Valtteri Siitonen

WORK-BASED USE OF SMART PERSONAL ASSISTANTS AND THEIR IMPACT ON TECHNOSTRESS

JYVÄSKYLÄN YLIOPISTO
INFORMAATIOTEKNOLOGIAN TIEDEKUNTA
2021

ABSTRACT

Siitonen, Valtteri
Work-based use of smart personal assistants and their impact on technostress
Jyväskylä: University of Jyväskylä, 2021, 95 pp.
Information Systems, Master's Thesis
Supervisor: Salo, Markus

The rapid proliferation of information technology use has had a significant impact on the work of individuals. Not all these impacts are positive, and one of the negative effects of information technology use is a phenomenon called technostress. Technostress has been found to cause many adverse effects on individual employees, such as exhaustion and decreased productivity. Some of the causes for technostress are the constant technological change and the adoption of new emerging technologies. One of the current emerging technologies is the smart personal assistant. The unique interactive way of using smart personal assistants provides its own set of challenges for the user. Thus, this study aims to examine the connection between technostress and smart personal assistants. Currently, the understanding of the connection between technostress and smart personal assistants is limited. This study provides new insights to both technostress and smart personal assistant research by examining how technostress emerges in the work-based use of smart personal assistants. These insights were gathered by examining how the context-specific design principles of smart personal assistants are connected to the creators of technostress. Adverse technostress outcomes were also examined. This study was conducted using a qualitative research approach involving semi-structured interviews of 20 smart personal assistant users from multiple organizations. The results suggest that technostress can occur in the work-based use of smart personal assistants. Many technostress creators, such as techno-overload and techno-uncertainty, were found to cause technostress in smart personal assistant use. Two new technostress creators, communication challenges and unrealistic expectations, closely related to smart personal assistant interaction, were also introduced. All but one of the smart personal assistant design principles were also connected to many of the technostress creators. These results provide insights into the connection between smart personal assistants and technostress and establish a basis for further research.

Keywords: technostress, smart personal assistant, stressor, outcome

TIIVISTELMÄ

Siitonen, Valtteri
Henkilökohtaisten älykkäiden avustajien työkäyttö ja siitä aiheutuva teknostressi
Jyväskylä: Jyväskylän yliopisto, 2021, 95 s.
Tietojärjestelmätiede, pro gradu -tutkielma
Ohjaaja: Salo, Markus

Informaatioteknologian käytön nopealla lisääntymisellä on ollut merkittäviä vaikutuksia ihmisten työskentelyyn. Kaikki vaikutuksista eivät kuitenkaan ole olleet myönteisiä ja yksi negatiivisista vaikutuksista on ilmiö nimeltä teknostressi. Teknostressin on todettu aiheuttavan työntekijöille monia ei-toivottuja seurauksia, kuten uupumusta ja heikentynyttä työtehokkuutta. Esimerkkejä teknostressiä aiheuttavista tekijöistä ovat esimerkiksi teknologian jatkuva muutos ja uusien kasvavien teknologioiden käyttöönotto. Henkilökohtaiset älykkäät avustajat ovat yksi näistä uusista kasvavista teknologioista. Henkilökohtaisten älykkäiden avustajien omanlaatuinen vuorovaikutukseen perustuva käyttökokemus aiheuttaa uudenlaisia haasteita niitä käyttäville työntekijöille. Tämän tutkimuksen tarkoituksena onkin tutkia teknostressin ja henkilökohtaisten älykkäiden avustajien työkäytön yhteyttä. Tällä hetkellä kyseisestä aiheesta on vain vähän tietoa. Tämän tutkimuksen tarkoituksena on tarjota uutta ymmärystä teknostressin ja henkilökohtaisten älykkäiden avustajien suhteesta tarkastelemalla, kuinka teknostressi ilmenee henkilökohtaisten älykkäiden avustajien työkäytössä. Tutkimuksessa tarkasteltiin mahdollisia teknostressin aiheuttajia, ja sitä kuinka henkilökohtaisten älykkäiden avustajien suunnitteluperiaatteet linkittyvät teknostressin aiheuttajiin. Lisäksi tarkasteltiin teknostressin seurauksia henkilökohtaisten avustajien työkäytössä. Tutkimus suoritettiin hyödyntäen laadullisia tutkimusmenetelmiä ja tutkimusaineisto kerättiin teemahaastatteluin. Tutkimukseen haastateltiin 20 henkilökohtaisten älykkäiden avustajien työkäyttäjää erilaisista organisaatioista. Tutkimustulokset osoittavat, että teknostressiä voi ilmetä henkilökohtaisten älykkäiden avustajien työkäytössä. Monet teknostressin aiheuttajat, kuten teknologiasta johtuva ylikuormitus ja teknologiaan liittyvä epävarmuus, aiheuttivat teknostressiä henkilökohtaisten älykkäiden avustajien käytössä. Tutkimuksessa löydettiin myös kaksi uutta teknostressin aiheuttajaa, kommunikaatiohaasteet ja epärealistiset odotukset, jotka liittyivät kiinteästi henkilökohtaisten älykkäiden avustajien erityispiirteisiin. Kaikki henkilökohtaisten älykkäiden avustajien suunnitteluperiaatteista, yhtä lukuun ottamatta, olivat yhteydessä teknostressin aiheuttajiin. Tutkimuksen tulokset tarjoavat tietoa henkilökohtaisten älykkäiden avustajien ja teknostressin yhteydestä sekä luovat pohjaa aiheeseen liittyvälle jatkotutkimukselle.

Asiasanat: teknostressi, henkilökohtainen älykäs avustaja, stressin aiheuttaja, seuraus

FIGURES

TABLES

TABLE OF CONTENTS

1 INTRODUCTION

The proliferation of information technology has brought many solutions that make individuals' lives easier by facilitating both work and leisure. Information technology use promotes people-to-people connectivity, brings enjoyment to users, and increases productivity. These positive effects of information technology use are well-known, but while trying to make people's lives easier, technology can sometimes hinder individuals' performance and cause unwanted negative outcomes. During the recent decades, there has been a growing interest in research towards the negative dark side effects of information technology (Tarafdar, Gupta & Turel, 2013).

One of the negative effects of information technology examined in research is a phenomenon called technostress. Technostress refers to stress caused directly or indirectly as a result of using information technology (Salo, Pirkkalainen, Chua & Koskelainen, 2017; Ragu-Nathan, Tarafdar, Ragu-Nathan & Tu, 2008). Technostress affects both work and leisure and is a growing problem in the modern technology-driven society. In the context of work, employees are increasingly dependent on information technology and must constantly adapt to the use of new applications and changing workflows (Ragu-Nathan et al., 2008). For instance, according to a study by Tarafdar, Ragu-Nathan, and Ragu-Nathan (2011), even 80% of those surveyed experienced increased stress at work due to technological complexity, system problems, and increased workload caused by information technology use. These negative aspects of information technology use, such as the complexity of technology, overload, and interruptions, have been recognized in multiple studies and are referred to as technostress creators (Galluch, Grover & Thatcher, 2015; Tarafdar, Ragu-Nathan & Ragu-Nathan, 2007; Tarafdar et al., 2011; Ragu-Nathan et al., 2008; Salo, Pirkkalainen & Koskelainen, 2019; Srivastava, Chandra & Shirish, 2015; Salanova, Llorens & Cifre, 2013). Technostress, like traditional stress, can cause a plethora of adverse work and wellbeing-related outcomes (Tarafdar, Cooper & Stich, 2019). Work-related outcomes can decrease the work productivity, commitment, and satisfaction of individual information technology users (Khan, Rehman & Rehman, 2013; Kumar, Lal, Bansal & Sharma, 2013; Tarafdar et al., 2007; Ragu-

Nathan et al., 2008). As further consequences, technostress can cause exhaustion, burnout, and mental health-related issues like depression and anxiety (Khedhaouria & Cucchi, 2019; Pawlowski, Kaganer & Cater, 2007; Reinecke et al., 2017). With new information technology solutions, such as applications and systems based on artificial intelligence and robotics on the way, the increase in technostress experienced by users can be expected to continue. (Atanasoff & Venable, 2017.) Therefore, it is important to study the possible effects of technostress among these new emerging technologies. One of these new smart technological solutions already gaining widespread use is the smart personal assistant.

A smart personal assistant (SPA) can be defined as a device or a software solution that is aimed to assist its users in performing various tasks using natural language processing and artificial intelligence (Mitchell, Caruana, Freitag, McDermott & Zabowski, 1994; Knote, Janson, Eigenbrod & Söllner, 2018a). Even though the idea of SPAs has been around for a few decades, only the recent advancements in technology have made SPAs available for widespread use (Hu, Pan & Liu, 2019). In the context of work-based SPA use, Gartner (2020) predicts that up to 50% of knowledge workers could be using a smart virtual assistant in their work by the year 2025. At the moment, SPAs can help users in their work with tasks such as information seeking, arranging appointments, and booking trips (Mitchell et al., 1994; Bentley et al., 2018). Research on smart assistants is diverse, and SPAs have been found to create multiple benefits for their users. SPAs have been proven to be a valuable aid in various contexts such as healthcare, e-learning, and automated customer service (Johansson, Petersson & Nilsson, 2013; Canbeck & Mutlu, 2016; Bentley et al., 2018; Go & Sundar, 2019).

Despite all the positive aspects of SPAs, there are many possible problems and challenges currently associated with SPAs. These challenges are related to, for example, the lack of personal customization, technical issues, and usability (Cowan et al., 2017; Milhorat et al., 2014; Han & Yang, 2018; Luger & Sellen, 2016). These problems have been identified to cause, for example, distractions and increased workload among users (de Barcelos Silva et al., 2020). Other challenges found by the SPA research have been, for example, issues with speech recognition and difficulty of use which have been linked with user frustration (Han & Yang, 2018; Cowan et al., 2017; Luger & Sellen, 2016). Even though the SPA research has found many challenges and issues with SPAs, little is known about how these issues and challenges affect individual SPA users.

Considering the connection between technostress and SPA use, Benlian, Klumpe, and Hinz (2019) found the intrusive technology features of SPAs to be a cause for technostress for users of smart home applications. Benlian et al. (2019) focused on the free time use of SPAs, but little to no research has been done on the connection of technostress and work-based SPA use. The aim of this study is to examine the gap in research related to technostress and work-based SPA use by answering the following research questions:

1. How does technostress emerge in the use of SPAs in the working environment?
2. How are the principles of SPAs related to technostress caused by SPA use, and what are those principles?

Research on the topic answers research calls from both technostress and SPA research. From the point of view of technostress research, there is a lack of knowledge related to a more context-specific understanding about technostress and technologies causing it in the context of work (Tarafdar, Pullins & Ragu-Nathan, 2015; Tarafdar et al., 2019). This study offers context-specific understanding related to the technostress creators and outcomes of work-based SPA use. For SPA research, this study tackles the unanswered question of how the identified key characteristics and features, called principles of SPAs, affect individual users (Knote et al., 2018a). Overall, the results of this study offer valuable insights considering what kind of negative effects the work-based use of new emerging technologies, like SPAs, can cause for individual users. The results of this study can also help with recognizing possible issues with current SPA implementations and fixing these issues moving forward.

The source literature of this study was retrieved by searching for prior literature using five databases: Google Scholar, ACM Digital Library, IEEE Xplore Digital Library, Science Direct, and Scopus. A conductive database search was done using the following keywords and all their combinations to identify relevant source material: "technostress", "smart personal assistant", and "intelligent personal assistant". When selecting source material, close attention was paid to the overall quality and relevance of the sources to the research topic.

To answer the research questions, empirical research was conducted using a qualitative research approach. In total, 20 semi-structured interviews were conducted to gather data from individuals who use and interact with SPAs in their work. The interviewees worked in organizations in several different fields and regularly used SPAs in their work. The usage of interviews enabled the gathering of actual real-life technostress experiences, which have been found useful in providing rich insights about uncovered topics related to real-life information technology use and technostress (Klein & Myers, 1999; Venkatesh, Brown & Bala, 2013; Salo et al., 2019).

The rest of this study proceeds as follows. Next, chapter two reviews prior technostress literature, and chapter three examines prior research related to SPAs. These sections take a detailed look into the prior literature by introducing important concepts, including technostress creators, technostress outcomes, SPA archetypes, and SPA principles. Chapter four examines the research methodology used in the empirical research of this study. The chapter goes through the empirical research design, including data collection and analysis, and discusses the quality and credibility of the study. Chapter five presents the results of the study. Finally, chapter six discusses the study's results, connects them to prior research, and presents both theoretical contributions and practical implications. Possible limitations and topics for future research are also discussed.

2 TECHNOSTRESS

Technostress is a relatively new phenomenon caused by the increasing implementation and use of information technology that started in the 1980s. Technostress has become a growing modern problem, and it is important to understand the issues it can cause and how the negative effects of technostress can be mitigated. This chapter will first discuss the definition and nature of technostress and then move on to discuss the individual characteristics, creators, and outcomes of technostress. Lastly, ways to mitigate technostress are discussed, focusing on the individual's ways for technostress mitigation.

2.1 Stress and technostress

Stress as a phenomenon has been researched for nearly a century. The first published stress research is from the 1930s when Hans Selye defined stress as "the non-specific neuroendocrine response of the body". Later the "neuroendocrine response" was dropped from the definition as it was found that stress does not only affect the neuroendocrine response but also affects the body in a variety of ways. This discovery is often considered the beginning of modern stress research. (Szabo, Tache & Somogyi, 2012.) The understanding and knowledge about stress have come a long way since the 1930s. A more recent and well-known definition of stress used in this study is by Lazarus and Folkman. Lazarus and Folkman (1984, p. 19) define stress as "a relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and endangering his or her wellbeing". To rephrase it, the person feels that they do not have the necessary capabilities or resources to cope with the challenges posed to them by the environment. This unbalance triggers a stressed state which can lead to psychological, physiological, and behavioral reactions. These reactions can cause symptoms such as headaches, anxiety, insomnia, and aggressive behavior (Michie, 2002.)

The negative effects of stress are usually originated from harmful long-term stress called distress. However, momentary stress can also have positive short-term effects, such as increased productivity and better self-efficacy. This kind of short-term positive stress is called eustress. (Le Fevre, Matheny & Kolt, 2003; Galluch et al., 2015; Califf, Sarker, Sarker & Fitzgerald, 2015; Califf, Sarker & Sarker, 2020.) It is also important to note that stress is always a subjective experience, and different individuals can perceive the feeling of stress differently. One can respond with distress while the other responds with eustress. (Lazarus & Folkman, 1984; Salo, Pirkkalainen, Makkonen & Hekkala, 2018.)

The phenomenon of technostress was identified in literature during the 1980s when Brod (1984) defined it as a modern disease caused by the inability to cope with new technology in a healthy manner. Technostress is a phenomenon that has become more common since the 1980s, and the research considering technostress started to become widespread after the turn of the millennium. Reasons for the increase in popularity of technostress research were the increase in technology use and the realization of the harmful effects of technostress (La Torre, Esposito, Sciarra & Chiappetta, 2018; Ennis, 2005; Ragu-Nathan et al., 2008; Tarafdar et al., 2013; Tarafdar et al., 2011). In modern technostress research, technostress is defined as a form of stress that is directly or indirectly caused by the use of information technology (Salo et al., 2017; Ragu-Nathan et al., 2008; Tarafdar et al., 2019).

The modern technostress research is largely based on the stress transaction theory (figure 1) presented by Lazarus (1966). The stress transaction theory broadly describes stress as a phenomenon and is still widely used in stress research. One of the important concepts in the stress transaction theory is called a stressor. Stressors, or in the context of technostress, technostressors, can be described as factors that cause technostress. Technostress research has found a plethora of these factors like information technology-related complexity, invasion of privacy, and computer self-efficacy (Tarafdar et al., 2007; Ragu-Nathan et al., 2008; Shu, Tu & Wang, 2011; Ayyagari, Grover & Purvis, 2011). A more in-depth look at the technostress creators found by the prior research is done later in this next section (section 2.3). The second important concept in the stress transaction theory is strain. Strain can be described as an outcome of stress, and it can cause earlier mentioned physiological, psychological, or behavior-related outcomes (Lazarus, 1966; Salo et al., 2017; Ragu-Nathan et al., 2008). Technostress outcomes are discussed in detail in chapter 2.4. The third important concept in the stress transaction model is a situational factor. Situational factors refer to a wide variety of factors that can affect how an individual experiences stress (Lazarus, 1966; Lazarus & Folkman, 1984). In the context of technostress, situational factors were first described as factors that reduce the impact of stressors and thus reduce the strain of the individual (Ragu-Nathan et al., 2008). However, situational factors can have several different meanings, and they usually comprise a much larger set of factors than only the inhibitors of stress. Thus, a more accurate concept to describe stress-reducing factors used in modern technostress research is a technostress inhibitor. Technostress inhibitors can

include factors like information technology modification, disengagement from information technology, and technical support (Salo et al., 2017; Salo, Makkonen & Hekkala, 2020; Ragu-Nathan et al., 2008). The process of reducing the impact of stressors is referred to as the stress mitigation process (Salo et al., 2017). The technostress mitigation process and the inhibitors of technostress are described in more detail in chapter 2.5.

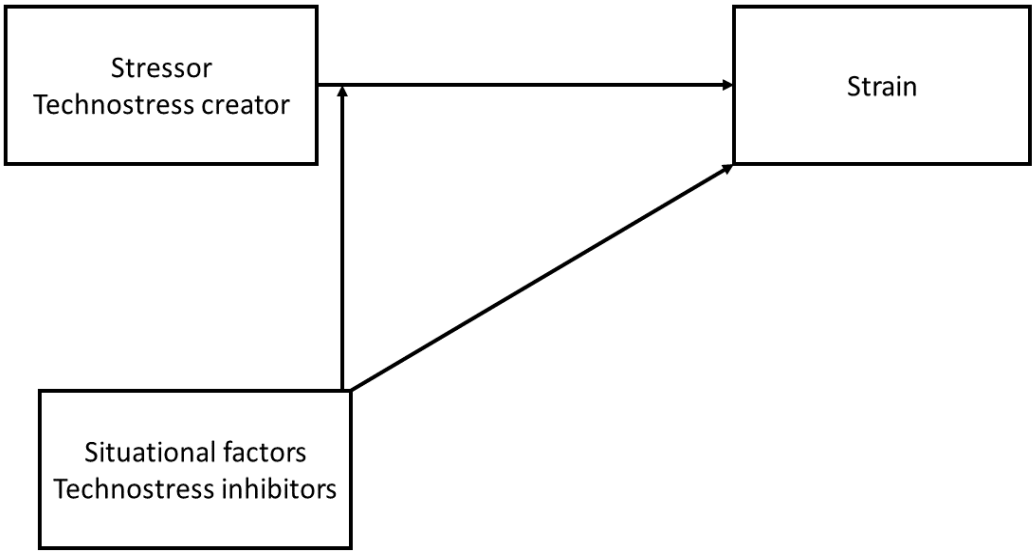

FIGURE 1 Simplified illustration following the stress transaction model (Ragu-Nathan et al. 2008)

2.2 Individual characteristics affecting technostress

Individual characteristics refer to factors that may influence how an individual experiences and mitigates stressful situations. Such factors are, for example, individual personality traits, cultural factors, age, and gender (Srivastava et al., 2015; Khedhaouria & Cucchi, 2019; Ragu-Nathan et al., 2008; Tu, Wang & Shu, 2005; Wang, Shu & Tu, 2008). These individual factors can either enhance or mitigate the technostress experience, thus changing how individuals respond to stress (Srivastava et al., 2015; Tarafdar et al., 2011).

Personality traits play an important role when reacting to a stressful situation because they can have an effect on the psychological stress outcome for individuals (Srivastava et al., 2015). Personality trait-related technostress research has focused on the so-called 'big five' personality traits, which are openness to experience, neuroticism, agreeableness, conscientiousness, and extraversion. (Srivastava et al., 2015; Khedhaouria & Cucchi, 2019; Krishnan, 2017.) The 'big five'-approach has been found to work as a baseline when trying to under-

stand individuals' overall personality characteristics and how they respond to stressful situations (Roccas, Sagiv, Schwartz & Knafo, 2002; Srivastava et al., 2015). Openness to experience refers to one's ability to be open-minded and put themselves in unusual situations. Neuroticism reflects the ease of someone becoming upset and having a negative mood because of that. Highly neurotic people tend to experience more feelings of anger, frustration, and depression. Agreeableness describes an individual who is cooperative, friendly, and modest. Extraversion relates to being talkative, sociable, energetic, and impulsive. Conscientiousness describes an individual who is hardworking, planful, organized, and responsible. (Judge, Higgins, Thoresen & Barrick, 1999; Roccas et al., 2002.) In the context of information technology use, the big five personality traits can influence how an individual reacts to, for example, the introduction of new information technologies. Differences between personality traits can also influence whether an individual responds to a stressor as a distressor or as an eustressor. (Srivastava et al., 2015.) The most significant personality traits affecting the creation of technostress have been found to be neuroticism, extraversion, and agreeableness (Srivastava et al., 2015; Khedhaouria & Cucchi, 2019; Krishnan, 2017).

Krishnan (2017) found that espoused cultural values can also increase the amount of technostress experienced by an individual. Cultural values can affect how individuals react to stressful situations by encouraging a certain kind of approach and behavior. Cultural values encouraging masculinity and power distancing were found to increase the experienced technostress the most. Masculinity refers to emphasizing values like earnings, competitiveness, and achieving goals, while power distancing refers to the degree of inequality accepted between individuals. (Krishnan, 2017.)

Other individual characteristics that can influence the perception of technostress are age, gender, and level of education. Higher age has been connected with increased resistance towards information technology and challenges with using information technology (Shu et al., 2011; Tu et al., 2005; Burton-Jones & Hubona, 2005). Men have also been found to experience more technostress than women. Possible reasons for this could be that men spend more time using information technology and experience more addictive feelings towards it. (Tarafdar et al., 2011; Ragu-Nathan et al., 2008; Shu et al., 2011.) Higher educated users have also been found to experience less strain than less educated users because higher educated users may be more confident with using information technology (Tarafdar et al., 2011; Ragu-Nathan et al., 2008; Shu et al., 2011; Burton-Jones & Hubona, 2005).

2.3 Technostress creators

Information technology use can create stress in a variety of ways, and there have been many technostress creators acknowledged in technostress research. These creators can vary from personal self-efficacy with information technology

to different aspects of the technology itself, such as its complexity (Tarafdar et al., 2007; Shu et al., 2011). Some of the stress creators are directly related to technostress, and some are more general work-related stressors that can also cause stress due to information technology use.

Some of the most used technostress creators in technostress research are techno-overload, techno-invasion, techno-complexity, techno-insecurity, and techno-uncertainty introduced by Tarafdar et al. (2007). Techno-overload refers to situations in which users must work longer and harder due to information technology use and control a large amount of information simultaneously (Tarafdar et al., 2007). Multiple real-time sources of information, such as smart devices and social networking sites, can expose users to a greater amount of information than ever before (Ragu-Nathan et al., 2008; Maier, Laumer, Eckhardt & Weitzel, 2015a; Maier, Laumer, Weinert & Weitzel, 2015b; Salo et al., 2019). This may lead to users being exposed to more information than they can efficiently handle, resulting in them having to work faster to cope with the increasing requirements. Trying to handle too much information can cause overload, resulting in users feeling frustrated and dissatisfied. (Fischer & Riedl, 2017; Ragu-Nathan et al., 2008.)

Techno-invasion describes situations in which users feel like they must be constantly connected through information technology, which makes the line between work and leisure blurrier and more difficult to distinguish (Tarafdar et al., 2007). Due to this continual connectivity, users can feel bound to the information technology they are using, which can create a feeling that technology is invading their time and space. This can create stress, increase user frustration, and decrease job satisfaction. (Ragu-Nathan et al., 2008; Tarafdar et al., 2011.)

Techno-complexity refers to situations in which users feel inadequate and unskilled in using information technology (Tarafdar et al., 2007). Information technology, including hardware, software, and applications, has become increasingly complex and difficult to use, leading to users taking a long time to learn to use a specific information technology (Ragu-Nathan et al., 2008; Tarafdar et al., 2011). This can make users feel uncertain about their skills with using information technology which again can lead to anxiety, fear, and even phobia when using or learning new information technologies (Tarafdar, Tu & Ragu-Nathan, 2010; Ragu-Nathan et al., 2008).

Techno-insecurity describes situations where users feel afraid of losing their jobs because they could be replaced by higher-skilled employees or technology automation (Tarafdar et al., 2007). The sense of techno-insecurity is present even among long-time information technology professionals as younger recruits often have good skills and enthusiasm to learn the latest information technologies. Therefore, existing professionals may feel that their jobs are under threat which can cause tension and stress (Tarafdar et al., 2011).

