

A Bibliometric Review of Technostress: Historical Roots, Evolution and Central Publications of a Growing Research Field

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Abstract

While previous research has provided critical insights into the different perspectives, methods, and theories on technostress, there is no bibliometric review available that clarifies the evolution and structure of the field. We use three bibliometric methods to assess the body of 252 technostress publications until 2019: reference publication year spectroscopy, co-word analysis, and co-citation analysis. In doing so, we analyze how the technostress field has evolved over time, clarify the interconnected concepts forming the discourse, and identify the most influential works.

1. Introduction

First coined in the 1980s [5], technostress is defined as a “*a modern disease of adaptation caused by an inability to cope with new technologies in a healthy manner*” (p. 16). It is characterized in two distinctive but interrelated processes – over-identification with technology and the struggle to accept technology [5]. While a primary aspect of over-identification with technology is a lack to interact and empathize with others, humans struggle to accept technology due to a variety of reasons (e.g. fear of making irreversible mistakes, perceived lack of skills) [5, 57]. A range of technology-related demands such as complexity, overload, and constant connectivity can cause stress in individuals and lead to serious undesirable physical, psychological, and behavioral consequences including antisocial behavior, anxiety, depression, heart disease, headaches, and muscle cramps [29, 44, 45, 52].

While existing literature reviews on technostress provide important insights into the breadth of methods, perspectives, and theories underpinning technostress literature [15, 16, 29, 45, 52], Tarafdar et al. [52] note that there is a need for more studies that “*articulate how the IS literatures on technostress and the non-IS literatures that study psychological stress can mutually enrich and inform one another*” and that “*it is necessary to understand the current theoretical expositions of technostress.*” (p. 2). To the best of our knowledge,

there is currently no review available that provides a bibliometric assessment of technostress literature. Bibliometric analysis helps to understand a research field’s composition, research concepts, influential authors, and interconnections [66]. In this vein, Zupic and Cater [66] emphasize that bibliometric reviews “*are not a substitute for but a complement to traditional methods of review*” (p. 436) and they can help to provide structure and guidance to a research field. Against this backdrop, and to complement the existing reviews on the technostress phenomenon, this paper sets out to address the following research question (RQ):

RQ: *How has the field of technostress research evolved since its inception and what are the main conceptual ideas underpinning technostress?*

Specifically, we use reference publication year spectroscopy (RPYS) to analyze the historical roots of technostress research [35], co-word analysis to map out the evolution of keywords [9], and co-citation analysis to identify central technostress publications [66]. In alignment with prior bibliometric reviews, we use the Scopus database (e.g. [20]). Assessing 252 publications published until 2019, we find that the historical roots of technostress are primarily based in psychology and biology and on quantitative methods. Our results also show that technostress research has continuously grown to a closely connected network with 14 clusters and 138 keywords in 2019. Finally, this research sheds light on the ten most central technostress publications, published mainly in IS, marketing, and psychology journals.

Our study complements the rich body of existing literature reviews by introducing a novel method to assess the evolution and conceptual structure of technostress research. In addition, our study assists scholars in gaining a clear pathway about the importance and potential impact of emerging research directions [64]. The study also provides meaningful insights for practitioners by identifying the causes, underlying processes, outcomes, and trends of technostress which can support practitioners to address the challenges associated with this phenomenon.

2. Foundations on Technostress

The transactional view of stress [31] has provided the theoretical foundation for technostress research in information systems (IS) literature (e.g. [44]). Lazarus and Folkman [31] define stress as “a particular relationship between the person and the environment that is appraised by the person as taxing or exceeding [their] resources and endangering [their] well-being.” (p. 19). Aligned with this perspective, research has captured technostress through four complementary lenses: (1) technology environmental conditions, (2) cognitive appraisals, (3) coping responses, and (4) strain [3, 19, 44, 52].

Technology environmental conditions refer to characteristics of organizational technologies that have the potential to cause technostress by creating a demand in the individual [3, 44]. First, ubiquitous technologies (e.g. mobile phones) enable constant connectivity. This can extend the regular workday and cause feelings of invasion to employees’ private time and space because they can be reached anytime and everywhere. Second, interconnected technologies demand users to handle multiple streams of information from a variety of sources [44], which can cause information overload [28]. Third, the rapid advances in technologies creates competitive pressure for companies to catch up to the latest developments [44]. As a result, users may feel intimidated and forced to increasingly spend more time in understanding and using technologies [44, 62]. Fourth, rapidly changing technologies require businesses to frequently update and modify their technologies to align them with their business processes. Such circumstances exacerbate the individual’s ability to establish experience with technologies and thus might result in technostress [44]. Fifth, technologies enable excessive multitasking to accomplish more tasks in less time. Consequently, users experience higher tensions, less control, and lower job satisfaction [44, 62]. Finally, work-related interruptions through technologies such as e-mail or instant messaging can hamper work productivity and thus trigger technostress [19].

