

The Version of Record of this manuscript has been published and is available in Harris, D., Li, WC. (eds) Engineering Psychology and Cognitive Ergonomics. HCII 2022. Lecture Notes in Computer Science, vol 13307. Springer, Cham, published on June, 16th, 2022.

[https://doi.org/10.1007/978-3-031-06086-1\\_12](https://doi.org/10.1007/978-3-031-06086-1_12)

## **Influence of technostress on work engagement and job performance during remote working**

Michele Di Dalmazi<sup>1</sup>[0000-0003-2878-8509], Marco Mandolfo<sup>1</sup>[0000-0001-6971-2194],  
Chiara Stringhini<sup>1</sup>[0000-0003-4221-6099], and Debora Bettiga<sup>1</sup>[0000-0002-0903-5328]

<sup>1</sup> Politecnico di Milano, Department of Management, Economics and  
Industrial Engineering, Via Lambruschini 4/B, 20156, Milan, Italy  
(michele.didalmazi; marco.mandolfo; debora.bettiga)@polimi.it  
chiara.stringhini@mail.polimi.it

**Abstract.** The Covid-19 pandemic forced millions of people worldwide to engage in remote working practices, and several organisations are expected to continue adopting work-from-home even in the post-pandemic scenario. This phenomenon has highlighted the importance of human-technology interaction in enabling telework, but it has also increased awareness about the potential adverse effects of information and communication technologies (ICTs) on employees' wellbeing. Even if recent literature has delved into these consequences in terms of technostress, there has been little quantitative analysis within the telework literature. The present study aims to fill this gap by introducing and testing an empirical model grounding on a transactional-based model of stress. We assess the influence of three techno-stressors (i.e., techno-overload, techno-complexity, and techno-invasion), two typologies of individual psychological responses as mediator variables (i.e., affective and cognitive strain), and individuals' work outcomes (i.e., work engagement and job performance). We collected self-reports through survey research involving a sample of 135 remote workers. Data was analysed using Partial Least Square – Structural Equation Modeling. The results show that techno-overload positively influences affective strain, techno-invasion positively influences both affective and cognitive strain, while techno-complexity positively influences cognitive strain. Further, we show that cognitive strain negatively affects both work engagement and job performance, while affective strain negatively influences only job performance. Possible stress coping strategies based on the redesign of the working environment and mindfulness practices to inhibit techno-stressors are discussed. Also, we discuss how adaptive systems tracking individual behavioral and cognitive strain can create positive feedback loops to enhance individual wellbeing.

**Keywords:** technostress; stress; remote working; home office; personal wellbeing; technology.

## 1 Introduction

The evolution of technology has impacted a plethora of fields without neglecting the professional one. Over the last decades, information and communication technologies (ICTs) have allowed telework to constantly evolve and diversify, providing organisations with manifold possibilities in terms of where, when, and how work can be performed. Moreover, during 2020 and early 2021, the outbreak of the Covid-19 pandemic forced a sizable portion of organisations to introduce mandatory remote working practices, permanently modifying the perception of the physical and temporal dimensions of the workplace by the employees. This phenomenon has underscored the relevance of human-technology interaction to enable work-from-home, but it has also raised awareness about the side effects that ICT-mediated telework could have on employees' wellbeing. Transitioning to home offices and employing ICTs to cooperate with colleagues has reportedly led to a fragmentation of work and influenced individuals' emotional stability, fatigue, and stress [1, 2].

In 1984, Brod defined technostress for the first time as “a modern disease of adaptation caused by an inability to cope with the new computer technologies in a healthy manner” [3]. So far, different studies have investigated technology-driven stressors which might induce strain and produce job-related outcomes in the workplace (e.g., [4, 5]) but less attention has been paid to remote-working settings. The unprecedented change that emerged from the pandemic offered the unique opportunity to study technology-human relationship. Research has shown that in nearly the 50% of organisations, the 81% of the employees had worked remotely during the coronavirus pandemic [6]. Interestingly, the same study revealed that about 40% of employees estimated to work remotely even in the post-emergency scenario. Hence, to see remote working as a viable alternative for the foreseeable future, it is essential to evaluate the long-term impacts of technology-driven stressors on individuals' wellbeing and organizational performance. To the best of our knowledge, there has been little quantitative analysis within the telework literature investigating the relationship between techno-stressors, individual psychological responses, and outcomes in terms of employees' work engagement and performance in the workplace.

