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ORIGINAL RESEARCH

Information overload in the information age: a review of the literature from business administration, business psychology, and related disciplines with a bibliometric approach and framework development

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Abstract In the light of the information age, information overload research in new areas (e.g., social media, virtual collaboration) rises rapidly in many fields of research in business administration with a variety of methods and subjects. This review article analyzes the development of information overload literature in business administration and related interdisciplinary fields and provides a comprehensive and overarching overview using a bibliometric literature analysis combined with a snowball sampling approach. For the last decade, this article reveals research directions and bridges of literature in a wide range of fields of business administration (e.g., accounting, finance, health management, human resources, innovation management, international management, information systems, marketing, manufacturing, or organizational science). This review article identifies the major papers of various research streams to capture the pulse of the information overload-related research and suggest new questions that could be addressed in the future and identifies concrete open gaps for further research. Furthermore, this article presents a new framework for structuring information overload issues which extends our understanding of influence factors and effects of information overload in the decision-making process.

Keywords Information processing · Information management strategies · Information overload · Literature review · Bibliometric literature analysis

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1 Introduction

Information overload is a decisive factor driving negative "work environments [that] are killing productivity, dampening creativity, and making us unhappy" (Dean and Webb 2011). Losses arising directly or indirectly from information overload are estimated at $650 billion worldwide each year (Lohr 2007)—an amount that equals the gross domestic product of Switzerland in 2015 (United Nations Statistic Division 2016).

Information overload occurs when decision-makers face a level of information that is greater than their information processing capacity, i.e., an overly high information load (Schroder et al. 1967; Eppler and Mengis 2004), but the phenomenon is not confined to the modern world. As Blair (2012) noted in her review article, even in the thirteenth century, scholars complained of "the key ingredients of the feeling of overload which are still with us today: 'the multitude of books, the shortness of time and the slipperiness of memory'" (Blair 2012, p. 1). Two radical innovations supported the rapid increase in the availability of information and the decrease in information search-related costs: Gutenberg's printing innovations and the rise of information technology (IT). Before these radical innovations, the issue of information overload was limited to a wealthy and privileged elite. In particular, the rise of IT and the use of internet services have resulted in an expansion of information overload-related problems for all social ranks. In ancient and medieval times, the nobility and academics almost exclusively faced information overload-related problems, as Blair (2012) and Levitin (2014) suggested.

Information (over-)load research peaked in the 1980s and 1990s; interest in this topic quieted down in the 2000s (Eppler and Mengis 2004; Ding and Beaulieu 2011; Lewis 1996; Edmunds and Morris 2000; Feather 1988) and languished in the 2010s. In retrospect, research found many impacts and implications of information load and developed countermeasures. However, a quarter century after interest in information load research peaked, the information load of managers in day-to-day operations has quadrupled. Thus, in the information age, information overload research in new areas (e.g., social media, virtual collaboration) seems to be rising rapidly (Dean and Webb 2011; Hemp 2009; Kolfschoten and Brazier 2013; Shapiro and Varian 2013).

But since the often-cited literature review of Eppler and Mengis (2004),[1] no study has yet focused on offering a comprehensive and overarching literature review regarding information overload. The prior literature offers some discipline-specific literature reviews, which allow in-depth insights and an understanding of information overload in each discipline: marketing and organizational science (Klausegger et al. 2007), healthcare management (Hall and Walton 2004), business informatics conferences (Melinat et al. 2014), technology-based education (Shrivastav and Hiltz 2013), general management (Jackson and Farzaneh 2012), and business-related psychotherapy (Case et al. 2005). But an actual review of information overload in today's information age is still missing.

[1] Google Scholar: 1302 cites [1.5.2018].

This literature review aims to close this gap and present a comprehensive and overarching literature review for 2004–2017. This paper contributes to prior research in four ways. First, this paper presents an actual and comprehensive overview regarding the information overload literature in a wide range of fields of business administration (e.g., accounting, finance, health management, human resources, innovation management, international management, information systems (IS) management, marketing, manufacturing, and organizational science). This overview can be a foundation for research in business administration with a focus on information overload issues. This review addresses a limitation noted by Eppler and Mengis (2004), namely that research focusing on information overload from other perspectives (e.g., psychology, health care, and mass communication) is not addressed adequately. As Webster and Watson (2002) noted, review articles are critical to strengthening research itself. Therefore, this paper also identifies the theoretical basis and the method (e.g., experiment, survey) of the papers to ensure comparability. Second, this paper structures prior studies and identifies some avenues for further research. Third, this paper addresses interdisciplinary papers, links fields of research that remain broadly isolated, and answers the call for research from Eppler and Mengis (2004), who stated that "the overload problem calls for interdisciplinary approaches as many of the open research questions in this field cross traditional disciplinary boundaries" (p. 341). Fourth, this paper provides a new framework for structuring information overload issues and extends our understanding of influence factors and effects of information overload in the decision-making process. This paper develops a thorough framework that spans from the starting situation, to the information search and selection via information processing, to decision-making, and to the ex post consequences of the decision.

The remainder of this paper is organized as follows: In the next section, I provide the theoretical basis for information overload and develop a working definition. The subsequent section presents the methodology, including the literature collection process of the bibliometric analysis and a sample description. The fourth section provides descriptive results of the bibliometric analysis. In the final sections of this paper, I present and discuss our results and draw conclusions.

2 Working definition of information overload

A widely used standardized definition of information overload is still missing. Eppler and Mengis (2004) listed seven definitions of information overload in the business research literature. Similar to business research, prior research on information processes suffers from a lack of standardized definitions across different disciplines (Edmunds and Morris 2000; Meadow and Yuan 1997). A necessary starting point for this study is a working definition of information overload. This situation prevails in the 2000s (Hadfi and Ito 2013). Thus, a working definition of information overload is needed.

In information overload situations, a decision-maker faces what Herbert Simon called "a wealth of information [which] creates a poverty of attention and a need to allocate that attention efficiently among the overabundance of information sources

that might consume it" (Simon 1971, pp. 40–41). While research has been aware of this phenomenon since the 1960s (Eppler and Mengis 2004; Bawden and Robinson 2009), the information age has significantly increased the amount of information available: "The information age is drowning us with an unprecedented deluge of data" (Levitin 2014). Shenk (1997) described this phenomenon as data smog, the "muck and druck of the information age" (Shenk 1997, p. 31). Today, decision-makers can acquire additional information easily (e.g., via management information systems), and the cost of additional information is very low compared to the cost in the pre-IT age (Levitin 2014; Shapiro and Varian 2013). For example, in pre-IT times, any calculation, evaluation, or determination of key performance indicators (KPI) entailed costs to pay employees to perform these calculations. In addition, the acquisition of further management accounting information or reports took time. Currently, a calculation that required several days in pre-IT times can be performed by a management information system (MIS) within seconds (Levitin 2014).

Although decision support IS and the acquisition of information developed rapidly, the decision-maker's cognitive capacity did not. Simon and Newell (1971) stated that limited short-term or working memory and limited information processing capacity per time unit are two decisive factors explaining why decision-makers cannot incorporate an overly high level of information given limited time.[2] While pre-IT decision-makers could evaluate the acquired information while further analysis was being pursued, today, additional information is available in a minimum of time. Hence, decision-makers may face situations in which they receive much more information than they are able to evaluate.

All prior approaches to information overload share the fact that a level, or a certain set of information, serves as the final straw. To simplify, I refer to this level or set of information a "point" (in the style of mathematical analysis) because in a function a point is represented by an X (the information level—as the independent variable) and a Y (decision-making performance—as the dependent variable). Considering the simple two-dimensional relationship between the information input as the independent variable (e.g., information load, information provided, information received) and the decision-making performance as the dependent variable, the decision output will improve between zero and the particular point at which the human information processing capacity is reached. Beyond that point, the decision-maker is being asked to handle more information than possible due to his/her limited information processing capacity. At this level of abstraction, all approaches to information load name this state "information overload". The underlying function that describes the relationship between information input and decision output diverges across the approaches. The prevailing view interprets this relationship as an inverted U curve (Driver and Streufert 1969; Driver et al. 1990; Schroder et al. 1967) (see Fig. 1).

Another approach is to consider information complexity in addition to the amount of information (Bawden and Robinson 2009; Eppler and Mengis 2004). IS

[2] The limitation of time is a theoretical construct drawing on infinite long-term memory, as Simon and Newell (1971) noted. Extreme examples might exist for managerial decisions in which unlimited time is given, but usually time is a decisive factor in managerial decision-making.