Primary and secondary cognitive appraisal processes determine to what degree technological environmental conditions function as stressors [31]. As for primary appraisal, individuals evaluate and categorize conditions with respect to their well-being as either irrelevant, benign-positive, or stressful. Stressful-appraised conditions trigger the evaluation of available and relevant coping resources (secondary appraisal) to respond to stressful situations [13, 31]. Technostress emerges when the individual’s coping resources are insufficient to manage situations appraised as stressful. Primary appraisal influences the relationship between technology environmental conditions and stressors,

while secondary appraisal moderates the relationship between stressors and coping responses [52]. Based on these theoretical considerations, scholars distinguish five main techno-stressors: *techno-insecurity*, *techno-invasion*, *techno-complexity*, *techno-overload* and *techno-uncertainty* [44, 54, 55].

According to Lazarus and Folkman [31] coping refers to “constantly changing cognitive and behavioral efforts to manage specific external and/ or internal demands that are appraised as taxing or exceeding the resources of the person” (p. 141). The coping process is dynamic and characterized by an individual’s specific cognitive appraisal processes [31]. Technostress research distinguishes two major forms of coping: problem-focused and emotion-focused [52]. Problem-focused coping focuses on managing or altering the stress causing situation such as by extending individual skills or knowledge [31]. Emotion-focused coping alters thoughts and emotions about the stressful situation [31].

Referring to the outcome of technostress [55], research distinguishes physiological, psychological, and behavioral strain [3, 13, 44]. Psychological strain manifests in emotional reactions to stressors and includes, for example, dissatisfaction [55] or exhaustion [34]. Behavioral strain refers to behavioral technostress responses and encompasses, among others, decreased productivity, quitting a job, or non-compliance behavior [44, 52]. Physiological strain is characterized by bodily responses and includes, for example, increased cardiovascular activity and cortisol levels [45].

3. Method

3.1 Index Database

Bibliometric assessments require an index database [33] and, therefore, not every academic database was eligible. While Scopus and Web of Science are the main databases for bibliometric analysis, it has been shown that Scopus yields a wider coverage and identification of citable articles than Web of Science, particularly in the field of IS [12, 38]. Hence, we decided to conduct our search in Scopus (for a similar approach, see [20]).

As noted by Tarafdar et al. [52], technostress research is inherently interdisciplinary in nature and it is important to acknowledge that different disciplines (e.g. IS, psychology) use slightly different terms to investigate the phenomenon. Therefore, we followed the keywords selection of Tarafdar et al. [52]. For literature published in IS, we used: (*techno* AND *stress*) OR *stress* OR *strain* OR *coping* as keywords. To find publications outside to IS, we used: (*techno* OR *ICT* OR *telework* OR *telecommut* OR “*e- mail*” OR *electronic* OR “*virtual work*”) AND (*stress* OR *strain* OR *coping*).

To consider full years of research activity, our research is delimited to the end of 2019. The initial search yielded 1033 publications published between 1982 and 2019. We excluded editorials, letters, and book reviews since they are not considered as citable items in bibliometric reviews [33], leaving 1023 records for title and abstract screening. In the screening, we only retained publications that are related to technostress with focus on techno-stressors, coping responses, technology environmental conditions, outcomes, and moderators of the stressor-outcome relationship. In order to ensure reliability of our selection process, two authors separately assessed the records and resolved disagreements using a consensus approach [42]. After removing 771 records, we arrived at a final sample of 252 articles. The sample size emphasizes one advantage of bibliometric assessments as they allow authors to evaluate a high number of academic records by applying a quantitative approach [66]. This becomes evident by comparing our sample size to other existing technostress reviews which assessed between 15 and 105 studies (e.g. [15, 16, 29, 52]).