The present study aims to fill this gap by assessing the influence of three techno-stressors (i.e., techno-overload, techno-complexity, and techno-invasion), two typologies of individual psychological responses as mediator variables (i.e., cognitive and affective strain), and individuals' work outcomes (i.e., work engagement and job performance).

## 2 Background

Even if remote working has become popular in recent years due to COVID-19 emergency, the practice is older in time. The first conceptualisation dates back to 1970s, when Jack Nilles shaped the notion of “telecommuting network” as the assembly of “computational and telecommunications components which enable employees of large organisations to work in offices close to (but generally not in) their homes, rather than commute long distances to a central office” [7]. During the COVID-19 pandemic, internet-based services became the primary mean to communicate, interact, and accomplish job task. However, prior research has described that certain processes may be accountable for delivering adverse reactions to ICTs. These processes can be summarised under the wide concept of “technostress”. Technostress is an IT user’s experience of stress when using technologies [5]. Hence, investigations on technostress are rooted in previous studies on general work stress. In the present paper we investigate such a construct following a transactional-based conceptualisation of stress [8]. With this end, we formulate a conceptual framework that encompasses three layers, namely techno-stressors, psychological strain, and organisational outcomes. These are illustrated in Fig. 1 and discussed in the following.

### 2.1 Techno-stressors

Techno-stressors are those technology-related factors that may create strain [5]. In 2007, Tarafdar and colleagues identified five techno-stressors that have been widely discussed by the majority of cross-sectional studies [4]. Those factors are techno-overload, techno-invasion, techno-complexity, techno-insecurity, and techno-uncertainty. Since the present study aims at investigating the effect of technostress caused by telework practices during the COVID-19 period, three techno-stressors are considered: techno-overload, techno-complexity, and techno-invasion. Indeed, techno-insecurity and techno-uncertainty relate most directly to the organisation's workplace, resulting in less suitable items to be investigated in the remote working environment.

First, techno-overload can be defined as ICTs’ potential to force users to work more, faster, and longer. This situation may elicit a change in work habits through the imposition of more work to be handled within very tight time schedules [9]. Second, techno-invasion is the ICTs’ effect of invading users' personal lives through constant connectivity. The continuous exposure to information conveyed by ICTs leads workers to be constantly accessible, resulting in individual’s losing control of time and space [4]. This situation presents many adverse effects on the individuals. For instance, a study noted that workers' perception of being constantly “on-call” negatively affects their sense of security and job satisfaction [10]. Finally, techno-complexity describes the situations in which ICTs’ features and complexity make users feel inadequate concerning their skills [4]. Since ICTs are subject to constant changes and updates, the hard skills needed - including technical capabilities and terminology - become more and more complex. This situation introduces anxiety and fear in all the employees who find new technolo-

gies intimidating and difficult to understand [11]. As mentioned before, these conditions may cause a series of adverse psychological, behavioural, and physical reactions known as individual strain.

## 2.2 Strain

Strain is defined as the individual's response to techno-stressors. Tarafdar et al. [9] proposed that techno-stressors can influence both the extent to which individuals are satisfied with the ICT applications they use and the job performed. Hence, there is a distinction between adverse job-related outcomes and adverse ICT-use related outcomes. Job-related outcomes include psychological strains, namely emotional reactions to stressor conditions such as dissatisfaction with the job, depression, and negative self-evaluation [9]. In psychology, this kind of strain occurs when organisational stress lead to ineffective cognitive functioning or disturbed affective states [12]. Consequently, we theorise it is further possible to distinguish between two components of technostress-induced psychological strain: the cognitive and affective components.

From one side, cognitive strain depicts the negative effect on individual cognitive functioning, namely the mental processes involved in information processing such as attention, working memory, decision-making, and learning [13]. On the other side, the term "affect" refers to the mental counterpart of internal bodily representations associated with emotions [14]. Affective strain is a significant outcome in stress research because it is inherently linked to the experience of stressful situations [15]. Hence, the construct is widely used in occupational stress research. In this study, the affective component of psychological strain is conceptualised as an individual state characterised by high arousal and displeasure, reflecting the anxious condition of affective wellbeing [16]. This decision is intended to mirror the stress impact on the affective component theorised by Pejtersen et al. [17].

