Brien, 2014), with such exceptions as specialised forums on the topic (VanScoy, et al., 2022). In this sense, the information behaviour field is evolving through debates, among others, on the applicability of traditional theories in professional contexts (VanScoy et al., 2024), or through calls for more systematic and transparent theory development (Ngulube & Mosha, 2023). Overall, although theory is central to understanding information behaviour, its use in research remains uneven.

Investigating the extent to which a particular theory is used in research is essential for ensuring cumulative knowledge building, rigour in research, and the advancement of knowledge within a field. Moreover, from the perspective of researchers, an in-depth analysis of the use of theory in a given field of knowledge helps assess the quality and legitimacy of claims based on the analysis and interpretation of the data, with the aim of identifying gaps or misapplications, and guiding future research and theoretical development. In this regard, numerous researchers have attempted to identify how theories in library and information science are constructed, disseminated, and transformed through a variety of methodological approaches. These investigations have used theoretical frameworks from such disciplines as sociology (Vakkari, 1998), as well as bibliographic (Urquhart, 2011), conceptual (Savolainen, 2017), and bibliometric approaches. From the latter point of view, several studies have considered the impact and diffusion of information behaviour theories, either by observing their direct citation or by analysing citations in context. Examples of research on the direct citation of theories include the work by Lund (2019), who ranked the most cited theories and theoretical models in the field; Wilson (2018, 2020, 2022), who examined the dissemination and use of theories and models from information behaviour research in disciplines beyond information science; and Park et al. (2022), who focused on the citations received by the theory of information worlds.

Although previous studies have ranked theories and/or models by their citation counts, this metric does not reveal whether they are used by the research community. Does a high number of citations imply deep theoretical engagement or merely rhetorical recognition? To answer this question, it is necessary to go beyond counting and analyse the context in which these theories and/or models are cited, which can be achieved through a context citation analysis. This methodological approach extends the conventional practice of citation counting by examining the actual content, meaning, and function of the citations within academic texts. The integration of quantitative and qualitative analyses is pivotal in this method, with a focus on the syntactic and semantic contexts of citations (Zhang et al., 2013). This approach aims to enhance comprehension of the interpretation, use, and contribution of the cited works to subsequent research. By analysing the surrounding text, context citation analysis offers a deeper insight into the intellectual processes of knowledge transfer that highlight the actual contribution of the cited works (González-Teruel & Abad-García, 2018).

Several studies have demonstrated the use of context citation analysis to determine the actual influence of works beyond mere citation counts. For instance, McCain and Salvucci (2006) applied it to determine the genuine impact of Frederick Brooks's *The Mythical Man-Month* and revealed that numerous citations merely superficially alluded to the text rather than engage with it critically or in depth. Similarly, Sieweke (2014) applied this technique to Pierre Bourdieu's work to distinguish between comprehensive and limited citations of it. Conversely, Zhen et al. (2020) applied this methodology to Manuel Castells's *The Rise of the Network Society* and revealed how its

impact varies by discipline. Similarly, Tsay (2009) analysed Ted Nelson's work and demonstrated how his ideas on hypertext had been cited in various academic fields. Several studies have also focused on the functions of citation. For example, Anderson (2006) analysed how Karl Weick's work has been interpreted through different strategies of citation, while Anderson and Sun (2010) analysed the legacy of James Walsh and Gerardo Ungson by using a similar approach. In addition to these applications, context citation analysis enables the tracking of the diffusion and evolution of theories. For example, González-Teruel and Abad-García (2018) used it to evaluate the integration of Elfreda Chatman's theories into subsequent research, distinguishing between citations that adopted her core concepts and those that only mentioned them in passing. A similar approach has been applied by González-Teruel and Pérez-Pulido (2020), who examined Reijo Savolainen's Everyday Life Information Seeking model to understand its impact on information behaviour research. Finally, a longitudinal analysis of citation contexts enables us to detect changes in the influence of a work over time. For example, Lu et al. (2017) identified how the motivations for citation change as a scientific field evolves by observing a transition from its conceptual to methodological uses.

Building on the approach taken by the author of this text for the context citation analysis of Chatman's theories and Savolainen's model, this study analysed Diane Sonnenwald's Information Horizon (IH) model. The Information Horizon model proposes that individuals' information behaviour is shaped by 'contexts, situations, and social networks' (Sonnenwald, 1999, p.1). It conceptualises an *information horizon* as a mental map of information resources that a person perceives as available and useful. Crucially, Sonnenwald operationalised this model through the *information horizon interview*, a graphic elicitation technique in which participants draw their own information horizons, thus making the abstract concept of context visible and analysable. This specific model was chosen because the author presents Information Horizon as both a theoretical framework and a methodology (Sonnenwald, 2005). This distinguishes it from other frameworks and offers a unique opportunity to analyse how a model that provides both conceptual tools and a specific data collection technique is adopted by the library and information science community. Regardless of its character as a *theoretical framework* or a *methodology*, in this study it is referred to as the *Information Horizon model* to align with the conventional terminology used for other seminal models in information behaviour research.

According to Hartel (2017), the Information Horizon model's relevance lies in being a pioneering visual method for studying information behaviour and allows information resources and search processes to be mapped by using techniques of graphic elicitation. Hartel (2017) has described how this model has inspired subsequent research and methodological refinements, such as those by Reijo Savolainen and Isto Huvila, due to its flexibility, participatory nature, and ability to render complex information-related practices visible and analysable. Furthermore, Greenberg et al. (2023) have emphasised the significance of Sonnenwald's Information Horizon model due to its capacity to integrate the behavioural, cognitive, and social aspects of information behaviour; its innovative application of the concept of the *information horizon*; its techniques for collecting graphical data; and its adaptability in studying diverse and frequently underrepresented communities.

Against this backdrop, this study explored the dissemination and impact of Sonnenwald's Information Horizon model, from its inception in 1999 to the present day. It addressed the following research questions: What impact has the Information Horizon model had, and in which types of research has it served as a reference? In which scientific disciplines has it been disseminated beyond library and information science? Is the Information Horizon model a theory or a methodology? Which dimensions of the model are most frequently cited?

Method

To answer the above research questions, this analysis followed the methodological guidelines applied in previous studies on the diffusion and influence of Chatman's theories (González-Teruel

& Abad-García, 2018) and Savolainen's model (González-Teruel & Pérez-Pulido, 2020). This study is the third component of a cumulative research agenda, applying the same protocols to a different model to ensure data comparability. This strict replication is necessary to identify divergent patterns of diffusion among the field's seminal theories, while avoiding the bias that could be introduced by differing methodological criteria. Specifically, a citation analysis and context citation analysis were performed. To this end, the documents that contained the foundations of the Information Horizon model were first selected. They constituted the *cited documents* for the purposes of this research. The *citing documents*, or those documents that cited any of the cited documents, were subsequently identified.