Techno-uncertainty refers to the constant change of information technology (Tarafdar et al., 2007). Rapid changes can cause users having to constantly learn how to use new technologies and applications, which can lead to users feeling overwhelmed, frustrated, and anxious. Learning new technologies also

takes a lot of time and effort, and the constant technological change can make previously studied information obsolete. Learning new technologies also increases the amount of time spent using technologies which in itself can cause overload and increase in stress. (Ragu-Nathan et al., 2008; Tarafdar et al., 2011.)

Fischer, Pehböck, and Riedl (2019) proposed three technostress creators to be added to complement the five technostress creators introduced by Tarafdar et al. (2007). These three proposed technostress creators are monitoring, cyberbullying, and techno-reliability. Monitoring refers to electronic performance monitoring of information technology use. Monitoring can affect user stress because it is usually not clearly stated what exactly is monitored and what type of data is collected. Cyberbullying refers to a phenomenon in which information technology is used for negative behavior against other users, and it has been found to possibly increase the daily stress experienced by users. (Fischer et al. 2019.) Reliability is defined as how dependable the features and capabilities of the technologies are (Ayyagari et al., 2011). Ayyagari et al. (2011) characterized reliability to be a technostress-related usability feature. However, it was also found to be the most cited stressor as a standalone stressor, techno-reliability, in the study conducted by Fischer et al. (2019).

Interruptions caused by information technology have also been found to cause stress and frustration among users. Interruptions refer to situations in which users have to switch their focus away from the task at hand to deal with a distraction caused by information technology. These distractions can be, for example, notifications and alerts. Interruptions can affect the user's workflow by decreasing satisfaction and productivity and increasing overload and strain. (Galluch et al., 2015; D'Arcy, Gupta, Tarafdar & Turel, 2014a.)

Shu et al. (2011) state that computer self-efficacy and technology dependence can influence the technostress experienced by individuals. Computer self-efficacy refers to the ability and confidence of an individual to perform tasks using information technology. Lower-skilled individuals can be more resistant to technological change, possibly increasing the amount of stress experienced by the individuals (Shu et al., 2011). On the contrary, higher-skilled users have been found to better overcome the challenges of using information technology and take a more positive approach towards challenges posed by information technology use. It has been found that high computer self-efficacy can decrease the technostress caused by techno-complexity and techno-insecurity. (Ragu-Nathan et al., 2008; Tarafdar et al., 2011; Shu et al., 2011.) Technology dependence refers to users' dependence on information technology in their job. High dependence on information technology can increase the likelihood of facing stressful situations when using information technology. High technology dependence has been found to increase techno-complexity and techno-uncertainty among users. (Shu et al., 2011.) Technoaddiction, in turn, refers to the need for coercive and repeated use of technology. Technoaddiction has also been found to increase the amount of technostress experienced by technology users and be an outcome caused by other technostress creators (Salanova et al., 2013; Brooks, Longstreet & Califf, 2017).

Ayyagari et al. (2011) introduced a set of five technology-related stress creators that have since been popular in technostress research. The five stress creators presented are work overload, role ambiguity, job insecurity, work-home conflict, and invasion of privacy. These stressors are mainly general work-related stressors that can have a component due to the use of information technology and thus influence the technostress experienced by employees. (Ayyagari et al., 2011.)

Work overload can be divided into quantitative and qualitative overload. Quantitative overload is focused on the sheer amount of work that the employee must complete. However, technostress research is generally more interested in qualitative overload as it is more focused on the psychological strain. Qualitative work overload means that the work done and the assignments given to employees exceed their capability or skill level. (Cooper, Dewe & O'Driscoll, 2001; Ayyagari et al., 2011.)

Role ambiguity refers to the level of ambiguity an individual experiences with their role-related tasks and the lack of information to perform those tasks (Cooper et al., 2001). Users may also have multiple differing roles at their workplace that they are trying to perform by maintaining constant availability using information technology. The goal of maintaining constant availability can create interruptions in their workflow. These interruptions make individuals question which role they are trying to fulfill at a given time and which tasks are related to which specific role. This feeling of confusion can create role ambiguity and the feeling of stress. (Ayyagari et al., 2011.)

Work-home conflict is the conflict experienced by an individual between the demands of work and family. The differing demands of work and family and the goal of constant availability can make separating work and leisure harder than before, which can cause a work-home conflict to arise. (Ayyagari et al., 2011; Ragu-Nathan et al., 2008.) Work-home conflicts were also researched by Leung and Zhang (2017), who found that a higher level of work-home conflict can increase the amount of techno-overload and techno-invasion experienced by individuals.

Invasion of privacy is the feeling of an individual that their privacy is compromised by information technology. This feeling creates a misfit between the intrusive features of information technology and the privacy needs of individuals, which can create strain and the feeling of technostress. (Ayyagari et al., 2011; Benlian et al., 2019.)

Job insecurity refers to the threat of job loss experienced by an individual because of information technology (Ayyagari et al., 2011). Job insecurity as a stress creator is in many ways identical to the techno-insecurity introduced by Trafdar et al. (2007) discussed earlier in this section.

Technostress creators have also been studied in specific contexts such as social networking sites and services (SNS) and security-related stress (SRS) (Maier et al., 2015b; Maier et al., 2015a; Salo et al., 2019; Tarafdar, Maier, Laumer, & Weitzel, 2020; D'Arcy, Herath & Shoss, 2014b; D'Arcy & Teh, 2019; Hwang & Cha, 2018). SNS-related technostress research is focused on how SNS,

like Facebook, can create technostress and what outcomes it can have. Stressors identified specifically related to SNS include SNS invasion, social overload, SNS disclosure, and SNS uncertainty (Salo et al., 2019; Maier et al., 2015a; Maier et al., 2015b). As an example of an SNS-related technostress creator, social overloading refers to situations in which an individual is receiving and/or giving too much social support, such as sending messages to other users. This can create exhaustion and thus increase the technostress experienced by users. (Maier et al., 2015a.) SRS-related research is focused on how technostress affects information security-related behavior, such as complying with information security policies. SRS-related technostress creators identified are SRS overload, SRS complexity, and SRS uncertainty. (D'Arcy et al., 2014b; D'Arcy & Teh, 2019; Hwang & Cha, 2018.) As an example of an SRS-related technostress creator, SRS overload describes situations in which increased workload caused by security requirements increases the time taken by the employees to finish their jobs, thus creating pressure and increasing the strain experienced by employees (D'Arcy et al., 2014b). A summary of the technostress creators discussed in this section can be found below in table 1.

TABLE 1 Technostress creators

Stress creators related to IT use	**Creators introduced by**	**Creators later used in, e.g.,**
Techno-overload Techno-invasion Techno-complexity Techno-insecurity Techno-uncertainty	Tarafdar et al., 2007	Ragu-Nathan et al., 2008; Pflügner et al., 2020a; Srivastava et al., 2015; D'Arcy et al., 2014b
Work overload Role ambiguity Job insecurity Work-home conflict Invasion of privacy	Ayyagari et al., 2011 (stressors due to ICTs)	Benlian et al., 2019; Salo et al., 2019; Maier et al., 2015b
Computer self-efficacy Technology dependence	Shu et al., 2011	Tarafdar et al., 2015; Dong et al., 2019; Qi, 2019
Technoaddiction	Salanova et al., 2013	Tarafdar et al., 2020; Brooks et al., 2017
Monitoring Cyberbullying Techno-reliability	Fischer et al., 2019	Oksanen et al., 2020
Interruptions	Galluch et al., 2015	Tams et al., 2017; Tams et al., 2018

2.4 Technostress outcomes

Technostress can cause a variety of different outcomes, also referred to as strains, for the individuals experiencing technostress. Following the categoriza-

tion presented by Tarafdar et al. (2019), technostress outcomes can be sorted into four different categories: job-related negative outcomes, information technology use-related negative outcomes, wellbeing-related negative outcomes, and physiological outcomes.

Technostress can have adverse outcomes on an individual's work performance. These job-related outcomes can hamper both the individual's and the organization's performance. For the employee, technostress interferes with innovation and reduces the time spent on creative thinking (Tarafdar et al., 2007; Tarafdar et al., 2011). The lack of creative thinking can lead to hastily performed work tasks, which reduces the efficiency and quality of work. Tarafdar et al. (2011) also state that employees suffering from technostress make less use of information technology in their work tasks. This can be problematic because information technology is one of the key tools used for innovation (Tarafdar et al., 2015). Technostress can also influence employee work motivation and job satisfaction. A decrease in motivation or job satisfaction can have negative effects, such as increase employee turnover and absenteeism, and decrease the overall atmosphere in the organization. (Ragu-Nathan et al., 2008; Tarafdar et al., 2011; Tarafdar et al., 2010; Khan et al., 2013.) All of the mentioned job-related negative outcomes can weaken the employee's image of the organization. As a result, this can decrease employees' organizational and continuance commitment (Ragu-Nathan et al., 2008; Tarafdar et al., 2011; Tarafdar et al., 2015; Kumar et al., 2013). Technostress experienced by the employees can also directly affect work efficiency and productivity (Tarafdar et al., 2011; Tarafdar et al., 2010; Khan et al., 2013; Kumar et al., 2013). Constantly changing information technology and the consequent learning of new information technologies can cause overload. This can reduce the time available for actual work-related tasks, which decreases efficiency and productivity. (Tarafdar et al., 2011.)

The second category of technostress outcomes is information technology use-related outcomes. Technostress, and the frustration it causes, can change the way users use information technology, negatively affecting the user experience, user satisfaction, and the perceived benefits of information technology use (Maier et al., 2015a; Tarafdar et al., 2011). Maier et al. (2015a) found that psychological technostress outcomes, like exhaustion, can cause discontinuous use intention and thus an urge to switch from one technology to another. The user can commit to these actions as an outcome caused by a stressful experience during information technology use, but also as a preventative measure to cope with stress (Maier et al., 2015a; Salo, Pirkkalainen, Chua & Koskelainen, 2021). An increase in information technology use has also increased the amount of multitasking, which can increase frustration and tension. This increased frustration and tension can cause the user to lose self-confidence when using information technology. Lack of self-confidence can make the user feel helpless and even afraid of using technology. (Ragu-Nathan et al., 2008; Reinecke et al., 2017; Tarafdar et al., 2007.) A more serious fear and nervousness related to information technology use is referred to as computer phobia (Tarafdar et al., 2007; Tarafdar et al., 2010). D'Arcy et al. (2014b) and D'Arcy et al. (2019) studied the impact of

technostress outcomes on security-related issues such as information security policy (ISP) violations and ISP compliance. It was found that an increase in technostress among users makes ISP violations more acceptable, and users are more likely to commit unsafe actions as an outcome of technostress (D'Arcy et al., 2014b; D'Arcy et al., 2019).

The third category of technostress outcomes is related to individual well-being and mental health. The link between technostress and mental health problems has been studied relatively extensively, and technostress has been found to affect mental health in several studies. Technostress outcomes affecting mental health have been found to be anxiety, depression, and burnout. (Pawlowski et al., 2007; Reinecke et al., 2017; Wang et al., 2008; Khedhaouria & Cucchi, 2019; Tarafdar et al., 2007.) The following technostress creators have been found to affect technostress-related mental health problems and burnout: techno-overload, techno-invasion, techno-complexity, and multitasking (Reinecke et al., 2017; Tarafdar et al., 2007; Ayyagari et al., 2011; La Torre et al., 2018). Technostress, and in particular multitasking, has been associated with exhaustion which debilitates employee work motivation, commitment, and job satisfaction (Ayyagari et al., 2011; Tarafdar et al., 2007). Other wellbeing-related outcomes of technostress have been found to be concentration problems, sleep problems, identity problems, social relation problems, negative self-view, and fluctuating mood (Salo et al., 2019; La Torre et al., 2018; Jena, 2015). Overall, technostress can have a variety of effects on welfare can lower individuals' wellbeing.

Technostress has also been found to have similar physiological outcomes as traditional stress. Technostress can cause, for example, headaches, restlessness, and drowsiness (Arnetz & Wilholm, 1997). Technostress can also affect the user's stress hormone levels. Galluch et al. (2015) measured specific stress hormone (alpha-amylase) levels of people experiencing technostress. It was found that users with higher alpha-amylase levels had been experiencing technostress and users with low alpha-amylase levels had not (Galluch et al., 2015). Riedl (2012) conducted a literature review of studies concerning physiological outcomes of technostress. The most common physiological outcomes identified in the study were increased blood pressure, heart rate, adrenaline, cortisol, and a decrease in melatonin levels (Riedl, 2012).

Despite the mainly negative outcomes of technostress, positive technostress (technoeustress) has been found to cause positive effects and outcomes. To obtain the positive effects of stress, one can only reach a certain stress level called the optimal amount of stress, after which performance will start to decline (Le Fevre et al., 2003). Ahmad, Amin, and Ismail (2014) found in their study that technoeustress can increase organizational commitment and productivity, but this may only apply if the negative technostress (distress) levels can be kept relatively low. Califf et al. (2015) and Califf et al. (2020) found in their studies that technoeustress is positively related to job satisfaction. The personality trait of conscientiousness has also been found to induce positive stressful feelings (Srivastava et al., 2015). The creators of technoeustress can be, for ex-

ample, positive challenges posed by information technology, the experience of information technology as an inspiring and useful tool, and optimal pace of technological change (Tarafdar et al., 2019; Califf et al., 2015; Califf et al., 2020). It is important to realize the positive effects of eustress, however, this study is mainly going to focus on the negative distress aspect of technostress. A summary of the negative technostress outcomes presented in this section can be found below in table 2.

TABLE 2 Negative technostress outcomes presented according to the categorization by Tarafdar et al. (2019)

Outcome group and sources	**Technostress outcome**
Job-related outcomes	Decrease in creative thinking and innovation
Tarafdar et al., 2007; Tarafdar et al., 2011; Tarafdar et al., 2015; Ragu-Nathan et al., 2008; Khan et al., 2013; Kumar et al., 2013	Reduced efficiency and productivity Decrease in information technology use in work tasks Reduced job satisfaction and motivation Increase in employee turnover Decrease in organizational and continuance commitment
Information technology use-related outcomes	Discontinuous use intention Information technology switching
Maier et al., 2015a; Tarafdar et al., 2011; Ragu-Nathan et al., 2008; Reinecke et al., 2017; Tarafdar et al., 2007; Tarafdar et al., 2010	Reduced self-confidence when using information technology Computer phobia Reduced user satisfaction
Wellbeing-related outcomes	Mental health issues: anxiety, depression, and burnout
Pawlowski et al., 2007; Reinecke et al., 2017; Wang et al., 2008; Khedhaouria & Cucchi, 2019; Ayyagari et al., 2011; Salo et al., 2019; Jena, 2015; La Torre et al., 2018	Exhaustion Concentration problems Sleep problems Social relation problems Negative self-view
Physiological outcomes	Headaches Restlessness
Arnetz & Wilholm, 1997; Galluch et al., 2015; Riedl, 2013	Drowsiness Increase in stress hormone levels Increase in blood pressure, heart rate, adrenaline, and cortisol

2.5 Technostress mitigation

As technostress and its negative effects become more common, it is important to consider how technostress can be prevented. Even though this study did not focus on technostress mitigation in its empirical research, it is important and helpful for users and organizations to understand the possible mitigation strat-

egies available to counter the possible technostress caused by smart personal assistants.

The purpose of technostress mitigation is to identify and create conditions for users and organizations to prevent technostress and its negative effects. Thus, technostress mitigation can be defined as preventing the adverse effects and outcomes of technostress (Ragu-Nathan et al., 2008; Tarafdar et al., 2011; Pirkkalainen, Salo, Makkonen & Tarafdar, 2019; Pirkkalainen, Salo, Tarafdar & Makkonen, 2019). Technostress literature considering the mitigation of technostress was first focused on the possible inhibitors on the organizational level (Ragu-Nathan et al., 2008; Tarafdar et al., 2011; Tarafdar et al., 2015; Wang et al., 2008). However, during recent years focus has switched more towards the individual's ways for technostress mitigation (Ioannou & Papazafeiropoulou, 2017; Salo et al., 2017; Salo et al., 2020; Salo et al., 2021; Pirkkalainen et al., 2017; Pirkkalainen et al., 2019; Sumiyana & Sriwidharmanely, 2020; Pflügner, Maier & Weitzel, 2020a; Tarafdar et al., 2020). First, this section briefly discusses the organizational ways for mitigating technostress, after which focus is switched to a more in-depth look at the individual's ways for technostress mitigation.

2.5.1 Organizational technostress mitigation

It is important for organizations to curb the occurrence of technostress. By lessening the effects of technostress experienced by employees, organizations may increase employee engagement, job satisfaction, and work efficiency, making a notable contribution to the performance and efficiency of organizations (La Torre et al., 2018; Ragu-Nathan et al., 2008). Organizations' means for alleviating technostress are based on modifying organizational mechanisms to help employees better cope with the creators of technostress and reduce the adverse effects of technostress creators. Four popular organizational means for technostress mitigation found in the literature are technical support, literacy facilitation, technology involvement facilitation, and innovation support (Ragu-Nathan et al., 2008; Tarafdar et al., 2011).

Technical support is an important part of organizational technostress mitigation due to the fast pace of technological change in organizations. Technical support can, and should, include both user training and help desk support. This is to make sure that users receive help and guidance in using both new and existing information technologies. (Ragu-Nathan et al., 2008; Tarafdar et al., 2011; Tu et al., 2005; Tu, Tarafdar, Ragu-Nathan & Ragu-Nathan, 2008; Fuglseth & Sørebø, 2014; Wang et al., 2008; Jena, 2015.) Technical support has been found to counter especially techno-complexity and techno-uncertainty, thus increasing organizational commitment, productivity, and job satisfaction (Ahmad et al., 2014; Ragu-Nathan et al., 2008; Tarafdar et al., 2011).

Literacy facilitation refers to encouraging the sharing of information technology-related knowledge inside the organization so that it is easily accessible. This way, employees can more easily educate themselves in using new technologies which can counter technostress caused by, for example, techno-

complexity. (Ragu-Nathan et al., 2008; Tarafdar et al., 2011; Fuglseth & Sørebø, 2014; Califf & Brooks, 2020.)

Technology involvement facilitation describes involving information technology users in information technology-related decision making and development. Technology involvement facilitation can lessen the effects of technostress caused by techno-complexity and techno-uncertainty as users are more aware of the possible changes, and they can have a say in the adoption of new technologies. (Tarafdar et al., 2011; Fuglseth & Sørebø, 2014; Califf & Brooks, 2020.)

Innovation support refers to how an organization encourages employees to experiment and learn. These measures aim to build an organizational culture that promotes new ideas, discussion, and communication between employees. Innovation support has been found to prevent technostress caused by techno-complexity and techno-insecurity because information technology users feel less restricted and more entitled to take risks and experiment with information technology. (Tarafdar et al., 2011.)

Other organizational means for technostress mitigation found in the literature are, for example, stress management training, job control, organizational rewards, delegation, communication regulation measures after work hours, and personnel selection (Hung, Chang & Lin, 2011; Wang et al., 2008; Tu et al., 2005; Pflügner, Reis, Maier & Weitzel, 2020b; Szalma & Hancock, 2007). All the organizational mitigation measures introduced in this section are summarized below in table 3.

TABLE 3 Organizational means for technostress mitigation

Group of measures and sources	**Mitigation measures**
"Organizational technostress inhibitors" by Ragu-Nathan et al. 2008. Tarafdar et al., 2011; Tu et al., 2005; Fuglseth & Sørebø, 2014;	Technical support Literacy facilitation Technology involvement facilitation Innovation support
Training and education Hung et al., 2011; Tu et al., 2005; Szalma & Hancock, 2007; Wang et al., 2008	Stress management training Job control Training and skill development
Task-related measures Szalma & Hancock, 2007; Wang et al., 2008	Delegation Task adaption
Communication-related measures Tu et al., 2005; Pflügner et al., 2020b	Communication regulation after work hours Improved communication with executives Best practices for internal communication Communication support
Organizational culture Szalma & Hancock, 2007; Wang et al., 2008	Organizational structure and atmosphere Personnel selection Rewards

2.5.2 Individual's technostress mitigation

Research focusing on the individual's ways for technostress mitigation has gained increasing interest and attention. As mentioned earlier, the importance of information technology use at work is constantly growing, and employees are more likely to face technostress at their work. Understanding the individual's ways for technostress mitigation can improve the individual's chances to mitigate the harmful effects of technostress at work and offer ways for organizations to support their employees with technostress mitigation (Pirkkalainen et al., 2019).

The concept of coping has been a growing trend in the research focusing on the individual's ways for technostress mitigation. Coping can be seen as a cognate concept to stress, and individuals use coping strategies to mitigate the harmful effects of stressful situations. The coping process includes four main concepts: a negative incident, appraisals, coping strategies, and an outcome. (Lazarus & Folkman, 1984; Salo et al., 2020; Pirkkalainen et al., 2019; Pirkkalainen et al., 2017; Tarafdar et al., 2020.) Right after a negative incident, users evaluate the importance of that negative event in relation to themselves. This evaluation can be defined as an appraisal. If the result of the appraisal is that the person sees the situation as stressful, they might end up using coping strategies to mitigate the issue. Appraisals also affect the person's decision on which coping strategies they will decide to use. (Lazarus, 1993; Salo et al., 2020.)

Coping strategies can be divided into two main categories, which are problem-focused coping strategies and emotion-focused coping strategies. The main goal of problem-focused coping strategies is to actively try and find ways to solve the root cause of stressors. In contrast, emotional-focused coping strategies are more focused on passive and reactive ways for technostress mitigation. However, there are exceptions to this division between different coping strategies. Emotion-focused coping strategies can also include active coping such as active improvement of information technology-control, which refers to the user's perception of how capable they are at using information technology. Problem-focused coping strategies can also include passive coping, like users restraining themselves from using the information technology causing stress until updates. (Salo et al., 2020; Pirkkalainen et al., 2019; Pirkkalainen et al., 2017; Gaudioso, Turel & Galimberti, 2017.) The following sections will take a look at the problem and emotion-focused coping strategies identified in technostress research.

One of the problem-focused coping strategies is to fix or modify the information technology used. Fixing or modifying the information technology refers to users fixing the stressors themselves by looking for a possible solution and applying that solution to overcome the problem. This adjusting makes the technology better suit the user's needs and actively eliminates the stressor. (Salo et al., 2017; Salo et al., 2020; Salo et al., 2021.) An example of this kind of coping could be changing phone settings like push notifications or applying a bug fix for a system. Another possible problem-focused coping strategy is that the user

adjusts their information technology use to better fit the quality of the information technology. Adjusting information technology use is usually done if the user feels like they do not want to switch or stop using a specific information technology. Reasons for this kind of behavior can be, for example, monetary loss if information technology use is stopped or user's personal history with using a specific information technology that results in a reluctance to switch away from using it. (Salo et al., 2020.) Users can also change their information technology use routines. These routine changes refer to modifying or switching stressful use routines, such as checking work emails in leisure time. (Salo et al., 2017.) Restraining from using a specific information technology until updates and switching to another information technology have also been found to be possible problem-focused mitigation methods. Restraining until updates can, in some cases, be a working coping strategy as the update cycles for information technology have become increasingly faster (Salo et al., 2020). Switching away from the problem-causing technology can also be a viable option if there are alternative technologies to choose from (Maier et al., 2015b; Salo et al., 2020; Salo et al., 2021). Modifying personal reactions to stress caused by information technology can also help users to mitigate and build a tolerance to stressors over time. When modifying their reactions, users should focus on training themselves to control their reactions to acknowledged stressors and evaluate the role of information technology in their lives. This can help users to modify their attitude to be more positive and calmer towards unpleasant situations caused by information technology. (Salo et al., 2017.) One of the possible techniques to make these changes is referred to as positive reinterpretation. Positive reinterpretation is described as a coping technique to infuse stressful situations with a positive meaning. In the context of technostress, this implies that information technology users should focus on the positive aspects of information technology use and discover new ways to use information technology in stressful situations. (Pirkkalainen et al., 2019.) Active distraction has also been found as a viable option for problem-focused coping. Active distraction refers to users actively diverting their attention away from stress-causing technologies by doing other activities and tasks. (Tarafdar et al., 2020.)