3.2 Reference Publication Year Spectroscopy

To provide insights into the historical science background of technostress research, we used RPYS analysis following Hou [22]. RPYS allows to detect a field's historical origins and to quantify their citation impact on contemporary research outputs [35]. Marx et al. [35] emphasized that *"the content of an earlier publication and that of the later publication are related and that the former is of significance to the knowledge claim in the latter"* (p. 752). In this regard, there is generally a positive relationship between the frequency of a cited work and the impact on the advancement of knowledge. Further, more frequently cited publications lean on previously highly cited research outputs [35]. Thus, the relationship between current research and past literature assists in quantifying the impact of certain concepts, theories, and methods on the development of knowledge within a given field [22, 35].

We used CRExplorer (<http://crexplorer.net>) to perform the RPYS analysis. We extracted all references with CRExplorer to identify the publication year of the most important documents in technostress. Then we removed duplicates and harmonized varieties of references. Finally, we determined the distribution of literature with the highest citation frequency in technostress research. As suggested by Marx et al. [35], we used a 5-year (i.e. Y-2, Y-1, Year of publication,

Y+1, Y+2) deviation from the median of citations and a minimum citation count of 10 to identify the historical roots of technostress research.

3.3 Co-word Analysis

Co-word analysis examines patterns of co-occurrences of pairs of items (e.g. keywords) to identify interrelated research concepts [9]. By representing research concepts, keywords are suitable to reveal the knowledge structure and its development within a particular field [49]. Following the advice of Su and Lee [49], we did not modify concepts of keywords.¹ However, it is necessary to standardize certain keywords because different keywords can be used to describe the same concept such as "technostress" and "techno-stress". Based on this approach, every standardized keyword represents a unique concept [49].

Keywords co-occur if they appear in the same citation context. The distance between two keywords is proportional to the relatedness of the keywords [49, 66]. Building on this co-occurrence, one can construct a network map that represents the conceptual space of a research field [66]. Keyword maps produced for consecutive time periods can help to comprehend the development of such concepts [26]. To visualize the evolution of major keyword clusters [43] whilst also displaying emerging topics, we considered all keywords that were mentioned at least twice [26].

We used VOSviewer (<http://vosviewer.com>) to perform the co-word analysis. It performs bibliometric analysis using the so-called Visualization of Similarities (VOS) technique and offers access to the VOS mapping technique. VOS is a mapping technique that serves as an alternative to the traditional multidimensional scaling (MDS). We chose VOSviewer because it provides a more satisfactory representation of a dataset than the traditional MDS approach which facilitates graphical interpretation [61]. VOSviewer clusters the keywords based on their co-occurrence [61].

3.4 Co-citation Analysis

To identify the most central technostress publications, we conducted a co-citation analysis [66]. Co-citation analysis establishes the similarity between publications, authors, or journals by determining co-citation counts [66]. Co-citation means that two documents are cited when they are listed in a citing item's reference list. The basic assumption of co-citation analysis is that the more frequently two items

¹ Su and Lee [49] argue that *"it is better not to modify the concept of keywords defined and selected by the authors since this will avoid unnecessary debates"* (p. 69).

are co-cited, the more closely they are linked together and the more likely they are assigned to one cluster [43, 66]. We used a document co-citation analysis to connect the published documents within technostress research which allows us to identify the most important works [66]. Following Raghuram et al. [43], we started with a co-citation threshold of 15 citations which we then gradually lowered to eight citations. This accounts for the fact that technostress is still a young research field [52]. We used VOSviewer to perform the co-citation analysis (<http://vosviewer.com>).

4. Results

4.1 Results of RPYS

Figure 1 shows the 5-year-median deviation curve [22]. Capturing the evolution of the knowledge structure over time [22], it reveals a total of 20 citation peaks between 1950 and 2019, with the four most prominent peaks in 1984, 2007, 2011, and 2015.