Selection of cited documents and documents that cite them

The *cited documents* used as references for the Information Horizon model were Sonnenwald (1999), Sonnenwald and Wildemuth (2001), Sonnenwald et al. (2001), and Sonnenwald (2005). To identify publications that cited any of these four papers, we conducted a bibliographic search by cited reference in October 2024 using Scopus, Google Scholar, and all databases accessible through the Web of Science platform.

Initially, 1,161 bibliographic references were retrieved. Following revision, the removal of duplicates, and normalisation, the corpus was reduced to 683 references. Of these, 568 documents written in English, French, Spanish, Portuguese, and Italian were selected, while the remaining 115 references published in other languages were excluded. A further eighty-two documents were subsequently discarded for one or more of the following reasons: inaccessibility of the full text ($n = 17$); absence of citations to the four papers being considered after content review ($n = 19$); and belonging to document categories that were irrelevant to context citation analysis, such as PowerPoint presentations and academic papers other than doctoral theses ($n = 46$). Six patent documents were specifically excluded from the latter group because, although they included some of the required references in their bibliographic lists, they did not cite them in the body of the text. Furthermore, as they were not academic literature and required differentiated analytical treatment, they were definitively excluded. Ultimately, 486 cited works were analysed: 251 scientific articles or chapters of serials; 109 doctoral theses; ninety-four conference papers; eighteen books; twelve book chapters; and two working papers.

Unlike previous studies which analysed Chatman's theories (González-Teruel & Abad-García, 2018) and Savolainen's model (González-Teruel & Pérez-Pulido, 2020) and which retrieved citing documents exclusively from Web of Science and Scopus, this research also incorporated Google Scholar to expand the scope of analysed documents. To make the results comparable with those of the previous studies, the citing documents and citations in context were analysed using two datasets: Dataset A, which was comprised of all 486 retrieved documents, and Dataset B, which was comprised only of 345 articles, chapters of serials, and conference papers (see Figure 1). These were the specific document types analysed in those previous studies.

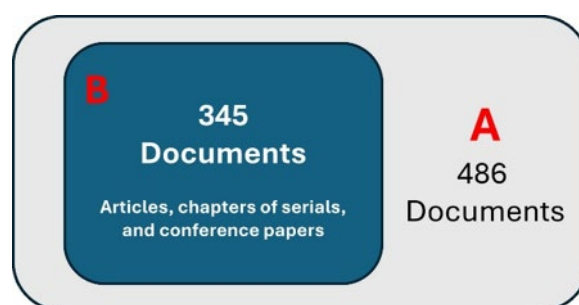


Figure 1. The two datasets analysed.

Once the citing documents were retrieved, a direct citation analysis was conducted followed by a context citation analysis using the relevant citations the documents contained.

Analysis of citing documents

The year of publication, average number of citations per year, type of work, and subject category of the citing documents were analysed.

The categories of work mentioned in the American Psychological Association's style manuals (2010, 2020) were referenced to classify the citing documents by type of work, or empirical, theoretical, bibliographical, methodological, and other. This ensured that the analysis used standardised and replicable classification criteria. Thus, empirical studies were classified as studies focusing on the systematic collection and analysis of original data to address previously unanswered questions. Theoretical studies explored or developed concepts and theories based on the literature and may have proposed new models. Bibliographical studies reviewed and analysed published work by using narrative or systematic reviews, content analysis, or bibliometric research. Methodological papers presented innovations in research methods and illustrated their proposals with data used only as examples. Finally, papers that did not fit into the above categories were grouped as *other* and included case studies and editorials. All citing documents were classified by document type, except for books, as it would be difficult to assign a single category to their contents.

The citing documents were classified as follows for the assignment of subject categories. Library and information science documents were defined as those published in journals included in the library and information science category of the Journal Citation Reports or the SCImago Journal & Country Rank (SJCR). Other types of documents, such as books or book chapters, were classified manually. Doctoral theses were classified as library and information science documents if they were developed in departments or programmes belonging to that field. Documents that did not meet these criteria were classified as non-library and information science and were assigned to one of the twenty-seven main subject areas defined by the SCImago Journal & Country Rank.

Analysis of citations in the citing documents (theoretical incidents)

Once the citing documents had been analysed, individual sentences were identified that included an in-text citation to one of the four *cited documents* (i.e., Sonnenwald, 1999; Sonnenwald and Wildemuth, 2001; Sonnenwald et al., 2001; and Sonnenwald, 2005). Each of these sentences was considered a *theoretical incident* or *unit of record*, which was understood as the minimal unit of meaning that was analysed (Bardin, 1986). However, when a preceding or following sentence referred to the same cited work, it was included as part of the incident as a context unit. This corresponded to the unit of understanding used to accurately interpret the log unit and was defined as the content a segment larger than the log unit that provided a more accurate understanding of its meaning (Bardin, 1986).

The following aspects of each theoretical incident were analysed.

Number of incidents and average number of incidents per document. Number of incidents was chosen as an analytic aspect based on the assumption that important citations would appear more frequently in the text, while non-essential citations would be mentioned only once (Hou et al., 2011).

Citation style. The methodological framework, validated in our previous studies (González-Teruel & Abad-García, 2018; González-Teruel & Pérez-Pulido, 2020), was adopted as a baseline to ensure that the data could be compared. However, given the specific visual nature of the Information Horizon model, a fifth category was introduced to capture graphical reproductions. Consequently, five citation styles were identified and classified according to the extent to which cited documents are mentioned, interpreted, and/or visually represented. As in previous reference research, it was assumed that ‘... a reference that is cited in an article but not explicitly mentioned in the text may

be considered less relevant than one discussed in detail in the body of the citing article' (Zhang et al., 2013, p. 1498). The five citation styles were as follows.

(A) Direct quotation: This is a verbatim reproduction of an excerpt from one of the cited works. For example, as cited by Agarwal (2018, p. 11): 'A situation is a set of related activities, or a set of related stories, that take place over time (Sonnenwald, 1999, p. 180)'.

(B) Specific mention, but performed, of a single work by Sonnenwald: This consisted of the mention of the content of a single work. Here is an example from Tsai (2012, p. 2): 'According to the theoretical framework of information horizons, contexts and situations are important factors influencing an individual's information behaviour. Investigating relationships among sources used by individuals helps us learn about individuals' information-seeking strategies and preferences for information sources (Sonnenwald et al., 2001)'.

(C) Specific mention, but interpreted, of several works by Sonnenwald: This is the mention of the content of several cited works. For instance, as described by Hartel et al. (2012): 'The most significant innovation of a visual method for studying information behavior was introduced in 2001: the information horizon interview (Sonnenwald, 1999, 2005), a technique in which subjects draw a map of their information horizon (an imagined landscape of information resources)'.