The most researched emotion-focused coping strategies are disengagement from information technology and distress venting (Maier et al., 2015a; Salo et al., 2020; Salo et al., 2017; Pirkkalainen et al., 2017; Pirkkalainen et al., 2019). Disengagement from information technology refers to a user taking a temporary break from information technology use to distance themselves from strain and negative effects. Distancing from information technology can help users to clear their minds and relieve their emotional charge. This helps users coming back to using information technology with a clear state of mind and mitigates the impact of technostress creators. (Pirkkalainen et al., 2019; Salo et al., 2017; Pirkkalainen et al., 2017.) Distress venting refers to users venting anger and other negative emotions during stressful situations. Venting is done to let off steam and air out negative emotions to restore emotional stability and gain back the focus to concentrate on the task at hand. Distress venting has been found to

create a temporary boost in productivity and help users mitigate the strain caused by technostress. (Pirkkalainen et al., 2019; Salo et al., 2017; Pirkkalainen et al., 2017; Salo et al., 2020.) Information technology control has been found to have a mitigating effect on technostress. Information technology control refers to the user's beliefs in how well they can perform tasks using information technology (Tarafdar et al., 2015). A high level of information technology control has been shown to lessen the tension and negative effects of technostress because users feel like they are in control of the situation. This feeling of control helps users to be more confident and deal with challenging situations. (Tarafdar et al., 2015; Pirkkalainen et al., 2019.) Salo et al. (2020) found three other emotion-focused coping strategies: empathizing with the information technology provider, downplaying the problem, and blaming the information technology or the user blaming themselves. When empathizing with the technology provider, users put themselves in the provider's position and feel empathy or pity towards them to cope with the stressful situation. On the contrary, blaming information technology can also be used to cope with stress. Users can also blame themselves for getting into a stressful situation and cope with the stress by taking the blame on themselves or by downplaying the problem to reduce the impact of the stressful situation. (Salo et al., 2020.)

Mindfulness has also been studied as a possible way for individuals to reduce technostress. Mindfulness can be described as a rich state of awareness that encourages the idea of being in the present rather than focus on the past or the future (Butler & Gray, 2006; Ioannou & Papazafeiropoulou, 2017). Mindfulness is a skill that can be practiced over time, and individuals can learn to better focus on the moment and let go of thoughts and feelings that are not relevant at that present moment (Grover, Teo, Pick & Roche, 2017; Pflügner et al., 2020a). Thatcher, Wright, Sun, Zagenczyk, and Klein (2018, p. 832-833) defined the concept of information technology mindfulness specifically in the context of information technology: "a dynamic information technology-specific trait, evident when working with information technology, whereby the user focuses on the present, pays attention to detail, exhibits a willingness to consider other uses, and expresses genuine interest in investigating IT features and failures". Information technology mindfulness has been proven as a useful tool to combat technostress by increasing user satisfaction, increasing performance, and enhancing users' other active coping strategies. (Ioannou & Papazafeiropoulou, 2017; Pflügner et al., 2020a; Thatcher et al., 2018.) A summary of the individual's mitigation measures and coping strategies can be found below in table 4.

TABLE 4 Individual's means for technostress mitigation and coping with negative information technology use experiences

Mitigation strategy and sources	**Mitigation or coping measure**
Problem-focused	Modification of information technology
	Adjusting own IT use
Salo et al., 2017; Salo et al., 2020;	Modification of IT use routines
Salo et al., 2021; Pirkkalainen et al., 2019;	Restraining until updates
Tarafdar et al., 2020	Switching the used information technology
	Modification of personal reactions to information technology
	Active distraction
Emotion-focused	Disengagement from information technology
Maier et al., 2015a; Salo et al., 2017;	Distress venting
Salo et al., 2020; Salo et al., 2021;	Technology control
Pirkkalainen et al., 2017;	Empathizing with the IT provider
Pirkkalainen et al., 2019;	Downplaying the problem
Tarafdar et al., 2015	Blaming the IT or oneself
Other	Mindfulness
Ioannou & Papazafeiropoulou, 2017; Pflügner et al., 2020a; Thatcher et al., 2018	

3 SMART PERSONAL ASSISTANTS

One of the goals of new information technology solutions has been to improve the interaction between computers and humans. Interaction between computers and humans has been enhanced by using intelligent and interactive computing solutions, which use artificial intelligence to provide more personalized and authentic communication with the user (Maedche, Morana, Schacht, Werth & Krumeich, 2016). One of these kinds of computing solutions is the so-called smart personal assistant. The proliferation of smart personal assistant use is a relatively new phenomenon, but their possibilities have been recognized in literature since the 1990s. Azvine, Dijan, Tsui, and Wobcke (2000) stated in the year 2000 that smart personal assistants have become a major business opportunity and that human-computer interaction would have many possible benefits for information seeking and sorting. However, only the recent advancements in technology during the 2010s have enabled a widespread integration of smart personal assistants into the daily lives of information technology users (Hu et al., 2019). This rapid increase in smart personal assistant use has created a growing interest in research towards smart personal assistants and users' experiences with them.

This chapter first discusses the concept and background of smart personal assistants. This is followed by a discussion of the architecture and technology behind the assistants. After that, archetypes, principles, and features of smart personal assistants are described. This chapter concludes with a discussion on the benefits and challenges of smart personal assistant implementations and the connection between smart personal assistant use and technostress.

3.1 Concept and background of smart personal assistants

The market and possibilities for smart personal assistants (SPAs) have been growing rapidly during the 2010s. The main reasons for this are advancements made in technologies that are closely tied with SPAs, such as artificial intelligence (Han & Yang, 2018; Hu et al., 2019; Mihale-Wilson, Zibuschka & Hinz, 2017). Modern SPAs can perform a variety of tasks ranging from everyday tasks such as information seeking and schedule planning to more complex tasks such as customer service and e-learning (Bentley et al., 2018; Zierau, Engel, Söllner & Leimeister, 2020; Luger & Sellen, 2016; Go & Sundar, 2019). Overall, SPAs are used in a plethora of contexts, like smart home integration, healthcare, and to increase organizational and group productivity (Fernando, Tan, Vasa, Mouzaki & Aitken, 2016; Bennett, Rokas & Chen, 2017; Budzinski, Noskova & Zhang, 2019; Myers et al., 2007; Winkler, Söllner, Neuweiler, Rossini & Leimeister, 2019a; Winkler, Neuweiler, Bittner & Söllner, 2019b). Despite the widespread use of SPAs and increased interest in SPA research, there is no universal definition for an SPA. However, some similarities repeat between the variety of definitions. These similarities are the utilization of artificial intelligence, interaction with the user, and performance of tasks (Knote et al., 2018a; Zierau et al., 2020; Mihale-Wilson et al., 2017; Hu et al., 2019). In this study, an SPA is defined as a computer system that interacts with the user using varying levels of artificial intelligence to perform tasks and services for the user. Deng (2018) defines artificial intelligence as a branch of computing that aims to develop theories, methods, algorithms, and applications to simulate and extend human intelligence. In the context of SPAs, this can include technologies such as natural language processing and deep learning (Knote et al., 2018a; Knote, Söllner & Leimeister, 2018b; Bellegarda, 2014).

The concept of a technology-based personal assistant was introduced in the 1990s. The evolution of SPAs can be viewed by comparing them to a classification of user assistance systems introduced by Maedche et al. (2016). The classification consists of two dimensions: the degree of intelligence and the degree of interaction of the assistance system. Based on these two dimensions, SPAs can be classified into two groups: basic user assistance systems and advanced user assistance systems. An illustration of the user assistance system classification is presented in figure 2.

The early personal assistants were software agents that could only give advice within highly specified use cases, but some prototypes did already use primitive artificial intelligence to improve the accuracy of the assistants (Mitchell et al., 1994; Zierau et al., 2020). The early personal assistants were aimed to help users with basic tasks such as information seeking, calendar scheduling, email filtering, and telephone call management (Azvine et al., 2000; Mitchell et al., 1994; Hoyle & Lueg, 1997). These early prototypes can mostly be categorized into basic user assistance systems. Basic user assistance systems offer a low level of intelligence and interaction and rely heavily on manual user input (Maed-

che et al., 2016). Despite the inaccuracy and limited use cases of the early personal assistants, the need and possible benefits of SPAs were realized. Azvine et al. (2000) stated that because of the ever-increasing amount of information, there is a need for computers that better understand the behavior of the user to increase productivity and avoid information overload.

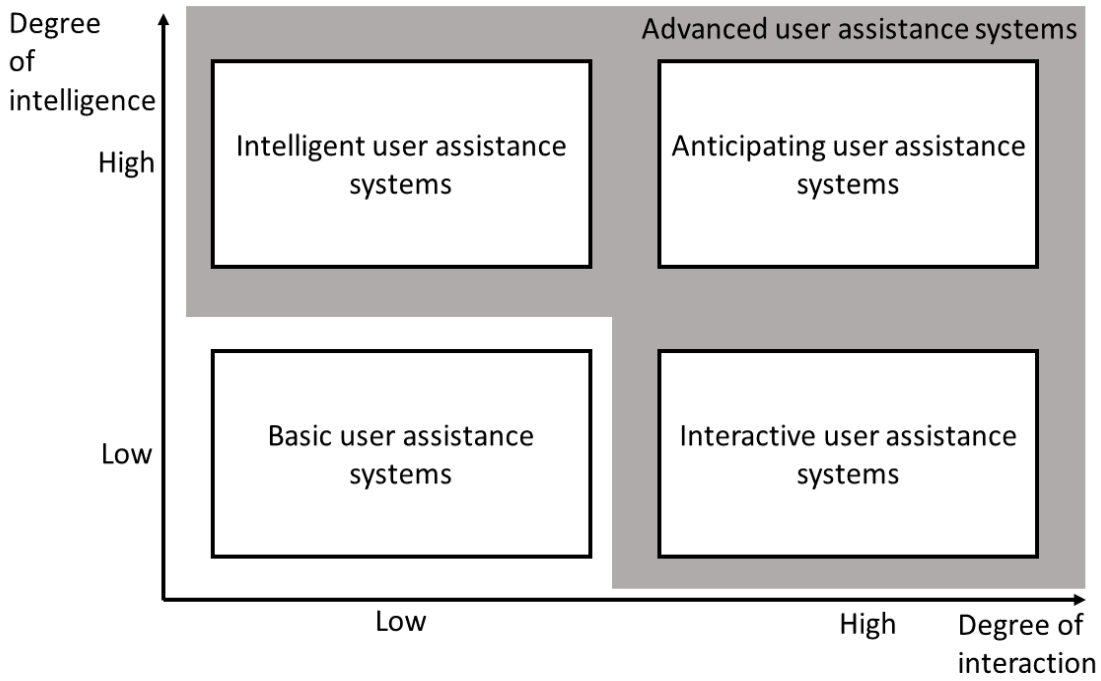

FIGURE 2 Classification of user assistance systems (Maedche et al., 2016, p. 368)

Recent advancements in technology, especially in artificial intelligence, have made the concept of an SPA more affordable and flexible. Because of these developments during the 2000s, SPAs can be found integrated into websites and smartphones as well as standalone hardware devices. (Han & Yang, 2018; Hu et al., 2019; Zierau et al., 2020; Knote et al., 2018b.) The modern SPAs can also be applied to more complex use cases like making purchases, e-learning, and assisting business decisions (Hu et al., 2019; Budzinski et al., 2019; Winkler, Büchi & Söllner, 2019c). Most modern SPAs can be categorized into advanced user assistance systems, but there are still differences between the level of interaction and intelligence that SPAs are able to provide. Anticipating user assistance systems offer a higher level of intelligence and interaction, proactive and context-aware decision making, and sophisticated dialog capabilities. (Knote, Janson, Söllner & Leimeister, 2019; Knote et al., 2018a; Maedche et al., 2016.) Modern SPAs that lack either intelligence or interaction can be categorized into either intelligent user assistance systems or interactive user assistance systems. Intelligent user assistance systems provide higher levels of intelligence but lack interaction. Intelligent user assistance systems are often highly adaptive, and they can be used as, for example, recommendation-focused systems in e-commerce

or software robots. Interactive user assistance systems contrarily lack intelligence but offer higher levels of interaction. Interactive user assistance systems often offer assistance on pre-determined patterns but are highly interactive and work in cooperation with the users. (Maedche et al., 2016; Knote et al., 2019.)

3.2 Architecture and technology

One of the most common ways that SPAs to interact with their users are artificial intelligence-driven natural language processing techniques (Knote et al., 2018b; Hauswald et al., 2016; Knote et al., 2018a; Bellegarda, 2014). Natural language processing refers to utilizing computing to process spoken or written language to perform different tasks (Collobert & Weston, 2008; Deng & Liu, 2018). Natural language processing is based on signal identification to understand the meaning of different signals such as speech, written text, and gestures (Deng & Liu, 2018). In the case of SPAs, natural language processing is used to interact with the user and provide assistance in the task given to the SPA (Knote et al., 2018a; Bellegarda, 2014). The smart personal assistant interaction model (figure 3) by Bellegarda (2014) describes a simplified natural language processing architecture used in most modern SPAs to interact with users.

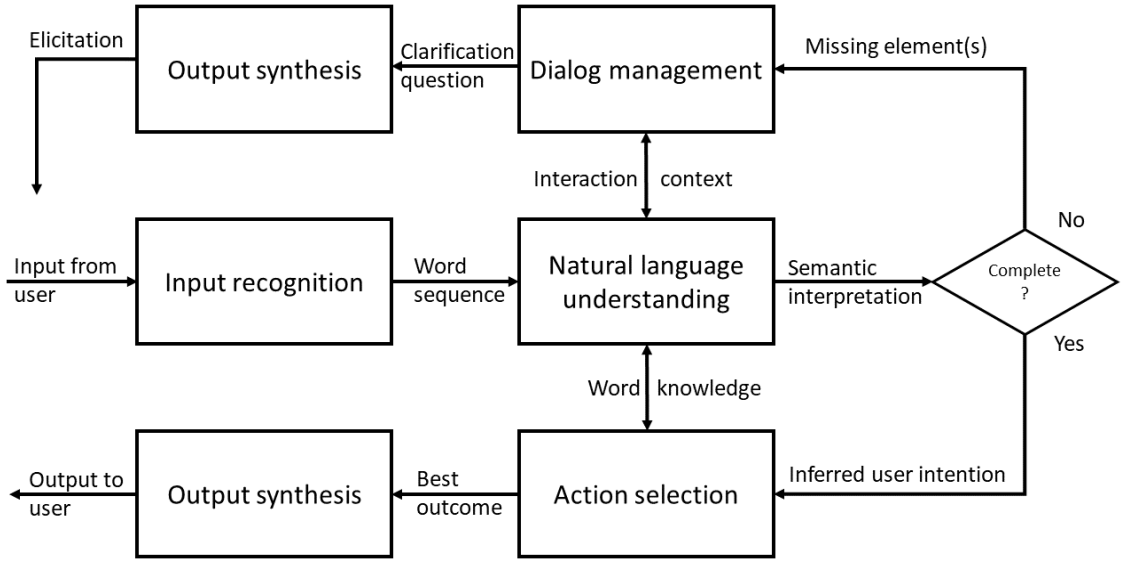

FIGURE 3 A simplified smart personal assistant interaction model adapted from Bellegarda (2014, p. 4)

First, the input given to the SPA is transformed into a word sequence so that natural language understanding and semantic interpretation can be done. If clear interpretation cannot be done, the SPA tries to deduce the missing ele-

ments to decide the best course of action or asks for further information from the user. Lastly, when the semantic interpretation is complete, the SPA will choose the best possible outcome to the best of its abilities and communicates the output to the user. (Bellegarda, 2014.)

The smart personal assistant interaction model provides a simplified overview of the operation of SPAs. However, it is important to note that there is no unified architecture for SPAs, but all of the basic elements in the model can be identified in most modern SPAs (de Barcelos Silva et al., 2019; Hauswald et al., 2016). Most of the current SPAs are built on their own architectures, and the exact elements of any given architecture are dependent on the functionality of that specific SPA. The features affecting the architecture of a specific SPA can be, for example, the level of context-awareness, possible directions of communication, and self-evolution capabilities (Hauswald et al., 2016; Knote et al., 2018a; Knote et al., 2018b). For instance, if an SPA uses vision to communicate with the user or it uses machine learning for self-evolution, the SPA needs those elements to be included in its architecture as well. The level of intelligence and possible conversation paths of the SPA also affect the level of semantic interpretation that the SPA is able to perform. (Hauswald et al., 2016.)

3.3 SPA archetypes

SPAs can be categorized into five distinctive archetypes based on their means of interacting with the user, the user interacting with them, and the goal of the interaction. The five different archetypes recognized are adaptive voice assistants, chatbot assistants, passive pervasive assistants, and natural conversation assistants (Knote et al., 2019). However, it is also important to note that archetypes and their features are often mixed with each other in real-life use cases, and one SPA can include characteristics from multiple archetypes.

The main communication method of adaptive voice assistants is speech combined with possible vision-based communication methods such as optical sensors and visual output (Knote et al., 2019). Adaptive voice assistants are capable of both receiving and responding using natural language, and they are used for multiple different use cases such as controlling smart devices and calendar scheduling (Han & Yang, 2018; Bentley et al., 2018). Most of the popular commercial SPAs like Siri, Alexa, and Cortana belong to adaptive voice assistants. Due to the nature of these assistants, they can adapt and learn from user input and thus improve their ability to perform tasks. (Knote et al., 2019.)

Chatbot assistants, also called text-based conversational agents, mainly use text and semantic text analysis to provide assistance services (Knote et al., 2019; Nuruzzaman & Hussain, 2018). Chatbots are designed for tasks such as customer service, technical support, and answering frequently asked questions (Go & Sundar, 2019). Chatbot assistants usually operate in closed systems and utilize domain-specific knowledge rather than third-party information. (Knote et al., 2019.) This can lead to inflexible dialogue capabilities and only using pre-

defined interaction methods (Nuruzzaman & Hussain, 2018). However, even if a chatbot assistant works in a closed system, it can still learn to provide better assistance through multiple encounters with different users, thus learning better patterns for assistance (Knote et al., 2019). There have also been developments in chatbots to increase their learning capabilities by using deep learning techniques to make chatbots more flexible and better at providing useful information (Nuruzzaman & Hussain, 2018). Chatbot assistants have allowed organizations to automate parts of their customer service and respond to the need for around-the-clock interaction (Go & Sundar, 2019).

The third SPA archetype is an embodied virtual assistant. Embodied virtual assistants often have human-like qualities, such as a sense of humor, empathy, and appearance, and they are usually designed to perform a specific task (Knote et al., 2019; Epley, Waytz & Cacioppo, 2007). An example of a task like this is e-learning, which is currently the most common use case for embodied virtual assistants (Winkler et al., 2019c; Canbeck & Mutlu, 2016; Knote et al., 2019). Embodied virtual assistants usually communicate using speech and visual output, and they are designed to increase and sustain human-like interaction in use cases where human-to-human communication has been the dominant way to accomplish a task, such as learning (Knote et al., 2019).

Passive pervasive assistants refer to SPAs whose main task is to collect as much data as possible to help the user accomplish a task or make a decision. Unlike the other assistant archetypes, passive pervasive assistants are often unidirectional and require minimal manual input from the user. The goal of a passive pervasive assistant is to be as seamless as possible while still enhancing users' productivity. (Knote et al., 2019.) In organizational environments, software robots utilizing intelligent robotic process automation (RPA) can be thought of as these kinds of SPAs. RPA solutions do not offer a high level of interaction with the user, but they accomplish tasks and help users in their daily work lives. (Aguirre & Rodriguez, 2017.)

The last group of assistants is natural conversation assistants. The goal of natural conversation assistants is to imitate human-to-human natural language interaction. Natural conversation assistants use sophisticated speech recognition to understand complex conversations and use natural language interaction techniques such as filler words. Natural conversation assistants are predicted to be used to perform tasks on behalf of the user and replace humans in tasks such as customer service. However, as of now, these types of assistants are still in an experimental stage. (Knote et al., 2019.) An example of a natural language conversational assistant is Google Duplex, which can perform tasks using natural-sounding and human-like conversations (Leviathan & Matias, 2018). A summary of the SPA archetypes presented in this section can be found below in table 5.

TABLE 5 SPA archetypes (Knote et al., 2019).

Archetype	Common features
Adaptive voice assistants	Speech and possibly vision-based interaction Bidirectional natural language interaction Learning through user input
Chatbot assistants	Designed to provide customer support and assistance Closed system operation Learning through experience
Embodied virtual assistants	Human-like design and qualities Speech and visual interaction
Passive pervasive assistants	Data collection for task accomplishing and decision making Unidirectional interaction (system to user) Minimal user input
Natural conversation assistants	Authentic human-to-human-like interaction Sophisticated speech recognition Bidirectional interaction

3.4 Principles and features of SPAs

SPAs are complex systems that are built using differing architectures and functionalities. However, there are similarities between different SPAs. Knote et al. (2018a) conducted an extensive literature review of SPA literature and found five unifying principles of SPAs. Knote et al. (2018a) presented these factors mainly as principles for further research, but these principles have been noted in prior literature as a major part and basis of the functionality of SPAs (Maedche et al., 2016; Abowd, Dey, Brown, Davies, Smith & Steggles, 1999; Russell & Norwig, 2003; Benlian et al., 2019; Touré-Tillery & McGill, 2015; Mourey, Olson & Yoon, 2017; Luger & Sellen, 2016). These five principles are context-awareness, self-evolution, multimodality, anthropomorphism, and platform integration (Knote et al., 2018a).

The exact definition and what is included in context-awareness varies. However, in the context of SPAs it can be defined as context-aware computing solutions to identify, process, and use contextual information to offer more personalized and tailored services for the user of the system (Knote et al., 2018a; Maedche et al., 2016). The inclusion of some level of context-awareness is said to be crucial to be able to call a system a smart assistant. Context-awareness can be obtained by using different kinds of techniques for piecing together information from different sources and prior actions. This means that the SPA can combine new and prior information from different sources to understand the context in which the user needs help in. Context-aware SPAs can react and detect changes in context and offer information and services relevant to the specific task of the user. The level of context-awareness varies between current SPA

implementations, but it is expected to rise as SPAs advance (Abowd et al., 1999; Knote et al., 2019; Mihale-Wilson et al., 2017.)

Self-evolution refers to the SPAs' ability to react and learn from unexpected situations (Knote et al., 2018a). Russell and Norvig (2003) describe a learning system that is able to flexibly adapt to unknown contextual information and change its behavior accordingly based on the critic it gets. This kind of a learning system makes the information technology using it more flexible and automated. Learning allows the system to operate in never-seen environments and to become more competent than it was prior to it started learning. (Russell & Norvig, 2003.) However, Knote et al. (2018a) point out that the self-evolution of current SPA implementations varies heavily. Some SPAs only utilize a set of 'if-then rules' in their interaction, and some use a goal-based model to end up in the desired outcome. These kinds of SPAs are mainly capable of learning through the development of the models and rules responsible for the actions of the assistants. Some modern SPAs also include more advanced learning architectures capable of utilizing techniques like deep learning to learn more effectively from user input over time. (Knote et al., 2018a.) These modern SPAs, like Amazon's Alexa, have become closer to the automated learning system described by Russell and Norwig (2003). Overall, most modern SPAs are capable of self-evolution and learning to some degree, depending on their design and architecture. The better the self-evolution mechanism of the SPA, the better the SPA can usually provide assistance to its users and adapt to changing circumstances. (Knote, 2019.)

Anthropomorphism refers to attaching human-like physical or non-physical features, emotions, behavior, characteristics, and attributes to a non-human object (Epley et al., 2007). Anthropomorphism is important for SPAs because humans are more likely to form a trusting connection with SPA technologies if they include well-made and trustworthy anthropomorphic features (Touré-Tillery & McGill, 2015; Mourey et al., 2017). These features allow users to connect more easily with their SPAs by providing a more familiar human-like feeling with the assistant (Pfeuffer, Benlian, Gimpel & Hinz, 2019). Anthropomorphic design features are usually embedded in the design of SPAs. Anthropomorphic design features on the hardware level can be, for instance, human-like shaping of the device. On the software level, anthropomorphic features can include facial expressions on the display or human-like voice and dialogue of the assistant. (Benlian et al., 2019.) However, anthropomorphic features can also cause issues because of users forming unrealistic expectations towards the SPAs they are using. This can create challenges with balancing between realistic expectations of the users and the functionality of the assistant. Overall anthropomorphic design features are an important part of SPAs that improve the interaction between the user and the assistant, and they have also been found to mitigate the intrusive negative effects of SPAs. (Knote et al., 2018a; Benlian et al., 2019.)