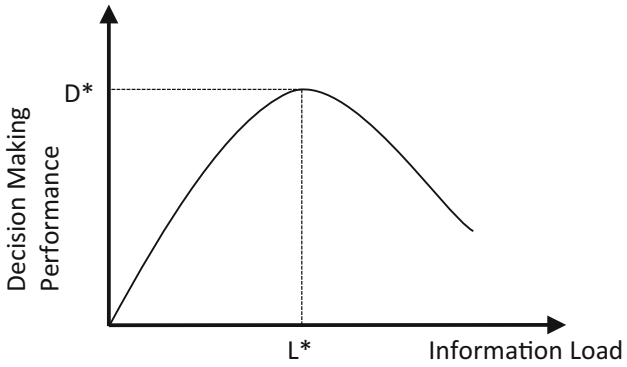

Fig. 1 Information and decision-making performance

research studies address the issue of information complexity with a special focus on information quality (e.g., Doll and Torkzadeh 1988 or Burton-Jones and Straub 2006). If information complexity is high, the decision-maker's information processing capacity might be reached well before the point when only the amount of information is used.

Following this view, at least two possible overarching explanations exist for this turning point (Schroder et al. 1967). First, from a cognitive viewpoint, decision-makers cannot use more information than his/her limited information processing capacity, stop acquiring information, and make a decision based on the limited information that they have (bounded rationality (Simon 1955)). This sequence assumes that the decision-maker is able to stop information acquisition. However, situations could occur in which stopping would not be possible, e.g., during a meeting.

Second, from an equipment-related viewpoint, the inverted U curve could be explained by limited resources (e.g., time or budget). If a resource that is decisive for decision-making (e.g., time or budget) is limited, the available information cannot be used efficiently. For example, an auditor who is strictly limited for time (to audit) and budget (for size, quality, etc., of his/her auditing team) could face situations where cognitive information processing is not the limitation, but rather his/her resources. Similar situations are imaginable for the context of incomplete contracts.

Limitations stemming from individual characteristics or resources are two sides of the same coin. In situations in which individual characteristics are the decisive driver of information overload, resource limitations might not be reached or could be negligible. By contrast, in situations where resource limitations dominate, individual characteristics might not be reached or may be negligible.

However, the prior literature on information overload focuses on cognitive issues in particular. A relatively recent literature review on information overload by Eppler and Mengis (2004) shows an omission in the research that differentiates between cognition-related and resource-related information overload. Although little research is available on the resource-related issues of information overload, we

do know that time is a decisive factor in decision-making and that time pressure can decrease decision-making performance due to information overload (Pennington and Tuttle 2007; Schick et al. 1990). However, the modeled time pressure in both experiments (Pennington and Tuttle 2007; Schick et al. 1990) allows decision-makers to read or analyze all information; thus, they are overwhelmed by the quantity of information. To return to the auditor example, this modeling of time pressure means that the auditor is able to read all expense vouchers, statements of account, etc., but is overwhelmed by the quantity of information. Instead, taking a resource viewpoint, expense vouchers, statements of account, etc., would be so numerous that the auditor (and his or her team) could not read all of them due to limited resources. Research is lacking that models such business situations. Furthermore, the lack of theoretical foundation to unite both business decision-making and information processing indicates a theory deficit.

Thus, I use the following working definition of information overload:

> *Information overload is a state in which a decision maker faces a set of information (i.e., an information load with informational characteristics such as an amount, a complexity, and a level of redundancy, contradiction and inconsistency) comprising the accumulation of individual informational cues of differing size and complexity that inhibit the decision maker's ability to optimally determine the best possible decision. The probability of achieving the best possible decision is defined as decision-making performance. The suboptimal use of information is caused by the limitation of scarce individual resources. A scarce resource can be limited individual characteristics (such as serial processing ability, limited short-term memory) or limited task-related equipment (e.g., time to make a decision, budget).*

3 Methodology

To investigate the body of literature on information overload, I conducted a bibliometric analysis following the procedure of Schaltegger et al. (2013). The scope of the following literature review on information overload encompasses all business administration studies that deal explicitly with information overload.

Following the procedure of Schaltegger et al. (2013), I started with a snowball sampling (Biernacki and Waldorf 1981). The bibliography on information overload was compiled beginning with the papers identified in Eppler and Mengis (2004).[3] I did not include working papers, reports, books, and conference proceedings—with one exception: regarding IS research, which highlights conferences, I included peer-reviewed papers that were presented at the four major conferences on information

[3] Eppler and Mengis (2004) reported a methodological limitation: They did not consider relevant articles that addressed information overload situations but used labels other than the four terms "information overload", "information load", "cognitive load", and "cognitive overload". Possible alternative labels might be "data smog, information fatigue/overkill/overabundance/breakdown/explosion/deluge/flood/stress/plethora, document tsunami, sensory overload" (Eppler and Mengis 2004, p. 329). Using snowball sampling avoids this methodological limitation.

systems (ICIS, ECIS, AMCIS, HICSS). This way, 489 journal articles and 6 IS conference papers were collected. To enlarge the bibliography, I conducted a literature search in four major databases: EBSCO, ProQuest, ScienceDirect and Emerald. Following Eppler and Mengis (2004), I searched for the keywords "information overload", "information load", "cognitive load", and "cognitive overload" with the following conditions: written in English, published after 2004, research articles/papers, peer-reviewed, published in journals. After removing duplicates, 1042 papers were collected in the literature search with the four major databases. Thus, comprehensive data triangulation was achieved by snowball sampling and database query, resulting in a robust bibliographic database with the following characteristics: 1537 research articles/papers in peer-reviewed journals, written by 818 authors, published in 383 academic peer-reviewed journals.

To focus on business administration, I used the VHB-JOURQUAL3 (a ranking of journals relevant to business research based on evaluations by members of the German Academic Association for Business Research) to identify relevant journals.[4] I excluded papers published in journals that are either not listed in the VHB-JOURQUAL3, are listed in category "D", or are ranked as "k.w.Z." (= "no academic journal"). This procedure resulted in 171 articles ranked in the VHB-JOURQUAL3.

To ensure that I did not miss business research-relevant papers, I performed a snowball sampling (Biernacki and Waldorf 1981) with the 171 articles. I found that 39 of these articles are cited in articles published in a peer-reviewed academics journal that do not appear in the VHB-JOURQUAL3: The Elsevier Journal named "Computers in Human Behavior" [CiteScore: 4.54, Impact Factor: 3.435, 5-Year Impact Factor: 4.252, SNIP: 2.137, SCImago Journal Rank (SJR): 1.595].[5] Regarding the journal's metrics, this journal can be seen as comparable to other IS journals in the VHB-JOURQUAL3 in category "B" (= important and renowned business research journals). Within the journal "Computers in Human Behavior", I repeated the literature search with the four major databases with the same parameters. I found 138 articles on information overload, but only 18 of these articles are business research-relevant, while the majority of the other articles focus on information overload in pedagogy or general information processing without any business context. I included the 18 articles in the business research-relevant sub-sample with the 171 articles ranked in the VHB-JOURQUAL3, resulting in 189 articles on information overload.

[4] In this literature review, I address a limitation noted by Eppler and Mengis (2004), namely that research focusing on information overload from other perspectives (e.g., psychology, health care, and mass communication) is not addressed adequately. As interdisciplinary journals are ranked in the VHB-JOURQUAL3, the database includes management-related articles from psychology or health economics and management. Particularly in health economics and management, physicians and patients face a substantial information load in time-critical decision situations. Due to the high relevance of time as a decisive success (or stress) factor in information overload-related situations for managers (e.g., Bawden and Robinson 2009; Pennington and Tuttle 2007; Schick et al. 1990; Tushman and Nadler 1978), the results of information overload studies including a strong reference to time are interesting for all disciplines of business administration.

[5] Values as of April 30, 2018 (https://www.journals.elsevier.com/computers-in-human-behavior).

4 Descriptive results of the bibliometric analysis

Prior literature reviews on information overload stated that information (over-)load research reached a peak in the 1980s and 1990s, but interest in this topic declined in the early 2000s (Eppler and Mengis 2004; Ding and Beaulieu 2011; Lewis 1996; Edmunds and Morris 2000; Feather 1988). Considering the development of information overload research after Eppler and Mengis (2004)'s review, two trends could be revealed: First, the number of peer-reviewed journal publications on information overload per year across all areas of research significantly increase per year, $\beta = 12.374$, $t(11) = 25.194$, $p < 0.001$ (see Fig. 2). Second, publications in business research-relevant journals are somewhat left behind, and their increase per year is slightly unstable when compared to total publications, $\beta = 0.742$, $t(11) = 2.417$, $p < 0.05$. Since 2005, the development has been characterized by strong outlays with lows particularly in 2006, 2009 and 2015 and with peaks in 2007 and 2012 (see Fig. 3). Although a chart depicting the number of publications on information overload cannot show a cause and effect relationship, the significant OLS-regressions regarding the increase in publications could be a first hint. Moreover, I find a significant correlation ($\rho = 0.740$, $p < 0.01$) between the number of publications in business research-relevant journals and the total number of peer-reviewed journal publications on information overload per year across all areas of research.