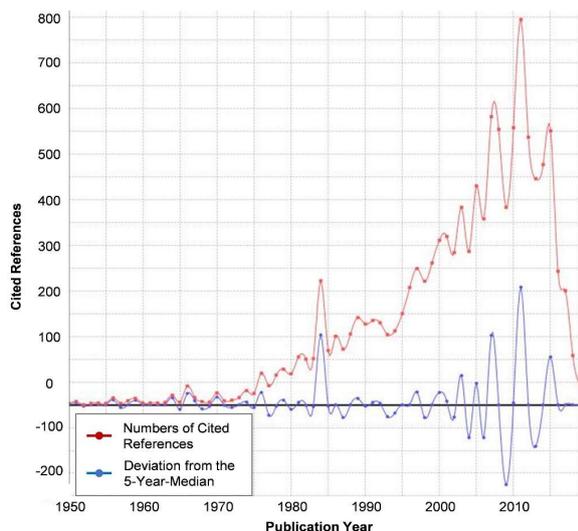


Figure 1. Evolution of Technostress Research

Table 1 provides an overview of the 20 citation peaks, the outlets and areas. It shows that while early research was mainly based in biology and psychology, more recent citation peaks are primarily in the IS area. Each peak is a highly cited publication that impacts current research outputs.

Between 1950 and 1983 we could identify works which are fundamental for technostress research but do not address technostress directly. Nine publications investigate stress from a biological and psychological points of view. Several methodological works set the foundations for later research. Establishing the biological perspective, Selye [47] introduced the notion

of homeostasis or general adaptation syndrome. Later work frequently refers to Selye [47] to discuss the physiology of technostress and to distinguish eustress and distress (e.g. [45, 52]). In terms of quantitative methods, the work by Campbell and Fiske [10] and Fornell and Larcker [17] emerged as highly influential articles. The Transactional Theory of Stress by Lazarus [30] and McGrath [36] are two works which act as critical theoretical foundations in technostress research.

Table 1: Top 20 Citation Peaks

#	Authors (Year)	Outlet [Area]
1	Selye (1956) [47]	Monography [BIO]
2	Campbell & Fiske (1959) [10]	Psych. Bulletin [PSY]
3	Kahn et al. (1964) [24]	Monography [PSY]
4	Lazarus (1966) [30]	Monography [PSY]
5	Rizzo et al. (1970) [46]	Admin. Sci. Quart. [MAN]
6	Selye (1976) [48]	Monography [BIO]
7	McGrath (1976) [36]	Handbook [PSY]
8	Karasek (1979) [25]	Admin. Sci. Quart. [MAN]
9	Fornell & Larcker (1981) [17]	J. Mkt. Res. [MKT]
10	Brod (1984) [5]	Monography [IM/PSY]
11	Carver et al. (1989) [11]	J. Pers. Soc. Psych. [PSY]
12	Aiken (1991) [2]	Monography [SOC]
13	Kupersmith (1992) [28]	Reference Serv. Rev. [SOC]
14	Weil & Rosen (1997) [62]	Monography [IM/PSY]
15	Moore (2000) [39]	MIS Quart. [IM]
16	Podsakoff et al. (2003) [41]	J. Appl. Psych. [PSY]
17	Tu et al. (2005) [57]	Commun. ACM [IM]
18	Tarafdar et al. (2007) [54]	J. Manag. Inf. Sys. [IM]
19	Ayyagari et al. (2011) [3]	MIS Quart. [IM]
20	Maier et al. (2015) [34]	Inf. Sys. J. [IM]

Note: Studies are listed in chronological order, with outlets categorized by subject areas (based on ABS 2018 Guide and SCImago Rank). We categorize books based on their key topics. BIO = Biology, IM = Information Management, MAN = Management, PSY = Psychology, SOC = Social Sciences.

Brod [5] in 1984 coined the term technostress and resulted in one of the main citation peaks. The peaks of Aiken [2] in 1991 and Podsakoff et al. [41] in 2003 emphasize that the importance of quantitative methods continued to grow. Also, the psychological perspective continued to be a major focus with a particular emphasis on the organizational context (e.g. [11, 39]). As such, main citation peaks discuss the phenomenon from an organizational point of view [28, 57]. The work of Tarafdar et al. [54] in 2007 introduced the concept of technostress in leading IS outlets [52]. Another major citation peak in 2011 is the work of Ayyagari et al. [3]. The authors used the person-environment fit model to clarify the relationship between technology characteristics, and stress within organizations. Finally, the most recent citation peak is marked by the work of Maier et al. [34], who expanded technostress research to the private context of social media.

organizational “users”, information systems are more and more being developed for consumers” (p. 248).

Finally, we see that the keyword *dark side* disappeared from the top 10 in the snapshot until 2019, indicating a change in perspective. In this context, Tarafdar et al. [52] concluded that the “*overarching and exclusive premise of the literature regarding technostress is that of a phenomenon associated with negative consequences.*” (p.7). By contrast, recent research since 2015 emphasized a so-called “*bright side*” of technostress, which denotes a favorable appraisal of demands that may entail positive psychological outcomes [7, 8].