Multimodality refers to the ability of an SPA to receive inputs and/or send outputs in more than one way. This is not a necessity of an SPA, but some mod-

ern SPAs follow this principle by combining multiple ways of communication. (Luger & Sellen, 2016.) Different ways of communication, such as facial expressions, gestures, and vocal and textual communication, are referred to as communication modes (Knote et al., 2019). Multimodality can be implemented either unidirectionally or multi-directionally. In a unidirectional implementation, either the user can give inputs to the SPA in more than one way (user to system), or the SPA can give outputs to the user in multiple ways (system to user). In the multidirectional implementation, both inputs and outputs can be done in both ways (bidirectional interaction). (Knote et al., 2018a; Knote et al., 2019.) It is also important to note that multimodality is connected to anthropomorphism and context-awareness. For example, if an SPA decides to respond to a user with a smile, it needs the anthropomorphic feature to respond with a smile and preferably context-awareness to know if responding with a smile is appropriate in that specific context. (Ochs, Pelachaud & Mckeown, 2017; Knote et al., 2018b; Benlian et al., 2019.)

Platform integrations have been noted as an important part of building a successful SPA. The lack of integration support with other ecosystems has been found to increase customer frustration. (Knote et al., 2018a; Cowan et al., 2017.) Especially with strict ecosystem borders, like with Apple's Siri, users have been found to wish for better integration with third-party apps and skills (Cowan et al., 2017). Rich ecosystem support allows users to customize their SPAs and gives them more ways to take advantage of their SPAs (Fernando et al., 2016).

3.5 Benefits and challenges

Albeit the idea behind SPAs is to make their users' lives easier and more effortless, literature has also noted multiple possible challenges and problems concerning the use of SPAs. This section is first going to go over the benefits of SPAs and, after that, discuss the challenges and problems with current SPA implementations.

3.5.1 Benefits of SPAs

The main benefits of SPAs can be divided into two groups which are utilitarian benefits and social benefits. Utilitarian benefits refer to the usefulness and convenience that SPAs provide to the user (McLean & Osei-Frimpong, 2019). One of the utilitarian benefits of SPAs is that they can increase common task productivity. Common task productivity usually refers to free time or work-related tasks, which in the case of SPAs can be for example information seeking, weather checking, making reservations or booking meetings, and controlling other smart home devices (Han & Yang, 2018; Bentley et al., 2018; Luger & Sellen, 2016; Canbeck & Mutlu, 2016). The benefits in common task productivity are usually related to the user's experience that the assistant can do the job fast-

er or better than the user themselves. SPA working on the task can also leave the user free to do something else, leading to more efficient multitasking, increasing overall productivity (Luger & Sellen, 2016). In terms of productivity, users have also been found to value the hands-free operation found in some voice-controlled SPAs. Hand-free operation enables users to further enhance their multitasking and use their devices, such as smartphones or work-related software, even if their hands are engaged with something else (McLean & Osei-Frimpong, 2019; Luger & Sellen, 2016).

Research has also focused on the utilitarian benefits of SPAs in organizational environments. When used efficiently, SPAs have been found to reduce transaction costs, increase organizational efficiency, enhance task management, and improve multitasking (Budzinski et al., 2019; Myers et al., 2007; Luger & Sellen, 2016). SPAs can increase the performance and efficiency of organizations by reducing the task and information overload experienced by employees, reducing the costs related to information seeking and decision making, improving customer service, and increasing sales (Budzinski et al., 2019; Go & Sundar, 2019; Myers et al., 2007; Touré-Tillery & McGill, 2015). SPAs have also been found to enhance workgroup performance by improving the group's collaboration quality and task outcome. Groups using SPAs can have more vivid conversations, and they are more focused on solving the task and achieving the desired goal. (Winkler et al., 2019a; Winkler et al., 2019b.) Customized SPA solutions are used in contexts like healthcare and learning to provide contexts-specific utilitarian benefits for their users, such as smart-home enabled healthcare and enhanced distance learning (Fernando et al., 2016; Bennett et al., 2017; Winkler et al., 2019a; Canbeck & Mutlu, 2016).

Social benefits refer to the feeling of social belonging and social attractiveness that users might feel when interacting with an entity with anthropomorphic features, like an SPA (McLean, & Osei-Frimpong, 2018). SPAs are sometimes used as conversational agents to keep company, do small talk, and entertain users, which can make the user form a socially attached relationship with the SPA (Knote et al., 2019; Bentley et al., 2018; Luger & Sellen, 2016). Socially attachable and trustable SPAs have been found to have the ability to fight the effects of social exclusion, mitigate the negative effects of technostress caused by SPAs, and make the conversations with the SPA more convincing and human-like (Cowan et al., 2017; Benlian et al., 2019; Mourey et al., 2017; Han & Yang, 2018; Touré-Tillery & McGill, 2015). The social attraction between the user and the SPA can also increase overall user satisfaction and commitment (Han & Yang, 2018).

Research has also speculated on two other groups of benefits which are hedonic benefits and symbolic benefits. However, hedonic benefits, which are related to the enjoyment and entertainment of SPAs, have not been found to be a major contributor to the overall use and acceptance of SPAs, at least as of now. (McLean & Osei-Frimpong, 2019; Luger & Sellen, 2016.) Few studies have researched the possible hedonic benefits of SPAs, and one of these benefits discovered is joy and entertainment gained from playful interactions with SPAs.

These playful interactions can include finding hidden special features of SPAs and having joking conversations with SPAs. However, according to current research, using SPAs for playful conversations lessens the accepted margin of error of the SPAs, and the amusement of playing with the SPAs can fade fairly quickly. (Luger & Sellen, 2016.) It is also important to note that SPAs are constantly evolving, and hedonic features may become more important and better executed in the future. Symbolic benefits refer to users gaining symbolic rewards by using SPAs such as enhancing their social status or self-image. Symbolic benefits have been found to be possible benefits of SPA use and adaption. However, more research is needed to clarify further the magnitude of symbolic benefits and their effect on SPA use. (McLean & Osei-Frimpong, 2019.) A summary of the SPA benefits presented in this chapter is found below in table 6.

TABLE 6 Benefits of SPAs

Benefits Group	**Benefit**	**Sources**
Utilitarian benefits	Common task productivity	Han & Yang, 2018; Bentley et al., 2018; Luger & Sellen, 2016; Canbeck & Mutlu, 2016.
	Hands-free operation and multitasking	McLean & Osei-Frimpong, 2019; Luger & Sellen, 2016.
	Organizational benefits	Budzinski et al., 2019; Myers et al., 2007; Go & Sundar, 2019; Luger & Sellen, 2016.
	Group performance	Winkler et al., 2019a; Winkler et al., 2019b.
	Context-specific benefits in healthcare and learning	Fernando et al., 2016; Bennett et al., 2017; Pradhan et al., 2018; Johansson et., 2013; Winkler et al., 2019a; Canbeck & Mutlu, 2016.
Social benefits	Fights social exclusion	Mourey et al., 2017.
	Technostress mitigation	Benlian et al., 2019.
	Human-like trustable relationship	Touré-Tillery & McGill, 2015; Han & Yang, 2018.
	Overall user satisfaction and continuance of use	Han & Yang, 2018.
Hedonic benefits	Joy	Luger & Sellen, 2016.
Symbolic benefits	Social status, self-image	McLean & Osei-Frimpong, 2019.

3.5.2 Challenges and problems of SPAs

The biggest and most researched challenge of current SPA implementations is privacy. SPAs rely heavily on collecting and processing sensitive data to operate and perform the assistive functions they are intended to do (Liao, Vitak, Kumar, Zimmer & Kritikos, 2019). SPAs are usually also operating in an open and noisy environment, making it difficult to build a fail-proof authentication mechanism to prevent unauthorized access for the device (Zhang et al., 2019). Research concerning the security and privacy of SPAs can be grouped into two distinct lines of research: research focusing on technical attacks and research focusing on human factors of security and privacy (Abdi, Ramokapane & Such, 2019).

Technical security refers to the SPA's ability to protect itself against malicious attacks and protect its users' private information (Abdi et al., 2019). One of the possible technical vulnerabilities of SPAs are malicious third-party skills that can be installed on some SPAs. These malicious third-party skills can steal sensitive information and gain unauthorized access to other skills installed on the device. Access to sensitive information can be obtained by impersonating another skill, thus getting the authentication needed to access the user's sensitive information. If the SPA is a physical device, the malicious skill can, in some situations, also gain control of the entire device. (Zhang et al., 2019.) Another technical way of purging the security of an SPA is to impersonate the user of the SPA and gain access to all the data stored on the device (Abdi et al., 2019). These authentication attacks are hard to prevent unless better authentication methods, like continuous voice authentication, can be implemented (Feng, Fawaz & Shin, 2017).

Research on human factors of security and privacy is focused on people's attitudes towards the perceived security of SPAs (Abdi et al., 2019). According to Mihale-Wilson et al. (2017), privacy concerns and mistrust towards SPAs are currently major factors for not buying an SPA among potential users. Active users are also concerned about their sensitive information, and not trusting the privacy features of an SPA can affect the overall user satisfaction and experience of SPAs (Abdi et al., 2019; Cowan et al., 2017; Liao et al., 2019). Users can, in some instances, even avoid certain tasks and turn off their devices in fear of privacy concerns (Liao et al., 2019). Privacy concerns and intrusive features of SPAs have also been identified as a cause for technostress among users (Benlian et al., 2019).

Overall, the challenges presented concerning the privacy of SPAs have resulted in the so-called personalization-privacy paradox. In the context of SPAs, the personalization-privacy paradox refers to the SPAs' need for personal data to offer services and information to the user at the expense of privacy (Knote, 2019). This creates a challenge for the development of SPAs if users who value

privacy are not willing to be profiled, which is essential for the functionality of SPAs (Karwatzki, Dytynko, Trenz & Veit, 2017). There have been possible solutions proposed to solve this problem, such as different user profiles. However, at least as of now, the main solution is still the user's readiness to give up privacy to achieve functionality. (Knote, 2019.)

The second major group of challenges with SPAs can be grouped into usability-related challenges. One of the usability challenges with current SPA implementations is the consistency of input recognition (Cowan et al., 2017; Han & Yang, 2018; Luger & Sellen, 2016). SPAs have been found to have trouble with recognizing and responding to user requests which can affect the user experience of SPAs (Han & Yang, 2018). Considering voice-based SPAs, issues have also been identified with users that use non-native accents, which creates a situation where users have to change the way they speak to maximize the potential of their SPAs (Cowan et al., 2017). Inconsistent and faulty speech recognition can also increase the effort users have to put into learning to use their SPAs. Studies have found that, when learning to use SPAs, users might change their sentence formation and word choices to make their SPA understand what they are trying to convey (Luger & Sellen, 2016). This makes the user experience more unnatural, which may affect the social relationship and trust between the user and the SPA (Touré-Tillery & McGill, 2015). The second usability-related challenge is the issue of trust towards the SPA to perform tasks given to it. The more inaccurate the SPA is in performing the task, the less the user trusts their SPA. As a result, users have been found to not trust their SPAs on tasks like setting alarms and writing emails which can affect the overall user satisfaction and perceived usefulness of the SPAs. (Cowan et al., 2017; Zierau et al., 2020; Luger & Sellen, 2016.) Lack of trust can also affect the user's confidence in the SPA's self-evolution and its ability to learn new operation models (Luger & Sellen, 2016). To improve the usability of SPAs, Milhorat et al. (2014) noted four technical challenges that could improve the overall user experience of SPAs. These four technical challenges are extended dialog history, improved context-awareness, dynamic system adaptation, and supported task hierarchy design. These technological improvements aim to improve the self-evolution and context awareness of SPAs to increase their intelligence, precision, and functionality. (Milhorat et al., 2014.) A summary of all the SPA challenges presented in this section can be found below in table 7.

TABLE 7 Challenges of SPAs

Challenge group	Challenge	Sources
Security-related challenges	Technical challenges: - Malicious skills - Authentication attacks	Abdi et al., 2019; Zhang et al., 2019; Feng et al., 2017.
	Human factors of security and privacy: - Security concerns - Avoidance of use - Technostress caused by privacy concerns	Abdi et al., 2019; Cowan et al., 2017; Liao et al., 2019; Benlian et al., 2019; Mihale-Wilson et al., 2017.
	Personalization-privacy paradox	Knote, 2019; Karwatzki et al., 2017.
Usability-related challenges	Speech recognition Difficulty of use Unnatural conversation Trust issues with task performance	Cowan et al., 2017; Han & Yang, 2018; Luger & Sellen, 2016; Touré-Tillery & McGill, 2015; Zierau et al., 2020.
	Technical challenges related to the usability of SPAs: - Context-awareness - Dialog history - System adaptation - Task hierarchy	Milhorat et al., 2014.

3.6 The connection between SPA use and technostress

This study is focused on the connection between work-based SPA use and its impact on technostress. As noted earlier, previous research has shown that SPAs have been proven useful for organizations in, for example, performing customer service, cutting costs, and improving productivity (Budzinski et al., 2019; Go & Sundar, 2019; Myers et al., 2007; Touré-Tillery & McGill, 2015). Even though these benefits have increased the use of SPAs in organizations, little research exists considering how SPA use affects individual employees. As pointed out in the previous sections, users have been found to experience frustration and lack of privacy when using SPAs due to lack of trust and unexpected behavior of SPAs (Liao et al., 2019; Han & Yang, 2018; Cowan et al., 2017; Luger & Sellen, 2016). These findings could imply that users experience some form of negative experiences or stress if the SPA does not perform as expected. SPA research has also found challenges related to the usability features like dialogue, reliability, and accuracy of SPAs (Cowan et al., 2017; Zierau et al., 2020; Luger & Sellen, 2016). These challenges have been found to negatively affect the user experience and satisfaction of SPA users. Users have also ended up not trusting

SPAs with tasks because they do not trust the SPA to perform them. (Cowan et al., 2017; Zierau et al., 2020; Luger & Sellen, 2016.) These challenges and problems have also been connected to, for example, lacking context-awareness, anthropomorphic features, and platform integration (Milhorat et al., 2014; Cowan et al., 2017; Knote et al., 2018a; Knote et al., 2019).

Even though SPA research has not directly examined the connection between technostress and SPA use, findings such as usability issues and lack of trust could indicate a possible connection between SPA use and technostress creators such as techno-complexity and techno-uncertainty (Ragu-Nathan et al., 2008; Tarafdar et al., 2011; Fischer & Riedl, 2017). A study by Benlian et al. (2019) also found a connection between intrusive technology features of SPAs and technostress experienced by users. Next, this study will focus on the empirical research conducted to provide insights into how technostress emerges in the context of work-based use of SPAs by examining the possible technostress creators and outcomes. Possible links of the SPA design principles of and technostress creators are also considered to better understand the effects of SPA-specific features on individual users.

4 RESEARCH METHODS

This study was conducted utilizing qualitative research methods. Qualitative research aims to approach and understand the topic of research from the participant's point of view (Hennink, Hutter & Bailey, 2020). Understanding the experiences, circumstances, and situations of those who participate in the research allows the participants to get their voices heard, which allows for a multiplicity of findings to emerge during the research (Hesse-Biber & Leavy, 2011). Qualitative research methods are often best used when researching topics of which little to no prior information is available (Dark, Shanks & Broadbent, 1998). Overall, qualitative research methods help with understanding different phenomena in the real-life contexts that they occur in (Hesse-Biber & Leavy, 2011). This study aimed to examine the connection between technostress and the use of SPAs in the context of work. The purpose of this study fits well with the basic principles of qualitative research described above. Stress is a highly subjective experience, and understanding the experiences of individuals is crucial to understand how technostress emerges in the context of SPA use. There is also little prior research available on the topic of technostress related to SPA use. Qualitative research methods have also been found suitable for gaining a context-specific understanding of how information technology use affects users in real-life situations (Venkatesh et al., 2013; Salo et al., 2019).

This chapter describes in detail the progression of the empirical research and the research methods used in this study. The first section of this chapter will look at the data collection and introduce the semi-structured interview used as the main method for data collection. The second section will describe the data analysis and how it was conducted. The third section will evaluate and describe factors affecting the quality and credibility of this study.

4.1 Data collection

Qualitative research has three main approaches for data collection: interviews, observation, and different kinds of written documents (Patton, 2002). Interviews were picked as the method for data collection in this particular study as they have been deemed useful in understanding human behavior and generating knowledge about unmapped research areas (Berg, 2004). Interviews have also been proven useful in gathering actual real-life technostress experiences to provide rich insights about uncovered topics related to information technology use and technostress (Klein & Myers, 1999; Venkatesh et al., 2013; Salo et al., 2019; Salo et al., 2021). More specifically, this study utilized semi-structured interviews in its data collection. Semi-structured interviews are a form of an interview in which the main themes for the interviews are predetermined. However, they still leave room for improvisation and other themes to emerge during the interviews (Myers & Newman, 2007). This flexibility allows a deep dive into the interview topics, which helps in understanding the actual real-life experiences of the interviewees (DiCicco-Bloom & Crabtree, 2006). The predetermined themes of technostress and SPA interaction allowed the interviewees to provide detailed descriptions of their technostress experiences during SPA use. At the same time, the freedomness provided by the semi-structured interview allowed the interviewees to get their voices heard and raise important issues outside of the main themes as well.

The main themes of the interviews were based on the key themes identified in both technostress and SPA research. The first theme focused on the general SPA use of the interviewees. The purpose of this theme was to gain a general understanding of what kind of SPA technologies the interviewees used in their work and how they used them. The second theme focused on the negative and stressful experiences of SPA use. The purpose of this theme was to gain an in-depth understanding of the negative and stressful experiences with using SPAs and how technostress emerges during SPA use. This theme also included sub-themes to examine the possible technostress creators and outcomes of SPA use. The third theme focused on the SPA principles introduced by Knote et al. (2018a). The purpose of this theme was to gain an understanding of how the SPA principles affect the emergence of technostress during SPA use. These themes were used to ensure that all the relevant themes of the study were acknowledged during all of the interviews. However, as mentioned earlier, the semi-structured interview is a flexible data collection method that requires improvisation and openness. Thus, these themes were not allowed to impact the flow of the interview. (Myers & Newman, 2007.) In practice, this meant that the main themes were addressed at different points between interviews depending on the output of the interviewee and the flow of the conversation.

Data collection started by recruiting potential interviewees to participate in the study using purposeful sampling. The idea of purposeful sampling is to select "information-rich cases from which one can learn a great deal about is-

sues of central importance to the purpose of the research" (Patton, 2002, p. 46). In the context of this study, purposeful sampling was utilized to gain a rich and detailed understanding of the connection between technostress and work-based SPA use. Prescreening was utilized to gather information about potential interviewees and their experiences with using SPAs at work. Prescreening was done via email, and the selection of interviewees was made based on their answers. Two conditions were set when picking potential interviewees: 1. The potential interviewee had to have used and interacted with SPAs regularly in their work. 2. The potential interviewee had to have had negative and stressful experiences when interacting and using SPAs in their work. The first condition was set to ensure that the interviewees had a decent amount of experience with using SPAs and that SPAs were relevant technologies in their work. The second condition was set to ensure that rich and detailed knowledge of the connection between technostress and SPA use could be gathered. Interviewees were recruited from multiple organizations and different levels of the organizational hierarchy. This was done to represent various voices in the data by interviewing individuals with different organizational statuses and SPA technologies that they used (Myers & Newman, 2007). Snowballing was also used to interview different individuals in the same organization to increase the diversity of the data.

In total, twenty interviews were conducted between 05.02.2021 and 31.03.2021. The interviews were conducted using online video communication platforms Zoom and Teams. The first three interviews were conducted with two interviewers (the researcher and the supervisor), and the remaining seventeen were conducted solely by the researcher. All of the interviews followed the same basic structure. First, the interviewer introduced themselves and provided basic information about the study and how the data gathered during the study would be utilized. The interviewee was also reminded about the voluntariness and anonymity of participating in the study. Second, the interviewer asked the interviewee to fill a preliminary information form that included the background information of the interviewee. The form included background information about gender, age, education, work experience, nationality, the interviewees' perceptions of their skills in using technology, and the role of technology in their work. Third, the semi-structured interview was conducted by going through the main themes of the interview following the guidelines for qualitative interviewing presented by Myers and Newman (2007). Fourth, to conclude the interview, the interviewer asked if there was anything that the interviewee would like to add to the topics that came up during the interviews. The length of the interviews varied between 36 and 63 minutes, with an average length of 45 minutes.

All of the interviewees were Finnish and worked in an organization located in Finland. Nine of the interviewees were male, and eleven were female. The age of the interviewees ranged between 26 to 55 years, with an average age of 36 years old. Two interviewees had a high school education, and eighteen had a higher education, being graduated from either a university or a university of applied sciences. The reported previous work experience of the interviewees

varied between 5 to 35 years. Out of this total work experience, the interviewees had worked with SPA technologies for six months to over three years. The interviewees used SPAs in their work for performing job-related tasks and testing SPAs used in their organization. Most of the interviewees were also in some way involved with the development of the SPA that they used and tested. If the interviewee's work was focused on the development of the SPA, the focus of the interview was kept on the use and interaction related to, for example, the test use of the SPA. A more detailed description of the SPA technologies used by the interviewees and how they used them is presented in section 5.1. Nineteen of the interviewees described their skills in using technology as 'good' or 'very good'. Only one of the interviewees described their technology use skills as 'average'. Eighteen of the interviewees described the role of technology in their work to be either 'big' or 'very big'. Two of the interviewees described the role of technology as 'moderate'. All the results of the preliminary information form filled by the interviewees are presented below in table 8.

TABLE 8 Summary of background information of the interviewees

Age	**Gender**	**Education**	**WE***	**Perceived skills in using technology**	**Role of technology in work**
32	Male	Higher education	7	Very good	Big
26	Male	Higher education	4	Very good	Very big
38	Female	Higher education	16	Average	Big
31	Male	Higher education	6	Good	Very big
40	Male	High school	20	Very good	Very big
42	Male	Higher education	17	Good	Big
44	Male	Higher education	20	Good	Big
52	Female	Higher education	25	Good	Very big
35	Male	Higher education	12	Very good	Very big
49	Female	Higher education	25	Good	Moderate
32	Female	Higher education	10	Very good	Very big
29	Female	Higher education	8	Good	Very big
28	Female	Higher education	5	Good	Very big
28	Female	High school	10	Good	Very big
27	Female	Higher education	9	Very good	Very big
55	Female	Higher education	33	Good	Big
31	Male	Higher education	7	Good	Moderate
34	Female	Higher education	14	Good	Big
38	Female	Higher education	15	Good	Very big
32	Male	Higher education	7	Very good	Very big

* WE = Work Experience in years

4.2 Data analysis

The purpose of qualitative data analysis is to transform data into findings. There is no universal way to conduct qualitative data analysis, but there are guidelines and well-established practices to aid with the task. (Patton, 2002.) In qualitative analysis, the researcher and the researcher's interpretations play an important role in the formation of the results (Klein & Myers, 1999). Thus, it is essential that the researcher reports the procedures they used to clarify how the results were achieved (Patton, 2002).

There is no distinct line between the end of data collection and the beginning of data analysis in qualitative research. The preliminary stage of the analysis starts during the interviews as the researcher makes interpretations of what the interviewees said and thinks about possible themes and patterns based on the interviewees' responses. (Patton, 2002.) During this study, these interpretations were made by, for example, summarizing and mirroring what the interviewees said and asking subsequent questions. These techniques were used to ensure that the interviewer had understood what the interviewees were trying to convey. (Myers & Newman, 2007.) Analysis was also conducted during the interviews by making notes about possible themes and patterns. The interviews were transcribed into written text by a third party, and thus no preliminary analysis was done by the researcher during the transcription phase.

Content analysis was used as the approach for data analysis in this study. Content analysis describes the sense-making effort of qualitative data, such as written documents or transcriptions of verbal documents, to identify the meaning of the dataset (Patton, 2002). The main phases of the analysis of this study followed the stages of content analysis presented by Berg (2004). These phases included reading through the transcriptions and establishing main data categories, establishing data-driven subcategories, coding all the relevant data into their respective categories, searching for patterns and relationships, and relating the findings to prior research (Berg, 2004). NVivo software was used during the analysis process in labeling the established categories, coding the data into their respective categories, and finding patterns and relationships between findings.

