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Does the proactive personality mitigate the adverse effect of technostress on productivity in the mobile environment?

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ABSTRACT

Reliance on mobile phones as the major communication medium in our lives has become pervasive in recent years. This study extends existing technostress theory by looking at the effect of two stress sources (techno-overload and communication overload) and the accessibility on productivity of mobile phone users. Two dimensions of the proactive personality were part of the extension to examine how such a personality mitigates the effect on stress. The results show that techno-overload was more of an "enhancer" to one's productivity, rather than what was found in some other studies. Communication overload lowered one's level of productivity, but its effect was lessened by the presence of one form of the proactive personality – the ability to confront situations. Managerial implications relating to these findings are provided.

1. Introduction

The market of handheld devices has grown at an exponential rate with 172 million devices being sold in 2009 and a yearly market growth of about 20% (Magni et al., 2010). Modern mobile phones, a form of handheld devices, can be used both as a mobile telephone and as a handheld computer that can potentially integrate more than 100 specific features (Haverila, 2012). End users are free to install mobile applications that allow them to complete work that was once only possible using a full size computer. The mobility provided by handheld devices far surpasses that of the laptop and desktop computers, making such devices a close part of our lives. As a result, ubiquitous computing through mobile devices is gradually becoming a reality (Ferreira et al., 2011).

In 2013, worldwide adoption of mobile handsets and basic mobile services has reached over 6.8 billion subscribers. The mobile-cellular penetration rate stands at 96% globally; 128% in developed countries; and 89% in developing countries. Statistical data shows that the number of mobile phone users all over the world increased by almost 5 billion between 2005 and 2013; there are almost as many mobile-cellular subscriptions as people in the world (International Telecommunication Union (ITU), 2013).

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Although, as global mobile-cellular penetration approaches 100% and market saturation is reached, growth rates have fallen to their lowest levels worldwide. However, mobile broadband adoption continues at a high growth rate (International Telecommunication Union (ITU), 2013). Survey data also indicates that mobile phone users who use mobile broadband to access the Internet in America accounted for about 50.4% of the market in March 2012 with a rising tendency (Nielsen, 2012). Mobile-broadband subscriptions have climbed from 268 million in 2007 to 2.1 billion in 2013. This reflects an average annual growth rate of 40% (International Telecommunication Union (ITU), 2013).

While mobile phones facilitate inter-human communication and accelerate the dissemination of information (Sutter and Holtgraves, 2013), they are also a source of stress due to their omnipresence and intrusiveness in our lives. This phenomenon is known as "technostress" (Ragu-Nathan et al., 2008; Tarafdar et al., 2007; Wheeler and Riding, 1994). Studies have also suggested that the multiple connection capabilities of mobile devices are the key to their omnipresent nature (Mallat et al., 2004; Nah et al., 2005; Tsalgatidou and Pitoura, 2001). As a result, users immerse themselves in a ubiquitous mobile technology that ultimately blurs the distinction between work and private life (Cousins and Varshney, 2009). Such technological use can lead to intrusiveness of work into one's private life where users find themselves engaging in work activities after office hours.

Past studies on technostress show that the stress derived from ubiquitous computing devices is mainly caused by unfamiliarity with the technology and a feeling of uncertainty and insecurity regarding the use of it. Following increased information technological competence and the rising use of it in the workplace, the key factors leading to technostress are no longer the unfamiliarity but rather the extended exposure to it. The literature does not yet offer insights into this form of technostress.

Additionally the concept of omnipresence as the main cause of technostress is different from the traditional understanding of it. Generally speaking, a pressure-laden work environment creates a negative perception of the organization on the part of the staff and also negatively affects their work performance. Past studies point out that people with a proactive personality may experience less difficulty adjusting to a high-pressured work environment (Crant, 2000; Fugate et al., 2004; Savickas and Porfeli, 2012). They tend to identify opportunities and act on them; they also show initiative, take action, and persevere outwardly (Bateman and Crant, 1993). It is therefore worth researching the effect of the proactive personality on the technostress created by the omnipresence of mobile devices.

However, the literature is still quite limited in correlating the proactive personality with technostress. Fuller and Marler (2009) completed a comprehensive review of research conducted between 1993 and 2009 concerning the relationship between proactive personality traits and other variables, such as the proactive personality and career success (e.g., Byrne et al., 2008; Erdogan and Bauer, 2005; Fuller et al., 2007; Ng et al., 2005; Seibert et al., 2001), job performance (e.g., Chan, 2006; Ones et al., 2007), proactive behavior (e.g., Crant, 1995; Crant, 2000; Parker et al., 2006; Seibert et al., 2001), motivation (e.g., Major et al., 2006; Ng et al., 2005; Wayne et al., 1999) and mobility/adaptability. (e.g., Fugate et al., 2004; Karaevli and Tim Hall, 2006; Ng et al., 2005). This overview shows clearly that no study has researched the correlation between proactive personality traits and the technostress stemming from mobile technologies. It is still unclear whether employees with proactive personalities can adjust more easily to a work environment that is characterized by pervasive technostress than those with differing personality types.

Based on the overview of the current research trends provided in the preceding paragraphs, we designed this study with two objectives. First, the technostress derived from continued mobile technology use is studied for its effect on productivity. This allows us to study technostress at all user experience levels, which extends the existing research that has focused primarily on technological unfamiliarity as the main source of technostress. Second, the role of the proactive personality on the above relationship is further studied to uncover insights on the effect of it. The resulting work is expected to extend the existing technostress theory with further generalizability into personality moderated technostress.

2. Literature review

2.1. Characteristics of mobile technologies

Mobile technologies have brought portability, reduction of space and time constraints, and multi-way interaction to a higher level (Sarker and Wells, 2003; Zhou et al., 2012) that enable possibilities to transform traditional business communication (Rahmati and Zhong, 2012). The key benefits of mobile technologies, as identified by Siau et al. (2001), include (1) ubiquity: communication without time and space constraints, (2) personalization: tailor-made information and customized services, (3) flexibility: multiple forms of communication (videoconferencing, email, chat, etc.) in one device, and (4) dissemination: timely multi-way delivery of business messages to intended customers. Similarly Liang and Wei (2004) outlined two other characteristics of mobile technologies, namely mobility and reachability. Reachability is further divided into personalization, convenience, instant connectivity, ubiquity, and localization. Therefore, mobile technologies can facilitate communication that not only helps save a significant amount of time, but also greatly shortens the time required to respond to customer needs, and provide feedback.