4.1 Publications in business research-relevant journals

Regarding the publications in business research-relevant journals, a comparison between disciplines of business research shows that the top five disciplines driving research forward on information overload in business administration are information systems and computer science, marketing, general management, logistics, and accounting (see Table 1). Particularly in information systems and computer science,

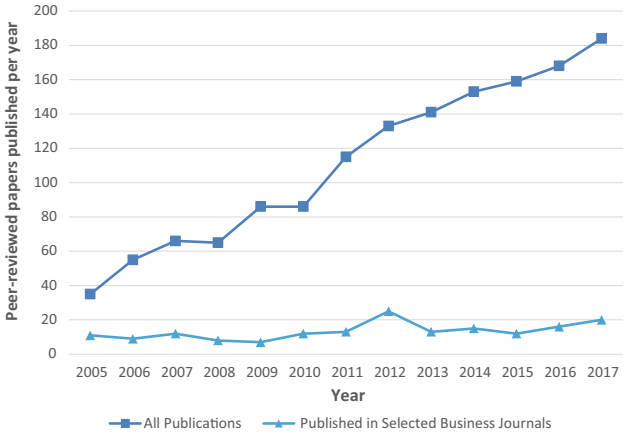

Fig. 2 Historical development of the number of information overload publications

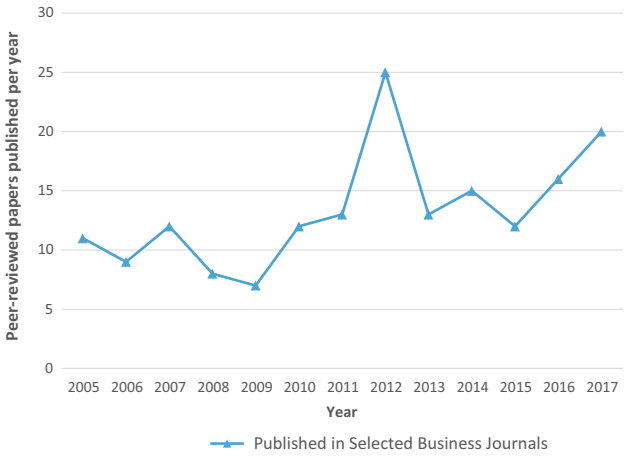

Fig. 3 Historical development of the number of information overload publications in business research-relevant journals

two journals publish 74.68% of all research articles in this field: decision support systems and computers in human behavior. The strong IS-related research can be found in the other top disciplines, e.g., in accounting, and the top publishing journal is the *International Journal of Accounting Information Systems*. The role of computer- or IS-based decision-making is often the starting point or a mediator/moderator.

Table 1 Publications in business research-relevant journals

Discipline	No. of journals	Publications	Share (%)
Information systems and computer science	14	83	42.13
Marketing	10	28	14.21
General management	14	27	13.71
Logistics	2	19	9.64
Accounting	5	10	5.08
Human resources	4	8	4.06
Finance	3	7	3.55
Operations research	3	6	3.05
Innovation and entrepreneurship	3	3	1.52
Organization	3	3	1.52
Environmental management	1	1	0.51
Health economics	1	1	0.51
Public administration	1	1	0.51
Total (multiple assignment possible)	66	197	100

Table 2 Publications in business research-relevant journals for different rating categories

VHB rating	Number of publications (%)	
A+	8	4.23
A	34	17.99
B	96	50.79
C	31	16.40
Listed but not ranked	2	1.06
Not listed	18	9.52
Total	189	100.00

Table 2 shows the distribution of publications regarding the VHB-JOURQUAL3 categories. The majority of publications belong to "B"-rated journals. A Kolmogorov–Smirnov test with the Lilliefors significance correction indicates a normal distribution ($p > 0.05$). Only eight papers are published in "A+"-rated journals. Here, a temporary peak occurs in 2006/07 when four of the eight papers are published. The results do not reveal any correlation between time and journal rating.

4.2 Authorship

Regarding authorship, Schaltegger et al. (2013) draw on the "Ortega hypothesis" (Cole and Cole 1972), which implies that scientific progress is based on the work of a small percentage and number of researchers and authors in each field. While prior work questions this hypothesis (e.g., Száva-Kováts 2004), I analyzed whether any authors were dominant in the field of information overload. In the business research-relevant sample of 189 papers from 462 different authors, no authors published more than 3 papers. In the total sample of 1537 papers from 818 different authors, one author has ten publications (Fred Paas), and 7 authors have five publications. Thus, I find no indication for the "Ortega hypothesis" in business-relevant information overload research.

4.3 Methodological approaches and underlying theories

Different methodological approaches exist for analyzing the literature on information overload. Between 2005 and 2017, 21.16% of the published papers are non-empirical (e.g., conceptual), whereas 78.84% draw on empirical methods. This review shows the heterogeneity of methods typically used to detect information overload.

In information overload research, the two dominating research methods are lab experiments and surveys (Table 3). Drawing on Hair et al. (2007), documenting effects in field research (e.g., by surveys) is important to test the external validity of experimental research (e.g., lab experiments). While lab research is very well suited to test theories, it is limited in its external validity. Thus, findings may not occur in practice, and laboratory research must be taken to the field to test its relevance. Next to lab experiments, researchers use online experiments to get more information on

Table 3 Publications in business research-relevant journals for methods

Research method	No. of publications	Share (%)
Lab experiment	57	30.16
Survey	54	28.57
Conceptual	22	11.64
Archival data	16	8.47
Simulation	9	4.76
Case study	8	4.23
Online experiment	6	3.17
Review articles	5	2.65
Qualitative interviews	4	2.12
Combinatorial optimization	4	2.12
Meta-analysis	3	1.59
Field experiment	1	0.53
Total	189	100.00

user behavior (e.g., in social networks). Field experiments or mixed methods, however, can be considered "rare orchid" methods, playing a negligible niche role in information overload research, although these methods might have the strength of a field approach that shows effects occurring in the workplace (Hair et al. 2007; Wang et al. 2014). While prior research has found many single leverage points that affect information search, information processing, and decision-making behavior, comprehensive and overarching studies are missing. Due to the limitations of lab experiments and surveys (Birnberg et al. 2008; Luft and Shields 2003; Sprinkle and Williamson 2008), new empirical methods such as action research or a combination of field experiments, surveys and archival data within larger companies might provide deeper insights into information overload.

5 New conceptual model for information overload-related research

The described lack of a common definition of information overload might root in the distinct heterogeneity of theoretical backgrounds used (see Table 4). The most-used theory is the human information processing approach by Schroder et al. (1967), on which the working definition of information overload has been based. Similar to the second most-used theory—information processing approach by Miller (1956)—the human information processing approach by Schroder et al. (1967) makes general assumptions about how decision-makers process information but do not limit the range of possible applications in research. Surprisingly, 35.45% of the papers do not use a theory but argue logically.

Table 4 Publications in business research-relevant journals regarding theoretical backgrounds

Theoretical background	No. of publications	Share (%)
Human information processing approach by Schroder et al. (1967)	27	14.29
Information processing approach by Miller (1956)	19	10.05
Cognitive load theory	11	5.82
Information overload approach by Malhotra et al. (1982)	10	5.29
Information theory	4	2.12
Principal agent theory synthesized with assumptions of bounded rationality	4	2.12
Wilson's (1999) model of information behavior	3	1.59
Attention deficit disorder/attention deficit trait	2	1.06
Bounded rationality	2	1.06
News communication approach by Rogers and Agarwala-Rogers (1975)	2	1.06
Additive information approach by Butters (1977)	1	0.53
Affect and social behavior approach by Moore and Isen (1990)	1	0.53
Affect infusion model by Forgas (1995)	1	0.53
Classical choice theory	1	0.53
Cognitive load theory synthesized with social capital theory	1	0.53
Communication theory	1	0.53
Constructive processing perspective by Payne et al. (1992)	1	0.53
Cultural management approach by Hofstede and Hofstede (2005)	1	0.53
Distraction conflict theory	1	0.53
Dual-process theory	1	0.53
Filter model of attention by Broadbent (1958)	1	0.53
Hierarchy of effects model synthesized with information overload approach by Malhotra et al. (1982)	1	0.53
Human information processing approach by Schroder et al. (1967) synthesized with prospect theory	1	0.53
Information diffusion theory based on epidemiology susceptible-infected-recovered-susceptible (SIRS) models by Bailey (1975)	1	0.53
Information overload approach by Malhotra et al. (1982) synthesized with paralysis by analysis approach by Lewis (1996)	1	0.53
Information overload concept by O'Reilly (1980)	1	0.53
Information processing approach by Miller (1956) synthesized with filter model of attention by Broadbent (1958)	1	0.53
Information processing approach by Miller (1956) synthesized with news communication approach by Rogers and Agarwala-Rogers (1975)	1	0.53
Information processing approach by Miller (1956) synthesized with SMCR model by Berlo (1960)	1	0.53
Information processing approach by Miller (1956) synthesized with mood congruency approach by Forgas and George (2001)	1	0.53
Information use approach by Stigler (1961)	1	0.53
Information weighting approach by Wedell and Senter (1997)	1	0.53
Input-processing-output (IPO) model	1	0.53
Job burn-out approach by Maslach and Jackson (1981)	1	0.53
Knowledge-based view	1	0.53