In the first phase of the analysis, the transcriptions were read through thoroughly, and four main data categories were identified. These categories were labeled as interviewees' connection with SPAs, technostress creators, SPA principles, and technostress outcomes. These main data categories closely followed the main themes of the semi-structured interviews discussed earlier. Data was coded into each of these categories by searching for themes related to each of the categories. For example, themes clearly causing stress and negative experiences for the interviewees were coded as technostress creators:

> (SPA keeps reminding) record the hours, record the hours, so I can understand that if you are having a busy day that it can make you feel stressed. (Later coded under the subcategory "interruptions" caused by disturbing notifications)

As another example, themes clearly describing outcomes of stressful situations were coded as technostress outcomes:

> If motivation starts to run out and you'll get frustrated, it will show in the quality of your work. (Later coded under the subcategory "job-related outcomes" causing decreased work motivation and decreased work quality)

In the second phase of the analysis, the main data categories identified in the first phase were divided into smaller subcategories. This was done by reading through all the codes related to each of the main data categories established in the first phase and further identifying more specific themes present in the data. Some of the subcategories included similar findings to prior research, and some were identified mainly based on the findings in the data. For example, the category of technostress creators was divided into nine subcategories. Some of the categories, such as techno-overload and techno-complexity, included similar findings to prior research and were labeled accordingly (Tarafdar et al., 2007; Ragu-Nathan et al., 2008; Tarafdar et al., 2011; Fischer & Riedl, 2017). For example, findings including multitasking were coded as techno-overload according to the findings of prior technostress research:

> That's kind of the problem that most of the times the assistant is in the bottom right corner (of the screen) and you should also do things which are in the bar on the left side (of the screen). And at some point, you forget to do those both and you'll get frustrated. (Coded under "techno-overload" caused by multitasking)

Findings that were not identified as their own categories in prior research were coded into new subcategories and labeled to describe the content of the findings. For example, in the category of technostress creators, these new subcategories were communication challenges and unrealistic expectations. As an example, all findings that were related to stress caused by the communication between the user and the SPA were coded as communication challenges:

> I'll just write a three-word question or so (to the SPA) thinking that the bot knows how to answer it. And then if it doesn't, you'll get a bit frustrated. (Coded under "communication challenges" caused by SPA cannot provide an answer to the user or provides false information)

In the third and final phase of the analysis, close attention was paid to the relationships and patterns that occurred in the data. These relationships were identified between technostress creators and SPA principles, and technostress creators and technostress outcomes. With the relationship between the technostress creators and SPA principles, attention was paid to which of the SPA principles were related to each of the technostress creators based on the interviewees' descriptions. This was done by going through all the codes of technostress creators and identifying possible links to each SPA principle. For example, the SPA principle of anthropomorphism was linked to the technostress creator of communication challenges through unnatural dialogue:

> I've seen those kinds of (SPAs) that there were just GIFs planted all over, and the bot just keeps responding "yay that's nice!" and you'll just think that this is a very annoying this bot. (Coded under "communication challenges" caused by unnatural dialogue related to "anthropomorphism")

With the relationships between technostress creators and technostress outcomes, attention was paid to which of the technostress creators triggered or were related to each of the technostress outcomes. The relationships were looked for by going through all the codes of technostress outcomes, identifying the context of the outcome, and its link to the technostress creators. For example, wellbeing-related technostress outcomes were found to be related to techno-uncertainty through sleeping problems caused by SPA changes:

> You might in the evening, and also at night, have dreams of what was happening with it (the SPA change) … Like there are sometimes and still are those sleepless nights because of it (the SPA change). (Coded under "wellbeing-related outcomes" causing sleep problems related to "techno-uncertainty")

Through the results of the analysis, it was possible to find new elements and link the context of technostress caused by SPA use into the prior technostress and SPA research. Table 9 describes and summarizes the progress of each phase of the analysis and how the identified categories were linked to prior research.

TABLE 9 Summary of the analysis and its phases

Phase 1: **Main data categories** were identified	**Phase 2:** **Subcategories** were identified and labeled by reflecting prior research to the findings	**Phase 3:** **Relationships and patterns** between different categories were identified
Interviewees' connection with SPAs	Closer connection with SPAs compared to other information technologies (Based mainly on data and prior literature e.g., Pfeuffer et al., 2019) No closer connection with SPAs compared to other information technologies (Based mainly on data and prior literature e.g. Pfeuffer et al., 2019)	
SPA principles (Main category and subcategories mainly based on Knote et al., 2018a)	Anthropomorphism Context-awareness Platform integration Self-evolution Multimodality	All of the principles, except multimodality, were related to technostress creators (described below)
Technostress creators	Communication challenges (Based mainly on data and prior literature e.g., Cowan et al., 2017)	Related to context-awareness, self-evolution, and anthropomorphism

(continues)

Table 9 continues

	Unrealistic expectations (Based mainly on data and prior literature e.g., Knote et al., 2018a)	Related to context-awareness, self-evolution, and anthropomorphism
	Technical challenges (Based mainly on data and prior literature e.g., Fischer et al., 2019)	Related to platform integration
	Techno-complexity (Based on e.g., Tarafdar et al., 2007)	Related to platform integration
	Interruptions (Based on e.g., Galluch et al., 2015)	Related to anthropomorphism
	Techno-overload (Based on e.g., Ragu-Nathan et al., 2008)	Related to platform integration
	Techno-uncertainty (Based on e.g Tarafdar et al., 2011)	Related to platform integration and self-evolution
	Distrust in SPA performance (Based mainly on data and prior literature e.g., Luger & Sellen, 2016)	
	Information security and privacy (Based on e.g., Benlian et al., 2019)	Related to platform integration
Technostress Outcomes	Wellbeing-related outcomes (Based on Tarafdar et al., 2019)	Related to unrealistic expectations technical challenges techno-overload, and techno-uncertainty
	Information technology use-related outcomes (Based on Tarafdar et al., 2019)	Related to technical challenges, and interruptions
	Job-related outcomes (Based on Tarafdar et al., 2019)	Related to communication challenges, techno-complexity, and interruptions
	Physiological outcomes (Based on Tarafdar et al., 2019)	Related to techno-uncertainty
	Emotional outbursts (Based mainly on data and prior literature e.g., D'Arcy et al., 2014b)	Related to communication challenges, unrealistic expectations, technical challenges techno-complexity, interruptions, techno-overload, and techno-uncertainty

4.3 Evaluating the quality and credibility of the study

This section describes how the quality and credibility of the research were taken into account in this study. Evaluating and ensuring the credibility of a qualitative study can be troublesome. The flexibility and room for different interpretations provided by qualitative methods can danger the credibility of qualitative studies. (Patton, 2002.) Thus, close attention was paid to the choices made during the research process to critically evaluate and improve the quality and credibility of this study. During data collection, the guidelines introduced by Myers and Newman (2007) were used to ensure the quality and credibility of the semi-structured interviews used for data collection. The principles for qualitative research introduced by Klein and Myers (1999) were also followed to improve the quality of the study.

To evaluate the quality of qualitative research, the role of the researcher and how it affects the collection and analysis of data should always be considered (Myers & Newman, 2007; Patton, 2002; Darke, Shanks & Broadbent, 1998). In qualitative research, the researcher's beliefs, values, and assumptions have an effect on the study, and these should be acknowledged, accepted, and minimized (Darke et al., 1998). The effects of the researcher's possible biases were taken into account in this study by carefully evaluating the meaning of the message that the interviewees were trying to convey. The possibility for multiple interpretations of the same message and suspicion towards possible biases of the researcher were also acknowledged (Klein & Myers, 1999). In the case of this study, the researcher also conducted their very first qualitative interviews and analysis. This is important to note as the inexperience of the researcher can affect the credibility of the study (Patton, 2002). These shortcomings were mitigated by receiving guidance from the supervisor of this study and conducting extensive research towards qualitative research methods and research themes by the researcher.

During data collection, it is important to minimize anything that might cause the interviewee to feel uncomfortable during the interviewees. If the interviewees start to feel uncomfortable, it can affect the disclosure and credibility of the answers. (Myers & Newman, 2007.) During the interviews of this study, uncomfortable situations were aimed to be minimized by showing empathy to the interviewees, careful construction of questions, and composed reactions to the interviewees' answers. The researcher also applied the role of the interviewer to involve listening, encouraging, and directing the conversation as advised by Myers and Newman (2007) to increase credibility.

Triangulation was also used to improve the credibility of this study. Triangulation was considered during both data collection and analysis. During data collection, triangulation was achieved by representing various voices, as mentioned earlier in this chapter. Representing various voices in the interviewees improves the credibility and diversity of the findings (Myers & Newman, 2007). During data analysis, triangulation was utilized by confirming that a spe-

cific finding came up in multiple interviews by multiple interviewees. This strengthens the credibility of the findings by providing multiple sources of evidence (Darke et al., 1998).

An important factor for the study's credibility is to describe the progress of the study as accurately as possible to demonstrate the trail of evidence of the findings (Darke et al., 1998; Klein & Myers, 1999; Patton, 2002). This was done in the previous sections of this chapter which described the research process in detail and justified the selection of the research approach and methods used in this study.

5 RESULTS

This chapter will go through the results of the study. First, background information is given on the SPA technologies that the interviewees used and how the interviewees used them. This section will describe the types of SPAs, their level of intelligence and interaction, and SPA principles present in the technologies. Second, the interviewees' connection with the SPAs that they used is considered. Third, an overview is given on the technostress experienced by the interviewees. Fourth, the focus is switched towards the technostress creators identified in the data and how the principles of SPAs affected the technostress creators. Lastly, this chapter will examine the technostress outcomes experienced by the interviewees due to the technostress creators presented. The interview quotes presented in this chapter were translated from Finnish to English, and the names of the organizations and SPA technologies were removed. During translation, close attention was paid not to alter the original meaning of the quotes. This is important as loose translations might impact the original message delivered by the interviewees and the credibility of the study (Patton, 2002).

5.1 General information on SPAs used by the interviewees

On a general level, all the SPAs used by the interviewees were organization-specific assistants tailored to meet the needs of a specific organization. The majority of the interviewees described the SPAs they used as chatbot assistants. These chatbot assistants mainly operated on organizations' websites to provide customer service for external customers and answer frequently asked questions. Some external chatbot assistants also acted as conversational assistants that provided information and support for users, such as students and youth. The interviewees interacted with the external chatbot assistants as they were using, testing, and developing the technology. However, some external chatbot assistants were also used by internal users for tasks like information seeking. The

second group of SPAs was used inside the organization as internal personal assistants. These personal assistants were integrated with other information technologies used by the organization to help their employees with, for example, accomplishing routine tasks and information seeking. The interviewees called these solutions bots, or internal or intranet chatbots. The third group of technologies was what the interviewees described as software robots. These software robots were trained to perform a specific task in the background to help their users in their work and had a relatively low level of interaction.

The level of artificial intelligence and smart features varied between different SPA implementations. Some technologies had a high level of intelligence utilizing features such as neural networks, machine learning, natural language processing, and synonym libraries. On the other hand, some of the SPAs were built on a relatively low level of intelligence and mainly relied on predetermined conversation paths and natural language identification to guide the conversation between the user and the SPA. Overall, a relatively wide variety of different SPAs with varying levels of intelligence and interaction were present in the data.

All interviewees described their SPAs to include at least one of the principles of SPAs. The most common SPA principle present in the data was anthropomorphism. The majority of SPAs had features such as human-like dialogue, name, personality, and appearance in the form of pictures or icons. These anthropomorphic features enabled the SPAs to appear more relatable and human-like. Interviewees also felt like names and human-like dialogue, such as joke-telling and usage of everyday language, made the SPAs more approachable and personal.

The majority of the SPAs present in the data included platform integrations to both internal and external information systems. Internal platform integrations allowed SPAs to access information and SPAs to be used through other communication platforms and organizations' websites. Internal platform integrations were often essential for the SPA to operate as intended. Some SPAs were also integrated to external information systems. External platform integration allowed the SPAs to provide additional features, such as buying travel tickets and having access to a larger pool of information.

Overall, the level of context-awareness in the SPAs was relatively low. Most of the SPAs had low-level features related to context-awareness, such as, knowledge of time, anniversaries, and holidays. However, generally, the SPAs did not have high-level features like connecting information from a previous conversation to the next one or user profiles to allow more personal interaction.

The level of self-evolution varied significantly between different SPAs. The concept of learning was present in almost all SPAs, but the manual labor required for "teaching" the technology varied between the SPA implementations. This was due to some SPAs utilizing more sophisticated self-evolution features, such as machine- and automated learning, which increased the level of automation compared to the SPAs that did not have those features.

Multimodality was the least utilized SPA principle as almost all SPAs only utilized text-based communication. Text-based communication was implemented either using text, clickable buttons, or their combination. However, some SPAs used pictures, GIFs, or other forms of media to support their text-based communication. Few SPAs also had voice-based functionalities, but those were not often used due to the lack of functionality and features.

5.2 Interviewees' connection with the SPAs

One of the important aspects of the interaction between the user and the SPA is the connection that the user forms with their SPA technology. The formation of a closer connection has been found to be one of the key characteristics that separate SPAs from most traditional information technologies. Most of the interviewees said that they had formed in some way a closer connection with the SPA compared to other information technologies that they use frequently.

Most of the interviewees saw SPAs as more human-like entities compared to traditional information technologies. This was primarily due to the anthropomorphic features of SPAs, such as personality, name, and human-like dialogue. For example, two interviewees described human-like dialogue, name, and personality of the SPA as factors affecting the closer connection:

> Although we have named other systems, this (SPA) is maybe in a certain way the most humane of these systems. It talks with you and it's named quite adorably, it isn't just a number sequence or code that name but rather it's really named like a human.

> Sure, they are quite fun, we have made those kinds of personalities (to the SPAs) and they (SPAs) are personalized in a way that they are more fun to use. You can also ask them to tell jokes and so on.

Anthropomorphic features were seen as important from the perspective of interaction as they would bring the SPA closer to the user and make the communication between the user and the SPA seem more natural. One of the interviewees emphasized the importance of naming SPAs as it builds the personality of the SPA and makes it easier to commit the SPA as a part of the organization:

> I am also all up for that chatbot should always have a name. In my opinion it builds its personality and it is also related to committing (the SPA to the organization) so that it is not talked about just as a bot. Its (SPA's) name can be for example Bridget and it can be started to be referred to in internal discussions like "well this lead has come from Bridget" and it's funny to see this kind of phenomenon actually happening in companies.

Another factor affecting the formation of a closer connection with SPAs was the amount of time and effort the interviewees had put into using and developing the SPA solutions. The interviewees described seeing the SPA develop over

time as an important factor in the formation of the closer connection. For some interviewees, the formation of a closer connection with the SPA resulted in humanizing the technology, and as a result, SPAs were sometimes referred to as workmates, buddies, or children. One interviewee saw the SPA as a workmate as it works alongside them and frees time to do other tasks:

> Sure, we've used that kind of chatbot technology as a tool in work guidance and it's experienced that it becomes your workmate and that you can possibly free working hours for doing something else.

Some interviewees also playfully regarded the SPAs to be like their own children. This approach was mainly present with interviewees who had been using a specific SPA for an extended period of time and who had also been involved in the development of the SPA:

> Yeah so this whole *SPA name* is kind of my favorite child 'cause I've been involved with it from the beginning so you get to know it (SPA) quite well and thoroughly.

However, for some interviewees, the connection was formed early on, as described in the following quote:

> Yes it (closer connection) started pretty early on, at that point we were building momentum for this chatbot-customer service, and then of course I handled the project and produced a significant amount of content (for the SPA) and was also building the data model. Surely those hours spent affected that connection from the beginning as it became such a significant part of my work, so already at that point it (SPA) became kind of my favorite child.

In some cases, the SPA was perceived as part of the working community and its daily life. The SPA would be referred to as he or she inside the workplace, and conversations were had about how the SPA was doing as if it was an employee of the organization. One interviewee described the feelings towards the SPA at their workplace, and their colleagues regard the SPA as a human-like entity:

> Especially if it was on a kind of a test drive or something, people worried about how is *SPA name* doing, if everything is alright, like if it (SPA) knows how to operate there and so on. It (SPA) is related to as an autonomous human-like entity, like an employee basically.

Only four of the interviewees did not feel a closer connection with their SPAs. These interviewees mostly felt like the SPA was only a tool for accomplishing certain tasks and regarded the SPA as any other information system. The interviewees described the reasons for not forming a closer connection with the SPA to be the lack of intelligence of the SPA, detailed knowledge of how the SPA operates, and weak human-like interaction. The lack of intelligence was seen as a hurdle for forming a closer connection with the SPA as it was seen as just a simple technology with instructions given to it to answer in a specific way:

> Yeah it's more like a tool and like it's not yet close (to being human-like), it would be interesting to see if the artificial intelligence (of the SPA) would at some point become more like a colleague … But yeah it's just more like a system and acts as a tool in this job.

> Yeah it's just a machine and quite a simple one at that.

Detailed knowledge of the operation was seen to break the "underlying magic" behind SPAs. By detailed knowledge, the interviewees referred to knowledge about how the SPA operates on a technical level and knowledge of the communication models of the SPA. In practice, this meant that the interviewee knew how they should ask certain questions to get certain answers. For example, one interviewee said that it broke the human-like illusion for them as it removed the human-like aspect of the SPA:

> Well maybe 'cause we've built it (SPA) ourselves there will be no surprises (in the interaction) which kind of removes its humanity … And that's probably the point of human-likeness and artificial intelligence that you'll get answer that you wouldn't expect.

5.3 Overview of the technostress experiences

This section provides an overview of the technostress experiences that the interviewees had with using their SPAs. The purpose of this section is to convey a general view of how the interviewees described their negative experiences with work-related SPA use. This section also compares and highlights the differences between the positive and negative experiences of the interviewees.

Overall, all interviewees described they had at least some negative or stressful experiences when using SPAs. However, there were noticeable differences between interviewees in how often and how severe these experiences had been. Most of the interviewees described the stressful experiences caused by SPAs use to be short-lasting but relatively impactful. For example, one of the interviewees described the stressful experiences to occur momentarily:

> Well maybe those (stressful experiences) were momentary. You don't like feel stressed or have stressful experiences all the time but more like momentarily.

In contrast, some interviewees described longer-lasting stressful experiences that had more severe effects on their work and wellbeing. For example, one of the interviewees described a longer-lasting stressful period related to SPA use that almost caused them to resign from their job, and another said they did not want to continue using the SPA for a while after a more stressful time period:

> Last year between January and June I threatened three times to my boss that I'll resign (due to SPA complexity), that this ain't gonna work out.

> Maybe those longer-lasting frustrations are caused by individual things, that when during one week you get enough of those feelings that you want to beat your head against a wall, in the next week you don't even want to open the system.

Interviewees described stressful experiences by using words such as stressful, frustrating, and annoying. These negative feelings were present, for example, in situations in which the SPA did not operate as intended or could not provide assistance to their users. The interviewees also regarded SPAs as new and interesting technologies which also have many challenges related to them. Some of these challenges present in the data were the lack of intelligence of SPAs, information security, technical challenges, the complexity of SPAs, and difficulties in evaluating the usefulness of the SPA to the organization. These challenges also caused negative experiences and stress for the users. A more detailed look into the technostress creators and their outcomes is presented in the following sections.

The negative experiences of the interviewees also contrasted with the positive ones, which the interviewees also had plenty of. Compared to the negative experiences, the positive experiences were usually described as longer-lasting that accompanied users in their daily work lives. For example, one of the interviewees described their positive experiences with SPA use like this:

> Yeah it (positive feeling) is more of a long-lasting phenomenon, that when something starts to go right and you really get the ball rolling, everything just works really well for some time, and so on.

On the other hand, negative experiences were generally regarded as more impactful by the interviewees:

> I guess those negative ones are the most powerful. That when those occur, they momentarily overwhelm you and you'll get really irritated.

The positive experiences were caused by, for example, SPAs helping users in their daily work lives, satisfaction related to SPA use and development, and the excitement of working with a new information technology. The benefits that SPAs brought with them were described to be, for example, increased productivity, increased efficiency, social benefits for not feeling left alone with a task, and monetary benefits by decreasing costs. These positive experiences and benefits were brought up to remark that not all experiences with SPA use are negative. From here on, the study will focus, in detail, on the technostress creators, technostress outcomes, and challenges encountered due to the use of SPAs.

5.4 Technostress creators and SPA principles affecting them

Technostress creators are defined as factors in information technology use that cause technostress. This section will go through in detail all the technostress creators identified in the data. This section will also link the relevant SPA principles to each technostress creator based on the interviews and explain how they impacted each individual technostress creator. However, it is important to mention that the findings of which SPA principles were related to the technostress creators are specific to this data set and should not be generalized. If a specific technostress creator was not related to an SPA principle in this data set, it does not mean that it could not affect that technostress creator in other circumstances.

In total, nine technostress creators were identified in the data. Some of the creators, such as communication challenges and unrealistic expectations, were identified as new technostress creators closely related to the context-specific principles of SPAs. Some of the technostress creators, such as techno-overload and techno-complexity, were creators already present in the current technostress research. However, these creators were also found to be affected by the context-specific principles of SPAs. It is also important to point out that some of the technostress creators were closely connected with each other, and in some cases, it was not possible to create a strict division between stress caused by different creators. For example, interviewees described stress caused by the stressor 'technical challenges' to also cause 'techno-overload' due to increased workload.

5.4.1 Communication challenges

Sixteen of the interviewees reported negative and stressful experiences related to the communication with the SPA they use. These communication challenges were identified to be the simplicity of the communication, user not acknowledging that they are communicating with an SPA, and that the SPA cannot provide an answer to the user or provides false information during communication.

The simplicity of the dialogue was related to the naturality and attractivity of the communication that SPAs are able to provide. If the dialogue was seen as too simplistic or dull, some of the interviewees felt that as negative and irritating. Unnatural responses can hurt the authenticity of the interaction and make the dialogue seem simplistic, repetitive, and annoying. The following quote describes one of the interviewee's views of irritating interaction with SPAs:

> I've seen those kinds of (SPAs) that there were just GIFs planted all over, and the bot just keeps responding "yay that's nice!" and you'll just think that this is a very annoying this bot. … So everything should be within the limits of good taste.

The interviewees also pointed out that diversity during the dialogue with an SPA is important, but at the same time, achieving a satisfying level of diversity

can be troublesome. One of the reasons for this was deemed to be the lack of intelligence and self-evolution of the SPA to learn and provide fruitful and exciting conversations. The Finnish language was also brought up as an issue due to its several different ways of asking questions and abundant usage of dialects. Another reason was related to the context-awareness of an SPA. For example, if the SPA could not connect the answer to an already had conversation, it can result in the conversation to seem loose and inhuman. For example, one interviewee described the lack of intelligence and context-awareness and their effect on limiting the communication:

> So our bots don't have any artificial intelligence, but we have only automation. That (automation) is quite basic and straightforward, there is just one answer for each specific question, and it (SPA) cannot pay attention it (to the previous conversation).

The second stressful factor in the communication with SPAs were situations in which the user did not acknowledge that they were interacting with an SPA. This could happen especially with external chatbot assistants where a user can start a conversation with and SPA and think that they are talking to a human assistant instead. This created stress for the interviewees because they had to constantly think about how to make the communication with the SPA seem natural, but at the same time not to mislead users into thinking that they are interacting with a human assistant. This created stress and challenges related to the design of anthropomorphic features in SPAs. For example, one interviewee expressed the frustration that these misunderstandings can cause, and another elaborated on the difficulties posed by the challenges:

> Yeah that's kind of the thing that the customer doesn't necessarily understand that they are discussing with a robot and that's surely a bit frustrating.

> On the other hand, there are sometimes problems because people really think that they are talking with a human. And especially 'cause it has a name, *SPA name*, many think that they are talking with a man called *SPA name*… That surely is one thing that we're kind of constantly struggling with, that how we can make it (SPA) human-like but not too humane.

The third factor creating technostress in SPA-user communication was that the SPA could not answer or provided false information for the user. False information and the lack of response were deemed stressful as it was seen as essential that the SPA could provide correct information for the user. Interviewees also pointed out that false information can be a risk for the image of the organization, especially if the SPA was used by external users. This made some of the interviewees feel frustrated and anxious when the SPA could not provide the asked information. For example, one interviewee expressed their frustration as the SPA did not manage to answer a simple question:

> I'll just write a three-word question or so (to the SPA) thinking that the bot knows how to answer it. And then if it doesn't, you'll get a bit frustrated.

5.4.2 Unrealistic expectations

Ten of the interviewees mentioned negative and stressful experiences related to unrealistic expectations towards SPAs. These unrealistic expectations were related to people's thoughts and beliefs on what SPAs can do and how they operate. According to the interviewees, these expectations were set too high, and the SPAs were sometimes thought of as highly intelligent self-learning machines that could answer any question directed at them. These presumptions caused pressure, annoyance, and frustration among interviewees as they had to constantly manage and ease their own and other people's expectations. For example, one of the interviewees described their experiences with unrealistic expectations towards SPAs:

> So maybe those were the most stressful experiences when we expressed that there is artificial intelligence in the background and that we're making an artificially intelligent application that includes cloud computing and machine learning and some other great things. So customers, and of course the organization, have quite high hopes about artificial intelligence and they are clearly not aware of what it (artificial intelligence) really is and what is for example the difference between artificial intelligence and machine learning and so on, so their expectations are already very high from the start… That sometimes you have to intervene and crush their expectations and dreams a bit that machine learning requires a huge amount of data, and if it even is artificial intelligence that is a whole another debate.