2.2. Technostress

The term "technostress" was coined by Brod (1984). He defined technostress as "a modern disease of adaptation caused by an inability to cope with the new information and communication technologies (ICTs) in a healthy manner." Khosrowpour

and Culpan (1989) found that most of their test subjects agreed that technological changes create personal stress. Weil and Rosen (1997) defined technostress more widely as "any negative impact on attitudes, thoughts, behaviors, or body physiology that is caused either directly or indirectly by technology." Technostress is more pronounced among employees in the field of information technology, since they not only create new technologies but also have to deal with the impact of them on their work and personal life (Tu et al., 2005). To adapt to the rapid changes of the information age, many company employees have to frequently upgrade their technological knowledge and skills (thus causing a heightened level of technological stress), while being exposed to even more complicated systems and expectations of higher productivity. Technostress therefore represents a management issue that organizations are currently facing in today's technological reliance work environment. Organizations will have to adopt appropriate measures to minimize the impact of technostress.

Tarafdar et al. (2007) were among the first who developed a scale to measure technostress. The scale includes: (1) techno-overload: employees are forced to increase their workload and the pace of their work due to communication technologies. (2) Techno-invasion: communication technologies intrude into their private lives. (3) Techno-complexity: employees experience a feeling of powerlessness due to their inability to cope with the complexity of new technologies. (4) Techno-insecurity: employees feel under threat to be replaced in the face of a constant upgrade of information technologies. (5) Techno-uncertainty: constant hardware and software upgrades and the necessity of error correction put a lot of pressure on employees.

In studying technostress on productivity, Karr-Wisniewski and Lu (2010) found that an excessive use of information technology in the workplace leads to a drop in productivity. They studied three forms of it: information, communication and system feature overload. All had a negative impact on the productivity of knowledge workers.

Compared to traditional information technologies, mobile technologies are characterized by their omnipresence and accessibility. Accessibility is the ability to access communication technologies in an easy and effortless manner from anywhere at any time (Barley et al., 2010). Meso et al.'s work (2005) based on the technology adoption theory and research on technology use shows that accessibility is perhaps the most accepted determinant of individual use (Agarwal and Venkatesh, 2002; Anandarajan et al., 2000; Majchrzak et al., 2000). ICTs use also depends on the degree of accessibility and availability (Madon, 1997; Meso et al., 2005). However, pervasive accessibility also implies prolonged use or frequent use even for business reasons that could become a source of stress.

To sum up, mobile technologies are a double-edged sword that bring us all kinds of benefits, but such benefits can easily become a source of stress when they become intrusive in our lives. Through the above review, we are most interested in stress-related factors and their relationship with the accessible nature of the technology. We therefore designed this study to focus on techno-overload (Tarafdar et al., 2007), communication overload (Karr-Wisniewski and Lu, 2010), and accessibility (Meso et al., 2005) to analyze the intangible and ubiquitous stress (conceptualized as ubiquitous technostress in Hung et al., 2011a) created by the use of mobile technologies that are characterized by high accessibility, mobility, ubiquity, and connectivity.

2.3. Productivity

Productivity generally refers to the ratio of output and input. In the manufacturing sector, the term refers to the value of manufactured products in relation to investments in raw materials, manpower, and the indirect costs that are required for the production process (Sandman and Hayes, 1982). Past studies have proposed various ways to measure productivity. The work productivity scale which was developed by Torkzadeh and Doll (1999) developed a scale to measure how IT affected the following four dimensions of productivity: (1) task productivity refers to the extent to which an information technology application improves the user's output per unit of time. (2) Task innovation connotes the extent to which an application helps users create and try out new ideas in their work. (3) Customer satisfaction is defined as the extent to which an application helps the user create value for the firm's internal or external customers. (4) Management control refers to the extent to which the application helps the user regulate work processes and performance.

Tarafdar et al. (2007) employed Torkzadeh and Doll's scale to study the relationship between technostress and productivity. The results show that among the factors associated with technostress, techno-overload, techno-invasion, techno-complexity, techno-insecurity, and techno-uncertainty tend to cause a drop in productivity. Other studies have also shown that technostress negatively affects organizational productivity (e.g., Spielberger and Reheiser, 1994; Wheeler and Riding, 1994).

Some scholars, however, disagree with the view that technostress negatively affects productivity. For instance, Hung et al. (2011b) reported a positive correlation between pervasive technostress and productivity. The Yerkes–Dodson law, developed by psychologists Robert M. Yerkes and John Dillingham Dodson in 1908, provides an explanation for this phenomenon (Onyemah, 2008). This law states that stress is positively correlated with productivity up to a certain point. Excessive stress levels, however, are negatively correlated. In other words, the level of work stress determines how productivity is affected. Wilke et al. (1985) found in their research on work stress, physical health, life satisfaction, and productivity that a U-type relationship between stress and productivity does indeed exist. The research of Karr-Wisniewski and Lu (2010), which is based on the principle of decreasing the marginal benefit formulated by Parkin in 1998 also suggests that technological overload results from use that exceeds the optimum level, which in turn has a negative effect on productivity.

The above discussion clearly shows that stress generated by the use of technology affects productivity. The direction of the impact, however, depends on the stress level experienced. If users experience a moderate amount of stress, it will have a positive effect on their productivity. Excessive amounts of technostress, on the other hand, have a negative impact.

The ability to adapt to stress differs depending on the personality traits of the employees who are exposed to the same environmental conditions which are characterized by the ubiquity of mobile technologies. The role that personality traits play on individual productivity levels in stressful environments is explored further below.

2.4. Personality traits

Research (such as Costa and McCrae, 1992) has shown that unique personality characteristics are reflected in individual behavior. If these characteristics continue to persist in certain situations, they are usually called personality traits. Personality traits can play a role in organizational environments. For example, the timely ability to adjust behavior in response to the outside environment tends to give employees an upper hand for new opportunities and challenges (Fugate et al., 2004; Hirschfeld et al., 2011). Personality traits that have a positive impact on workplace performance are referred to as a "proactive personality" (Fugate et al., 2004; Fuller and Marler, 2009; Seibert et al., 1999).

A proactive personality refers to an individuals' disposition towards engaging in active role orientations, such as initiating change and influencing their environment (Bateman and Crant, 1993; Fuller and Marler, 2009). Past studies have concluded that people with a proactive personality tend not to be affected by environmental constraints or changes (Crant and Bateman, 2000). They actively seek opportunities to display their ambition and take active steps to affect changes in the environment (Crant, 2000). Fuller and Marler (2009) reviewed the existing research on proactive personality traits and suggested that these traits were positively correlated with career success, proactive behavior (including responsible attitudes and creativity), work performance, role breadth self-efficacy, and flexible role orientation. People who lack proactive personality traits usually fail to seize opportunities to make adjustments and choose to adapt to existing environments. In the face of environmental change, they are only able to adjust their behavior patterns in a passive way (Bateman and Crant, 1993; Crant and Bateman, 2000). The key differentiating feature of the proactive personality and behavior is an active rather than passive approach toward work (Bateman and Crant, 1993; Kim et al., 2009).