Table 4 continued

Theoretical background	No. of publications	Share (%)
Knowledge-based view synthesized with organizational learning approach by Huber (1991)	1	0.53
Need for cognition approach	1	0.53
Organization of decentralized information processing approach by Radner (1993)	1	0.53
Organizational learning approach by Shrivastava (1983) synthesized with Lindblom's (1959) concept of incrementalism	1	0.53
Passive bounded rationality model by DeShazo and Fermo (2002)	1	0.53
Personal construct theory by Kelly (1955)	1	0.53
Prospect theory	1	0.53
Relational complexity model by Halford et al. (1998)	1	0.53
Sensemaking approach by Weick (1995)	1	0.53
Social cognition theory	1	0.53
Strength of weak ties approach by Granovetter (1983), theory of affordances	1	0.53
Theory of semantic internalization	1	0.53
Transactional theory of stress	1	0.53
No explicit theory addressed/argumentation with empirical evidence only	67	35.4
Total	189	100

The occurrence of such a range of theories and approaches reveals a need to conceptualize research areas and survey and synthesize prior research using a framework. Following the recommendations of Webster and Watson (2002), I structured prior research in a thorough framework.

Eppler and Mengis (2004) used a conceptual framework, structuring research on information overload as a *cycle* (causes → symptoms → countermeasures → causes). By contrast, I arrange these elements as a *functional chain* to structure the research (see Fig. 4); this structure allows me to follow the psychological understanding of the prior management literature. Mental processes and states are interpreted as mediators between a stimuli and a behavior (Birnberg et al. 2008). By focusing on the individual instead of organizations or societies, management psychology explains "subjective phenomena" (Birnberg et al. 2008, p. 115).

Furthermore, a thorough framework is missing that spans from the starting situation to the information search and selection via information processing to decision-making and to the ex post consequences of the decision. Prior approaches can capture the steps between, such as Wilson's (1999) model of information behavior, which focuses on information seeking and information satisfaction in a documentation/library setting, or the Factor-Based Model of Jackson and Farzaneh

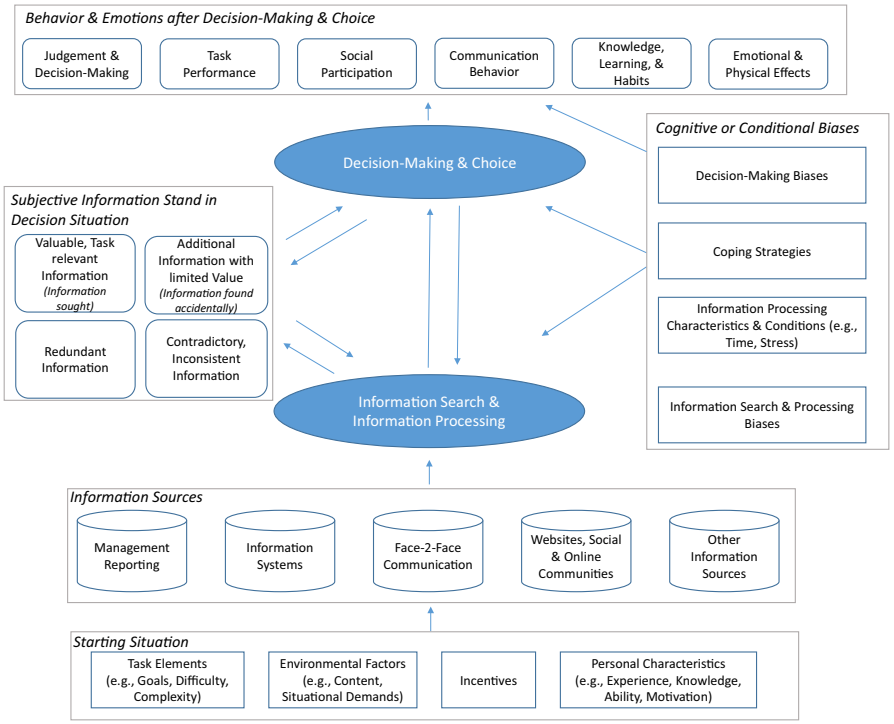

Fig. 4 Framework

(2012), which approaches information overload as a scale of information underload and overload.

Thus, a framework is developed that categorizes the important elements relevant to information overload research as derived from the analyzed articles and shows the relationships between these elements. Considering the big picture, the empirical literature on information load is characterized by concrete, highly detailed empirical research with very specific studies using a wide range of theoretical backgrounds. These studies primarily focus on the following broad topic areas:

1. Which ex ante starting situation leads to changes in information processing behavior and/or decision-making?
2. What role does the source of information (e.g., information system, communication, database, social media, websites, online communities) play in information search, information processing, and decision-making? How does the type of information source affect an individual's behavior in information search, processing and decision-making?
3. Which biases occur during information search and processing (e.g., evaluation, editing)? How do information processing characteristics and conditions (e.g., limited time, stress) affect information search and processing?

4. How does the processing of information itself influence the subjective informational stance of the decision-maker in the decision situation?
5. What effects do these identified influences and biases have on information overload and how does information overload affect the situation after the decision has been made (e.g., judgement, task performance, behavior, emotions)?

These broad topic areas can be clustered into five categories relevant to decision-making in information overload situations: starting situation, information sources, information search and information processing, subjective information stance in decision-making situations, decision-making and choice, and behavior and emotions ex post.

The arrows drawn in Fig. 4 represent the major steps in the functional chain. For reasons of clarity and comprehensibility, I do not map the overarching arrows (e.g., personal characteristics → information search and processing biases, personal characteristics → motives or personal characteristics → judgement and decision-making). Furthermore, relationships might run in the opposite direction (e.g., judgement and decision-making → information sources or communication behavior → source preferences).

Information overload is seen as a decisive issue across all disciplines within business administration and economics, but aside from a range of case applications (see Tables 5, 6, 7, 8, 9), new fundamental theory-building research is missing. The reason for this lack is that human cognitive processes are most often seen as a black box—except in recent studies in neuroeconomics (Denham 2015; Oizumi et al. 2014). While empirical studies draw on theoretical models of the most-cited theoretical literature (e.g., the human information processing approach by Schroder et al. (1967), the information processing approach by Miller (1956), or information theory (Shannon and Weaver 1959)), comprehensive empirical testing is lacking for recent theoretical findings in neuroeconomics (Denham 2015; Oizumi et al. 2014).

First, the category *starting situation* includes the ex ante-relevant factors influencing the information search, information processing and decision-making process. It comprises the characteristics of the task or the decision to be made (e.g., level of difficulty, complexity, goals), the environmental factors that affect the situation in which the decision-making process begins (e.g., context, situational demand), the personal characteristics of the decision-maker (e.g., experience, knowledge, ability, motivation) and the incentives present (e.g., decision performance links to variable payment). This category contains the elements that might lead to biased behaviors on the next steps and that might be the starting point of information overload. The known effects of starting situation aspects on information processing, decision-making and the occurrence of information overload are shown in Table 5.

The next category is *information sources*, which plays a decisive role in overload situations. The selection of information sources and the decision-makers' source preferences are fundamental to determining what he or she will consider in his or her information search and information processing. The subjective perception of the characteristics of the source (e.g., trust, reputation) and the characteristics of

Table 5 Known effects of starting situation aspects on information processing, decision-making and the occurrence of information overload