Prior research has described various affective dimensions of strain (such as anxiety [18], and tension [19]) as well as negative cognitive experiences (e.g., fatigue and exhaustion [20]) due to the use of technologies. For instance, Lewis underlined that the use of ICT may lead to poor decision-making, difficulty in memorising and remembering, and a reduced attention span [21]. For these reasons, we suppose that the techno-stressors has an influence on an individual's cognitive and affective reactions. Specifically, remote working may force users to work more and fulfil multiple demands within very tight time schedules. This simultaneous exposure to multiple stimuli creates a gap between what they are demanded to do and what they can efficiently handle [22]. Hence, we hypothesise that this exhausting condition may deliver negative consequences both from a cognitive and affective viewpoint. Namely:

H1a: Techno-overload has a positive influence on affective strain

H1b: Techno-overload has a positive influence on cognitive strain

Moreover, the invasion of private life due to technology may create pressures of constant connectivity (techno-invasion). This scenario may lead employees to manifest

symptoms like fatigue, burnout, tension, and dissatisfaction, thus influencing cognitive and affective response. Consequently, we propose the following hypothesis:

H2a: Techno-invasion has a positive influence on affective strain

H2b: Techno-invasion has a positive influence on cognitive strain

Finally, techno-complexity forces workers to spend resources learning and understanding ICTs, to not feel unskilled [9, 23]. This condition may raise negative affective states such as anxiety in all those employees who find new technologies intimidating [11], making ICT learning processes difficult [24], and thus requiring higher cognitive efforts. Formally:

H3a: Techno-complexity has a positive influence on affective strain

H3b: Techno-complexity has a positive influence on cognitive strain

### 2.3 Job-related Outcomes

The consequences of technostress are not limited to individuals' wellbeing since strain can lead to organisational outcomes too. Several studies have investigated the unfavourable effect of techno-stressors on companies' performance such as organisational commitment [5] and productivity [23]. However, very few studies have addressed the topic of job engagement within telework practice and none have investigated the relationship between techno-stressors, strain, and work engagement. According to Khan's definition of work engagement, employees are engaged when they are physically, cognitively, and emotionally connected with their work [25]. Work engagement has been discussed in the "off-line" job context because of its direct impact on organisational results. Indeed, engaged employees experience positive feelings like gratitude, joy, enthusiasm, and better health [26], resulting in readiness to dedicate their full resources to accomplish work goals and, as a consequence, to work more [4]. To be engaged, employees should present a significant involvement both from a cognitive and emotional point of view. Hence, it is expected that psychological strain shows a negative relationship with work engagement. Hence, the following hypotheses are theorised:

H4a: Affective strain has a negative influence on work engagement

H4b: Cognitive strain has a negative influence on work engagement

Campbell described individual work performance as "behaviours or actions that are relevant to the goals of the organisation" [27], entailing that: (i) individual work performance should be defined in terms of behaviours rather than results, and (ii) it includes only those behaviours that are relevant to the organisation's goals [28]. As a consequence, individual work performance is not output-oriented (as productivity); rather it can be measured through quality of outputs, job knowledge, and leadership, to name three [29]. Individual work performance is a multidimensional, abstract, and latent construct that cannot be pointed to or measured directly. For this reason, it should be distinguished from other constructs, even if different concepts often seem to be used

interchangeably in the literature. Individual work performance is a very relevant construct for organisations since it represents an early signal of team and company performance, both factors that raise organisation competitiveness [28]. Even if in literature the impact of technostress on task [30] and end-user performance [9] has been deeply investigated, to the best of our knowledge, there is a lack in the study of the relationship between psychological strain and individual work performance in the remote working environment. Hence, we investigate the impact of strain on individual work performance by testing the following hypotheses:

H5a: Affective strain has a negative influence on work performance

H5b: Cognitive strain has a negative influence on work performance

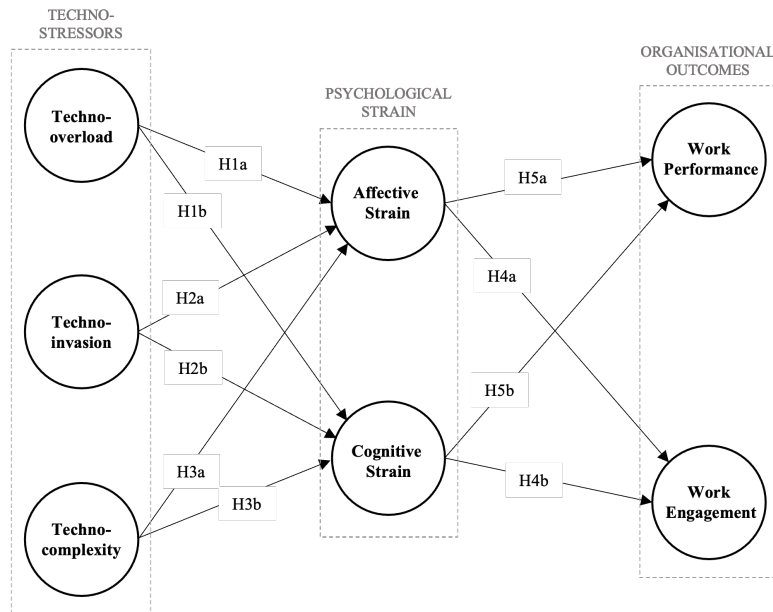


Fig. 1. Conceptual model and related hypotheses

### 3 Materials and Methods

We developed our questionnaire relying upon already-validated constructs. Techno-stressors were measured with the short version of the scale developed by Molino and colleagues [31]: we took into account three items for techno-overload, three items for techno-invasion, and four items for techno-complexity. Psychological strain constructs were measured employing the Copenhagen psychosocial questionnaire II [17], using four items for each strain (cognitive and affective). Items to measure work engagement has been taken and adapted from the Short version of the Utrecht Work Engagement Scale [32]: three items were selected from the vigour and dedication class, while one

item was employed to investigate the absorption dimension. Finally, individual work performance has been measured through a 3-items construct taken from the Individual Work Performance Questionnaire [28]. All items were measured with Likert scales (from 1 = strongly disagree/never to 7 = strongly agree/always to answer) and translated into Italian. A full copy of the items investigated is provided in Table 1 in Appendix.

The questionnaire was delivered in the form of a digital survey delivered to a sample of 171 Italian workers experiencing work-from-home from January 2020 to June 2021. Overall, 135 responses have been usable for analysis purposes, representing the 79% of the overall collected questionnaires (57% female,  $M_{age} = 32.1$ ,  $SD_{age} = 9.8$ , age-range = 21-61). Participants have been contacted asking them to fill in a self-reported questionnaire on a voluntary basis. After the collection of the responses, a construct reliability check was performed. Overall, 57% of the respondents worked remotely for more than 5 months, 26% resorted to remote working for 3-5 months, while the remaining part worked remotely for two months or less. The majority of the sample (77%) proved to be full-time workers, and 76% of the total respondents worked from home more than four days a week. Most of the participants were married or cohabited with friends/roommates (84%), while 80% did not have children.

A data analysis was carried out using Partial Least Square – Structural Equation Modeling (PLS–SEM) to test the relationships among techno-stressors, psychological strain, and organisational outcomes. PLS–SEM is a second-generation multivariate data analysis method that tests linear and additive models. It can be considered a valid alternative to canonical correlation or covariance-based structural equation modelling since it can relate a set of independent variables to multiple independent dependent variables. We opted for PLS–SEM due to the explorative type of research. Our sample size was satisfactory, being more than 10-times the largest number of structural paths directed to a particular latent construct in the structural model [33]. The estimations and data manipulations were performed using SmartPLS3.

## 4 Results

The number of iterations to find convergence was 8, suggesting the goodness of the model [34]. The reliability and validity measures, as well as the descriptive statistics for the model constructs are available in Table 2 in Appendix. We assessed composite reliability and Cronbach's alpha as a convergent validity test. CR index is above 0.70, and Cronbach's alpha values range from 0.709 to 0.921 and are greater than the recommended minimum value of 0.7, thus confirming the validity of our model [35]. We employed AVE to test of both convergent and divergent validity. AVE values were above 0.5, a threshold indicating convergent validity [36]. We establish discriminant validity by the Fornell–Larcker criterion [37]. All our AVE square roots were satisfying this condition. As a measure of fit of the model, we evaluated the standardized root mean square residual (SRMR). Our model has a saturated model SRMR of 0.076, that is below the suggested maximum value of 0.08 [38], thus confirming the good fit. Fi-

nally, our model does not present critical collinearity issues among the measured constructs indicators since structural Variance Inflation Factor (VIF) coefficients are all lower than 5 [39].