(D) Nonspecific mention: Citations of Sonnenwald's work are used, among others, in a general context, and without any particular analysis or elaboration. For instance, as exemplified by Cisek and Krakowska (2019): 'The researchers have taken various approaches and used different spatial metaphors when referring to it, including conceptual geographies (Greyson, O'Brien, and Shoveller, 2017), immediate information spaces or personal information environments (Hartel and Thomson, 2011), information fields (Johnson, 2003), information grounds (Fisher and Naumer, 2006), information horizons (Sonnenwald, 2005), information use environments (Taylor, 1991), information worlds (Burnett and Jaeger, 2011), and small worlds (Chatman, 1991; Savolainen, 2009) ...'.

(E) Visual citation: This is the reproduction of an image of the Information Horizon model, or its recreation in visual, graphical, or textual form.

Location of citation. Each citation in documents that were structured according to the introduction, methods, results, and discussion [IMRD] format was located based on the assumption that the section in which the theoretical incident appeared was indicative of the author's use of the cited document and the type of information that it provided. To this end, the location of the theoretical incident was classified as falling into one of the following sections: the abstract (A); the introduction and/or literature review (I+L) (as both contextualise the research problem); the theoretical framework and/or methodology (T+M) (where the conceptual and design-related aspects of the study are presented); or the results, discussion, and/or conclusions (R+D+C) (which interpret and contextualise the findings). Moreover, to obtain evidence on the use of the Information Horizon model as a theoretical or methodological reference, the theoretical incidents classified in the theoretical framework and/or methods category were analysed in detail. According to Sonnenwald (2005), Information Horizon is a theoretical framework and a methodology. In this study, therefore, these terms are not defined in advance but are understood as presented by the original author and operationalised by citing researchers through placement of citations in the theoretical or methodological sections of their papers.

Content cited. A content analysis of the theoretical incidents was conducted. The key terms and expressions present in Sonnenwald's Information Horizon model were first identified and extracted from the cited documents. A unified list was created to standardise these terms as they appeared in the reference work. By using this list as a basis, the mentions of these concepts were located within the theoretical incidents. This made it possible to calculate their frequency of occurrence and proportion within the set of incidents.

Results

Citing documents

Year of publication

Figure 2 shows the evolution of publications that have cited the Information Horizon model over time. The Information Horizon model received its first four citations in the same year as Sonnenwald (1999), which was cited an average of eighteen times per year between 1999 and October 2024. The average number of citing documents decreased to 12.8 times when articles, chapters of serials, and conference papers were considered separately.

In general, the Information Horizon model received few citations until 2004. From 2005 onwards, citations steadily grew and reached a first significant peak in 2012 with twenty-nine citations. The citation rate subsequently remained high until 2023, when it started to decline.

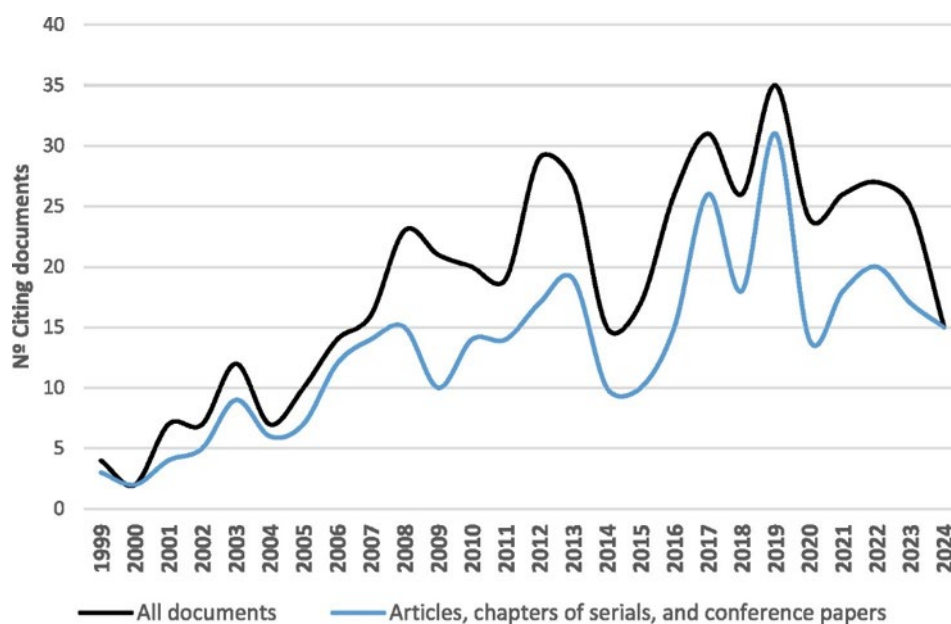


Figure 1. Evolution of citing documents (N = 436).

Type of work

Most of the citing documents (68.3%) were classified as empirical, followed by theoretical (12.3%), bibliographical (7.4%), and methodological (4.5%). Figure 3 shows the evolution of different types of citing publications. Empirical papers were the most frequently captured category throughout the analysed period, with a high growth from 2005 to 2007 and a reduction from 2020 to 2022, as the number of citing documents also decreased. Theoretical and bibliographical papers were in second and third places, respectively, in terms of frequency. Despite their importance, they never exceeded the number of citations by empirical papers. The presence of other types of papers was merely anecdotal throughout this period.

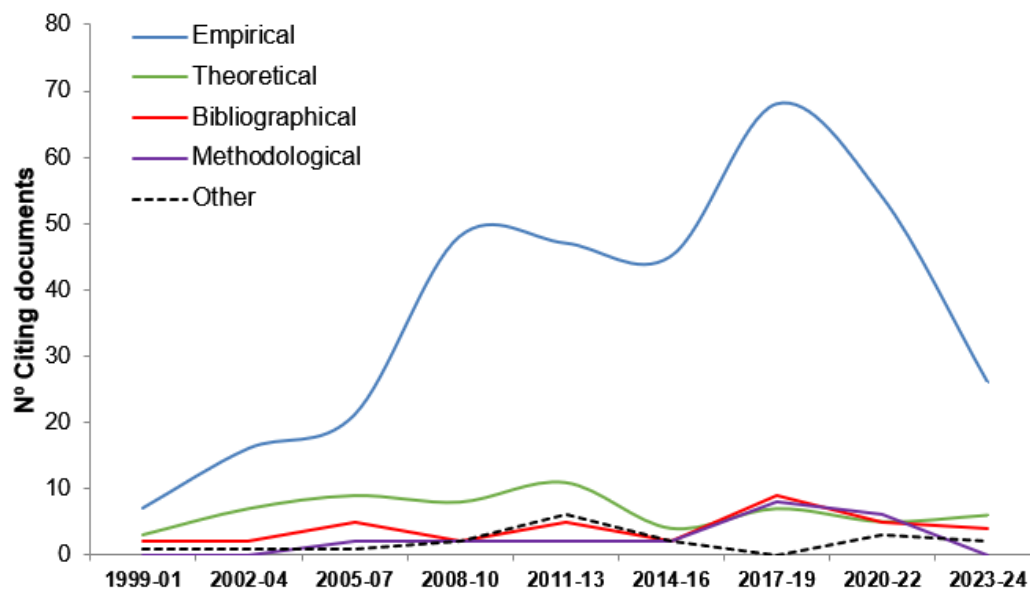


Figure 2. Types of documents citing the Information Horizon model (N = 436).