Bateman and Crant (1993) developed the "proactive personality scale" with 17 items and tested it with three samples of students. The scale was quite stable across these samples (Bateman and Crant, 1993; Savickas and Porfeli, 2012). Since proactive individuals are purported to "select, create, and influence work situations that increase the likelihood of career success" (Seibert et al., 2001), a proactive personality implies the ability to transform attitudes and environments, make clear-cut judgments, and face challenges directly. In a follow-up study, Onyemah (2008) found two distinct dimensions in Bateman and Crant's proactive personality scale: "a tendency to confront situations head-on" and "a tendency to transform situations into opportunities." Both types reflect a person's determination to influence the environment rather than be influenced by it (Bateman and Crant, 1993; Crant, 1995; Onyemah, 2008).

The above discussions clearly indicate that proactive personality traits play an important role in stressful environments. Such people are better able to adapt when facing technostress and are therefore less affected by techno-overload or communication overload. On the contrary, people who lack proactive personality traits are less able to adapt to the environment when facing technostress and tend to be more affected by techno-overload or communication overload.

3. Research model and hypotheses

3.1. Research framework

Based on the theoretical foundation of techno-overload and communication overload, we proposed a conceptual model and corresponding hypotheses (Fig. 1) to examine how a proactive personality affects the relationship between these two aspects of technostress and productivity. Table 1 presents the definitions of the variables used in the model.

3.2. Technostress and productivity

The main focus of this study is an analysis of the phenomenon of pervasive technostress generated by modern mobile phone technology. The scale for the measurement of technostress as developed by Tarafdar et al. (2007) includes five dimensions: techno-overload, techno-invasion, techno-complexity, techno-insecurity, and techno-uncertainty. Although their model was empirically examined through a sample of operational level employees from two organizations who used locally developed systems and generic productivity software (i.e., MS Office), the generalizability of this model outside of that realm could offer some insights. In fact, some sources of technostress identified in Tarafdar et al. may not seem dominant or influential in the mobile environment. For example, the pervasiveness of mobile devices with their user-friendly interface have made it easier for newcomers to master them. The few dominant mobile systems in the market are strikingly similar in terms of their operation. This similarity has also contributed to the flattening of the learning curve for new adopters. As a result, system complexity (or techno-complexity) has become less of a problem for mobile users. Therefore, any inability of an employee to master mobile technology will not last too long, thus diminishing the threat of techno-insecurity (job security relating to their inability to master technology). When considering technostress in the mobile environment, one is reminded of the many differences between mobile applications and traditional ICTs (as studied in Tarafdar et al.) as well as new sources of technostress (e.g., stress from the ability to communicate any time and any place).

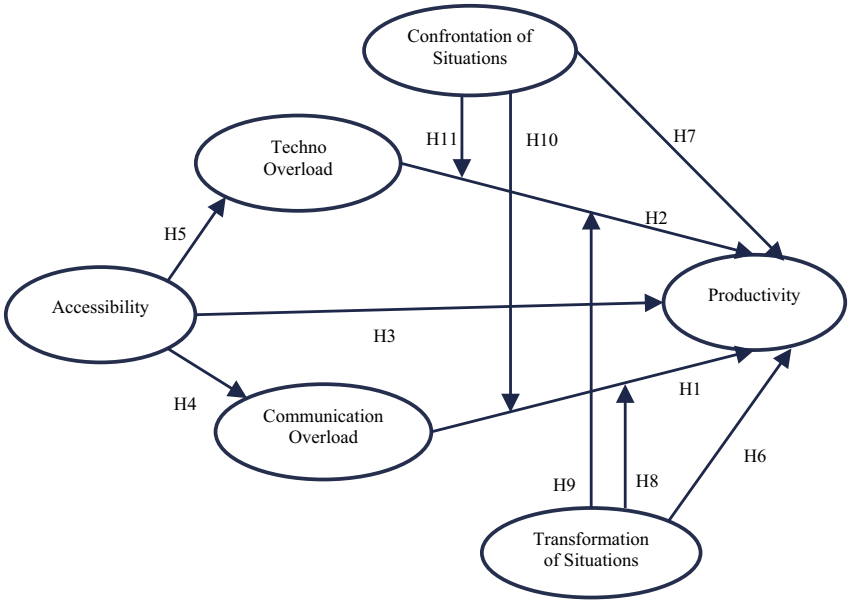

Fig. 1. Research model.

Table 1
Definition of variables.

Dimensions	Definition of measurement variables		References
Pervasive technostress	Techno-overload	Mobile technologies force staff members to accelerate their work and extend their work hours	Ragu-Nathan et al. (2008), Tarafdar et al. (2007), Tarafdar et al. (2011)
	Communication overload	Information from external sources which is transmitted via mobile technologies on a regular basis obstructs the workflow	Fisher and Wesolkowski (1999), Karr-Wisniewski and Lu (2010), Ragu-Nathan et al. (2008)
	Accessibility	Communication technologies can be accessed without effort from anywhere at any time	Barley et al. (2010), Meso et al. (2005)
Proactive personality traits	Transformation of situations	Ability to transform or surmount environments rather than adjust or acquiesce to them	Bateman and Crant (1993), Crant (1995), Crant and Bateman (2000), Kim et al. (2009), Maddi (1989), Onyemah (2008)
	Confrontation of situations	People are pro active, create environments and set them in motion as well as rebut them	Bandura (1986), Bateman and Crant (1993), Crant (1995), Crant and Bateman (2000), Kim et al. (2009), Onyemah (2008), Scheier and Carver (1993)
Productivity	Increased work efficiency and output during work hours through mobile technologies as perceived by staff members		Tarafdar et al. (2007), Torkzadeh and Doll (1999)

In addition, Karr-Wisniewski and Lu, 2010 analyzed the relationship between the excessive use of communication technologies in the workplace and productivity using three dimensions of techno-overload: information overload, communication overload, and system feature overload. Some of these dimensions may not be as pronounced for the work related use of mobile devices when compared to other forms of communication technologies. For example, some unique functions of mobile phones (such as sound recording, video recording, photography or even personal digital assistant services) allow users to store different types of information and process them at a later time in a desired sequence. This helps alleviate the problem of information overload, which, as Karr-Wisniewski and Lu suggested, is caused by excessive amounts of information that individual users are not able to process at one time.