Another reason for stress mentioned by one of the interviewees was that they felt like they could not affect or change the high expectations inside the organization:

> There are quite a lot of preconceptions and strong visions concerning SPAs. So it might sometimes be that the person who has no knowledge of the topic has such strong vision that it's hard to take interest in advice coming from a person who is more acquainted with the topic (SPA).

Unrealistic expectations were linked to the SPA principles of self-evolution, anthropomorphic features, and context-awareness. In some cases, the expectations for the self-evolution of SPAs were set too high, which frustrated some of the interviewees. The high expectations towards anthropomorphic features of SPAs showed in expectations towards the human-like dialogue capabilities of SPAs. This resulted in users asking complicated questions from the SPA and expected it to understand them and answer accordingly. Some users also expected the SPA to know the context of whom it was talking to and provide information for that specific user. For example, one of the interviewees expressed their frustration with unrealistic expectations towards the principles of SPAs like this:

> Customers can have that kind of perception that I'll just write here my social security number and my name and ask why I haven't received my pension. Well it's clear that the bot can't answer those kinds of questions. People sometimes have very wrong kind of perceptions of what these chats are capable of and they don't understand that

> it's a bot not a person… So it's kind of frustrating that the customer has higher expectations than we can achieve. Like we would of course want to help them as well as possible, but these things are so complicated and personal. People are in such different situations that we can't reach that kind of level of personal assistance that customers expect.

One of the interviewees also mentioned expectations to affect the techno-insecurity that the users felt towards SPAs. This insecurity was related to the SPAs' intelligence and evolution which led to fear of SPAs stealing the jobs of users:

> So people might think that you can make miracles with the (SPA) technology or that it will just come and steal our jobs. There might rise these kinds of fears towards that (technology).

5.4.3 Technical challenges

Eleven interviewees mentioned stress related to technical challenges, issues, or problems. Stress related to technical challenges was caused by both issues with the development platform of the SPA and the SPA itself being temporarily unavailable to use. Technical challenges with the development platform caused interruptions for some interviewees, which was seen as disturbing and frustrating. Some interviewees also felt that the development platform lacked functionality and features, which hindered their workflow. For example, one interviewee described the technical limitations of the development platform to be annoying and frustrating:

> Its (SPA feature) implementation isn't necessarily always possible on behalf of the system or it requires so much typing… And just, those are kind of frustrating situations when you have to change, for example, a link to all two hundred states. Just like why do I have to make the change separately to every state, and why can't I just write to that system that wherever this link is, it will change it to this new one. So those kinds of situations are the most annoying and the most challenging for me.

Technical challenges that made SPAs being temporarily unavailable to use were also seen as a cause for stress. These technical issues caused interruptions for the workflow of the interviewees and built pressure to get the SPA back online again. Often fixing the technical issues with the availability of the SPA was not in the hands of the interviewees, which made the situation frustrating and annoying. For example, one of the interviewees described situations like this hideous as all they could do is to report about the problem and then just wait for the issue to get fixed:

> Then there's sometimes these kinds of issues that the whole *SPA name* just doesn't work and every chat goes straight to our customer service which is a really big momentary problem for us. And those system failures are really hideous because you can't affect them in any way, and you just can't do anything else than just to send a message that "could you fix this asap" and then just wait for something to happen.

Technical challenges were connected to the SPA principle of platform integration. Platform integrations caused issues with both internal and external integrations to information systems and platforms. Interviewees told platform integrations could increase the number of technical challenges with SPAs which in some cases increased workload, causing overload, and increased the complexity of the SPA. For example, one of the interviewees described a troublesome integration that caused technical issues and interruptions:

> It (platfrom integration) has occasionally caused some problems since we implemented it and we've had some battles with it. It's just a bit too complicated and it should be made simpler. It causes those kinds of situations in which customers are left hanging in the chat when they try to move from the bot to customer service while the system is down. And it might cause confusing situations for the customer service as they cannot serve new customers and the system just goes into some kind of a loop.

5.4.4 Techno-complexity

Techno-complexity was found to be a relevant technostress creator in the context of SPA use. Nine of the interviewees described negative and stressful experiences caused by the complexity of SPAs. One of the reasons for experiencing techno-complexity was the learning process to understand the technological solutions of SPAs and how they are used. The interviewees needed this technological understanding in their interaction with SPAs, and the SPA technology and tools related to it were sometimes regarded as difficult to grasp. As a result, the learning process was sometimes seen as time-consuming and stressful. For example, one interviewee described their difficulties with dealing with the complexity of the SPA they used like this:

> In itself it's a big challenge that how can I handle the whole system environment where the bot is used and developed. It has taken a lot of time to understand how it really works… But it's also very frustrating and sometimes, actually several times, I've felt like I'd want to throw my laptop into the wall. There's just so many things to grasp on that sometimes you just don't know even know where to start and how could I divide this into smaller parts.

Difficulties with learning caused some of the interviewees to doubt their skills in using SPAs which also caused stress and frustration. One of the interviewees had even threatened to resign from their job due to the complexity of an SPA they used and developed:

> Well the coding involved (with SPAs) that's just Greek to me, like when you forget to add an additional node and it (SPA) does everything vice versa and you have to know how to test it in a million different ways using entities and all kinds of things. So I have to say that last year between January and June I threatened three times to my boss that I'll resign (due to SPA complexity), that this ain't gonna work out.

As mentioned earlier with technical difficulties, platform integrations were regarded to increase the complexity of the SPA in some cases. Platform integration was the only principle that was connected to techno-complexity during the interviews.

5.4.5 Techno-overload

Techno-overload refers to situations during information technology use that increase the users' workload, multitasking, and information overload. Five of the interviewees described stressful experiences related to techno-overload. One of the reasons for experiencing techno-overload was multitasking. SPAs were mentioned to increase multitasking if the interviewee was doing something else and managing the SPA simultaneously as described by one of the interviewees:

> That's kind of the problem that most of the times the assistant is in the bottom right corner (of the screen) and you should also do things which are in the bar on the left side (of the screen). And in some point you forget to do those both and you'll get frustrated.

Some interviewees also found SPAs to increase their workload. It came up as a surprise for a few interviewees of how much maintenance and constant updating the SPA needs. These updates increased the workload of the interviewees more than they had originally imagined. For example, one of the interviewees described the increased workload as a negative surprise:

> On the other hand, if I think about the technologies in my previous jobs when I was for the first time dealing with this chatbot thing. I was surprised that they actually needed daily care. You just can't train it (SPA) and think "that's it and now it knows how to answer the questions and there's no need to do anything else" but it really requires precise maintenance. That maybe surprised me. In a negative way.

Techno-overload was also caused by technical issues, as was mentioned earlier with technical challenges. Especially sudden technical issues could cause rapid temporary changes in the workload, causing overload and stress. Only SPA principle linked to techno-overload was platform integration via increased workload caused by technical difficulties.

5.4.6 Techno-uncertainty

Eight of the interviewees had experienced stress caused by techno-uncertainty related to SPA use. Techno-uncertainty can be caused by the constant change in information technology. Some of the interviewees reported stressful experiences caused by the constant updates and changes of SPAs. Especially big updates were reported to cause uncertainty because those changed many things at once, the updates were hard to prepare for, and the updates caused an increase in

workload for the interviewees. One of the interviewees described significant changes that are hard to prepare for to be one of the most stressful experiences in working with SPAs, and another expressed their frustration and tension related to the problems caused by the changes of their SPA:

> Well maybe it has been the most stressful when there will be a change that is like a month away and you can't prepare for it in any way, although you know that the change is coming.

> Let's say that the phase where there is the most amount of frustration and so on is the implementation of the changes … Well at that point issues are starting to emerge and you'll get a bit nervous about how everything is going to work out.

Some interviewees also experienced techno-uncertainty related to the functionality of the SPA. The interviewees felt uncertain about if the SPA worked well enough for the organization and how the SPA's usefulness to the organization can be proved. For example, two of the interviewees described their worry and stress about evaluating the usefulness of the SPA and how the advantages of SPAs can be proved to the organization:

> There's that uncertainty that you have to evaluate every week that does it make any sense to maintain it (SPA). After all it costs quite a bit and it's been used for a while so does it make any sense… But it's (uncertainty) about, does it serve its purpose, is it competent enough and does it have everything there, at that point.

> And maybe it stresses a little sometimes that how can we argue the development (of the SPA) if we don't even know if it (SPA) cuts costs at all.

Two SPA principles, platform integration, and self-evolution were identified to be connected to stressful experiences caused by techno-uncertainty. Platform integration was connected to techno-uncertainty as it is closely related to the changes with SPAs. For example, one of the interviewees felt uncertain about if the integration of their SPA with other systems would cause issues:

> If we switch or integrate other applications, we have to stress that can we even keep this (SPA) involved and do those other (applications) support this. There's that (uncertainty), if one application is removed from that chain of applications then we have to also keep in mind those others (applications) because they are so closely linked.

The lack of SPA's self-evolution abilities was also connected to techno-uncertainty experienced by the interviewees. For example, one of the interviewees felt uncertain about changes as they might interrupt the learning of the SPA and lead to issues, such as the SPA giving false information to the users:

> And also there is bigger things we have to do whenever there's a change. Those must be done right away and not after a week. Like everything must be up to date that it (SPA) doesn't give wrong answers. And especially if products change or there's a new section of law or something else, those things have to be taught to it and make new paths immediately (to not interrupt the learning of the SPA).

5.4.7 Interruptions

Interruptions are closely related to, for example, techno-invasion, and they refer to situations during information technology use, in which users have to switch their focus away from the task at hand to deal with a distraction caused by information technology. Four interviewees reported negative and stressful experiences caused by interruptions during SPA use. These negative feelings were mostly related to disturbing notifications. Disturbing notifications were seen as interrupting the workflow and, in some cases, regarded as spam. For example, some of the SPAs sent daily or weekly reminders that were regarded as disturbing and annoying by the interviewees:

> It sends like proactively those notifications to you if you've forgotten to do something. Like if you are already having a bad day, been busy and feeling a bit stressed and so on, it doesn't necessarily feel nice that at end of a long day you get a message from *SPA name* that you've forgotten to record some hours or something else. So it might be a bit triggering sometimes.

Interruptions were, in some cases, related to the anthropomorphic features of the SPA. This could happen in situations where, for example, the tone of voice of the SPA was seen as inappropriate or annoying by the user. For example, one of the interviewees described the notifications of their SPA to be too straightforward and authoritative:

> *SPA name* has had a pretty straightforward and dull way to present things, like reminding to record your hours, nowadays we are reminded of recording hours daily. So it (SPA) has irritated people even though it's not a person but people regard it as a human-like creature.

5.4.8 Distrust in SPA performance

Four interviewees reported negative experiences related to distrust towards SPAs' performance to accomplish tasks. According to the interviewees, distrust towards SPA task performance resulted in the users not trusting the information that the SPA was giving them. Despite the identical information, users still wanted confirmation from another source due to distrust towards the SPA to provide accurate information. This frustrated some of the interviewees as the lack of trust towards the SPA performance was seen as underserved. For example, one interviewee felt frustrated because of the lack of trust towards SPA's performance and speculated a possible reason for distrust to be that the information came from a non-human assistant:

> There's a lot of those situations that the customer doesn't want to believe that she/he will get the same answer from a bot as they do from a human. So there's a lot of frustration connected to those situations. Maybe it's just that people don't trust that it (SPA) will give you the right answer and also that they have that kind of attitude that

> they feel like they are above the answer that 'a machine' can give or something like that.

Distrust towards SPAs was not directly linked to any of the SPA principles in this data set.

5.4.9 Information security and privacy

Two of the interviewees reported negative experiences related to information security and privacy of SPAs. These negative experiences were related to the difficulty of managing information security and privacy-related issues and users' suspicions related to the security of SPAs. Information security and privacy were seen as complex concerns causing trouble for the interviewees. Information security-related concerns also made the users doubt the information security of the SPA, which in some cases limited SPA use. One of the interviewees described issues with ensuring and implementing the information security of the SPA to be the most troublesome part in working with SPAs:

> Figuring out things like information security or other things that you are not at your best, can be troublesome, and sometimes it is just hard to figure out how to get started with them. For example, when I didn't know how to begin with solving issues like that has caused the most headache in my work.

The issues with ensuring and implementing the information security were related to the SPA principle of platform integration:

> Like those kinds of situations where your own knowledge isn't at its strongest, like things related to integrations and such, you should actually know how those things work to define it (information security required) correctly and so on.

Another interviewee described the users' suspicions and tension related to the privacy of SPAs:

> Just people have preconceptions about what information those (SPAs) record and what information I have to give about myself. And their threshold to try might be very high because you are nervous to use the bot if you are not familiar with them.

A summary of all the technostress creators presented in this section and the SPA principles linked to them are presented below in Table 10.

TABLE 10 Summary of technostress creators and the SPA principles related to them

Technostress creator	**Causes**	**SPA principles and how they were related to the technostress creators**
Communication challenges	-Simplistic or inhuman dialogue -Users not acknowledging that they were communicating with an SPA -The SPA was not able to provide an answer for the user or provided false information	Anthropomorphism: - Unnatural dialogue was seen as frustrating and annoying - Difficulties with balancing the human-like features caused issues and stress Context-awareness: - Lack of context-awareness hindered the communication Self-evolution: - Lack of intelligence prevented the use of automation to enhance the communication
Unrealistic Expectations	- Lack of knowledge about how SPAs operate and what they are capable of - Difficulties with changing unrealistic expectations - Unrealistic expectations caused insecurity in users (Linked to the technostress creators "Techno-insecurity" and "Job insecurity" in prior research)	Anthropomorphism: - Unrealistic expectations towards human-like dialogue led to frustration Context-awareness: - Unrealistic expectations towards context-awareness led to frustration Self-evolution: - Unrealistic expectations towards the self-evolution of the SPA led to frustration - Users saw SPAs as a threat to their jobs
Technical challenges	- Technical issues with the development platform - Lack of features and functionalities on the development platform - SPA unavailable due to technical issues - Increased workload due to technical challenges (Linked to techno-overload)	Platform integration: - Platform integrations caused technical challenges and increased the complexity of the system (Linked to techno-complexity)
Techno-complexity	- Difficulties with understanding how to use the technology - Questioning of own technical skills due to frustration and slow learning	Platform integration: - Platform integrations increased the complexity of the SPA
Interruptions	- Disturbing notifications - Workflow interruptions	Anthropomorphism: - Tone of voice of the interruptions and the attitude of the SPA were seen as annoying
Techno-overload	- Increased multitasking -Increased workload due to updates and constant maintenance	Platform integration: - Platform integrations increased overload due to technical challenges

(continues)

Table 10 continues

Techno uncertainty	- Constant updates - Updates were hard to prepare for - Uncertainty about the usefulness of SPAs	Self-evolution: - Changes or updates impacted the self-evolution of the SPA Platform integration: - Platform integration caused uncertainty due to changes in the SPA
Distrust in SPA performance	- Information given by SPAs was regarded as unreliable because it was given by a non-human entity	
Information security and privacy	- Challenges in ensuring and implementing the information security of an SPA - Suspicions and tension related to the privacy concerns of SPAs	Platform integration: - Platform integrations caused issues for the information security of the SPA

5.5 Technostress outcomes

Technostress can cause adverse outcomes, also referred to as strains, for those who experience stress due to the use of information technology. All of the interviewees had experienced some kind of negative outcomes due to technostress caused by SPA use. For some interviewees, these outcomes were more severe, such as sleep problems, while some others only experienced temporary anger and frustration. This section will go through all the adverse technostress outcomes identified in this data set. The outcomes were grouped into four different categories introduced by Tarafdar et al. (2019). These categories were wellbeing-related outcomes, information technology use-related outcomes, job-related outcomes, and physiological outcomes. One complementary category, emotional outbursts, was also introduced. This category consists of outcomes related to negative emotions caused by technostress that did not fit directly into the other categories.

5.5.1 Wellbeing-related outcomes

Technostress was found to affect the wellbeing of the interviewees. Wellbeing-related outcomes were mostly related to the increased workload experienced by the interviewees related to, for example, usability issues or technical difficulties. The increased workload made some of the interviewees feel overwhelmed and exhausted. Exhaustion was present, for example, when the interviewees had experienced pressure because of tight schedules and getting work done on time:

> You should really pay attention (all the time) but your schedules just cause so much pressure. Like I said, it (SPA) takes 120% of your working hours so it is in that sense the worst thing.

One interviewee also described dealing with technical problems as excruciating for them:

> If there's a technical issue that hasn't been solved and schedules are stretched, that's very excruciating.

Some of the interviewees had also experienced sleeping problems due to stress caused by using SPAs. Sleeping problems were related to, for example, techno-uncertainty caused by the changes and updates of the SPAs. One interviewee mentioned that they had sleepless nights due to changes in the SPA that they used:

> You might in the evening and also at night have dreams of what was happening with it (the change) … Like there are sometimes and still are those sleepless nights because of it (the change).

Another interviewee expressed having lost sleep due to unrealistic expectations towards their SPA:

> I surely had some sleepless nights because of those negative experiences. Those unfinished things make you feel upset and if your expectations are really high and the product (SPA) isn't yet completely what was visioned.

5.5.2 Emotional outburst-related outcomes

The most frequent outcomes of technostress were emotional outbursts. Emotional outbursts were brought up as their own category as they were the most frequent outcome of technostress but were not directly linked to other categories presented in this section. Emotional outbursts were described as situations where the interviewees experienced a temporary negative state of mind caused by a stressful experience during information technology use. The interviewees described these negative experiences to cause emotions like frustration, annoyance, and irritation. Most interviewees had experienced these emotions, but the strength of the emotion and how it affected the interviewees varied. Some interviewees did not feel like the negative emotions had a major impact on them, but they expressed these emotions as stressful and hard to explain. For example, one of the interviewees expressed their frustration because of technical challenges:

> Especially if there are several (negative) situations at the same time, you'll get frustrated. And like yeah maybe frustration is the best way to describe it. Like when you think that everything is fine and suddenly it is not.

Another interviewee described frustrative situations caused by usability issues as stressful:

> So maybe it's kind of stressful, and also very frustrating at the same time, maybe it's just that those frustrating things that stress you I guess.

Some others experienced more considerable effects due to these negative emotions that led to temporary anger and an urge for aggressive behavior. For example, one of the interviewees described a frustrating experience like this due to the complexity of SPAs:

> It's also very frustrating and sometimes, actually several times, I've felt like I'd want to throw my laptop into the wall.

Emotional outbursts and negative emotions were brought up with all of the technostress creators described in the previous section.

5.5.3 Information technology use-related outcomes

Some of the interviewees had experienced outcomes that affected their SPA use and use intention. The interviewees described these outcomes as the need to take a break from using the SPA or giving up on using the SPA altogether. Interviewees often described these information technology use-related outcomes to build up over time due to multiple stressful experiences during SPA use. These stressful experiences were related to, for example, interruptions and technical difficulties. For example, one of the interviewees mentioned a bad week with multiple negative experiences to result in not wanting to use the SPA for a while:

> That kind of feeling that you want to give up… that when during one week you get enough of those feelings that you want to beat your head against a wall, in the next week you don't even want to open the system.

Another interviewee who had experienced technostress outcomes that affected their SPA use intention described these feelings to be caused by constant interruptions:

> Yeah, you'd probably just want to remove the *SPA name* from Slack but you just can't do it. I guess these days it's possible to put it on mute that it doesn't send you notifications. But if you haven't realized to do it, it just makes you want to ignore the whole thing.

5.5.4 Job-related outcomes

Negative job-related technostress outcomes were identified to be a decrease in work motivation and interruptions in the workflow of the interviewees. Some of the interviewees felt like the lack of motivation was caused by the familiarity

of the SPA they worked with and the loss of interest in the technology. As the technology became familiar, the communication challenges with the SPA became more apparent. This, in some cases, decreased the motivation to further use and develop the SPA. For example, one of the interviewees had to start seeking new challenges in working with SPAs and stated the lack of motivation to also affect the quality of their work:

> At the beginning when I started, I was really excited and interested but I have noticed that those feelings have started to fade. And maybe in this job you'll have to consciously search for new challenges… if the motivation starts to run out and you'll get frustrated, it will show in the quality of your work.

On the contrary, the lack of knowledge and skills could also affect the motivation of the interviewees. One of the more severe job-related outcomes was that one of the interviewees threatened to resign due to the complexity and lack of knowledge of the SPA that they were using and developing:

> So I have to say that last year between January and June I threatened three times to my boss that I'll resign (due to SPA complexity), that this ain't gonna work out.

Interruptions were also seen to have negative consequences considering the workflow of the interviewees. Interruptions caused breaks and pauses in the workflow of the interviewees that caused them to switch their focus away from the task they were currently doing. Interviewees felt this was annoying and disturbing for their work and productivity. For example, one of the interviewees described the interruptions as distracting for their work:

> And also in my opinion, in this job there's a lot of things that take quite a bit of concentration. And there are interruptions (caused by the SPA) which bother quite a lot and it takes lot of time to get back on track.

Another interviewee felt the interruptions as triggering especially when combined with rush and hurry:

> You get a notification from *SPA name* that you've forgotten to record some hours or something else. So it might be a bit triggering sometimes.… Yeah it's maybe connected to everything else as well, like surrounding stress or pressure or unfinished things. And then, once again you'll get that notification that this thing isn't done. Like thanks for the information, that helps a lot.

5.5.5 Physiological outcomes

The only physiological outcome identified due to technostress caused by SPAs was increased heart rate. One of the interviewees described a situation in which a technical issue with an SPA caused their heart rate to rise significantly:

> Your smart watch flashes in red and your heart rate beats roughly 160 per second.

A summary of all the technostress outcomes presented in this section can be found below in Table 11.

TABLE 11 Summary of the technostress outcomes

Outcome group	**Related technostress creators**	**Outcome**
Wellbeing-related outcomes	Unrealistic expectations Technical challenges Techno-overload Techno-uncertainty	- Exhaustion - Sleep problems
Emotional outburst-related outcomes	Communication challenges Unrealistic expectations Technical challenges Techno-complexity Interruptions Techno-overload Techno-uncertainty	- Frustration - Anger - An urge for aggressive behavior
Information technology use-related outcomes	Technical challenges Interruptions	- Taking a break from SPA use - Wanting to quit using the SPA
Job-related outcomes	Communication challenges Techno-complexity Interruptions	- Decreased work motivation - Decreased productivity - Decreased work quality - Threats to resign
Physiological outcomes	Techno-uncertainty	- Increased heart rate

6 DISCUSSION

This chapter discusses the results in detail and examines the possible limitations of this study. First, the research questions will be answered by discussing the connection between work-based SPA use and technostress. Second, the results are connected to prior research, and the theoretical contributions of this study are reflected. Third, the practical implications of this study are described. Lastly, the possible limitations of this study are discussed, suggestions for future research are examined, and a conclusion is presented.

6.1 Technostress and SPAs

This study aimed to examine technostress related to the use of smart personal assistants (SPAs) in the context of work. Although SPAs have become more widespread and the number of users has been predicted to increase rapidly during the following years, research on the user experience and technostress caused by SPA use has been limited. Thus, the goal of this study was to examine how technostress emerges in the work-based use of SPAs to gain an understanding of the individual users' experience with SPAs. The study was carried out utilizing qualitative research methods, and data was collected by interviewing 20 SPA users working in various organizations using semi-structured interviews. This study sought to answer the following two research questions: "*How does technostress emerge in the use of SPAs in the working environment?*" and "*How are the principles of SPAs related to technostress caused by SPAs, and what are those principles?*".

First, on a general level, the results of this study suggest that users do experience technostress and its adverse outcomes caused by work-based SPA use. All interviewees described some negative or stressful experiences and outcomes caused by the work-based use of SPAs. However, there were individual differences in how the interviewees described the duration and impact of the stressful experiences. Most of the interviewees described their technostress experi-

ences with SPAs to be mostly short-lasting but relatively impactful in nature. Whereas some of the interviewees also described longer-lasting stressful periods caused by the use of SPAs. Both the longer and short-lasting experiences were found to have a plethora of different outcomes for the interviewees' work performance, wellbeing, information technology use, and state of mind through emotional outbursts. Most interviewees were also found to have a closer connection with the SPAs they used compared to other information technologies.