Table 2. Top 10 keywords until 2015 and 2019

#	Keywords		KTLS		Occurrences	
	2015	2019	2015	2019	2015	2019
1	technostress	technostress	141	435	60	157
2	inf. systems	stress	47	122	20	34
3	stress	inf. systems	45	112	16	38
4	job satisfaction	stressor	24	46	7	11
5	self-efficacy	social media	24	45	7	14
6	stressor	coping	20	45	5	13
7	survey research	inf. sys. usage	16	43	5	11
8	org. commitment	job satisfaction	16	39	4	13
9	continuance	continuance	16	37	5	9
10	dark side	org. commitment	15	32	4	8

Note: Keywords are sorted according to keyword total link strength (KTLS). Keyword total link strength quantifies the links one keyword has with all other keywords (calculated with VOSviewer).

4.3 Results of Co-citation Analysis

The co-citation analysis yields a network of 138 publications as visualized in Figure 3. Thereby, each document is assigned a total link strength that quantifies the links with all other documents. For instance, a high total link strength shows that a document has several strong links to a limited number of other documents or many weak links with a large number of other publications [23, 61].

Up until the end of 2019, the analysis reveals five co-citation clusters. Cluster 1 is the largest cluster and contains 44 references. The document with the highest weight in this cluster is Lazarus and Folkman’s [31] work on the transactional theory of stress. Other central documents within this cluster also discuss the phenomenon of psychological stress (e.g. [30]). Cluster 2 includes 35 references, with the highest weight by the work of Ragu-Nathan et al. [44] on technostress in organizations. Similarly, Ayyagari et al. [3] and Tarafdar et al. [55] present important articles within this cluster that discuss technostress in an organizational context. Cluster 3 contains 29 documents (highest weight: Tarafdar et al. [54]). Interestingly, this cluster contains historically important articles as revealed by the RPYS (e.g. [2, 13, 47]). This highlights the

relevance of the article of Tarafdar et al. [54] for technostress research [52]. Cluster 4 contains 27 documents, with the highest weight contributed by the 1984 monography by Brod [5] coining the term technostress. Similar central publications within this clusters are Kupersmith [28] and Weil and Rosen [62]. Lastly, Cluster 5 contains three articles (highest weight: Beaudry and Pinsonneault [4]). The articles discuss user adaption, information security policy compliance, and organizational stress.

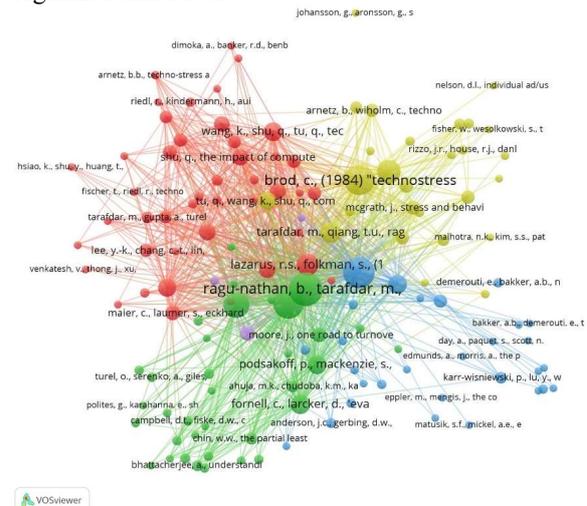


Figure 3. Results of Co-citation Analysis

Note: A document’s label and bubble size reflect its weight. The proximity between bubbles indicates how closely related articles are.

Table 3 lists the 10 most central publications which influenced technostress research based on their total link strengths. This includes publications with inherent focus on technostress (e.g. [3, 44]) as well as papers not directly related to technostress such as method papers (e.g. [17, 41]). It reveals that the top articles appeared in IS, marketing, and psychology journals and that they primarily employed the methods of surveys, literature reviews, and simulation analysis. Most documents discussed technostress in an organizational context. While two articles evaluated research methods [17, 41], one work discussed the underlying psychological processes of stress [31].

The co-citation analysis identifies Ragu-Nathan et al. [44] as the most central article influencing technostress research until 2019. The scholars developed and validated the technostress questionnaire in organizations. The study was published in 2008 when technostress research was still in its early stages. Since then, the questionnaire has been widely used (e.g. [18, 56]) which might be one contributing factor why technostress research is predominantly applied in an organizational context (e.g. [29, 45]).