As the interface of mobile devices continues to improve, users no longer suffer from system feature overload, resulting in a drop in productivity due to highly complex system features. Communication overload is the only dimension in mobile phone dominated work situations that still continues to exist. Due to the fact that mobile technologies can remain connected at all times through Wi-Fi or mobile networks, all forms of communication messages that are delivered very frequently and instantly can become a source of technostress.

As for the correlation between communication overload and techno-overload on the one hand and productivity on the other, we know from past research that stress has a lot of negative effects on individuals. Many studies also prove that stress

generated by technology leads to a drop in staff productivity. For instance, Tarafdar et al. (2007) discovered that technostress has a negative impact on productivity. Karr-Wisniewski and Lu's (2010) research also shows that the excessive use of information technologies by knowledge workers leads to information, communication, and system feature overload. These three factors have a negative impact on productivity. Of the three, communication overload had the biggest impact. Moreover, Tennant (2001) discovered that work stress not only affects productivity but is also the main factor leading to more and more mental disorders such as depression. Leung et al. (2005) also state that employees who are exposed to a stressful work environment not only feel overwhelmed but may also suffer from physical ailments, which in turn negatively affect their work performance. We therefore summarize the above literature development in the following two hypotheses, one for each form of the overload:

H1. Communication overload has a negative relationship with productivity.

H2. Techno-overload has a negative relationship with productivity.

3.3. Accessibility increases both technostress and productivity

Accessibility through ICT is generally considered an enhancement to the quality of our lives and personal productivity (Ollo-López and Aramendía-Muneta, 2012), but it can also be used to extend work into personal time (Ayyagari et al., 2011; Kudyba and Diwan, 2002). The constant connectivity through today's mobile phones enhances the speed of work flow and expectations of productivity (Ayyagari et al., 2011; Clark and Kalin, 1996). This clearly incentivizes businesses to push for mobile phone communications. As a result, ICTs could lead to burnout (Ayyagari et al., 2011; McGee, 1996) and the sacrificing of personal time (Middleton and Cukier, 2006; Murray and Rostis, 2007). It is regarded as a growing source of stress (Barley et al., 2010) that results from the additional demands of work causing individuals' inability to disengage from it (Ayyagari et al., 2011). We, therefore, postulate the following hypotheses between accessibility and productivity as well as two forms of technostress:

H3. Accessibility has a positive relationship with productivity.

H4. Accessibility has a positive relationship with communication overload.

H5. Accessibility has a positive relationship with techno-overload.

3.4. Proactive personality traits increase productivity

Bateman and Crant (1993) believe that people with proactive personalities attempt to stabilize their environment and will take active steps to influence their surroundings. A large number of studies indicate that proactive personality traits have a significant positive correlation with individual career success and work performance. Past studies suggest that people with proactive personalities actively seek for opportunities and take vital measures, which enable them to control environmental change and remain relatively unaffected by environmental constraints (Crant, 2000; Fuller and Marler, 2009; Seibert et al., 1999). Onyemah (2008) found two dimensions in Bateman and Crant's proactive personality scale, namely "transformation of situations" and "confrontation of situations." Based on the fact that people with proactive personalities tend to actively transform or confront situations to overcome difficulties when facing stress (Bateman and Crant, 1993; Crant, 1995), we infer that a positive correlation should exist between proactive personality traits and productivity. Based on the existing body of research (e.g., Bateman and Crant, 1993; Crant, 1995, 2000; Fuller and Marler, 2009; Onyemah, 2008; Savickas and Porfeli, 2012; Seibert et al., 1999) on the proactive personality, we propose the following two hypotheses regarding the relationship between the two proactive tendencies (transformation of situations and confrontation of situations) and productivity:

H6. Transformation of situations has a positive relationship with productivity.

H7. Confrontation of situations has a positive relationship with productivity.

3.5. Proactive personality as a moderator

Studies have shown that proactive personality traits not only have a direct effect on performance, but they may also have a moderating function in a stressful work environment (Bateman and Crant, 1993; Buss, 1987; Harvey et al., 2006; Parker and Sprigg, 1999). The research of Buss (1987) indicates that people with proactive personalities will not passively accept

stress caused by the environment. They will instead actively avoid certain social situations. They also have the ability to select situations and tend to become more active in favorable ones.

More specifically, when people with proactive personalities face a high workload, they actively manage their work requirements and thereby reduce the adverse impact of them (Parker and Sprigg, 1999). In other words, highly energetic and proactive employees are better able to adapt to high workloads and transform stress into positive energy (Harvey et al., 2006). They may even actively assist their coworkers in the performance of their work duties and engage in work behavior beyond their responsibility (Bateman and Crant, 1993). On the other hand, people who lack these personality traits are less likely to be active and energetic. They tend to passively adapt to the environment and rely on others to implement change. They are therefore more likely to passively accept work requirements, which in turn lead to stress (Parker and Sprigg, 1999).

Scholarly research also proves that proactive personality traits have an indirect moderating effect on work stress and work performance. Parker and Sprigg (1999) found in their empirical research that proactive personalities moderate the relationship between work and stress perception. At the same time, it has also been discovered that proactive personalities may moderate the relationship between interpersonal conflict as an aspect of work stress and work attitudes such as a sense of happiness or job satisfaction. Cunningham and De La Rosa (2008), on the other hand, discovered that proactive personality traits can also mitigate a negative relationship between family-work conflicts and life satisfaction. In other words, individuals with highly proactive personalities show a greater level of life satisfaction when facing high levels of work stress.

Onyemah (2008) treats "proactive tendencies" as a moderating variable in his research on the correlation between role stress and work performance. He believes that sales personnel with proactive personalities tend to be more active and energetic when facing stressful situations. Yet, the results of his study do not support this hypothesis. The present study, on the other hand, focuses on employees who are long-term users of mobile phones and mobile technologies. The type of stress they face is different from the role stress as specified by Onyemah (2008). In addition, this study aims to analyze the negative impact of the pervasive technostress that is caused by techno-overload, communication overload, and accessibility on productivity under the condition of the long term use of mobile technologies. No conclusive evidence currently exists in the literature as to whether proactive personality traits can effectively moderate the negative relationship between pervasive technostress and productivity. We therefore postulate that people with proactive personalities (as measured using Onyemah's two dimensions of his proactive personality scale) are better able to adapt to the environment when facing pervasive technostress and are therefore less likely to let techno-overload or communication overload affect their productivity:

H8. Transformation of situations can moderate the negative relationship with communication overload on productivity.