If we considered only articles, chapters of serials, and conference papers (Dataset B) (Figure 4), most of the citing documents were also empirical (63.5%), followed by theoretical papers (16.5%). These increased in relation to the total number of documents, followed by bibliographical papers (9.6%) and methodological papers (5.5%). The evolution of this group of documents followed a similar pattern to that of the general dataset.

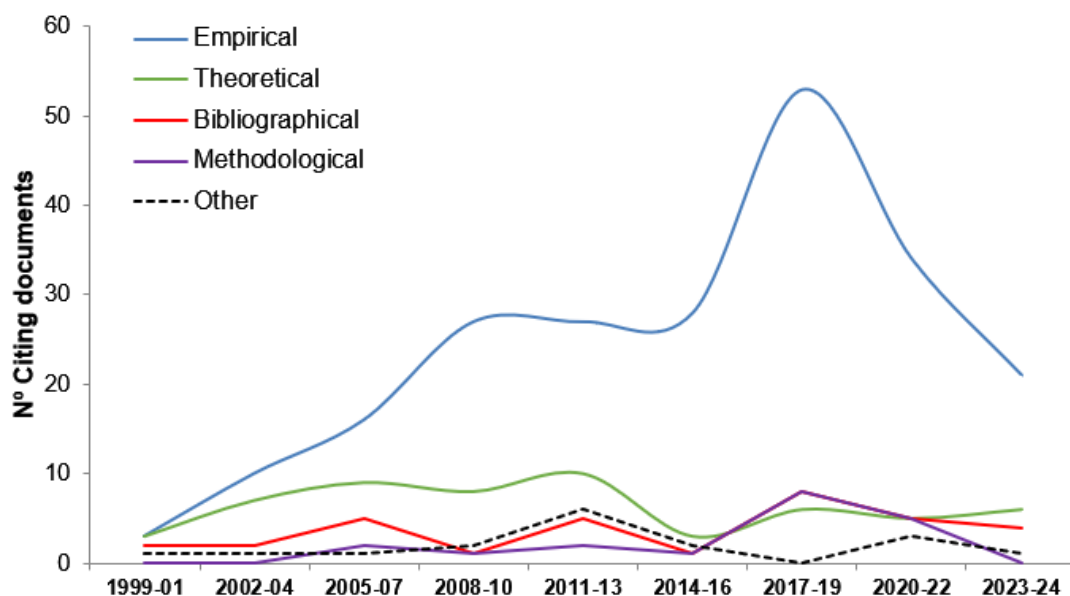


Figure 3. Types of documents citing the Information Horizon model in Dataset B (articles, chapters of serials, and conference papers, n = 345).

Subjects

The citing documents classified as belonging to library and information science [LIS] outnumbered non-library and information science [Non-LIS] citing papers, which indicated that research was strongly focused on this field (Figure 5). However, 25.3% of the papers citing the Information

Horizon model originated from disciplines outside the library and information science field. This was equivalent to 123 papers (n = 86 papers, or 24.9%, in Dataset B).

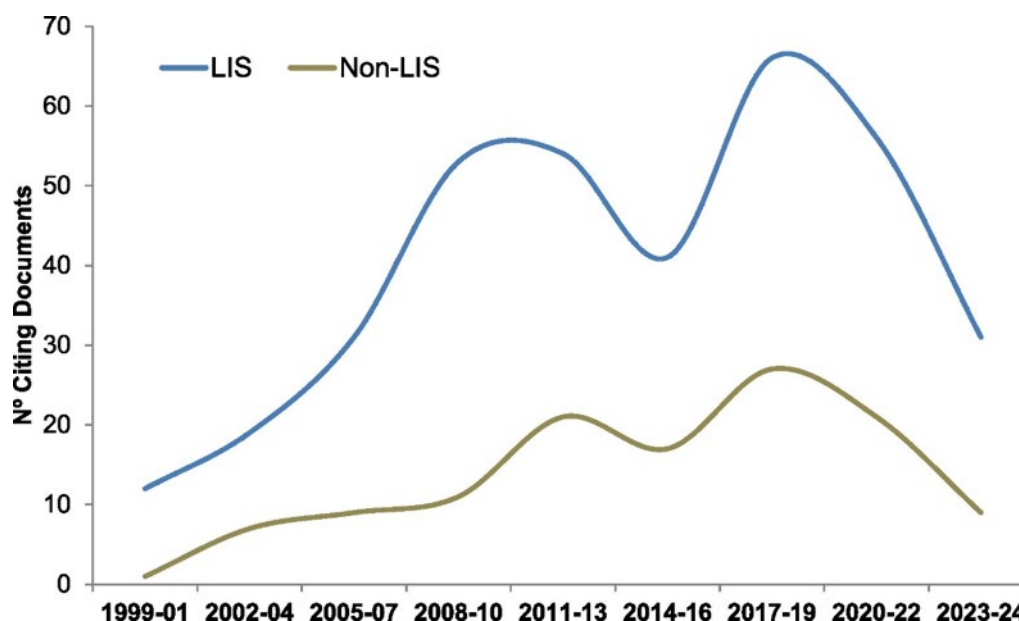


Figure 4. Subject categories, library and information science [LIS] and others [Non-LIS], in which the citing documents appeared (Dataset A).

Table 1 shows subjects other than library and information science to which documents that cited the Information Horizon model belonged. In general this model was most frequently cited in the social sciences (32.5%) and computer sciences (28.5%). However, when the analysis was limited to articles, chapters of serials, and conference papers, computer science led the citations, representing 36.0% of the sample which surpassed the social sciences (24.4%).

	DATASET A All documents %	DATASET B Articles, chapters, of serials, and conference papers %
Social sciences	32.5	24.4
Computer science	28.5	36.0
Business, management, and accounting	17.9	15.1
Multidisciplinary	13.0	17.4
Engineering	6.5	8.1
Medicine	6.5	9.3
Decision sciences	5.7	8.1
Arts and humanities	4.9	5.8
Environmental science	4.9	3.5
Psychology	4.9	7.0
Mathematics	3.3	4.7
Economics, econometrics, and finance	1.6	2.3
Energy	1.6	2.3
Nursing	1.6	2.3
Agricultural and biological sciences	0.8	1.2
Education	0.8	0.0

Table 1. Subject categories, other than library and information science, in which the citing works appeared

Moreover, business, management, and accounting ranked third in both datasets, with a citation rate of 15.1% in Dataset B and 17.9% overall. Citations from research in applied areas also stood out, including engineering, medicine, and decision sciences, albeit to a lesser extent. Finally, 17.4% of the citing documents in Dataset B were published in journals classified under the 'Multidisciplinary' subject category.