Aspect of starting situation	Factor influencing information overload	Discipline	References
Task element	Task complexity and task interdependency	ACC	Ding and Beaulieu (2011), Simnet (1996)
		IS	Gupta et al. (2013), Speier et al. (1999, 2003), Wang et al. (2014)
		MAR	Hunter and Goebel (2013)
		MS	Kock (2000), Tushman and Nadler (1978)
	Task novelty, task too innovative	MS	Tushman and Nadler (1978), Herbig and Kramer (1994)
	Task interdisciplinarity	IM/LS	Bawden (2001), Foster (2004)
	Varying task priorities	IS	Sharma et al. (2014)
	Goal specificity	IS	Tam and Ho (2006)
	Information collection and availability is a company goal	IS	Farhoomand and Drury (2002)
	Decision-maker's attention	ECS	Anderson and de Palma (2012)
		IS	Hargittai et al. (2012), Tam and Ho (2006)
	Overall diversity of the provided information in task	ACC	Iselin (1988)
	Number of alternatives/attributes/options	MAR	Greifeneder et al. (2010), Scheibehenne et al. (2010)
	Multitasking	IS	Tarafdar et al. (2010)
Environment	Heterogenous groups	IS	Grise and Gallupe (1999/2000), Wilson (1996)
		SCM	Hult et al. (2004)
	Virtual collaboration	IS	Bawden (2001), Grise and Gallupe (1999/2000), Jones et al. (2004), Paul and Nazareth (2010), Speier et al. (1999)
		MAR	Schultze and Vandenbosch (1998)
	Use of information control instruments	MAR	Ariely (2000), Wu and Lin (2006)
	Personalized information services/portals/interfaces	IS	Tam and Ho (2006), Wang et al. (2014)
		MS	Sherer et al. (2003)
	Technology adaption too high	ECS	Cukrowski and Baniak (1999)
	Choice-rich environment	ECS	Hensher (2006)
	Herd behavior of others	IS	Hu and Lai (2013)
	Frequency/occurrence of interruptions	IS	Gupta et al. (2013), McCoy et al. (2007), Speier et al. (1999), Speier et al. (2003)
	Technostress at workplace	IS	D'Arcy et al. (2014)
	Cultural background	MS	Borkovich and Morris (2012), Klausegger et al. (2007)
	Project overload	IS, MS	Caniëls and Bakens (2012)
	Number of network contacts	IS	Sasaki et al. (2015)
		MS	Sherer et al. (2003)
	Overly high organizational use of information and communications technologies (ICT)/IT-driven environment	IS	Allen and Shoard (2005), Bucher et al. (2013), Moore (2000), Soucek and Moser (2010), Tarafdar et al. (2010)
	Role overload	MAR	Hunter and Goebel (2013)
	Perceived fearful corporate culture	PSY	Hallowell (2005)
	High technology dependency	IS	Karr-Wisniewski and Lu (2010)

Table 5 continued

Aspect of starting situation	Factor influencing information overload	Discipline	References
Incentives	Performance-based monetary incentives	ACC	Awasthi and Pratt (1990), Tuttle and Burton (1999)
	Mood congruency bias	ACC	Ding and Beaulieu (2011)
Personal characteristics	Limited information processing ability/capacity	ACC	Chewning and Harrell (1990), Greiling and Spraul (2010), Pennington and Tuttle (2007), Shields (1980, 1983), Simnet (1996)
		FI	Bouwman et al. (1993), Lev and Thiagarajan (1993), Rogers and Grant (1997)
		IS	Davis and Ganeshan (2009), Hiltz and Turoff (1985), Shrivastav and Hiltz (2013)
		MAR	Herbig and Kramer (1994), Lee and Lee (2004), Lurie (2004)
		MS	O'Reilly (1980)
	Prior knowledge and experience	FI	Agnew and Szykman (2005)
		IS	Saunders et al. (2017)
		MAR	Bettman and Park (1980), Chen et al. (2009), Owen (1992), Wu and Lin (2006)
	General personal characteristics/ demographics (e.g., age, gender)	IS	Holton and Chyi (2012), Sasaki et al. (2015)
		PSY, IM	Benselin and Ragsdell 2016
	Polychronic attitude	MAR	Hunter and Goebel (2013)
	Work stress	MS	Klausegger et al. (2007)
	Epistemic motivation	PSY	Amit and Sagiv (2013)
	Awareness	IS	Saparova et al. (2013)
	Information avoidance tendency	HE	Case et al. (2005)
	Health status	HE	Chan and Huang (2013)
		PSY	Hallowell (2005)
	User's allegiance	IS	Hsu and Liao (2014)
	Fairness attitude	IS	Roetzel and Lohmann (2014)
	Risk attitude	ACC	Pennington and Tuttle (2007)
		IS	Davis and Ganeshan (2009)
	Star employee status	HR	Oldroyd and Morris (2012)
	Mood	ACC	Ding and Beaulieu (2011)
		MS	Braun-LaTour et al. (2007)
	Psychological ill-being	HE, IS	Swar et al. (2017)
	Personal skills	ORG, IS	Whelan and Teigland (2013)

ACC accounting, *ECS* economics, *FI* finance, *HE* health economics/management, *HR* human resources, *IM/LS* information management/library science, *IN* innovation management, *INTM* international management, *IS* information systems, *MAR* consumer research/marketing, *MF* manufacturing, *MS* management science/general management, *ORG* organizational science, *PSY* psychology

Table 6 Known effects of information source aspects on information processing, decision-making and the occurrence of information overload

Aspect of information sources	Factor influencing information overload	Discipline	References
Databases	Relationship internal/ external databases	MS	Klausegger et al. (2007)
	External knowledge sources	IS	Dong and Netten (2017)
	Market knowledge acquisition	IN	Zhou and Li (2012)
	Amount and complexity of user reviews	IS	Fink et al. (2018)
	Website complexity	IS	Chen (2018), Lin (2006), Rodríguez-Molina et al. (2015), Wang et al. (2014)
Social networks	Participation in social networks	IS	Koroleva and Bolufe-Röhler (2012), Li and Sun (2014), Sasaki et al. (2015)
		HR	Oldroyd and Morris (2012)
	Strength of ties to other network users	IS	Koroleva and Kane (2016)
	Herd behavior	IS	Hu and Lai (2013)
	Number of friends/ network ties	IS	Koroleva and Kane (2016), Sasaki et al. (2015)
	Social media news speed	IS	Lee et al. (2017)
Information source design	Suboptimal management information system design	IS	Ackoff (1967)
	Suboptimal information source presentation mode	IS	Wheeler and Arunachalam (2009)
	Suboptimal platform design	MAR	Chen et al. (2009), Holton and Chyi (2012), Li (2016)
		HE	Cartwright et al. (2002)
	System feature overload	IS	Lee et al. (2016)
	System feature use	IS	Sasaki et al. (2015)
	Content recommendation/ personalization	IS	Aljukhadar et al. (2012), Chen et al. (2016), Liang et al. (2007), Xiao and Benbasat (2007), Zhang et al. (2018)
	Additional, unwanted information provided	MAR	Wu and Lin (2006)
		IS	McCoy et al. (2007)
	Provided information filtering tools	MAR	Chen et al. (2009)
	Provision of search agents	IS	Yen et al. (2006)
		MAR	Alba et al. (1997)
	Media (over-)richness	IS	Wheeler and Arunachalam (2009)
	Cyber-based information search only	PSY	Misra and Stokols (2012)
	Use of push/pull information systems	HE	Wilson (2001)
		IM/LS	Edmunds and Morris (2000), Herther (1998)
		MS	Klausegger et al. (2007)

Table 6 continued

Aspect of information sources	Factor influencing information overload	Discipline	References
Source preferences	Trust	IS	Kim and Benbasat (2009), Koroleva and Kane (2016), Xiao and Benbasat (2007)

engaging with the source (e.g., convenience of information collection, ease of operation, information provided per query) contribute essentially to the effectiveness of information search and information processing—or to information overload. This category also includes the availability, clarity and comprehensibility of information gathered by external sources. Note that this category addresses external information sources from the decision-maker's viewpoint. Internal information sources (e.g., memory) are not included in this category but are part of the next category [note that even internal sources of information might lead to biases, e.g., the availability bias studied by Kahneman (2011)]. The known effects of Information Sources aspects on information processing, decision-making and the occurrence of information overload are shown in Table 6.

The third category is *information search and information processing* (including aspects of information processing characteristics and conditions), which represents the actual process through which the decision-maker searches for and processes information. This category includes the search, evaluation, editing, and weighting of information. A range of business administration and economic theories focus on these steps, e.g., prospect theory (Tversky and Kahneman 1974). Information search and information processing is related triangularly to subjective information stance in decision-making situations and decision-making and choice. This triangle reflects the insight of cognitive management psychology that decision-making and choice might precede search and evaluation (e.g., in confirmation bias situations (Tversky and Kahneman 1974)). The present framework allows consideration of these situations (decision-making and choice before information search and information processing) but allows alternative directions (information search and information processing before decision-making and choice) as well. The known effects of information search and information processing aspects on information processing, decision-making and the occurrence of information overload are shown in Table 7.