H9. Transformation of situations can moderate the negative relationship with techno-overload on productivity.

H10. Confrontation of situations can moderate the negative relationship with communication overload on productivity.

H11. Confrontation of situations can moderate the negative relationship with techno-overload on productivity.

Based on the literature, and the research framework of this study as shown in Fig. 1, this study developed 11 hypotheses, as shown in Table 2.

4. Analysis and results

4.1. Sample profile

Visitors to major online discussion forums were invited to fill out the survey. An incentive was provided to encourage participation. A total of 836 individuals responded, but some did not fit our target profile of work-related mobile phone

Table 2
Research hypotheses.

Hypotheses	Content
H1	Techno-overload has a negative relationship with productivity
H2	Communication overload has a negative relationship with productivity
H3	Accessibility has a positive relationship with productivity
H4	Accessibility has a positive relationship with communication overload
H5	Accessibility has a positive relationship with techno-overload
H6	Transformation of situations has a positive relationship with productivity
H7	Confrontation of situations has a positive relationship with productivity
H8	Transformation of situations can moderate the negative relationship with communication overload on productivity
H9	Transformation of situations can moderate the negative relationship with techno-overload on productivity
H10	Confrontation of situations can moderate the negative relationship with communication overload on productivity
H11	Confrontation of situations can moderate the negative relationship with techno-overload on productivity

Table 3
Respondent profile.

Variable	Value	Frequency	Percentage (%)
Gender	Male	359	59.73
	Female	242	40.27
Age	20 or below	3	0.50
	21–30	493	82.03
	31–40	91	15.14
	41–50	7	1.17
	51 or more	7	1.17
Education	Junior high	2	0.33
	Senior high	13	2.16
	College	418	69.55
	Master's	161	26.79
	Ph.D.	7	1.17

users. This type of population was targeted because work-related stress was our main focus. Six hundred and one remained in the final data set after removing missing data, and individuals outside of the target group.

Of the six hundred and one respondents, 359 (59.73%) were male and 242 (40.27%) were female. The gender representation leant slightly toward the male. Most respondents were between 21 and 30, followed by the second largest group of between 31 and 40. The majority had a college or above degree with college students being the largest group (69.55%) followed by those with a master's degree (26.79%). Mobile phone usage is fairly even between the three groups with 1–2 times per day being the largest group (37.77%). This is followed by 6 times or more per day (32.11%) and 3–5 times per day (30.12%). Demographic details are also reported in Table 3.

4.2. Measurement model, construct validity and reliability

The survey questionnaire was sent to three experienced scholars and three practitioners to ensure an acceptable level of face validity. Wording problems, ambiguity and sentence structure were improved following the suggestions of these experts. The revised version of the questionnaire was then pre-tested by thirty individuals who use mobile phones for work. Further improvements were made to arrive at the final version of the questionnaire.

The psychometric properties of the measures for latent variables were studied by examining their factor loadings, construct validity and reliability. Confirmation factor analysis (CFA) was first conducted to study the measurement model and the corresponding construct indicator variables. The fit indices ($\chi^2 = 668.155$, d.f. = 258, $\chi^2/\text{d.f.} = 2.59$, CFI = 0.942, TLI = 0.932, RMSEA = 0.051) were reasonably well compared to commonly accepted guidelines (e.g., $\chi^2/\text{d.f.} < 5$, CFI > 0.900, TLI > 0.900, RMSEA < 0.08), providing some basic evidence for the model fit (chi-square = χ^2, comparative fit index = CFI, Tucker–Lewis index = TLI, root mean square error of approximation = RMSEA).

Convergent validity refers to the principle that indicator variables for the same construct should correlate among themselves at least moderately. It was tested by checking if the factor loadings of indicators for a construct were statistically significant and above 0.500. The results from CFA showed that the smallest factor loading of all indicators was 0.580 and the largest was 0.876. Additionally, Fornell and Larcker (1981) suggested that measures should contain less than 50% of the error variance to show an adequate level of convergent validity (i.e., average variance explained, AVE should exceed 0.500). Table 4 shows that all AVEs range from 0.573 for confrontation of situations to 0.760 for productivity, all exceed the minimum threshold of 0.500.

Discriminant validity refers to the principle that indicators of a construct should not be highly correlated with the indicators of a different construct. The widely used guideline suggested by Fornell and Larcker offers the foundation for testing discriminant validity, where the square root of the AVE for a construct should be greater than the correlations shared between the current and other constructs. In the last four columns of Table 4, the square root of a construct's AVE is shown in bold face on the diagonal line and all off-diagonal entries were correlations among constructs. As the table shows, all diagonal values exceed the inter-construct correlations, thus the discriminant validity is reasonably sufficient.

Furthermore, construct reliability was checked by calculating Cronbach's alpha and composite reliability for each construct. The results in Table 4 indicate that these reliability measures range from 0.744 to 0.895 for Cronbach's alpha and 0.840 to 0.927 for composite reliability (CR). All exceeded the widely accepted minimum of 0.700, providing some reasonable evidence for construct reliability.

4.3. Proactive personality

The proactive personality scale was originally developed by Bateman and Crant (1993), where they tested the 17-item instrument with three samples of students. Results suggested that the instrument was fairly stable across all three. Onyemah (2008) modeled his proactive personality instrument after Crant and Bateman (2000), showing that two distinctive dimensions were possible. Onyemah named the two: "tendency to confront situations head-on" (four items)

Table 4
Reliability and validity.

	Alpha	CR	AVE	Acce	Comm	Tech	Conf	Trans	Prod
Accessibility	0.821	0.881	0.651	**0.807**					
Communication overload	0.797	0.867	0.621	0.486	**0.788**				
Techno Overload	0.784	0.860	0.607	0.566	0.406	**0.779**			
Confrontation of situations	0.744	0.840	0.573	0.235	0.098	0.242	**0.757**		
Transformation of situations	0.861	0.900	0.644	0.177	0.172	0.270	0.635	**0.802**	
Productivity	0.895	0.927	0.760	0.239	−0.067	0.371	0.385	0.266	**0.871**

Note: The square root of a construct's AVE is shown in bold, accessibility = Acce, communication overload = Comm, techno overload = Tech, confrontation of situations = Conf, transformation of situations = Trans, productivity = Prod.

and "tendency to transform situations into opportunities" (seven items). To verify Onyemah's results, we first entered all his proactive personality variables into an exploratory factor analysis. The results after applying the varimax rotation suggest a two-factor solution. We ran several further tests to confirm the dimensionality of this construct, including a scree plot, a very simple structure criterion, and a chi square significance test. All recommended a two-factor solution. Following Onyemah's convention, the two factors were named "tendency to confront situations" and "tendency to transform situations." The Cronbach's alpha for confrontation of situations was 0.744 and for transformation of situations it was 0.861.