All journal articles within the top 10 which focus on technostress used the research method of surveys. This finding is reinforced by the fact that Fornell and Larcker [17] and Podsakoff et al. [41] represent central publications which influenced technostress research. Both articles focus on quantitative research methodologies and common method biases. This confirms that technostress research largely builds on quantitative data gathered through surveys [15, 52].

Table 3. Top 10 most central publications that influence technostress research

Authors (Year)	PTLS	Outlet [Area]	Method
Ragu-Nathan et al. (2008) [44]	2036	Inf. Sys. Res. [IM]	survey
Ayyagari et al. (2011) [3]	1802	MIS Quart. [IM]	survey
Tarafdar et al. (2007) [54]	1754	J. Manag. Inf. Sys. [IM]	survey
Tarafdar et al. (2010) [55]	1405	J. Manag. Inf. Sys. [IM]	survey
Brod (1984) [5]	1186	Monography [IM/PSY]	lit. review
Lazarus & Folkman (1984) [31]	987	Monography [PSY]	lit. review
Tarafdar et al. (2011) [56]	889	Commun. ACM [M]	survey
Fornell & Larcker (1981) [17]	829	J. Mkt. Res. [MKT]	simulation
Weil & Rosen (1997) [62]	820	Monography [IM/PSY]	lit. review
Podsakoff et al. (2003) [41]	797	J. Appl. Psych. [PSY]	lit. review

Note: Publication total link strength (PTLS) quantifies a publication's links with all other publications considered in the analysis (calculated with VOSviewer). Publications are ordered by PTLs, with outlets categorized by subject areas (based on ABS 2018 Guide and SCImago Rank). We categorize books based on their key topics. BIO = Biology, IM = Information Management, MAN = Management, PSY = Psychology, SOC = Social Sciences.

5. Discussion

Our analysis shows that technostress is a continuously growing field that has its historical roots in biology, psychology, and quantitative methods. The Transactional Theory of Stress [31] emerged as its central theoretical foundation (e.g. [44, 52, 57]). A majority of studies rely on quantitative methods (i.e. surveys) to explain and predict technostress (for a review see Fischer & Riedl [16]). However, the emerging perspective of neurobiology [45] provides important complementary insights to broaden our understanding of how individuals experience technostress. While the majority of technostress research focuses on organizational technologies, we can observe a broadening of application areas in recent years, including healthcare IT (e.g. [7]), smartphone (e.g. [32]), electric mobility (e.g. [40]), social media (e.g. [34]), and education (e.g. [63]). Further, whereas

earlier work has predominantly conceptualized technostress as an unintended negative consequence of technology usage (for a review see Tarafdar et al. [52]), a recent shift in focus shows that positive technostress appraisals (eustress) receive increasing research attention. Along this development, the keyword “dark side” appeared less frequently in recent years, while “coping” and “social media” appear more frequently.

Based on our findings, we identify three areas (techno-eustress, usage context, and research methodology) for future research as summarized in Table 4 which we discuss in the following.

Table 4. Area for future research

#	Area	Explanation
1	Techno-eustress	Techno-eustress presents the positive side of stress that individuals experience while using IS. Techno-eustress in context of (1) technology environmental conditions, (2) appraisal processes, (3) coping responses, and (4) outcomes presents fruitful research opportunities.
2	Usage context	While historically technostress research predominantly considered organizational contexts, emerging application fields (e.g. education, mobility, social media) call for a broadened perspective on hedonic and utilitarian usage in the private context, as well as their intersection (e.g. work-from-home arrangements).
3	Research methodology	Technostress research relies predominantly on quantitative surveys which in turn creates the potential for complementary methodological approaches (e.g. bibliometric assessments, design science research, physiological measurements).

Techno-eustress. Recent studies expanded our understanding of the phenomenon of technostress by incorporating a so-called bright side, namely techno-eustress (e.g. [7, 8]). This finding of our review aligns with Tarafdar et al. [52], noting that techno-eustress “introduces a new theoretical aspect to the phenomenon of technostress by considering its positive aspects and outcomes” (p. 25). As a positive affective state, techno-eustress differs from techno-distress in terms of the underlying coping and appraisal processes. In this regard, users may evaluate their interaction with IS as challenging and apply coping processes towards positive outcomes [7]. From a conceptual perspective, eustress or techno-eustress respectively can be captured through four complementary lenses: (1) technology environmental conditions, (2) appraisal processes, (3) coping responses, and (4) outcomes [7, 36], each of which raising important aspects for future research.