Citations in citing documents (theoretical incidents)

The analysis and review of the 486 citing documents revealed that seven of them contained only a bibliographic reference in the final list of references, and no in-text citation. Furthermore, not all citing documents had an introduction, methods, results, and discussion [IMRD] structure. Therefore, the analysis of locations of the theoretical incidents referred to the 306 documents that had in-text citations *and* an introduction, methods, results, and discussion structure (see row 3, Table 2). However, the frequency and style of citations in the remaining 479 documents were captured and analysed, which yielded 1,353 theoretical incidents (see row 2, Table 2).

	DATASET A All documents N		DATASET B Articles, chapters of serials, and conference papers N	
	Analysed documents	Theoretical incidents	Analysed documents	Theoretical incidents
1. Citing documents (CD)	486		345	
2. CD with cite in text	479	1,353	338	642
3. CD with cite in text and IMRD structure	306	849	214	433

Table 2. Frequency of citing documents, including documents with in-text citations and in-text citations and an IMRD structure, and theoretical incidents across each group of documents.

Restricting the data to articles, chapters of serials, and conference papers (Dataset B), we found that 338 of the 345 documents had in-text citations, generating 642 theoretical incidents. However, of these 338 documents, only 214 had an introduction, methods, results, and discussion [IMRD] structure, and it was only from these that we could determine the location of the theoretical incidents within the structure. This reduced the number of theoretical incidents to 433 incidents.

Frequency of citation

As shown in Table 2, we identified a total of 1,353 theoretical incidents citing the Information Horizon model in the 479 documents that were analysed in Dataset A, representing an average of 2.8 incidents per document. Of these documents, 276 (57.6%) contained a single incident (56% of library and information science papers and 62.5% of non-library and information science papers). Furthermore, 156 documents (32.6%) contained between two and five incidents (33.7% library and information science and 29.2% non-library and information science), while forty-seven documents (9.8%) contained six or more incidents each (10.3% library and information science and 8.3% non-library and information science).

The paper with the largest number of incidents that was classified as belonging to library and information science was the PhD thesis by Hirsh (2021), who aimed to investigate the information horizons of cosplay fans. Likewise, the non-library and information science paper with the most theoretical incidents was a doctoral thesis in the field of business, management, and accounting by Mousavinejad (2016). Mousavinejad's objective was to define the information-related requirements of information systems in the context of individual decision making in equivocal situations. Both doctoral theses each contained forty-eight theoretical incidents.

Restricting ourselves to Dataset B, we obtained 642 theoretical incidents that cited the Information Horizon model in the 338 analysed documents (Table 2), which was equal to an average of 1.9 incidents per document. Of these, a total of 217 documents (64.2%) contained a single incident (62.4% of library and information science papers and 69.9% of non-library and information science papers). Furthermore, 106 documents (31.4%) contained between two and five incidents (32.5% library and information science and 27.7% non-library and information science), while fifteen documents (4.4%) contained six or more incidents (5.5% library and information science and 2.4% non-library and information science).

The library and information science document with the most incidents ($n = 18$) was the article by Huvila (2009), who investigated the analytical maps of the information horizon of a group of archaeology professionals based on Sonnenwald (1999). Conversely, the non-library and information science document with the most theoretical incidents ($n = 9$) was an article by Martin (2012), which was classified under the arts and humanities, business, management, and accounting, and social sciences. In this article, Martin investigated the information horizons of a group of videogame players.

Finally, Figure 6 illustrates the evolution of the average number of theoretical incidents per document across the studied period for both datasets. In Dataset A, the average number of theoretical incidents per document increased, particularly between 2002 and 2004 (1.8), and 2020 and 2022 (3.7). The average in Dataset B was consistently lower and more stable.

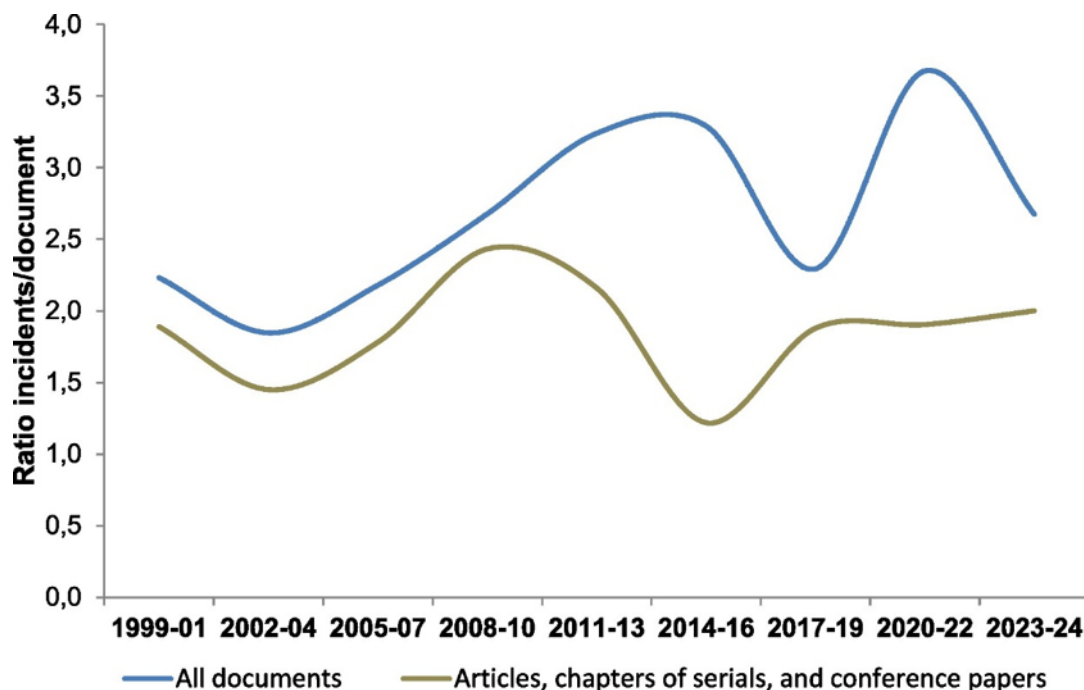


Figure 5. Evolution of average incidents per document

Citation style

The most frequently used citation style was the specific (and interpreted) citation of a single work by Sonnenwald (category B, 56.2% of citations), followed by nonspecific citations (category D, 21.2%), direct citations (category A, 10.6%), and specific (and interpreted) citations of several works by Sonnenwald (category C, 10.2%) (Table 3). Theoretical incidents, classified as images, represented 1.5% of the total. If we considered the theoretical incidents in categories A and B as essential, as they referred to a specific work, and those in categories C and D as superficial or merely formal, as they were part of sentences citing several works, essential citations represented

66.8% of the total while superficial citations represented 33.2%. In Dataset B, these percentages were 64.9% and 35.1%, respectively.