4.4. Moderator in the structural model

A Partial Least Squares (PLS) was conducted to test the structural model. The path coefficients of a PLS are similar to those of the standardized beta coefficients of regressions. A bootstrap re-sampling procedure was conducted to validate the statistical significance of path coefficients.

As the moderator (i.e., the proactive personality) is a latent variable, Marsh et al.'s (2004) work on an unconstrained approach to model the latent interaction effect seems appropriate. In the unconstrained approach, indicators of each latent variable involved are first centered (or standardized as suggested in Chin et al., 2003) and then used to create product indicators for the interaction term. Centering (or standardizing) helps lower the correlations among the product indicators (Chin et al., 2003). This approach, as Marsh et al. put it implies that "... no complicated nonlinear constraints are imposed to define relations between product indicators and the latent interaction factor (as in the constrained approach)" and "... the unconstrained approach does not impose any constraints derived from the multivariate normality assumption of the latent variables as does the constrained approach" (p. 277). These properties of the unconstrained approach are favored and widely used in studies that model latent interaction effects.

Following the above unconstrained approach, four latent interaction terms were created by calculating the standardized product indicators of the two proactive personality dimensions and the two antecedent variables of productivity (i.e., techno-overload and communication overload).

Fig. 2 the structural model that includes the whole sample. As predicted, accessibility lead to the two types of overload (techno overload and communication overload were 0.566, $p < 0.001$ and 0.486, $p < 0.001$, respectively), which in turn influenced the ultimate dependent variable-productivity. The direct effect of communication overload on productivity is negative (−0.299, $p < 0.001$), meaning that the higher the perception of communication overload, the lower the productivity. But, techno overload had a direct positive effect on productivity (0.317, $p < 0.001$), suggesting that the higher the perception of communication overload, the higher the productivity. The direct effect of accessibility on productivity was positive (0.125, $p < 0.001$), meaning that the higher the perception of accessibility, the higher the productivity.

Both confrontation of situations and transformation of situations also had a direct positive effect on productivity (0.178, $p < 0.001$ and 0.188, $p < 0.001$, respectively). The only significant moderating effect was confrontation of situations ($p < 0.05$) on the relationship between communication overload and productivity. The path coefficient of the moderating effect was negative (−0.118), suggesting that higher confrontation of situations worsened the effect of communication overload on productivity (show in Table 5).

To sum up, we conducted a structural equation model analysis with two proactive personality traits as moderating variables. Table 6 summarizes the results of the hypothesis test. In total, the results of the seven hypotheses are considered significant based on the statistical analyses while four are not supported. The results of the hypotheses tests are described below.

First, we proposed two hypotheses regarding the relationship between communication overload and techno-overload on the one hand and productivity on the other: H1. Communication overload has a negative relationship with productivity, and H2. Techno-overload has a negative relationship with productivity. Only hypothesis 1 was proven to be valid. This indicates that the higher the communication overload experienced by mobile phone users, the lower their productivity will be. H2 could not be sustained. In other words, higher levels of techno-overload do not lead to lower productivity levels but rather to a significant increase in productivity.

Second, we formulated three hypotheses regarding the relationship between accessibility on the one hand and productivity and the two technostress variables on the other: H3. Accessibility has a positive relationship with productivity; H4. Accessibility has a positive relationship with communication overload; H5. Accessibility has a positive relationship with

Table 5
Results of structural model.

Independent variable	Direction	Dependent variable	Direct effect	Moderation effect	
				Confrontation of situations	Transformation of situations
Accessibility	→	Techno overload	0.566***	–	–
Accessibility	→	Communication overload	0.486***	–	–
Techno overload	→	Productivity	0.317***	−0.057	-0.019
Accessibility	→	Productivity	0.125**	–	–
Communication overload	→	Productivity	−0.299***	−0.118*	0.063
Confrontation of situations	→	Productivity	0.178***	–	–
Transformation of situations	→	Productivity	0.188***	–	–

* $P < 0.05$.
** $P < 0.01$.
*** $P < 0.001$.

Table 6
Results of hypothesis test.

Hypotheses	Content	Results
H1	Communication overload had a negative relationship with productivity	Supported
H2	Techno-overload had a negative relationship with productivity	Not supported
H3	Accessibility had a positive relationship with productivity	Supported
H4	Accessibility had a positive relationship with communication overload	Supported
H5	Accessibility had a positive relationship with techno-overload	Supported
H6	Transformation of situations had a positive relationship with productivity	Supported
H7	Confrontation of situations had a positive relationship with productivity	Supported
H8	Transformation of situations can moderate the negative relationship with communication overload on productivity	Not supported
H9	Transformation of situations can moderate the negative relationship with techno-overload on productivity	Not supported
H10	Confrontation of situations can moderate the negative relationship with communication overload on productivity	Supported
H11	Confrontation of situations can moderate the negative relationship with techno-overload on productivity	Not supported

techno-overload. All three hypotheses were found to be valid. This indicates that moderately higher levels of Accessibility tend to raise the productivity levels of mobile phone users. If accessibility exceeds manageable levels, higher levels of accessibility will lead to significant communication and techno-overload.

Third, we postulated two hypotheses regarding the relationship between the two proactive personality traits (“transformation of situations” and “confrontation of situations”) and productivity: H6. Transformation of situations has a positive relationship with productivity; H7. Confrontation of situations has a positive relationship with productivity. Both hypotheses were supported by our analysis. This signals that mobile phone users with proactive personality traits such as “transformation of situations” or “confrontation of situations” exhibit higher productivity levels.

Finally, we proposed a hypothesis regarding the moderating effect of the two proactive personality traits on the impact of pervasive technostress on productivity: H8. Transformation of situations can moderate the negative relationship with communication overload on productivity; H9. Transformation of situations can moderate the negative relationship with techno-overload on productivity; H10. Confrontation of situations can moderate the negative relationship with communication overload on productivity; H11. Confrontation of situations can moderate the negative relationship with techno-overload on productivity. Only hypothesis 10 was found to be valid. This shows that only “confrontation of situations” had a significant moderating effect on the negative impact of technostress on productivity. This effect is confined to the phenomenon of communication overload since no significant impact of “confrontation of situations” on the correlation between techno-overload and productivity could be observed. “transformation of situations”, on the other hand, had no significant moderating effect on the correlation between the two aspects of technostress (communication overload and techno-overload) and productivity.