Subjective *information stand* in decision situation is the fourth category. This category captures what information decision-makers have actually processed and what information value they have gained as a result. This category must be established because from the decision-making process view, when the decision-maker completes information search and information processing, the subjective information stance is the essential starting point for decision-making. This category differentiates between four different types of information:

Table 7 Known effects of information search, information processing and its characteristics and conditions on further information search and processing, decision-making and the occurrence of information overload

Aspect	Factor influencing information overload	Discipline	References
Information characteristics	Information complexity	ACC, FI	Plumlee (2003)
		ECS	Hensher (2006)
		IS	Paul and Nazareth (2010)
		MAR	Lee and Lee (2004), Li (2016), Lurie (2004), Reutskaja and Hogarth (2009)
		MS	Amit and Sagiv (2013), Driver and Streufert (1969), Schneider (1987)
	Amount of information	ACC	Casey (1980), Chewning and Harrell (1990), Roetzel (2014), Roetzel et al. (2015), Shields (1980, 1983), Simnet (1996)
		MAR	Herbig and Kramer (1994), Jacoby et al. (1974), Jacoby (1977, 1984), Malhotra et al. (1982), Malhotra (1984), Schultze and Vandenbosch (1998), Wang et al. (2007)
		HE	Swar et al. (2017)
		IS	Borkovich and Morris (2012), Gao et al. (2018), Hiltz and Turoff (1985), Davis and Ganeshan (2009), Shrivastav and Hiltz (2013)
	Novelty of information	MS	Schneider (1987)
	Search depth	IS	Lin (2006)
	Ambiguity/diversity of information	MS	Schneider (1987), Schroder et al. (1967)
		ACC	Iselin (1988)
		HE	Slawson et al. (1994)
		MAR	Li (2016), Lurie (2004)
	Information accessibility	IS	Hsu and Liao (2014), Roetzel and Lohmann (2014)
		MAR	Schultze and Vandenbosch (1998)
	Information equivocality	IS	Lee and Lee (2004)
	Information structure	MAR	Lurie (2004)
	Threat of information unavailability	IS	Davis and Ganeshan (2009), Tushman and Nadler (1978)
	Share of redundant information	IS	Lee et al. (2016)
	Use of incremental analysis methods	MS	Bettis-Outland (2012)

Table 7 continued

Aspect	Factor influencing information overload	Discipline	References
Conditions	Time pressure/ restrictions	ACC	Pennington and Tuttle (2007), Schick et al. (1990)
		IS	Hiltz and Turoff (1985), Paul and Nazareth (2010)
		MAR	Scheibehenne et al. (2010)
		MS	Kock (2000)
		PSY	Hahn et al. (1992), Misuraca and Teuscher (2013)
	Unconscious decision-making	IS	Gao et al. (2012), Messner and Wänke (2011)

- Valuable task-relevant information: The value of information is determined by its utility for decision-making. Information that increases the decision-maker's insight and understanding of a decision situation obtains a higher value, whereas information that is useless to the decision-maker in the decision situation obtains a lower value. The valuable task-relevant information is the share of information for which the decision-maker actually searched.
- Additional information with limited value: The share of information that the decision-maker found accidentally but can use to some extent for decision-making.
- Redundant information: The share of information whose value depends on the decision maker's intention and on the sequence of information search and information processing, and decision-making and choice. If information search and information processing precedes decision-making and choice, then redundant information has a limited-to-negative value for decision makers because it does not increase his or her understanding of the decision situation but ties up cognitive resources (i.e., information processing capacity). Otherwise (i.e., decision-making and choice before information search and information processing), if the decision maker wants to justify an already made decision (e.g., in confirmation bias or self-justification situations), the redundant information might have a positive marginal utility because it underpins the already-made decision. The latter is a subjective value from the decision-maker's viewpoint.
- Contradictory, inconsistent information: The share of information that contradicts the decision-maker's evaluation so far. On the one hand, the decision-maker might tend to ignore or discard such information [e.g., to avoid cognitive dissonance (Festinger 1954)]. On the other hand, such information might urge the decision-maker to search for further information to obtain a clearer evaluation.

Table 8 Known effects of subjective information in decision situation on decision-making and the occurrence of information overload

Aspect/bias	Effect	Discipline	References
Attractive stimulus overload	Increasing number of information and choices in decision situations lead to intrapersonal conflicts	PSY	Lipowski (1970)
Information search	Decrease in the proportion of information searched	ACC	Anderson (1988), Swain and Haka (2000)
		MS	Payne (1976)
	Increase of variability in information search	ACC	Anderson (1988), Swain and Haka (2000)
		IS	Cook (1993)
		MS	Payne (1976)
	Less systematic search strategy	ACC	Swain and Haka (2000)
	Increase of noncompensatory search patterns	ACC	Pennington and Tuttle (2007)
		IS	Cook (1993)
	Discard/ignore search results	PSY	Case et al. 2005
	Use of search agents	MAR	Alba et al. (1997)
		IS	Lau et al. (2001), Yen et al. (2006)
	Personal interest while searching	MAR	Alba et al. (1997)
Information processing	Highly selective information selection and processing	MAR	Herbig and Kramer (1994)
		IS	Hiltz and Turoff (1985), Osburg et al. (2016)
		IM/LS	Bawden (2001), Edmunds and Morris (2000)
		IN	Sparrow (1999)
	Incongruent information response	MAR	Braun-LaTour et al. (2007)
	Attention of decision-maker	MAR	Sicilia and Ruiz (2010)
		ECS	Anderson and de Palma (2012)
	Affordance of decision-maker	IS	Koroleva and Kane (2016)

Table 9 Known effects of information overload on decision-maker's behavior and emotions after decision-making and choice ex post

Aspect of behavior and emotions after decision-making and choice	Result of information overload/reaction due to information overload	Discipline	References
Task performance	Decreasing decision-making performance	ACC	Abdel-Khalik (1973), Chewning and Harrell (1990), Schick et al. (1990), Shields (1980)
		FI	Agnew and Szykman (2005), Spindler (2011), Ward and Ramachandran (2010)
		IS	Gupta et al. (2013), Okike and Fernandes (2012), Speier et al. (1999), Scott (2005), Speier et al. (2003), Ward and Ramachandran (2010)
		MAR	Chen et al. (2009), Hunter and Goebel (2013), Jacoby et al. (1974), Jacoby (1984), Keller and Staelin (1987), Korhonen et al. (2018), Malhotra (1984), Malhotra et al. (1982), Meyer (1998)
		IM/LS	Bawden (2001), Bawden and Robinson (2009), Hwang and Lin (1999), Edmunds and Morris (2000)
		PSY	Hallowell (2005), Misra and Stokols (2012)
	Confusion regarding the decision	MAR	Jacoby et al. (1974), Malhotra et al. (1982)
	Decision delayed or canceled	MAR	Sicilia and Ruiz (2010)
	Decreasing decision satisfaction	MAR	Jacoby (1984), Messner and Wänke (2011), Reutskaja and Hogarth (2009)
		IS	Davis and Ganeshan (2009)
		IM/LS	Bawden and Robinson (2009)
	Increase in decision satisfaction	ACC	O'Reilly (1980)
	Decrease/lack/reduction of attention level	MAR	Sicilia and Ruiz (2010)
		IS	Li and Sun (2014)
	Radical innovation generation	IN	Zhou and Li (2012)

Table 9 continued

Aspect of behavior and emotions after decision-making and choice	Result of information overload/reaction due to information overload	Discipline	References
Judgement	Decreasing judgement accuracy/efficiency/ performance	ACC	Pennington and Kelton (2016), Pennington and Tuttle (2007), Shields (1983), Simnet (1996)
		FI	Agnew and Szykman (2005), Hilary and Menzly (2006), Hilton (2010), Spindler (2011)
		IS	Lankton et al. (2012)
		MAR	Ketron et al. (2016), Sicilia and Ruiz (2010), Summers (1974)
	Decreasing prediction performance	ACC	Snowball (1979, 1980)
	Greater tolerance of error	MS	Sparrow (1999)
Communication behavior	Increasing communication intensity	HR	Oldroyd and Morris (2012)
		IS	Chen and Lee (2013), Li and Sun (2014)
	Reduction of communication intensity	MS	Schneider (1987)
	Simplification of communication	IS	Jones et al. (2004)
	Word-of-mouth activities	MAR	Gottschalk and Mafael (2017), Hutter et al. (2013)
	Reduction of technology acceptance	IS	Swar et al. (2017)
	Social network service fatigue	IS	Lee et al. (2016)
Social participation	Reduction of active participation in social communities	IS	Jones et al. (2004), Zha et al. (2018), Zhang et al. (2016)
	Unfriend/unfollow behavior	IS	Sasaki et al. (2015)

Table 9 continued

Aspect of behavior and emotions after decision-making and choice	Result of information overload/reaction due to information overload	Discipline	References
Knowledge, learning, and habits	Learning to handle overload over time	MAR	Ariely 2000
	Project management information system quality decreases	IS, MS	Caniëls and Bakens (2012)
	E-mail-free workdays	IM/LS	Bawden and Robinson (2009)
	Change of coping strategy	IS	Scott (2005), Zeldes et al. (2007)
		MS	Ledzińska and Postek (2017), Luedicke et al. (2017), Savolainen (2007)
	Slower adaption of IT/ICT	IS	Maes (1994)
	Growing into specialized filtering habits/roles	MAR	Wu and Lin (2006)
		IS	Schuff et al. (2006)
		ORG	Whelan and Teigland (2013)
	Information distribution behavior	MF, IS	Okike and Fernandes (2012), Scott (2005)
		SCM	Hult et al. (2004)
	Disruption of established cognitive processes	HE, PSY	Cartwright et al. (2002), Sweller et al. (1983), Sweller (1988)
	Change of user preference	IS	McCoy et al. (2007)
	Acceleration of decision-making behavior	ACC	Pennington and Tuttle (2007)
	Increase of overtime	MS	Klausegger et al. (2007)
	Change in organizational learning	MS	Wei and Ram (2016)
	Knowledge acquisition and retrieval	IS	Lankton et al. (2012)
	Use of push/pull information systems	MS	Klausegger et al. (2007)
		IM/LS	Edmunds and Morris (2000), Herther (1998)
		HE	Wilson (2001)