DATASET A All documents			DATASET B Articles, chapters of serials, and conference papers	
	N	%	N	%
A	143	10.6	36	5.6
B	761	56.2	381	59.3
C	138	10.2	64	10.0
D	291	21.5	158	24.6
E	20	1.5	3	0.5
Total	1,353	100.0	642	100.0
Note. Categories are defined as A) Direct quotation: B) Specific (and interpreted) mention of a single work by Sonnenwald: C) Specific (and interpreted) mention of various works by Sonnenwald: D) Non-specific mention: E) Images				

Table 3. Frequency and percentage of citation style category across both datasets

When we analysed the citation styles of documents classified as belonging to library and information science, the pattern was similar to that described for all documents: a total of 65.5% in Dataset A and 62.3% of essential theoretical incidents in Dataset B. If we obtained the same data for non-library and information science papers, 71.6% of the incidents in them were theoretical and essential, and rose to 76% in Dataset B.

It is worth noting the theoretical incidents that were classified as images. In total, twenty incidents appeared in fourteen documents, most of which were doctoral theses. These incidents were categorised into four types:

- Fourteen incidents reproduced images illustrating different aspects of the Information Horizon model in the cited documents.
- One incident (Tsai, 2013, p. 49) presented a theoretical framework based on the synthesis of three models from other researchers, including Sonnenwald's (1999) Information Horizon model.
- Two incidents involved Friday (2021, pp. 78–79) presenting the design of the research and showing the sources of information within or outside the information horizons of family historians, as defined by Sonnenwald (1999).
- Finally, three incidents (Jones, 2008, pp. 35 and 86; Moosa, 2010, p. 11) provided graphical representations that integrated and classified various theoretical models of information behaviour, and Sonnenwald's Information Horizon model was referenced in relation to them.

Location of citations

Table 4 shows the locations of theoretical incidents within articles featuring the introduction, methods, results, and discussion [IMRD] structure in both datasets and the type of citation style the incidents represented (per categories outlined in Table 3). In Dataset A, the highest concentration of incidents was observed in the introduction and/or literature review (I+L) sections, with 418 incidents representing 49.2% of the total. This was followed by sections presenting the research design via theoretical framework and/or methods (T+M), which accounted for 35.1% of incidents (n = 298). Finally, 127 incidents (15.0%) were obtained in the results, and discussion, and/or conclusion (R+D+C) sections in which the results were contextualised. The distribution in Dataset B was similar. Again, the highest proportion was recorded in the

introduction and/or literature review, with 189 incidents (43.6%). This was followed by theoretical framework and/or methods with 172 incidents (39.7%), results, and discussion, and/or conclusion with 66 incidents (15.2%), and abstracts with six incidents (1.4%).

	DATASET A All documents							DATASET B Articles, chapters of serials, and conference papers						
	A	B	C	D	E	T.I.	%	A	B	C	D	E	T.I.	%
Abstract		5		1		6	0.7		5		1		6	1.4
I+L	55	234	29	92	8	418	49.2	16	121	9	42	1	189	43.6
T+M	19	190	28	58	3	298	35.1	8	122	12	30		172	39.7
R+D+C	2	81	10	34		127	15.0	1	44	4	17		66	15.2
Total incidents	76	510	67	185	11	849	100	25	292	25	90	1	433	100

Table Note 1. Categories are defined as A) Direct quotation: B) Specific (and interpreted) mention of a single work by Sonnenwald: C) Specific (and interpreted) mention of various works by Sonnenwald: D) Non-specific mention: E) Images
Table Note 2. 'T.I.' reflects total incidents across section: I+L: Introduction and/or literature review; T+M: Theoretical framework and/or methodology; R+D+C: results, discussion, and/or conclusion.

Table 4. Locations and styles of the citations in citing documents across Dataset A and B.

Conversely, the finding that incidents featuring the A and B (i.e., essential) styles appearing in the theoretical framework and/or methods sections may suggest an explicit use of the theory and/or methodology. In Dataset A, these essential incidents represented a total of 209 incidents (i.e., 24.6% of incidents in documents with an introduction, methods, results, and discussion [IMRD] structure). This was equal to 22% in library and information science documents and 33.2% in non-library and information science documents. In Dataset B, they represented 130 incidents (30% of incidents in documents with an introduction, methods, results, and discussion [IMRD] structure, 25% in library and information science documents, and 49.4% in non-library and information science documents).

Table 5 shows how the theoretical incidents were distributed within the theoretical framework and methods according to the citation style in both datasets. In the total set of incidents across documents (N = 849), the methods (M) and theoretical framework (T) categories each accounted for 17.6% of the recorded incidents (149 incidents each). However, when considering only essential incidents (citation styles A and B), there were 112 incidents in the methods category (13.2%) and ninety-seven in the theoretical framework category (11.4%).

	DATASET A All documents							DATASET B Articles, chapters of serials, and conference papers						
	A	B	C	D	E	T.I.	%	A	B	C	D	E	T.I.	%
Methods (M)	9	103	12	25		149	17.6	4	67	6	15		92	21.2
Theoretical framework (T)	10	87	16	33	3	149	17.6	4	55	6	15		80	18.5
Other	57	320	39	127	8	551	64.9	17	170	13	60	1	261	60.3
Total incidents	76	510	67	185	11	849	100	25	292	25	90	1	433	100

Table Note 1. Categories are defined as A) Direct quotation: B) Specific (and interpreted) mention of a single work by Sonnenwald: C) Specific (and interpreted) mention of various works by Sonnenwald: D) Non-specific mention: E) Images.
Table Note 2. 'T.I.' reflects total incidents.

Table 5. Location and style of the citations (methods and theoretical framework).

When considering only Dataset B (n = 433 incidents), a slightly higher proportion was observed for the methods (21.2%) and theoretical framework categories (18.5%) compared with that in the overall set. When only essential theoretical incidents were considered, 71 incidents were recorded in the methods category (16.4%) and 59 in the theoretical framework category (12.6%).