Second, multiple technostress creators were connected to the emergence of technostress in the context of SPA use. Both new technostress creators and technostress creators already presented in prior technostress research were identified in the study. These technostress creators were communication challenges, unrealistic expectations, technical challenges, techno-complexity, interruptions, techno-overload, techno-uncertainty, distrust in SPA performance, and information security and privacy. The most common technostress creators identified in the study were communication challenges between the user and the SPA, unrealistic expectations towards SPA technologies, and technical challenges with SPA technologies. The common occurrence of these technostress creators implies that the context-specific challenges of SPA technologies affect the emergence of technostress in SPA use. These technostress creators negatively affected the user experience of the interviewees, causing stress and adverse outcomes such as frustration, discontinuous use intention, and decreased work motivation. Technostress creators broadly presented in prior technostress research, techno-overload, techno-complexity, techno-uncertainty, and interruptions, were also present in this study. Factors causing technostress related to these technostress creators were, for example, lack of knowledge of how to use SPAs, increased workload caused by multitasking, and interruptions to the workflow of the users. The negative experiences caused by these technostress creators resulted in, for example, exhaustion, decreased work motivation, and sleep problems. Distrust in SPA performance and challenges related to the information security and privacy of SPAs were the least prominent technostress creators identified in the results of this study. This was surprising as trust towards SPAs and privacy concerns are some of the most researched challenges related to SPA technologies.

Third, the principles of SPA technologies were found to be related to the emergence of technostress in SPA use. SPAs are interactive and intelligent information technology solutions that were found to bring their own context-specific challenges for their users. Five SPA principles described by Knote et al. (2018a) were used to describe the context-specific principles and features of SPAs. These principles were anthropomorphism, context-awareness, platform integration, self-evolution, and multimodality. Anthropomorphic features were related to technostress caused by communication challenges, unrealistic expectations, and interruptions. Results suggest that anthropomorphism can affect technostress through, for example, unnatural conversations and unrealistic expectations towards the anthropomorphic features of SPAs. Platform integrations were connected to technostress caused by technical challenges, techno-

complexity, techno-overload, techno-uncertainty, and information security and privacy, making it the SPA principle connected to the largest amount of technostress creators. Platform integrations affected the stress creators due to, for example, the issues with platform integrations increasing the workload of the users and by making users feel uncertain about future platform integrations. Context-awareness was linked to technostress caused by communication challenges and unrealistic expectations. The lack of context-awareness was connected to the creation of stress by, for example, hindering the dialogue between the user and the SPA by making it feel unnatural. Self-evolution was connected to stress caused by communication challenges, unrealistic expectations, and techno-uncertainty. The lack of self-evolution of the SPA made it more difficult to improve the communication between the SPA and the user, which affected the stress experienced by interviewees. Self-evolution also raised uncertainty among interviewees related to both the lack of self-evolution and unrealistic expectations towards self-evolution, causing fear of job loss. Multimodality was the only principle that was not linked to any of the technostress creators. One possible reason for this is that multimodality was not found in most SPAs used by the interviewees, resulting in the interviewees only using SPAs through one form of communication.

Overall, the results suggest that technostress can emerge in SPA use through both more SPA-specific technostress creators and technostress creators already established in prior research. However, all technostress creators can still be affected by the SPA principles and the unique interaction between the user and the SPA. Next, the results presented in this section will be discussed in more detail by connecting them into both technostress and SPA research and discussing the theoretical contributions of this study.

6.2 Connections to prior research and theoretical contributions

The aim of this study was to fill the gap in research related to the connection between technostress and SPA use. This study extends the work by Benlian et al. (2019), who studied the effects of free time SPA use on technostress. In this study, the connection between technostress and SPAs was approached by examining how technostress emerges during the work-based use of SPAs. From the point of view of technostress research, this approach answers the call for more context-specific understanding about technostress in the context of work (Tarafdar et al., 2015; Tarafdar et al., 2019). The results suggest that technostress can emerge in the context of work-based use of SPAs through multiple technostress creators. These findings extend the current knowledge of the connection between technostress and SPA use. This study also contributes to the SPA research by answering two calls for research. First, this study provides answers to the question of what kind of effects the SPA principles and features have on individual users (Knote et al., 2018a). As the main contribution, the results suggest that the SPA principles can affect the creation of technostress among indi-

vidual SPA users. This finding contradicts with Benlian et al. (2019), who found the SPA principle of anthropomorphism to mitigate the harmful effects of technostress. The contradicting finds could imply that the principles of SPAs can both create and mitigate technostress depending on the quality of the principles. Second, this study integrates theoretical concepts to real-life SPA use. The lack of theoretical integration has been noted as a shortcoming in prior SPA research (Zierau et al., 2020). This study also found the results of prior SPA research related to negative user experience to also be connected to technostress experienced by SPA users. These findings were, for example, frustration caused by usability, unnatural behavior, and poor accuracy of the SPA (Cowan et al., 2017; Zierau et al., 2020; Luger & Sellen, 2016). The results of this study also support the findings of Touré-Tillery and McGill (2015) and Mourey et al. (2017) that SPA users can form a closer connection with the SPA technologies they use.

The unique, highly interactive way of using SPAs had an effect on how technostress emerges in the context of work-based SPA use. As a contribution, two new technostress creators were introduced in this study: communication challenges and unrealistic expectations. This study also expanded on the understanding of previously known technostress creators, such as techno-complexity, techno-overload, and interruptions, by introducing them in the context of SPA use (Ragu-Nathan et al., 2008; Tarafdar et al., 2007; Galluch et al., 2015). SPA-specific design principles were also linked to the technostress creators to understand how the features of SPAs can affect the creation of technostress.

Communication challenges were introduced as a new technostress creator in the context of SPA use, and it was also the most common technostress creator identified in this study. Communication challenges were highly dependent on the unique way of communication between the user and the SPA compared to other information technologies. However, even if the category of communication challenges as a stress creator is new, it can be linked to the principles and features identified in SPA research. One of the communication challenges causing stress was identified to be simplistic and unnatural dialogue with SPAs. The challenges with unnatural dialogue were linked to the principle of anthropomorphism, as poorly designed anthropomorphic features were found to increase unnatural dialogue. These findings also comply with the findings by Cowan et al. (2017). Anthropomorphic features also caused misunderstandings when the user did not acknowledge that they were communicating with an SPA. This caused issues with balancing the human-like features of SPAs which was also acknowledged as a possible issue by Benlian et al. (2019). Context-awareness was linked to communication challenges through the lack of context-awareness hindering the conversation between the user and the SPA. The lack of context-awareness caused the dialogue to feel loose and inhuman as the SPAs could not connect the previous dialogue with the user to the next one. These issues were also recognized by Maedche et al. (2016) and Luger and Sellen (2016), who pointed out that SPAs should start to utilize more features related to context-awareness to improve the communication capabilities of SPAs.

The other new technostress creator introduced in this study was unrealistic expectations towards the SPAs. These unrealistic expectations were caused by the lack of knowledge about how SPAs operate and what SPAs are capable of. The lack of knowledge led to some of the users considering SPAs as highly intelligent and autonomous technologies that could answer any question aimed at them. These unrealistic expectations were quickly shattered if the system did not perform on par with the user's expectations, which led to users feeling frustrated, unsatisfied, and stressed. Interviewees also had difficulties with changing the expectations of others in the organization. Stress caused by unrealistic expectations was also related to the technostress creator of techno-insecurity introduced by Tarafdar et al. (2007) as one of the interviewees reported the fear of SPAs stealing the jobs of users. Unrealistic expectations were related to the SPA principles of anthropomorphism, context-awareness, and self-evolution. Knote et al. (2018b) found in their study that unrealistic expectations towards the anthropomorphic features of SPAs can affect the satisfaction of the user. The results of this study support these findings. This study also expands the understanding of the SPA principles of context-awareness and self-evolution as they were not previously linked to the unrealistic expectations of SPA users.

Three of the technostress creators, techno-complexity, techno-overload, and techno-uncertainty, introduced by Tarafdar et al. (2007), were identified in the results of this study. Techno-insecurity was also present in the results caused by unrealistic expectations towards SPAs, as mentioned earlier. Techno-complexity refers to situations in which the user feels inadequate or unskilled due to the complexity and difficulties in information technology use and learning (Tarafdar et al., 2007; Tarafdar et al., 2010). The results of this study had similar findings related to the use of SPAs. Some users felt like SPAs were hard to grasp, which resulted in them doubting their skills in using SPAs. The SPA principle of platform integration was also found to increase techno-complexity and stress for some SPA users. Techno-overload was present in this study due to increased multitasking and workload caused by the use of SPAs. These findings are in line with prior technostress research and their findings (Ragu-Nathan et al., 2008; Maier et al., 2015a; Salo et al., 2019). This study's contribution to techno-overload as a technostress creator is the link between the SPA principle of platform integration and increased overload. However, this finding contradicts with Knote et al. (2018a) and Cowan et al. (2017), who found platform integrations to increase user satisfaction. The reason for the contradicting findings could be that in the studies by Knote et al. (2018a) and Cowan et al. (2017), platform integrations were better implemented or were not visible to the user because of the SPA design. Ragu-Nathan et al. (2008) and Tarafdar et al. (2011) found techno-uncertainty to be related to constant changes and updates in information technology that can cause stress and frustration among users. This study also had similar findings. Constant updates and changes in SPAs caused users to feel frustrated and doubtful about the SPA they used, which caused stress and frustration. Techno-uncertainty was also linked to increased overload due to users having to relearn to use SPAs due to updates and chang-

es. These findings are also in line with findings of prior research (Ragu-Nathan et al., 2008; Tarafdar et al., 2011). This study's contribution to techno-uncertainty is the introduction of SPA principles platform integration and self-evolution as possible factors to increase uncertainty among users. This also provides an understanding of how the principles of platform integration and self-evolution can affect individual SPA users (Knote et al., 2018a).

Galluch et al. (2015) researched the effects of interruptions caused by information technology use. Interruptions were described as situations in which users have to switch their attention away from the task at hand to deal with interruptions caused by information technology use. In prior research, these interruptions were found to disturb the user's workflow, causing stress, overload, and strain. (Galluch et al., 2015.) The findings of this study suggest that the use of SPAs can also cause interruptions. Users felt distracted and frustrated due to notifications and issues caused by SPAs which affected their concentration and productivity. Technostress experiences caused by interruptions were also connected to the SPA principle of anthropomorphic features. Interruptions due to notifications and reminders were seen as more annoying if the tone of voice of the SPA was regarded as irritating. This finding further confirms the importance of well-made human-like features emphasized by Touré-Tillery and McGill (2015).

Technical challenges were reported by over half of the interviewees as a cause for technostress. Technical challenges were related to usability issues due to the lack of features and functionality of the SPAs and SPAs being unavailable due to technical issues. These findings are in line with the study conducted by Milhorat et al. (2014), who found technical challenges to cause usability issues to SPA users. The findings also support Fischer et al. (2019), who found the poor reliability of information technology to be a possible cause for technostress. Cowan et al. (2017) researched lack of functionality, who found the lack of features of SPAs to cause negative experiences, such as frustration, among users. Technical challenges were also linked to the SPA principle of platform integration. Platform integration caused technical issues, which in turn caused stress for the users.

In this study, distrust in SPA performance caused stressful experiences to four of the interviewees. Stress caused by distrust was related to users not trusting the SPA to accomplish its tasks. Lack of trust towards the task performance of SPAs was also researched by Cowan et al. (2017) and Dubiel, Halvey, and Azzopardi (2018). According to their findings, the lack of trust towards the task performance of SPAs was one of the biggest reasons that caused discontinuous use intention. Distrust towards SPA performance was not identified to cause as powerful reactions in this study. However, the presence of distrust in the data can further indicate that there are challenges related to the distrust towards SPA performance.

Information security and privacy concerns are one of the most researched challenges related to SPAs (Abdi et al., 2019; Benlian et al., 2019; Cowan et al., 2017; Liao et al., 2019). Challenges related to information security and privacy

have been found to cause users not to adopt SPAs or avoid the use of SPAs due to privacy concerns (Liao et al., 2019). Ayyagari et al. (2011) introduced privacy concerns as a possible technostress creator and found a connection between privacy concerns and technostress. Benlian et al. (2019) tested this connection in the context of SPAs and found intrusive technology features to cause privacy concerns and stress for the users. In this study, however, stress related to privacy concerns was only reported by two of the interviewees. Thus, privacy concerns did not play a major part as a technostress creator in this study. One possible reason for this could be that earlier studies examining users' reactions to information security, and privacy concerns were focused on the context of free time SPA use. More research should be done if there are differences in privacy and information security-related concerns between the contexts of free time and work-related use of SPAs.

The technostress outcomes caused by SPA use were found to be broadly similar to technostress outcomes found in prior technostress research. Technostress caused by SPA use was found to be related to all the negative outcome categories presented by Tarafdar et al. (2019). These negative outcomes were wellbeing-related, information technology-use-related, job-related, and physiological outcomes. This implies that even if the context causing technostress changes, the outcomes of technostress can remain relatively similar. Emotional outbursts were also introduced as technostress outcomes in this study. This category described outcomes like sudden negative emotions and aggressive behavior caused by technostress.

This study recognized two wellbeing-related outcomes, which were exhaustion and sleep problems. These outcomes have also been connected to wellbeing in prior technostress research (Pawlowski et al., 2007; Reinecke et al., 2017; Salo et al., 2019). Wellbeing-related outcomes were found to be connected to techno-overload and techno-uncertainty, which agrees with the findings of previous studies (Reinecke et al., 2017; Salo et al., 2019; Ragu-Nathan et al., 2008). However, this study also connected unrealistic expectations and technical challenges to cause negative wellbeing-related outcomes among SPA users. Technostress was found to affect the information technology use of the interviewees through discontinuous use intention. Discontinuous use intention was researched by Maier et al. (2015a). They found that exhaustion and other negative experiences in information technology use can make the user want to take a break from information technology use or stop using that information technology entirely. The results of this study agree with Maier et al. (2015a). This study also found that interruptions and technical challenges can impact the discontinuous use intention of the user due to multiple smaller annoyances during SPA use. Prior research has found negative job-related outcomes caused by techno-complexity, techno-overload, and interruptions. These outcomes can be, for example, decreased work motivation, productivity, and quality (Tarafdar et al., 2007; Tarafdar et al., 2011; Ragu-Nathan et al., 2008; Khan et al., 2013). This study supports these findings but also introduces communication challenges as a cause for job-related technostress outcomes. The repeating interactions and

conversations with SPAs can end up in the user feeling bored and annoyed, decreasing the work motivation of the SPA user. The only physiological outcome recognized in this study was increased heart rate. Physiological outcomes did not have a major role in the findings of this study, but increased heart rate has also been noted in previous studies such as Riedl (2012). Emotional outbursts included all the negative outcomes that were not directly related to any of the outcomes introduced by Tarafdar et al. (2019). Negative emotions, such as frustration, anger, and helplessness, have been recognized in prior technostress research as common technostress outcomes that can lead to other outcomes, such as job-related or wellbeing-related outcomes. (Ragu-Nathan et al., 2008; Tarafdar et al., 2011; Reinecke et al., 2017; Salo et al., 2020). Emotional outbursts were the most common outcome reported by the interviewees in this study. Emotional outbursts were linked to all of the technostress creators identified in this study and caused, for example, an urge for aggressive behavior, frustration, and anger.

6.3 Practical implications

First, this study introduces practical implications to the users of SPA technologies in organizations. The understanding provided by this study can help users recognizing possible technostress creators and challenges with SPA use to prepare for them. For example, if a user knows that specific features of SPAs can cause overload, they might want to look out for possible implications of overload to avoid the negative effects caused by it. As another example, if the user recognizes that their expectations towards the SPA might be too high, they might want to actively lower their expectations to better match the capabilities of SPA technologies. This study also discussed the possible technostress outcomes related to SPA use. Knowledge about these outcomes can help SPA users recognize possible technostress experiences by pondering whether, for example, a decrease in work motivation could be related to work-based SPA use.

Second, this study's results can help organizations plan their SPA implementations and focus their attention on fixing or improving the possible issues with SPAs used by their employees. For example, it would be important to inform their employees about the frequent changes that SPAs need to improve and stay operational. It would also be important to clearly communicate what the SPA is designed to do and how it operates to avoid unrealistic expectations towards the implemented SPA technology. However, this can be troublesome if the organizations are the ones with these expectations. Thus, it would be important for organizations to become familiar with the opportunities and limitations of the current SPA technologies before implementations. Overall, this study provides useful insights for organizations interested in SPA technologies about the possible negative effects and outcomes of SPA use on their employees. This knowledge can help organizations plan their decisions considering the

SPA technology they want to implement or develop to minimize the adverse outcomes of SPA use.

Third, the results of this study can help with the design and development of SPA solutions. Close attention should be paid to, for example, the design of anthropomorphism and platform integrations of SPA solutions. The design of SPAs was found to have a noticeable impact on the user experience and the emergence of technostress among users in this study. Thus, anthropomorphic features of SPAs should be well balanced and sound natural to not evoke negative emotions among users of SPAs. It would also be important to develop easily integrable SPAs to minimize the issues related to platform integrations. There should also be an opportunity for users to mute or remove SPA notifications if they want to solely focus on their work without the SPA interrupting their workflow. SPAs that are easily approachable and easy to use would also benefit users and help them avoid techno-complexity and distrust towards SPA performance.

6.4 Limitations and suggestions for future research

First, semi-structured interviews pose possible limitations for the data collection of this study. Collecting data using interviews limits the generalizability of the results and relies on self-reported experiences recalled by the interviewees. Although self-reported data collection methods have been proven reliable in prior technostress research, it still poses its limitations due to relying on the memory and expression of the interviewees (Ayyagari et al., 2011; Salo et al., 2019; Ragu-Nathan et al., 2008). This study provides useful insights and a first look at the technostress experiences related to work-based SPA use. However, more research should be done utilizing various research approaches and data collection methods to further examine and validate the technostress creators and SPA principles affecting them in the context of work-based SPA use.

Another possible limitation of this study is related to the role of the interviewees in the organization. As described earlier, most of the interviewees were also involved with the development of the SPA that they used in their work. This was due to most organizations developing their own customized SPA solutions using third-party tools, which caused the users of SPAs to also be involved with the development process. On the one hand, this allowed the collection of technostress experiences from users who had gained the most amount of experience with interacting and using SPAs. The development experience also helped with collecting detailed descriptions of the SPA principles present in the SPAs. On the other hand, some of the interviewees had a detailed understanding of the technologies they used, which could affect the strength and regularity of the technostress experiences. It is hard to say if the detailed knowledge might have increased technostress due to more regular use and closer connection with the SPA or decreased technostress due to the more detailed understanding of how to use SPAs. More research should be conducted focusing on end-users

who are not involved with the development of the SPAs to compare the experiences of different groups of users.

The third possible limitation of this study is that all the interviewees were of the same nationality, that being Finnish. The Finnish language introduces its own challenges related to the usability issues of SPAs, as mentioned earlier in the results section of this study. Some of the SPA implementations used by the interviewees were only available in English due to the challenges or lack of functionality with the Finnish language. This might affect the technostress experiences of some of the interviewees as they had to either deal with the limited functionality of using SPAs in Finnish or use them in a foreign language. More research should be done with participants from multiple nationalities to further examine the impact of using SPAs in different languages and accents and its impact on technostress and user experience. For example, Cowan et al. (2017) found that speech recognition issues can be caused by the user's accent, resulting in usability issues.

The fourth possible limitation is related to the SPA technologies that the interviewees used. The principle of multimodality was not present in most of the SPAs, and therefore the connection between multimodality and technostress creators could not be examined in this study. Knote et al. (2018a) noted that multimodality is not necessary for SPAs as rich communication can also be achieved only using one form of communication, such as text. However, as SPAs become more widespread, it is probable that SPAs will start utilizing a more varied scale of communication methods. This assumption was also shared by most of the interviewees in this study. Thus, more research should be done on the effects of multimodality on user experience and technostress.

Other possible areas for future research can also be identified based on the results of this study. First, technostress mitigation had to be left out from the scope of this study. Thus, it is important for future research to also examine how the adverse effects of technostress can be mitigated in the context of SPA use. Another possible area for future research is to examine the possible reasons and the connection of SPA principles with the distrust towards the performance of SPAs. More research should be done on the topic as there still remains a gap in understanding of the possible reasons behind the distrust towards SPA performance. Another possible topic for further research would be to examine how the connection between the user and SPA affects the formation of technostress. This study was not able to provide results considering if a closer connection with an SPA could increase or mitigate technostress. Lastly, more research should be conducted to identify when the principles of SPAs might mitigate and create technostress. As mentioned earlier in this chapter, Benlian et al. (2019) found the principle of anthropomorphism to mitigate technostress, whereas, in this study, it was related to the creation of technostress. It would be important to understand how the quality of the SPA principles can affect user experience and technostress to help with the design of SPAs.

6.5 Conclusion

The use of information technology continues to spread to all aspects of work and leisure, and new information technology solutions constantly emerge. It is important to examine the negative effects of these new information technology solutions to minimize stress and adverse outcomes of individual users. SPAs are a constantly evolving information technology that is predicted to boom in popularity during the following years. As SPAs become more popular, it is likely that the adverse effects caused by the use of SPAs do as well. This study examined the gap in research related to the work-based use of SPAs and technostress to understand the negative and stressful effects of work-based SPA use. The results of this study imply that SPAs can cause technostress in multiple different ways and that the context-specific design principles and features of SPAs play a major role in how technostress emerges in SPA use. Technostress caused by SPA use was also found to have similar adverse outcomes compared to technostress experienced in other contexts of information technology use. This study provided theoretical contributions to both technostress and SPA research and practical implications to individual users and organizations. The insights of this study can be used to further examine the connection between technostress and SPA use to understand and minimize the negative effects of SPA technologies use in the future.

REFERENCES

Abdi, N., Ramokapane, K. M. & Such, J. M. (2019). More than smart speakers: security and privacy perceptions of smart home personal assistants. *Proceedings of the Fifteenth Symposium on Usable Privacy and Security*, 451-466.

Abowd, G. D., Dey, A. K., Brown, P. J., Davies, N., Smith, M. & Steggles, P. (1999). Towards a better understanding of context and context-awareness. *Proceedings of the International Symposium on Handheld and Ubiquitous Computing,* 304-307.

Aguirre, S. & Rodriguez, A. (2017). Automation of a business process using robotic process automation (RPA): A case study. *Applied Computer Sciences in Engineering,* 65-71.

Ahmad, U. Amin, S. & Ismail, W. (2014). Moderating Effect of Technostress Inhibitors on the Relationship between Technostress Creators and Organisational Commitment. *Jurnal Teknologi, 67*(1), 51-62.

Arnetz, B. B. & Wiholm, C. (1997). Technological stress: Psychophysiological symptoms in modern offices. *Journal of Psychosomatic Research*, *43*(1), 35-42.

Atanasoff, L. & Venable, M.A. (2017). Technostress: Implications for Adults in the Workforce. *The Career Development Quarterly, 65*(4), 326-338.

Ayyagari, R., Grover, V. & Purvis, R. (2011). Technostress: Technological Antecedents and Implications. *MIS Quaterly, 35*(4), 831- 858.

Azvine, B., Djian, D., Tsui, K. C. & Wobcke, W. (2000). The intelligent assistant: An overview. *Intelligent Systems and Soft Computing*, *1804,* 215-238.

Bellegarda, J. R. (2014). Spoken language understanding for natural interaction: The siri experience. *Natural Interaction with Robots, Knowbots and Smartphones,* 3-14.

Benlian, A., Klumpe, J. & Hinz, O. (2019). Mitigating the intrusive effects of smart home assistants by using anthropomorphic design features: A multimethod investigation. *Information Systems Journal*, *30*(6), 1010-1042.

Bennett, J., Rokas, O. & Chen, L. (2017). Healthcare in the smart home: A study of past, present and future. *Sustainability*, *9*(5), 840.

Bentley, F., Luvogt, C., Silverman, M., Wirasinghe, R., White, B. & Lottridge, D. (2018). Understanding the long-term use of smart speaker

assistants. *Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies*, *2*(3), 1-24.

Berg, B. L. (2004). *Qualitative research methods for the social sciences.* Boston, MA: Pearson Education.

Brod, C. (1984). *Technostress: The human cost of the computer revolution.* MA: Addison Wesley Publishing Company.

Brooks, S., Longstreet, P. & Califf, C. (2017). Social Media Induced Technostress and its Impact on Internet Addiction: A Distraction-conflict Theory Perspective. *AIS Transactions on Human-Computer Interaction, 9*(2), 99-122.