Table 9 continued

Aspect of behavior and emotions after decision-making and choice	Result of information overload/reaction due to information overload	Discipline	References
Emotions and personal state	Lower job satisfaction	MAR	Hunter and Goebel (2013)
		MS	O'Reilly (1980)
	User satisfaction	IS	Liang et al. (2007)
	Lower satisfaction with the organizational communication	MS	O'Reilly (1980)
	Overconfidence	MAR	Jacoby (1984), Meyer (1998)
		MR	O'Reilly (1980)
		PSY	Hallowell (2005)
	Increased distractibility/impatience	IM/LS	Bawden and Robinson (2009)
	Demotivation	MS	Baldacchino et al. (2002)
	Tendency for job turnover	IS	Moore (2000)
	Stress/technostress	ACC	Schick et al. (1990)
		MAR	Malhotra (1984)
		IS	D'Arcy et al. (2014), Lee et al. (2016), Plotnick et al. (2009)
		MS	Klausegger et al. (2007), Ledzińska and Postek (2017)
		PSY	Misra and Stokols (2012)
	Poorer health status	PSY	Hallowell (2005), Misra and Stokols (2012)
	Increase of negative emotions (anger, depression)	IS	Swar et al. (2017)

The known effects of subjective information stance in decision situation aspects on information processing, decision-making and the occurrence of information overload are shown in Table 8.

The fifth category is decision-making and Choice. This step is the third part of the triangular relationship with information search and information processing and subjective information stance in decision-making situations. This category consists of the decision step of the decision-making process: the selection of one of the existing alternatives. While the process of information search and information processing is affected by a variety of possible biases, it is prone to such biases as well [e.g., bounded rationality (Simon 1955), overconfidence (Tversky and Kahneman 1974), and emotionally driven decision-making on impulse (Forgas 1995; Moore and Isen 1990)].

Last, the category behavior and emotions after decision-making and choice describe the results of the decision-making process, including the effects on the

individual decision-maker (e.g., emotions, choice satisfaction, communication behavior, knowledge, habits), the relevant task or purpose of the decision-making process (e.g., task performance, judgement, decision-making performance), and the consequences for the organization (e.g., social participation, corporate performance as an outcome of individual performance). The known effects of behavior and emotions after decision-making and choice aspects on information processing, decision-making and the occurrence of information overload are shown in Table 9.

6 Recent trends and add-ons in information overload literature 2005–2017

Comparing the business administration literature with the literature overview by Eppler and Mengis (2004), this situation clearly remains unchanged. The level of citations is very low for the business administration literature and neuroeconomics in the area of information overload (Eppler and Mengis 2004).

Most studies analyzed in this literature review consider up to three of the five possible categories of my framework. Due to the limitations of empirical research (Birnberg et al. 2008; Luft and Shields 2003), and experimental research in particular, no study depicts the entire framework shown in Fig. 4. Hence, the empirical research on information overload is quite fragmented. This situation is compounded by the fact that each discipline within business administration and economics applies its own focus and tool kit to analyze information overload. While management accounting research identifies information overload as a negative mediator affecting the impact of a stimuli (e.g., management control system) on behavior (Birnberg et al. 2008), IS research focuses on IS design and user preferences (Borkovich and Morris 2012; Johansson et al. 2014). More recently, marketing research has treated information overload as a proxy for choice overload, which in turn reduces the likelihood of triggering a purchase decision (Scheibehenne et al. 2010).

Furthermore, a range of conceptual papers identify information overload issues in a variety of disciplines in business administration, in particular in accounting (e.g., Greiling and Spraul 2010; Oluwadare and Samy 2015), information systems research (e.g., Cartwright et al. 2002; D'Arcy et al. 2014; Li and Sun 2014), international management (e.g., Borkovich and Morris 2012), marketing (e.g., Anderson and de Palma 2012), organizational science (e.g., Bettis-Outland 2012), and economics (e.g., Cukrowski and Baniak 1999). In the following, I describe the tendencies of the recent research identified in the framework's five categories (see Fig. 4).

Furthermore, and following the methodology of Ramnath et al. (2008), I differentiate by discipline to indicate the different analytical lenses and subjects of these disciplines.

To ensure compatibility to prior literature reviews, in particular to the interdisciplinary review of Eppler and Mengis (2004), I provide tables with known effects on and of information overload. Here, I combine the recently analyzed

effects and the effects reported in prior literature reviews to facilitate a big picture of each category.

Furthermore, I draw on my framework to identify "hotspots" of information overload research as well as areas "off the beaten track" which would significantly add to the big picture of information overload. Table 10 shows that the majority of information overload studies focus on topic along the major steps in the functional chain [146 of 189 (77.25%)]. The remaining papers conduct research within the five categories. The paths "information sources → behavior and emotions after decision-making and choice", "cognitive or conditional biases → behavior and emotions after decision-making and choice", and "starting situation → behavior and emotions after decision-making and choice" are intensively investigated (59.58%).

From a bird's eye perspective, I see three larger trends in research on information overload. On the one hand, one may argue that subsuming the heterogeneous field of information overload literature is an exaggeration towards simplification. On the other hand, a practical alternative might be to use the range of paths in Table 5 to define the relevant trends. In the latter, one would identify 18 different trends instead of four. In the light of this trade-off, I decided to take four trends—to avoid that the reader runs into the danger of suffering from information overload.

6.1 Trend I: "Information overload as a design issue—caused by the (mis-)use of computers and information systems"

This major trend draws on a long stream of research rooting in the seminal paper named "Management Misinformation Systems" by Ackoff (1967). While the core issue of providing a too high amount of information or too complex information when using management information systems, databases, etc., may confuse its users, it may also affect their ability to prioritize or complicate the retrieval of information (Farhoomand and Drury 2002; Hiltz and Turoff 1985). Retrospectively, the digitalization and virtualization of the decision-making environment dominate the literature, which is primarily driven by IS research. Reducing information overload is one of the major challenges of IS research in the information age (Dean and Webb 2011). While an information system may facilitate greater information flow (potentially leading to overload), it also has the potential to help decision-makers organize, store, and process information. Nevertheless, MISs are seen as one of the major causes of information overload in information and communication technology (ICT)-related tasks (Levitin 2014; Shapiro and Varian 2013). Here, information overload has been shown to lead to decreases in decision performance in virtual communication (e.g., Jones et al. 2004; D'Arcy et al. 2014), to less systematic and less thorough search strategies (e.g., Paul and Nazareth 2010; Hiltz and Turoff 1985).

The issue causing information overload is the same as described by Ackoff (1967): while the system is getting more efficient, the user adapts in a vastly slower way. The user's personal characteristics seem to play a very important role regarding individual thought patterns, which affect information search, information

Table 10 Recent research within the framework

Beginning at…	No of publications	Ending at…	No of publications
Starting situation	41	Information sources	3
		Information search and processing	6
		Decision-making and choice	6
		Behavior and emotions after decision-making and choice	26
Information sources	43	Information search and processing	7
		Decision-making and choice	4
		Behavior and emotions after decision-making and choice	32
Information search and processing	12	Subjective information stand in decision situation	1
		Decision-making and choice	8
		Behavior and emotions after decision-making and choice	3
Subjective information stand in decision situation	12	Information search and processing	1
		Decision-making and choice	5
		Behavior and emotions after decision-making and choice	6
Cognitive or conditional biases	38	Information search and processing	1
		Cognitive or conditional biases	1
		Subjective information stand in decision situation	2
		Decision-making and choice	5
		Behavior and emotions after decision-making and choice	29

processing, and decision-making behavior (e.g., Allen and Shoard 2005; Benselin and Ragsdell 2016; Hunter and Goebel 2013).

The prior research regarding system or user adaption is characterized by a strong orientation toward "hard" technical characteristics such as algorithm efficiency, availability, compatibility, system feature design, and visualization (see Table 6). In the last decade, there have been few approaches to the "soft" characteristics (e.g., subjective user experience and trust) that shift the focus from a more technical viewpoint to a psychological viewpoint (e.g., Koroleva and Bolufe-Röhler 2012; Wu and Lin 2006).

One major aspect of information processing is not in the focus of researchers yet: how information can be processed and evaluated by "intelligent" information systems. While decision support systems or decision aid are widely investigated, the wide field of machine learning, deep learning and artificial intelligence, which is one of the most important drivers of digitalization, is not linked with information overload literature yet.

6.2 Trend II: "Information overload as a virus—spreading through (social) media and news networks"

People do consume more information via the internet than ever before (Levitin 2014). Not surprisingly, the dominant discipline in research on information sources and its effects on information search, information processing, and decision-making behavior is IS research. The consideration of information processing and decision-making on the cloud applications and over social media environments is readily observable (e.g., Jones et al. 2004; Sasaki et al. 2015; Tarafdar et al. 2010).