Evolution of citation style and location according to introduction, methods, results, and discussion [IMRD] structure

Figure 7 illustrates the temporal evolution of the proportion of theoretical incidents in papers with an introduction, methods, results, and discussion [IMRD] structure, and separately shows the results for both datasets. In the most recent period (2023–2024), the highest percentage of incidents was concentrated in the theoretical framework and/or methods section. This accounted for 50.0% of all documents and 56.5% of those in Dataset B, indicating a strong presence of theoretical content in this part of the text. This was a significant change from 2005–2007, when the introduction and literature review (I+L) section was predominant, accounting for 74.1% of all documents and 72.7% of those in Dataset B. Conversely, the results, discussion, and conclusions (R+D+C) section exhibited a less dominant trend, reaching a maximum of 22.2% in Dataset A and 21.7% in Dataset B in 2023–2024, although it showed a slight increase compared with that in 2005–2010. Overall, a shift in focus from the introductory sections to the theoretical framework and/or methods (T+M) sections can be identified from 2014–2016 onwards.

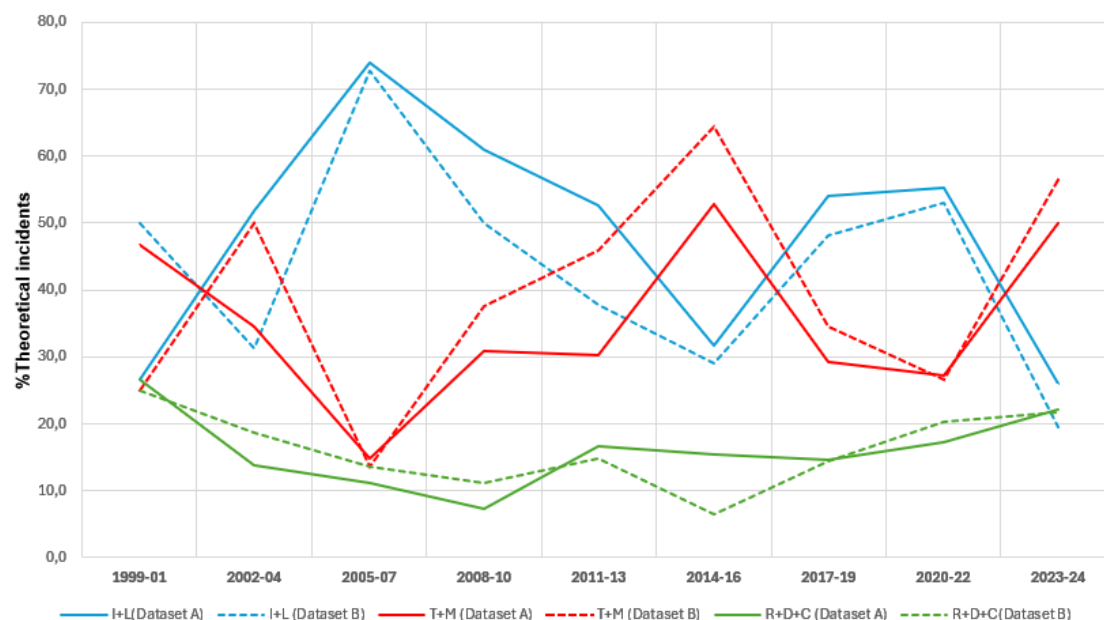


Figure 6. Locations of citations in the citing documents (all documents and only articles, chapters of serials, and conference papers).

Content cited

Table 6 shows the terms and expressions related to the Information Horizon model that appeared in at least five of the analysed documents. As expected, the high frequency of the concepts *information horizon* (present in 49.4% of theoretical incidents and 59.5% of documents), *contexts* (37.8% and 51.0%, respectively), and *situations* (26.5% and 34.8%) stood out. Such methodological aspects as *interview* and *information horizon maps* were also present, as were references to social networks and information behaviour.

	Theoretical incidents		Documents	
	N	%	N	%
Information horizon	669	49.4	289	59.5
Contexts	512	37.8	248	51.0
Situations	358	26.5	169	34.8
Information resources	186	13.7	119	24.5
Social networks	183	13.5	100	20.6
Interview	173	12.8	108	22.2
Information horizon maps	94	6.9	45	9.3
Human information behaviour	68	5.0	40	8.2
Information seeking behaviour	66	4.9	40	8.2
Information seeking process	44	3.3	36	7.4
Lack of knowledge	20	1.5	15	3.1
Social network analysis	20	1.5	17	3.5
Graphical representation	14	1.0	13	2.7
Information places	10	0.7	8	1.6
Information seeking situations	6	0.4	6	1.2
Electronic mentoring	4	0.3	4	0.8

Table 6. Terms and expressions of the Information Horizon model which appeared in the analysed theoretical incidents

Discussion

The results of the two-level citation analysis of Sonnenwald's Information Horizon model presented in this paper provided a nuanced view of the model's academic impact and uptake in library and information science and other disciplines. Following previous studies on Chatman's theories (González-Teruel & Abad-García, 2018) and Savolainen's model (González-Teruel & Pérez-Pulido, 2020), this paper took a dual approach to assessing the influence of the citations: direct and contextual citation analysis. By strictly replicating the methodology applied to Chatman and Savolainen, we provide a valid comparative baseline to assess the unique characteristics of the Information Horizon model's influence.

In terms of citations, the Information Horizon model exhibited an evolutionary pattern comprising four phases: initial low attention (1999–2004), sustained growth (2005–2011), a high citation plateau (2012–2022), and a recent decline (2023–2024). These phases corresponded to the lifecycle of the citations described by Gou et al. (2022) and others. This pattern was also identified in the evolution of other theories, such as Chatman's theories and Savolainen's model. However, the last phase, which showed a decline in citations, might also have occurred due to the date on which the analysed data were downloaded (October 2024) and the fact that the total number of citing documents was not included. It is not possible to validate whether this decrease really occurred only after a few more months.

The Information Horizon model achieved an annual citation rate that was higher than Chatman's theories, especially her Information Poverty Theory ($n = 10.7$ citations per year), and was comparable to Savolainen's model ($n = 18.5$ citations per year). However, if examining only results in Dataset B (articles, chapters of serials, and conference papers), the average number of citations per year fell to 12.8. The difference between the figures ($n = 18$ vs. $n = 12.8$ citations per year) represented the significant contribution of citations from doctoral theses. This demonstrated their formative role in and capacity to sustain long-term research, which is typical of this type of

academic work. In any case, we should not overlook the crucial role played by these documents in strengthening library and information science research (Sugimoto et al., 2009), for which the Information Horizon model has proven to be a benchmark.

Moreover, the predominance of empirical papers (68.3% in Dataset A and 63.5% in Dataset B) among papers citing Sonnenwald's works was indicative of the degree of maturity reached by the Information Horizon model. As observed in publication trends for Chatman and Savolainen, a sustained increase in empirical research suggested a greater willingness within the scientific community to operationalise theoretical frameworks for solving research problems. Moreover, this finding aligned with an upward trend in strategies observed for empirical research in the library and information science field (Järvelin & Vakkari, 2022). Conversely, the Information Horizon model was not only cited by most works as a contextual reference, but it had also explicitly been incorporated into the design of studies. This placed it ahead of the Information Poverty Theory and Everyday Life Information Seeking model, which were mostly cited for their reputational value (González-Teruel & Abad-García, 2018; González-Teruel & Pérez-Pulido, 2020).