Budzinski, O., Noskova, V. & Zhang, X. (2019). The brave new world of digital personal assistants: Benefits and challenges from an economic perspective. *NETNOMICS: Economic Research and Electronic Networking*, *20*(2), 177-194.

Burton-Jones, A. & Hubona, G. (2005). Individual differences and usage behavior: revisiting a technology acceptance model assumption. *ACM SIGMIS Database: The DATABASE for Advances in Information Systems, 36*(2), 58-77.

Butler, B. S. & Gray, P. H. (2006). Reliability, mindfulness, and information systems. *MIS Quarterly*, *30*(2), 211-224.

Califf, C. B. & Brooks, S. (2020). An empirical study of techno-stressors, literacy facilitation, burnout, and turnover intention as experienced by K-12 teachers. *Computers & Education*, *157*, 103971.

Califf, C. B., Sarker, S. & Sarker, S. (2020). The Bright and Dark Sides of Technostress: A Mixed-Methods Study Involving Healthcare IT. *MIS Quarterly*, *44*(2), 809-856.

Califf, C., Sarker, S., Sarker, S. & Fitzgerald, C. (2015). The bright and dark sides of technostress: An empirical study of healthcare workers. *Proceedings of the International Conference on Information Systems.*

Canbek, N. G. & Mutlu, M. E. (2016). On the track of artificial intelligence: Learning with intelligent personal assistants. *Journal of Human Sciences*, *13*(1), 592-601.

Collobert, R. & Weston, J. (2008). A unified architecture for natural language processing: Deep neural networks with multitask learning. *Proceedings of the 25th International Conference on Machine learning,* 160–167.

Cooper, C. L., Dewe, P. J. & O'Driscoll, M. P. (2001). *Organizational stress: A review and critique of theory, research, and applications*. SAGE Publications, Inc.

Cowan, B. R., Pantidi, N., Coyle, D., Morrissey, K., Clarke, P., Al-Shehri, S., ... Bandeira, N. (2017). "What can i help you with?" infrequent users' experiences of intelligent personal assistants. *Proceedings of the 19th International Conference on Human-Computer Interaction with Mobile Devices and Services*, 1-12.

D'Arcy, J. & Teh, P. L. (2019). Predicting employee information security policy compliance on a daily basis: the interplay of security-related stress, emotions, and neutralization. *Information & Management*, *56*(7), 103-151.

D'Arcy, J., Gupta, A., Tarafdar, M. & Turel, O. (2014a). Reflecting on the "dark side" of information technology use. *Communications of the Association for Information Systems, 35*(5), 109-118.

D'Arcy, J., Herath, T. & Shoss, M. K. (2014b). Understanding employee responses to stressful information security requirements: A coping perspective. *Journal of Management Information Systems*, *31*(2), 285-318.

Darke, P., Shanks, G. & Broadbent, M. (1998). Successfully completing case study research: combining rigour, relevance and pragmatism. *Information Systems Journal, 8*(4), 273-289.

de Barcelos Silva, A., Gomes, M. M., da Costa, C. A., da Rosa Righi, R., Barbosa, J. L. V., Pessin, G., ... Federizzi, G. (2020). Intelligent personal assistants: A systematic literature review. *Expert Systems with Applications*, *147*, 113193.

Deng, L. & Liu, Y. (2018). *Deep Learning in Natural Language Processing*. Springer International Publishing.

Deng, L. (2018). Artificial intelligence in the rising wave of deep learning: the historical path and future outlook [perspectives]. *IEEE Signal Processing Magazine*, *35*(1), 177–180.

DiCicco-Bloom, B. & Crabtree, B. F. (2006). Making sense of qualitative research. *Medical Education*, *40*(4), 314-321.

Dong, Y., Xu, C., Chai, C. S. & Zhai, X. (2019). Exploring the structural relationship among teachers' technostress, technological pedagogical content knowledge (TPACK), computer self-efficacy and school support. *The Asia-Pacific Education Researcher*, 29(2), 1-11.

Dubiel, M., Halvey, M. & Azzopardi, L. (2018). A Survey Investigating Usage of Virtual Personal Assistants. *arXiv preprint*, *1807*.04606.

Ennis, L. A. (2005). The evolution of technostress. *Computers in Libraries*, *25*(8), 10-12.

Epley, N., Waytz, A. & Cacioppo, J. T. (2007). On seeing human: A three-factor theory of anthropomorphism. *Psychological Review, 114*(4), 864–886.

Feng, H., Fawaz, K. & Shin, K. G. (2017). Continuous authentication for voice assistants. *Proceedings of the 23rd Annual International Conference on Mobile Computing and Networking*, 343–355.

Fernando, N., Tan, Felix, F. T. C., Vasa, R., Mouzaki, K. & Aitken, I. (2016). Examining digital assisted living: towards a case study of smart homes for the elderly. *AIS eLibrary Research-in-Progress Papers*, 70.

Fischer, T. & Riedl, R. (2017). Technostress research: a nurturing ground for measurement pluralism? *Communications of the Association for Information systems*, *40*(1), 375-401.

Fischer, T., Pehböck, A. & Riedl, R. (2019). Is the technostress creators inventory still an up-to-date measurement instrument? Results of a large-scale interview study. *International Conference on Wirtschaftsinformatik.*

Fuglseth, A. M. & Sørebø, Ø. (2014). The effects of technostress within the context of employee use of ICT. *Computers in Human Behavior*, *40*, 161-170.

Galluch, P., Grover, V. & Thatcher, J. B. (2015). Interrupting the workplace: Examining stressors in an information technology context. *Journal of the Association for Information Systems, 16*(1), 1-47.

Gartner. (8.10.2020). *Brace Yourself for an Explosion of Virtual Assistants*. Retrieved from (14.05.2021) https://blogs.gartner.com/anthony_bradley/2020/08/10/brace-yourself-for-an-explosion-of-virtual-assistants/

Gaudioso, F., Turel, O. & Galimberti, C. (2017). The mediating roles of strain facets and coping strategies in translating techno-stressors into adverse job outcomes. *Computers in Human Behavior*, *69*, 189-196.

Go, E. & Sundar, S. S. (2019). Humanizing chatbots: The effects of visual, identity and conversational cues on humanness perceptions. *Computers in Human Behavior*, *97*, 304-316.

Grover, S. L., Teo, S. T., Pick, D. & Roche, M. (2017). Mindfulness as a personal resource to reduce work stress in the job demands-resources model. *Stress and Health*, *33*(4), 426-436.

Han, S. & Yang, H. (2018). Understanding adoption of intelligent personal assistants. *Industrial Management & Data Systems*, *118(3),* 618-636.

Hauswald, J., Laurenzano, M. A., Zhang, Y., Yang, H., Kang, Y., Li, C., ... Petrucci, V. (2016). Designing future warehouse-scale computers for Sirius, an end-to-end voice and vision personal assistant. *ACM Transactions on Computer Systems*, *34*(1), 1-32.

Hennink, M., Hutter, I. & Bailey, A. (2020). Qualitative research methods. SAGE Publications, Inc.

Hesse-Biber, S. N. & Leavy, P. (2011). The practice of qualitative research. SAGE Publications, Inc.

Hoyle, M. A. & Lueg, C. (1997). Open Sesame!: A look at personal assistants. *Proceedings of the International Conference on the Practical Application of Intelligent Agents and Multi-Agent Technology, 51*(60), 51-60.

Hu, Q., Pan, Z. & Liu, J. (2019). The Duality of Autonomy on Continuous Usage of Intelligent Personal Assistants (IPAs): From Agency Perspective. *Proceedings of the Pacific Asia Conference on Information Systems*.

Hung, W. H., Chang, L. M. & Lin, C. H. (2011). Managing The Risk Of Overusing Mobile Phones In The Working Environment: A Study Of Ubiquitous Technostress. *Proceedings of the Pacific Asia Conference on Information Systems*.

Hwang, I. & Cha, O. (2018). Examining technostress creators and role stress as potential threats to employees' information security compliance. *Computers in Human Behavior*, *81*, 282-293.

Ioannou, A. & Papazafeiropoulou, A. (2017). Using IT mindfulness to mitigate the negative consequences of technostress. *Proceedings of the Americas Conference on Information Systems*.

Jena, R. K. (2015). Technostress in ICT enabled collaborative learning environment: An empirical study among Indian academician. *Computers in Human Behavior*, *51*, 1116-1123.

Johansson, P. E., Petersson, G. I. & Nilsson, G. C. (2013). Nursing students' experience of using a personal digital assistant (PDA) in clinical practice—an intervention study. *Nurse Education Today*, *33*(10), 1246-1251.

Judge, T. A., Higgins, C. A., Thoresen, C. J. & Barrick, M. R. (1999). The big five personality traits, general mental ability, and career success across the life span. *Personnel Psychology*, *52*(3), 621-652.

Karwatzki, S., Dytynko, O., Trenz, M. & Veit, D. (2017). Beyond the Personalization–Privacy Paradox: Privacy Valuation, Transparency Features, and Service Personalization. *Journal of Management Information Systems, 34*(2), 369–400.

Khan, A., Rehman, H. & Rehman, D. S. U. (2013). An empirical analysis of correlation between technostress and job satisfaction: A case of KPK, Pakistan. *Pakistan Journal of Information Management and Libraries*, *14,* 9-15.

Khedhaouria, A. & Cucchi, A. (2019). Technostress creators, personality traits, and job burnout: A fuzzy-set configurational analysis. *Journal of Business Research*, *101*, 349-361.

Klein, H. K. & Myers, M. D. (1999). A set of principles for conducting and evaluating interpretive field studies in information systems. *MIS Quarterly, 23*(1), 67–93.

Knote, R. (2019). Towards Solving the Personalization-Privacy Paradox for Smart Personal Assistants. *Proceedings of the Hawaii International Conference on System Sciences.*

Knote, R., Janson, A., Eigenbrod, L. & Söllner, M. (2018a). The what and how of smart personal assistants: principles and application domains for IS research. *Multikonferenz Wirtschaftsinformatik.*

Knote, R., Janson, A., Söllner, M. & Leimeister, J. M. (2019). Classifying smart personal assistants: an empirical cluster analysis. *Proceedings of the Hawaii International Conference on System Sciences*.

Knote, R., Söllner, M. & Leimeister, J. M. (2018b). Towards a pattern language for smart personal assistants. *25th Conference on Pattern Languages of Programs.*

Krishnan, S. (2017). Personality and espoused cultural differences in technostress creators. *Computers in Human Behavior*, *66*, 154-167.

Kumar, R., Lal, R., Bansal, Y. & Sharma, S. K. (2013). Technostress in Relation to Job Satisfaction and Organisational Commitment among IT Professionals. *International Journal of Scientific and Research Publications*, *3*(12), 1-3.

La Torre, G., Esposito, A., Sciarra, I. & Chiappetta, M. (2018). Definition, symptoms and risk of techno-stress: A systematic review. *International Archives of Occupational and Environmental Health, 92*(1), 13-35.

Lazarus, R. S. (1966). *Psychological stress and the coping process*. New York, NY, US: McGraw-Hill.

Lazarus, R. S. (1993). From Psychological Stress to the Emotions: A History of Changing Outlooks. *Annual Review of Psychology, 44*(1), 1-22.

Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal, and coping.* NY: Springer International Publishing.

Le Fevre, M., Matheny, J. & Kolt, G. S. (2003). Eustress, distress, and interpretation in occupational stress. *Journal of Managerial Psychology, 18*(7), 726-744.

Leung, L. & Zhang, R. (2017). Mapping ICT use at home and telecommuting practices: A perspective from work/family border theory. *Telematics and Informatics*, *34*(1), 385-396.

Leviathan, Y. & Matias, Y. (2018). Google Duplex: an AI system for accomplishing real-world tasks over the phone. *Google research.*

Liao, Y., Vitak, J., Kumar, P., Zimmer, M. & Kritikos, K. (2019). Understanding the role of privacy and trust in intelligent personal assistant adoption. *Information in Contemporaru Society*, 102-113.

Luger, E. & Sellen, A. (2016). "Like Having a Really Bad PA" The Gulf between User Expectation and Experience of Conversational Agents. *Proceedings of the Conference on Human Factors in Computing Systems*, 5286-5297.

Maedche, A., Morana, S., Schacht, S., Werth, D. & Krumeich, J. (2016). Advanced user assistance systems. *Business & Information Systems Engineering*, *58*(5), 367-370.

Maier, C., Laumer, S., Eckhardt, A. & Weitzel, T. (2015a). Giving too much social support: Social overload on social networking sites. *European Journal of Information Systems, 24*(5), 447-464.

Maier, C., Laumer, S., Weinert, C. & Weitzel, T. (2015b). The effects of technostress and switching stress on discontinued use of social networking services: A study of facebook use. *Information Systems Journal, 25*(3), 275-308.

McLean, G. & Osei-Frimpong, K. (2019). Hey Alexa… examine the variables influencing the use of artificial intelligent in-home voice assistants. *Computers in Human Behavior*, *99*, 28-37.

Michie, S. (2002). Causes and management of stress at work. *Occupational & Enviromental Medicine*, *59*(1), 67-72.

Mihale-Wilson, C., Zibuschka, J. & Hinz, O. (2017). About user preferences and willigness to pay for a secure and privacy protective ubiquitous personal assistant. *Proceedings of the European Conference on Information Systems.*

Milhorat, P., Schlögl, S., Chollet, G., Boudy, J., Esposito, A. & Pelosi, G. (2014). Building the next generation of personal digital assistants. *1st International Conference on Advanced Technologies for Signal and Image Processing*, 458-463.

Mitchell, T. M., Caruana, R., Freitag, D., McDermott, J. & Zabowski, D. (1994). Experience with a learning personal assistant. *Communications of the ACM*, *37*(7), 80-91.

Mourey, J. A., Olson, J. G. & Yoon, C. (2017). Products as pals: Engaging with anthropomorphic products mitigates the effects of social exclusion. *Journal of Consumer Research*, *44*(2), 414-431.

Myers, K., Berry, P., Blythe, J., Conley, K., Gervasio, M., McGuinness, D. L., ... Tambe, M. (2007). An intelligent personal assistant for task and time management. *AI Magazine*, *28*(2), 47-61.

Myers, M.D. & Newman, M. (2007). The qualitative interview in IS research: Examining the craft. *Information and Organization, 17*(1), 2-26.

Nuruzzaman, M. & Hussain, O. K. (2018). A survey on chatbot implementation in customer service industry through deep neural networks. *IEEE 15th International Conference on e-Business Engineering,* 54-61.

Ochs, M., Pelachaud, C. & Mckeown, G. (2017). A User Perception--Based Approach to Create Smiling Embodied Conversational Agents. *ACM Transactions on Interactive Intelligent Systems*, *7*(1), 1-33.

Oksanen, A., Oksa, R., Savela, N., Kaakinen, M. & Ellonen, N. (2020). Cyberbullying victimization at work: Social media identity bubble approach. *Computers in Human Behavior*, *109*, 106363.

Patton, M. Q. (2002). *Qualitative research and evaluation methods, 3rd edition*. SAGE Publications, Inc.

Pawlowski, S. D., Kaganer, E. A. & Cater, J. J. (2007). Focusing the research agenda on burnout in IT: Social representations of burnout in the profession. *European Journal of Information Systems, 16*(5), 612-627.

Pfeuffer, N., Benlian, A., Gimpel, H. & Hinz, O. (2019). Anthropomorphic information systems. *Business & Information Systems Engineering*, *61*(4), 523-533.

Pflügner, K., Maier, C. & Weitzel, T. (2020a). The direct and indirect influence of mindfulness on techno-stressors and job burnout: A quantitative study of white-collar workers. *Computers in Human Behavior*, *115,* 106566.

Pflügner, K., Reis, L., Maier, C. & Weitzel, T. (2020b). Communication Measures to Reduce Techno-Invasion and Techno-Overload: A Qualitative Study Uncovering Positive and Adverse Effects. *Proceedings of the Computers and People Research Conference,* 114-122.

Pirkkalainen, H. & Salo, M. (2016). Two decades of the dark side in the information systems basket: Suggesting five areas for future research. *Proceedings of the European Conference on Information Systems.*

Pirkkalainen, H., Salo, M., Makkonen, M. & Tarafdar, M. (2017). Coping with technostress: When emotional responses fail. *Proceedings of the International Conference on Information Systems*.

Pirkkalainen, H., Salo, M., Tarafdar, M. & Makkonen, M. (2019). Deliberate or instinctive? Proactive and reactive coping for technostress. *Journal of Management Information Systems*, *36*(4), 1179-1212.

Pradhan, A., Mehta, K. & Findlater, L. (2018). "Accessibility Came by Accident" Use of Voice-Controlled Intelligent Personal Assistants by People with Disabilities. *Proceedings of the Conference on Human Factors in Computing Systems*, 1-13.

Qi, C. (2019). A double-edged sword? Exploring the impact of students' academic usage of mobile devices on technostress and academic performance. *Behaviour & Information Technology*, *38*(12), 1337-1354.

Ragu-Nathan, T. S., Tarafdar, M., Ragu-Nathan, B. S. & Tu, Q. (2008). The consequences of technostress for end users in organizations: Conceptual development and empirical validation. *Information Systems Research, 19*(4), 417-433.

Reinecke, L., Aufenanger, S., Beutel, M. E., Dreier, M., Quiring, O., Stark, B., Wölfling, K. & Müller, K. W. (2017). Digital stress over the life span: The effects of communication load and internet multitasking on perceived stress and psychological health impairments in a german probability sample. *Media Psychology, 20*(1), 90-115.

Riedl, R. (2012). On the biology of technostress: literature review and research agenda. *ACM SIGMIS Database: the DATABASE for Advances in Information Systems*, *44*(1), 18-55.

Roccas, S., Sagiv, L., Schwartz, S. H. & Knafo, A. (2002). The big five personality factors and personal values. *Personality and Social Psychology Bulletin*, *28*(6), 789-801.

Russell, S. & Norvig, P. (2003). *Artificial intelligence a modern approach.* Upper Saddle River, NJ: Pearson Education.

Salanova, M., Llorens, S. & Cifre, E. (2013). The dark side of technologies: Technostress among users of information and communication technologies. *International Journal of Psychology, 48(3),* 422-436.

Salo, M., Makkonen, M. & Hekkala, R. (2020). The Interplay of IT Users' Coping Strategies: Uncovering Momentary Emotional Load, Routes, and Sequences. *MIS Quarterly*, *44*(3), 1143-1175.

Salo, M., Pirkkalainen, H. & Koskelainen, T. (2019). Technostress and social networking services: Explaining users' concentration, sleep, identity, and social relation problems. *Information Systems Journal*, *29*(2), 408-435.

Salo, M., Pirkkalainen, H., Chua, C. & Koskelainen, T. (2017). Explaining information technology users' ways of mitigating technostress. *Proceedings of the European Conference on Information Systems*, 2400-2476.

Salo, M., Pirkkalainen, H., Chua, C. E. H. & Koskelainen, T. (2021). Formation and Mitigation of Technostress in the Personal Use of IT. *MIS Quaterly,* Forthcoming.

Salo, M., Pirkkalainen, H., Makkonen, M. & Hekkala, R. (2018). Distress, Eustress, or No Stress?: Explaining Smartphone Users™ Different Technostress Responses. *Proceedings of the International Conference on Information Systems,* 1-17.

Shu, Q., Tu, Q. & Wang, K. (2011). The impact of computer self-efficacy and technology dependence on computer-related technostress: A social cognitive theory perspective. *International Journal of Human-Computer Interaction, 27*(10), 923-939.

Srivastava, S. C., Chandra, S. & Shirish, A. (2015). Technostress creators and job outcomes: Theorising the moderating influence of personality traits. *Information Systems Journal, 25*(4), 355-401.

Sumiyana, S. & Sriwidharmanely, S. (2020). Mitigating the harmful effects of technostress: inducing chaos theory in an experimental setting. *Behaviour & Information Technology*, *39*(10), 1079-1093

Szabo, S., Tache, Y. & Somogyi, A. (2012). The legacy of hans selye and the origins of stress research: A retrospective 75 years after his landmark brief "letter" to the editor# of nature. *The International Journal on the Biology of Stress*, *15*(5), 472-478.

Szalma, J. L. & Hancock, P. (2007). Task loading and stress in human–computer interaction: Theoretical frameworks and mitigation strategies. *The Human-Computer Interaction Handbook,* 115-132.

Tams, S., Grover, V., Thatcher, J. & Ahuja, M. (2017). When modern technologies meet ageing workforces: older workers are more affected by demands from mobile interruptions than their younger counterparts. *Proceedings of the Hawaii International Conference on System Sciences*.

Tams, S., Thatcher, J. B. & Grover, V. (2018). Concentration, competence, confidence, and capture: An experimental study of age, interruption-based technostress, and task performance. *Journal of the Association for Information Systems*, *19*(9), 857-908.

Tarafdar, M., Cooper, C. L. & Stich, J. (2019). The technostress trifecta - techno eustress, techno distress and design: Theoretical directions and an agenda for research. *Information Systems Journal, 29(*1), 6-42.

Tarafdar, M., Gupta, A. & Turel, O. (2013). The dark side of information technology use. *Information Systems Journal, 23*(3), 269-275.

Tarafdar, M., Maier, C., Laumer, S. & Weitzel, T. (2020). Explaining the link between technostress and technology addiction for social networking sites: A study of distraction as a coping behavior. *Information Systems Journal*, *30*(1), 96-124.

Tarafdar, M., Pullins, E. B. & Ragu-Nathan, T. S. (2015). Technostress: Negative effect on performance and possible mitigations. *Information Systems Journal, 25(2)*, 103-132.

Tarafdar, M., Tu, Q. & Ragu-Nathan, T. S. (2010). Impact of technostress on end-user satisfaction and performance. *Journal of Management Information Systems*, *27*(3), 303-334.

Tarafdar, M., Tu, Q., Ragu-Nathan, B. S. & Ragu-Nathan, T. S. (2007). The impact of technostress on role stress and productivit. *Journal of Management Information Systems, 24*(1), 301-328.

Tarafdar, M., Tu, Q., Ragu-Nathan, T. S. & Ragu-Nathan, B. S. (2011). Crossing to the dark side: examining creators, outcomes, and inhibitors of technostress. *Communications of the ACM, 54*(9), 113-120.

Thatcher, J. B., Wright, R. T., Sun, H., Zagenczyk, T. J. & Klein, R. (2018). Mindfulness in Information Technology Use: Definitions, Distinctions, and a New Measure. *MIS Quarterly, 42*(3), 831-847.

Touré-Tillery, M. & McGill, A. L. (2015). Who or what to believe: Trust and the differential persuasiveness of human and anthropomorphized messengers. *Journal of Marketing*, *79*(4), 94-110.

Tu, Q., Tarafdar, M., Ragu-Nathan, T. S. & Ragu-Nathan, B. S. (2008). Improving end-user satisfaction through techno-stress prevention: some empirical evidences. *Proceedings of the Americas Conference on Information Systems*, 236.

Tu, Q., Wang, K. & Shu, Q. (2005). Computer-related technostress in China. *Communications of the ACM, 48*(4), 77-81.

Venkatesh, V., Brown, S. A. & Bala, H. (2013). Bridging the qualitative-quantitative divide: Guidelines for conducting mixed methods research in information systems. *MIS Quarterly, 37*(1), 21–54.

Wang, K., Shu, Q. & Tu, Q. (2008). Technostress under different organizational environments: An empirical investigation. *Computers in Human Behaviour, 24*(6), 3002-3013.

Winkler, R., Büchi, C. & Söllner, M. (2019c). Improving Problem-Solving Skills with Smart Personal Assistants: Insights from a Quasi Field Experiment. *Proceedings of the International Conference on Information Systems.*

Winkler, R., Neuweiler, M. L., Bittner, E. & Söllner, M. (2019b). Hey Alexa, Please Help Us Solve This Problem! How Interactions with Smart Personal Assistants Improve Group Performance. *Proceedings of the International Conference on Information Systems*.

Winkler, R., Söllner, M., Neuweiler, M. L., Conti Rossini, F. & Leimeister, J. M. (2019a). Alexa, can you help us solve this problem? How conversations with smart personal assistant tutors increase task group outcomes. *Conference on Human Factors in Computing Systems*, 1-6.

Zhang, N., Mi, X., Feng, X., Wang, X., Tian, Y. & Qian, F. (2019). Dangerous skills: Understanding and mitigating security risks of voice-controlled third-party functions on virtual personal assistant systems. *IEEE Symposium on Security and Privacy,* 1381-1396.

Zierau, N., Engel, C., Söllner, M. & Leimeister, J. M. (2020). Trust in Smart Personal Assistants: A Systematic Literature Review and Development of a Research Agenda. *International Conference on Wirtschaftsinformatik*, 99-114.