Essential topics of research studies in the last decade draw on the rapid development of the web and the vast amount of information provided on different channels and portals such as online news streams (e.g., Holton and Chyi 2012), online shopping (e.g., Li 2016; Wu and Lin 2006) and social network sites (e.g., Koroleva and Bolufe-Röhler 2012; Koroleva and Kane 2016 Lee et al. 2016). Another relevant topic, particularly in marketing research, is the effect and efficiency of (pop-up) ads and other channels for unwanted advertising (e.g., McCoy et al. 2007).

The common finding of these research studies is that information overload does not scare users to use these channels or platforms. Users seem to ignore possible side effects of information overload up to a very high level before retreating from these channels or platforms. From a bird's eye perspective, this situation might be compared with the spread of a disease. Thus, people often act irrationally by infecting others (i.e., sending more messages, likes, news to other members of their network) instead of sparing themselves (i.e., making a rest/recovery from their overloaded status).

Moreover, while prior research in other disciplines finds that trust affects the information weighting behavior of decision-makers (e.g., in risk management (Earle 2010; Slovic 1993) or innovation management (Bstieler 2006; Staples and Webster 2008)), the role of trust in information selection in potential information overload situations is widely unclear—except for the study of Koroleva and Kane (2016), which focuses on Facebook users and trust issues but is not applicable to most business situations.

The intensive use of social media and the steady exposition to information overload might cause emotional, mental and physical effects. In the last decade, there are studies which focus on mental (e.g., Braun-LaTour et al. 2007; Hallowell 2005) and physical health parameters (e.g., Chan and Huang 2013), showing information overload's negative effects on emotions (e.g., Swar et al. 2017) and on perceived health (e.g., Hallowell 2005; Misra and Stokols 2012). Information overload does not only affect working behavior, but also leads to less time devoted to contemplative activities (Misra and Stokols 2012).

6.3 Trend III: "Information overload as an "search obstacle"—new ways to circuit and adaptions in information search and processing"

Based on the trinity of the three articles of Miller (1956), Newell and Simon (1972) and Schroder et al. (1967), the inverted U-shaped relationship is replicated and confirmed in the last decade (e.g., Davis and Ganeshan 2009; Roetzel 2014; Sicilia and Ruiz 2010). There is a shift in research from the focus on the amount of

information towards the focus on the complexity (Lee and Lee 2004; Li 2016; Lurie 2004; Reutskaja and Hogarth 2009) and interdependence of information (e.g., Amit and Sagiv 2013; Lankton et al. 2012; Wang et al. 2014).

Moreover, recent research shifts the spotlight on typical work situations affected by the information age such as production (e.g., Okike and Fernandes 2012), innovation (e.g., Zhou and Li 2012) or consumer-relevant decisions in households (e.g., Hensher 2006), risk judgements (Pennington and Tuttle 2007) or virtual work (Paul and Nazareth 2010). Furthermore, negative effects of the information age and user-centered aspects in virtual environments are investigated by research (e.g., user attention (e.g., Anderson and de Palma 2012; Sicilia and Ruiz 2010) or affordance (e.g., Koroleva and Kane 2016)). These studies show that the fundamental issue of biased information search is replicable in new work environments.

The main driver of information search and processing issues is a usual suspect known since the 1960s: limited time (Schroder et al. 1967). Time pressure and time restrictions often lead to information overload (Misuraca and Teuscher 2013; Scheibehenne et al. 2010). Thus, human information search and processing biases are still used to getting their way in digitalized environments.

However, there is a lack of research investigating sources of stress other than time regarding information search and processing. Other stress factors such as self-induced stress (e.g., aspiration level) are still under-researched. These stress factors do not need to be linked to the task; often, employees face stress factors that are not considered or measurable by the organization (Levitin 2014).

In the information age, there is a need for research to clarify how an oversupply of information might affect known cognitive biases. While prior research on information search suggests that information search and information processing are affected by cognitive biases such as self-justification and that decision-makers react to unpleasant situations or information stands by acquiring even more information (e.g., Schultze et al. 2012), studies on information overload are missing.

Moreover, psychological research shows that decision-makers react differently when information is retrospective or prospective (e.g., Conlon and Parks 1987; Schultze et al. 2012). This might open interesting avenues for further research because decision-makers often receive retrospective and/or prospective information (e.g., corporate planning, budgeting). Further research should analyze whether decision-makers react differently when facing an overly high level of retrospective versus prospective information.

In strategies on coping these information search and processing biases, three major directions are visible in recent research: the technology-centered view including the use of technical countermeasures (e.g., filter agents, search protocols, visualization), which has slightly increased (e.g., Koroleva and Bolufe-Röhler 2012); the human-centered view to consider the decision-maker's behavior or emotional or physical effects (e.g., stress reduction), which is essentially driven by IS research (e.g., D'Arcy et al. 2014; Lee et al. 2016; Plotnick et al. 2009); and the information process-centered view, which draws on countermeasures to address the complexity and mass of information (e.g., Lee and Lee 2004; Paul and Nazareth 2010; Sumecki et al. 2011). The three approaches tackle different categories of the framework. In Table 11, the different categories are assigned to the three views.

Table 11 Coping strategies

View	Leverage point	Strategy	Discipline	References
Human-centered view	Decision-maker's emotional and physical effects	Reduction of stress	ACC	Schick et al. (1990)
			IS	D'Arcy et al. (2014, Lee et al. (2016), Plotnick et al. (2009)
			MAR	Malhotra (1984)
			MS	Klausegger et al. (2007)
			PSY	Misra and Stokols (2012)
		Improvement of mood	ACC	Ding and Beaulieu (2011)
	Starting situation (personal characteristics)	ICT-related method training (e.g., prioritization)	ACC	Schick et al. (1990)
			IM/LS	Bawden (2001)
			IS	Sumecki et al. (2011)
		Time-management training	IM/LS	Bawden (2001)
		Withdrawal strategy	MS	Savolainen (2007)
		Discarding information strategy	IS	Holton and Chyi (2012)
Information processing-centered view	Starting situation (information characteristics)	Complexity reduction	ACC	Greiling and Spraul (2010), Iselin (1988)
			IS	Ackoff (1967), Grise and Gallupe (1999/2000), Hiltz and Turoff (1985), Lee and Lee (2004), Paul and Nazareth (2010), Sumecki et al. (2011)
			MAR	Lurie (2004)
		Reduction of the amount of information	IS	Davis and Ganeshan (2009)
	Starting situation (task characteristics)	Improvement of goal specificity/link to incentives	ACC	Tuttle and Burton (1999)
			IS	Tam and Ho (2006)
			MS	Baldacchino et al. (2002)
	Information search and information processing (conditions)	Relaxation of time pressure	ACC	Pennington and Tuttle (2007), Schick et al. (1990)
			MAR	Scheibehenne et al. (2010)
Technology-centered view	Decision-maker's behavior	Focus on filtering information/ use of filter algorithms	IS	Koroleva and Bolufe-Röhler (2012)
			MS	Savolainen (2007)
	Information source	Enhancement of visualization	IM/LS	Chan (2001)
			MAR	Meyer (1998)
		Improvement of (search) agents	IS	Berghel (1997), Edmunds and Morris (2000), Maes (1994)
			MAR	Alba et al. (1997)

7 Conclusions

Discovering the effects of information search, selection, processing, and evaluation in the decision-making process and the occurring biases and limitations is key for out understanding of the decision-making process itself. This study incorporates a wide range of effects from the starting situation ex ante to the decision consequences ex post.

In conclusion, this review has some limitations to address. First, I include business-related research only and exclude other research fields (e.g., pedagogy). There might be insights into these areas which are relevant for business administration research as well. Further research might address this limitation. Second, I searched for the keywords "information overload", "information load", "cognitive load", and "cognitive overload". There might be relevant studies on information overload or related topics which do not use these keywords in their titles or abstracts. While the snowball sampling (Biernacki and Waldorf 1981) might be a valid strategy to reduce such errors, there might be further articles which are not cited in this review.

In this paper, I have provided some perspective on possible avenues of research regarding information overload following the three major trends. The avenues for future research that seem the most promising to me include the following. First, the interdisciplinary research regarding the link between digitalization, virtual organizations, and business psychology is a decisive uprising research direction, following the call for research from Eppler and Mengis (2004). Second, there is little research done to enhance our understanding of the interlinks between all five categories. Prior research merely focused on one to three of the categories. I look forward to research clarifying the interdependencies between the influence factors of the categories. More research is needed to understand the interaction between decision-maker's emotions, his or her decision-making-related information processing, and the virtualness of the environment. I expect this research to have implications for emerging concepts and theories regarding virtual collaboration in organizations. Third, I encourage researchers to continue exploring the factors that make some decision-makers better information processors than others in different tasks and environments.

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