4.5. Discussions on findings

The results of this study lead to several directions of discussion. Past studies on the relationship between accessibility and technostress (including techno-overload and communication overload) on the one hand and productivity on the other have found that the accessibility of mobile phones tends to raise the productivity of workers due to the ubiquity and connectivity of these devices that allows users to work efficiently without any time or space constraints (Middleton and Cukier, 2006; Murray and Rostis, 2007). However, due to the accessibility of these devices, users also experience technostress (Karr-Wisniewski and Lu, 2010; Tarafdar et al., 2007). This study discovered that the higher the communication overload, the more pronounced the negative effect on productivity would be. While in the past it was believed that techno-overload had a negative impact on the productivity of workers (Tarafdar et al., 2007), the present study shows that techno-overload actually leads to improved work performance.

The above mentioned difference may possibly be explained in the following way: Tarafdar et al.'s sample included operational level personnel who were asked to use their in-house built systems that may have imposed some steeper learning curves. Technological complexity has been more of a road blocker than an enabler until users were more comfortable with it. In the mobile environment, the major operating system (OS) players are exceedingly similar in terms of the forms of user interactivity provided in their systems. This spurred the famous patent fight on user interface, design usability and data handling techniques between Apple and Samsung recently. The similarity of user experience across mobile OS vendors has greatly reduced technological complexity. As a result of road blockers being eliminated or reduced, productivity has been boosted.

The results of this study also indicate that the omnipresence and accessibility of mobile phones has both advantages and disadvantages. While accessibility increases the possibility of techno-overload that helps improve work performance, it also causes communication overload that lowers the productivity of mobile phone users. The role of accessibility on productivity, however, is both direct and indirect. The direct effect was 0.125, while the indirect effects are 0.179 ($0.566 * 0.317$) through techno-overload and -0.145 ($0.486 * -0.299$) through communication overload. All three paths as shown in Fig. 2 are rather similar in magnitude, with the path through techno-overload being the strongest, and the direct effect being the weakest. Since these effects vary by approximately 0.05, they are quite similar in weight on productivity in a practical sense. This empirical result again shows that accessibility can have both a positive and a negative effect on productivity.

Consistent with past studies (e.g., Bateman and Crant, 1993; Crant, 1995; Crant, 2000; Fuller and Marler, 2009; Seibert et al., 1999), our work confirms the direct effect of the proactive personality on productivity. We went a step further following Onyemah's conception of dimensionality to look at the effect of the two dimensions on productivity. The results show that even the two dimensional construction of the construct is consistent with the prediction that the proactive personality has a positive effect on productivity. Compared to the two sources of stress (techno-overload and communication overload), the direct effect of the proactive personality (0.178 for confrontation of situations and 0.188 for transformation of situations) is not as strong. This is indicative that the proactive personality comes second after stress in regard to affecting levels of productivity.

We were even more interested in whether or not these two proactive personality traits would have a significant moderating effect on the relationship between technostress and productivity. To the best of our knowledge, there were then no studies that could shed any light on this issue. The results of this study, however, clearly indicate that not all proactive personality traits are able to moderate the relationship of stress sources on productivity. First, the two proactive personality dimensions in this study had no statistically significant moderating effect on the relationship between techno-overload and productivity. Since techno-overload is found to have a positive effect on productivity, having a proactive personality does not further enhance or reduce that. Second, the negative effect of communication overload on productivity is lessened through one of the proactive personality dimensions (confrontation of situations), but not the other one. By taking both points together, it appears that the proactive personality is more of a stress reducer through the removal of obstacles. This is confirmed by the nature of the questions asked to measure the confrontation of situations (e.g., overcome obstacles, fix problems that I do not like, champion one's own ideas and tackle problems head on).

The above discussion shows that only one of the two proactive personality traits has a significant moderating effect on the relationship between technostress and productivity. Past research points out that it has quite a diverse moderating effect on

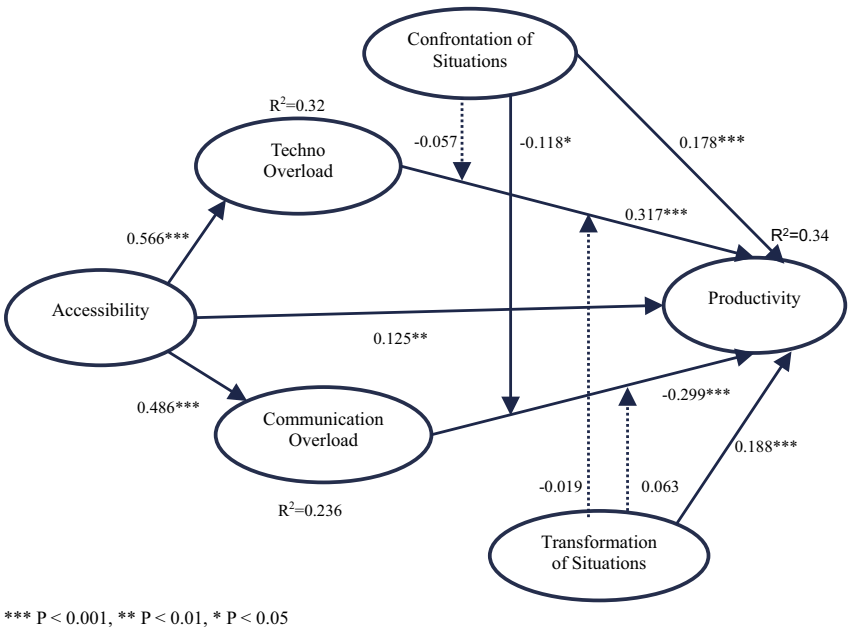

Fig. 2. Structural model.

several different variables. For example, Parker and Sprigg (1999) found that it had a moderating effect on job demands, but not on job control. Harvey et al.(2006) found the moderating effect of it on the relationship between conflict and four out of five outcome variables (including grades, exhaustion from work, exhaustion from school, and job satisfaction), while it had no direct effect on all these four outcome variables. Although these studies imply that the moderating effect of the proactive personality on performance related outcome variables is possible, it is not consistently found to be so. Despite much research, there is very little empirical evidence on the relationship of stress sources and productivity, a situation which is happening all around us in today's technologically centric environment.