First, future research should broaden the understanding of technology environmental conditions (e.g. IS design) in relation to techno-eustress. Stressors are inherently neutral which means that individuals might appraise a stressor differently [21]. Thus, an individual-focused research approach appears beneficial in order to understand this interplay further [7, 13].

Second, during the appraisal process the individual decides if a stressor is positive or negative [21]. This process is strongly impacted by individual differences [21, 36]. Consequently, a further understanding of the appraisal process and the role of individual differences in relation to techno-eustress is a vital area for future research. Third, as coping responses can appear in different forms future research should investigate how individuals can cope with techno-distress and savor techno-eustress [7]. This is particularly relevant in relation to organizational outcomes as studies which investigate this relationship are limited [52]. Finally, understanding the relationship between techno-eustress and organizational outcomes so that “*intended and unintended outcomes can be anticipated by managers*” ([7], p. 811) would complement earlier work on the negative aspects of technostress and hence present a fruitful avenue for future research (e.g. [7, 8, 65]). This more nuanced approach is important to understand the holistic stress process in the context of IS [7, 52].

Usage context. Since 2015, research has started to investigate technostress in a range of private contexts, including smartphones (e.g. [32]), mobility (e.g. [40]) and social media (e.g. [34]). For instance, users can experience social overload when using social networks [34]. A general increase in the development of IS for consumers increases the necessity for technostress research in this application field [37]. Contrary to IS usage in organizational contexts [16], IS usage in private contexts is largely voluntary (*hedonic use* [58]) and individuals can switch between technologies. Maier et al. [34] refer to this phenomenon as switching behavior or more precisely as switching-stress creators and switching-exhaustion, broadening the conceptual view of technostress in private as compared to organizational settings. Further, the rapid proliferation of work-from-home arrangements (e.g. due to COVID-19 restrictions) poses new technological and organizational challenges [60]. Therefore, future research should investigate the underlying technostress assumptions and processes for different technologies and usage settings.

Research methodology. In line with the reviews by Tarafdar et al. [52] and Fischer and Riedl [15], our bibliometric analysis confirms that technostress research relies predominantly on quantitative surveys. Complementary methodological approaches can help researchers to expand the existing insights. For instance, neurobiological outcomes of technostress can be assessed through a range of physiological measurements such as adrenal cortical secretions, blood pressure, brain activity, galvanic skin response, or pupil dilation [1, 19, 45, 50]. In addition, mixed-methods research provides “*an opportunity to develop novel theoretical perspectives by combining the strengths of quantitative and qualitative methods*” ([59], p. 436). In this regard,

Califf et al. [7] emphasize the necessity to utilize mixed-methods in technostress research to account for the different usage settings that make it difficult to draw significant insights from existing theories and approaches. Thus, future technostress research may leverage mixed-method designs to address confirmatory and exploratory research questions simultaneously, which, in turn, enables a more complete assessment of the technostress phenomenon across different usage contexts [59]. Finally, a design-oriented approach can be used to provide insights into how systems can be designed to reduce stress in human-computer interaction and aid users in their coping strategies [1].

With our bibliometric assessment, we contribute to extending the methodological discourse in technostress research. However, our study is also subject to limitations that create further avenues for future research. First, future bibliometric studies could explore other databases (e.g., Web of Science) to capture publications that are not captured by Scopus. A further limitation is that we only considered author keywords in the co-word analysis. However, not every piece of bibliographic data contains keywords [66]. Future studies may apply text mining methods (e.g. on abstracts or full texts) to expand the findings of our co-word analysis. In addition, researchers could apply additional bibliometric techniques (e.g. bibliographic coupling or life-cycle analysis) to shed additional light specifically on emerging developments in technostress research. Compared to co-citation analysis, bibliographic coupling does not rely on historically accumulated citations. In doing so, this method enables researchers to assess emerging fields by taking into account more recent publications that have not been cited yet [66]. Finally, a bibliometric study provides an overview of a research field, but it cannot offer an in-depth understanding of a research field [43]. Future research could apply further review methods, such as a meta-analysis to assess the rich body of existing research and potential existing contradictions.

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