Finally, a thematic analysis of the citing papers revealed that the Information Horizon model exhibited a stronger interdisciplinary projection than the theories of Chatman and Savolainen. While the latter two had citation rates outside of the library and information science field, ranging from 10.5% to 20.2%, rates of citations of the Information Horizon model reached 25.3%. This demonstrated its ability to transcend the original discipline. This was also consistent with the growing interest in information behaviour among other disciplines (Deng et al., 2019). Conversely, non-library and information science fields that most frequently cited this model were the social sciences and computer science. This suggested a technical application of the Information Horizon model in digital, computer, or systems environments, as evidenced by the fact that six patents cited it, even though they had not been included in our analysis (see the Methods section). At the same time, it may also suggest a conceptual or methodological basis in the social sciences. Furthermore, the percentage of documents classified as multi-disciplinary reached 17.4%, which reinforced the versatility of the Information Horizon model. However, this finding should be interpreted with caution due to the growing number of multi-disciplinary journals and difficulties with precise thematic area classifications.

When we examined citations within the context of the papers in greater detail, we observed that the Information Horizon model had an average number of citations per document and a percentage of texts with a single theoretical incident that were comparable to those reported by Savolainen (González-Teruel & Pérez-Pulido, 2020), particularly with regard to articles, chapters of serials, and conference papers. However, when examining the full set of documents (Dataset A), the Information Horizon model exhibited a higher average number of theoretical incidents per document and a lower percentage of texts with a single incident. This difference was largely due to the inclusion of many doctoral theses in the overall corpus, as this type of publication tends to be longer, and dissertations used the Information Horizon model more extensively. It is worth noting that the presence of a single theoretical incident in a paper often indicated the low relevance of the cited work to the citing study (Ding et al., 2013; Voos & Dagaev, 1976; Zhu et al., 2015). Conversely, a higher number of incidents related to the same source within a paper suggested that the work was more important to the citing author. Indeed, texts with the most theoretical incidents were mostly doctoral theses, with Huvila (2009) standing out among the articles and papers, as the Information Horizon model formed the basis of all the research reported.

Two aspects stand out regarding the style of citations. First, there was a lower percentage of direct citations (category A) of the Information Horizon model than those observed for Chatman's theories and Savolainen's model. This reinforced the argument made in previous work, that there are many ceremonial quotations (Rosenbaum, 2010) which are often used as mere rhetorical

devices, rather than as indicators of concrete references to ideas, arguments, or texts by authors. However, despite the low percentage of direct citations to the Information Horizon model, the percentage of essential citations (categories A and B) was higher than that for the Chatman and Savolainen models (González-Teruel & Abad-García, 2018; González-Teruel & Pérez-Pulido, 2020). This could be interpreted as a higher degree of appropriation and adaptation of the model, particularly in documents from non-library and information science disciplines, where the percentage of essential citations was 76%. Moreover, the visual category (1.5%) reflected graphical incorporation of the model, primarily in doctoral theses, a phenomenon that has not been previously studied in works focusing on Chatman or Savolainen.

The key application of the Information Horizon model became apparent when analysing the section of the information, methods, results, and discussion [IMRD] structure in which the theoretical incidents were located. Unlike the patterns observed in Chatman's theories and Savolainen's model, the Information Horizon model exhibited a clearly differentiated profile. In the full dataset, incidents located in the theoretical framework and/or methods section (T+M) accounted for 35.1% of the total number of analysed documents, a significantly higher proportion than in the other two models. This percentage rose to 39.7% when considering only articles, serialised book chapters, and conference papers (Dataset B). Conversely, the proportion of citations in the introductory and literature review sections (I+L) decreased from 49.2% in Dataset A to 43.6% in Dataset B. Citations in the results, discussion, and/or conclusion sections (R+D+C) remained consistently low at 15% and 15.2% in Datasets A and B, respectively. This trend was also confirmed in the final evolutionary analysis. While citations to the Information Horizon model were mostly concentrated in the I+L sections in the early years of the period examined, which reflects its reputational value, citations in the T+M section have become dominant in the most recent period (2023–2024): a total of 50% of all documents, and 56.5% of articles and conference papers. This suggested an evolution from initial theoretical recognition to the active adoption of the model in the design of methodological research, which contrasted with the stability observed in the models of Chatman and Savolainen that continue to be cited primarily for their reputational value.

The evolution observed in the location and style of the citations indicated that the Information Horizon model evolved from a mere rhetorical reference to an explicit tool. Its balanced presence in the theoretical framework and methodological design of documents featuring the introduction, methods, results, and discussion [IMRD] structure suggested a functional, application-oriented use beyond a formal acknowledgement. In this sense, the Information Horizon model clearly differed from Chatman's theoretical framework and Savolainen's model, the presence of which remained predominantly concentrated in the introductory sections, with a discursive rather than an operational character. This interpretation was reinforced by the frequent incorporation of key concepts in the quotations, such as *information horizon* (49.5%), *contexts* (37.8 %) and *situations* (26.5 %), which was evidence of a high degree of conceptual internalisation. In contrast, citations of Chatman's framework and Savolainen's model contained lower percentages of specific concepts and a more frequent use of generic or ambiguous expressions. This pattern suggested that the Information Horizon model tended to be *operationalised* more often than it was simply *mentioned*.

Conclusion

In conclusion, the results of this study suggest that the Information Horizon model has achieved a sustained upward trajectory in terms of its impact, application, and conceptual integration. Unlike the other analysed frameworks, the Information Horizon model exhibits a higher number of essential citations, a clearer shift towards substantial use as a theoretical and/or methodological framework, stronger interdisciplinary adoption, and a more consistent use of key concepts. These findings demonstrate that the model has been recognised and adopted in a variety of contexts, as well as adapted and applied in diverse ways.

Beyond these specific findings, the study highlights a critical distinction in the dissemination of knowledge within information behaviour research. Comparisons with earlier theoretical models reveal that, whereas purely conceptual frameworks may remain rhetorical authorities, models offering specific data collection tools, such as the Information Horizon interview, achieve deeper operational integration into research designs in library and information science and other disciplines. Ultimately, these findings suggest that the longevity and interdisciplinary reach of a theory or model may depend less on its conceptual density and more on its methodological usability, with the operationalisation of concepts identified as a key factor in theoretical diffusion.

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Prior publication of this chapter was fully disclosed to the journal's Editor on submission and on acceptance by the journal. The book's editors themselves (Professors Sonnenwald and Hartel) originally recommended and encouraged me to submit this expanded version to Information Research.

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