5. Conclusions

In contrast to the studies on technostress in the past, we focused on two key stress variables (namely communication overload and techno-overload) because they were better related to the domain of our applications-mobile phones. This study tested whether proactive personality traits could increase the productivity of mobile phone users and moderate the relationship between pervasive technostress and productivity. The results clearly indicate that the omnipresence and accessibility of mobile phones has a positive effect on communication overload and techno-overload. Techno-overload, however, improves the work performance of mobile phone users, while communication overload tends to lower their productivity levels.

Moreover, this study also shows that mobile phone users with proactive personality traits such as transformation of situations or confrontation of situations tend to perform better at their jobs. People who are able to confront situations tend not to be affected by the negative impact of communication overload on productivity. Generally speaking, technostress caused by the accessibility of mobile phones has different effects on productivity. While techno-overload improves the work performance of mobile phone users, communication overload leads to a lower productivity level. Workers with proactive personality traits exhibit a higher productivity level if they use mobile phones. The confrontation of situations as a personality trait, in particular, has a more pronounced moderating effect on the negative correlation between communication overload and productivity.

5.1. Contributions

The current study contributes to the academic field in several ways. The first key contribution from the theoretical standpoint is the extended generalizability of the two dimensional form of the proactive personality into the mobile environment. Onyemah's work was one of the first that extended Bateman and Crant (1993) and Crant (1995)'s scale on the proactive personality into the two-dimensional form, but it was administered to salespeople and their sales performance with no regard to technology. Our confirmation of the dimensionality through a series of factor selection tests shows that the two-dimensional version of the construct is viable and empirically recommended to model mobile phone users.

Second, apart from the general conception of the proactive personality being a positive force in many areas, we are able to offer deeper insights into its role. Our findings show that the proactive personality has a direct positive effect on productivity, but a mixed moderating effect on the relationship between stress sources and productivity. Despite Bateman and Crant's statement that "proactive people scan for opportunities, show initiative, take action, and persevere until they reach closure by bringing about change" (p. 105) leading to the conception of the direct effect of the proactive personality on outcome variables (such as productivity), such a relationship is not always supported (in such studies as Parker and Sprigg, 1999). Our work not only empirically supports Bateman and Crant as well as the general belief, but it also shows that both dimensions of the proactive personality have a rather similar direct positive effect on productivity. In other words, either the transformation type of proactive personality or the confrontation type can lead to a heightened level of productivity. The moderating role of the proactive personality only lessens the negative effect of communication overload, while posing no statistically significant effect on boosting or lessening techno-overload.

Our third area of contribution lies in the fact that our work represents the later part of the technological learning curve. Compared with Tarafdar et al.'s work which showed that techno-overload had a negative relationship with end user performance through the second-order variable called technostress creators, our positive relationship between techno-overload and productivity seems quite different. As we discussed before, the similarity of users' experience in mobile operating systems and a simplified user interface have likely made it easier (or a flat learning curve) for users to master the system features (even across different platforms). Therefore, techno-overload in our work represents the vast amount of features and apps on mobile phones that could "overwhelm" users, but this comes with a positive implication for one's own productivity. The fourth area of our contribution is derived from the inclusion of accessibility and two of its resulting types of stress sources (techno-overload and communication overload) all studied together for their intertwined direct and mediating effects. With this approach, we were able to present a more balanced result from multiple angles.

5.2. Implications

The results of this study have the following implications. First, regarding technostress, techno-overload is positively related to productivity, while the effect of communication overload on it is negative. This indicates that managers should actively encourage employees to use these new technologies, since the techno-overload caused by mobile phones raises

productivity levels. This study also found that the use of new mobile technologies not only has no significant negative effect on users' productivity levels, but that it actually allows workers who use them to achieve good results with comparatively little effort.

Mobile phone use does however generate communication overload, which has a negative impact on productivity. Work-related mobile phone communication should therefore be kept at a moderate level outside of normal work hours. If communication exceeds the manageable level, communication overload will likely occur. Managers are recommended to reduce the frequency of mobile phone use for work assignments and other work related tasks. One strategy is to reduce the communication frequency by combining multiple discrete communications into one aggregated message delivered preferably within normal work hours. Since techno-overload was found to have a positive effect on productivity, one other possibility is to employ a software-based work flow system that automatically directs tasks to the intended recipients. Employees, on the other hand, are recommended to communicate with their supervisors and clients in an efficient and timely manner during work hours that allows for resolution of matters before the end of the day. Similarly a work-flow system may be adopted for the same reason of keeping communication centrally controlled.

Second, the results of this study also show that the accessibility of mobile phones is positively correlated with communication overload and techno-overload. In other words, the widespread use of mobile phones generates the stress and strain related to the exposure to communication and technology. Managers are recommended to encourage mobile phone use for work related reasons since accessibility is a necessary prerequisite for effective communication, but it should be treated with respect for one's privacy and personal times in order not to cause a heightened level of stress.

With regard to proactive personality traits on technostress and productivity, the results of this study show that workers with such traits exhibit a higher level of productivity. In addition, we also found that people who are able to confront situations can mitigate the stress coming from communication overload. These two results also signal that proactive personality traits are one of the key factors affecting productivity. During the hiring process, managers can therefore make use of aptitude and personality tests to determine how to fit unique personality traits into appropriate job applicants. Managers can also organize regular on-the-job training courses for current staff members who lack proactive personality traits to give them an opportunity to acquire them thereby providing them with the ability to face communication overload in a positive manner. This will also enable them to seek for and develop appropriate solutions to reduce the negative impact of communication overload on their productivity.

In conclusion, an efficient use of mobile technologies, which are characterized by convenient connectivity while avoiding excessive levels of communication overload, is a key factor affecting the productivity of users. Furthermore, by providing them with proactive personality traits and stress management skills, the negative impact of communication overload on productivity can be moderated.

5.3. Limitations and future research

This study has several limitations. In our research, we focused solely on workers who use mobile phones in the workplace and did not conduct an analytical comparison of different occupational fields. Future studies could examine workers in different occupational sectors such as the hi-tech and financial sectors. Future research could also investigate the difference in the technostress levels experienced by different occupational groups and the reasons for the difference. In addition, future studies could also focus on different occupational echelons and work experience categories (e.g., different levels of technostress experienced by lower-level employees and upper-echelon managers or employees with different experience levels during mobile phone use) as well as analyze the reasons for the different stress levels.

Furthermore, our sample was drawn from university graduates and lower-level employees with less than three years work experience. Our results are therefore only applicable to these groups. Finally, the productivity in this study was collected from self-reported perceptions, rather than actual figures from the field. One way to improve a future study would be to collect the productivity data from multiple sources (e.g., opinions of superiors or actual statistical data) when a more unified measure becomes available across the multiple roles of employees.

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