After the model had been validated, the hypothesised relationships among the constructs of the structural model were tested. A bootstrapping with 5,000 samples was conducted [40]. Then, determination coefficients, path coefficients, and significance levels were examined. As shown in Fig. 2, the majority of the hypotheses are supported. Indeed, excluding H1b, H3a, and H4a, all the path coefficients are significant at the 0.05 significance level and below. The coefficients of determination  $R^2$  are 0.335 for affective strain, 0.271 for cognitive strain, 0.158 for work engagement, and 0.247 for work performance, representing adequate effects for our model [41]. Blindfolding technique was used as a measure of predictive relevance of the model. The Q2 values of cross-validated redundancy are 0.257, 0.151, 0.083, and 0.144 for affective strain, cognitive strain, work engagement, and individual work performance, respectively. Since all the Q2 values are above zero, the observed values are adequately reconstructed, and the model has predictive relevance [42].

The results show that, through the mediation of affective and cognitive strain, techno-stressors tend to reduce both the work engagement and job performances of remote workers. In particular, we show that techno-overload positively influences affective strain, techno-invasion positively influences both affective and cognitive strain, while techno-complexity positively influences cognitive strain. Further, we show that cognitive strain affects negatively both work engagement and job performance, while affective strain influences negatively only the job performance.

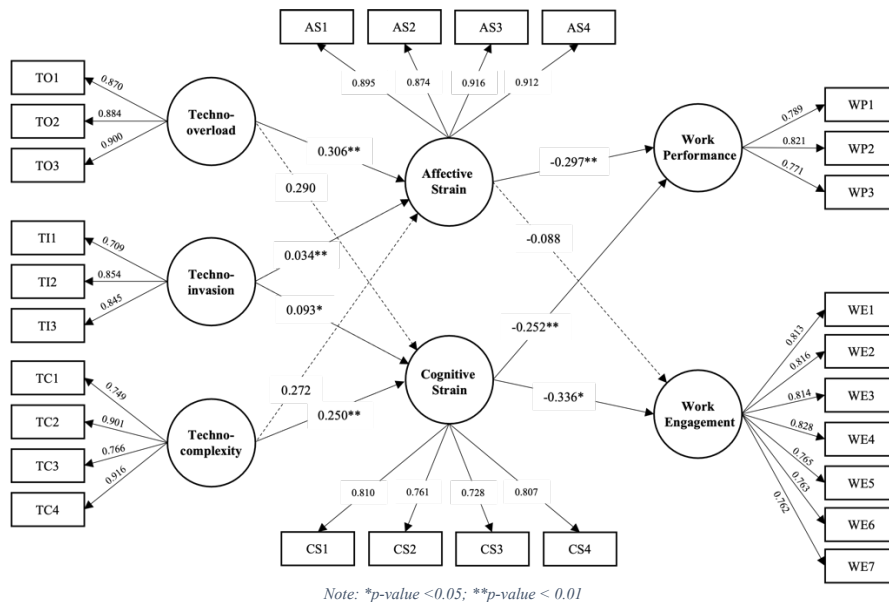


Fig. 2. Structural Model Results



## 5 Discussion and Conclusion

This study carries meaningful insights on the relationships among the main technostressors involved in telework practices and work outcomes, also evaluating the mediating role of individual psychological response. In our model, techno-invasion presents a more extensive effect with respect to techno-overload and techno-complexity, since it is the only stressor to influence both the psychological strains. These results underline that constant connectivity, which causes techno-invasion, may require a higher employee effort to concentrate on working activities rather than domestic ones, consequently manifesting significant effects on individual wellbeing. Moreover, techno-complexity seems to significantly affect the cognitive resources of the workers. This result is not surprising since the tendency of workers to spend time and effort in learning and understanding complex ICT, as well the prolonged hours spent in understanding something considered out of their capabilities, may induce employees to be mentally strained. Finally, since techno-overload positively influences the affective strain, it can be safe to assume that the negative feelings raised by working faster and longer may increase pressure on employees. If not properly managed, this pressure might be translated into high arousal and displeasure, introducing the employee to a condition of anxiety, ultimately impacting his/her performance.

Even if we proved that affective strain negatively influences individual work performance (underlining the importance of a positive state of mind in approaching job-related tasks), no significant relations between affective strain and work engagement have been found. This result is unexpected since the definition of engagement includes an emotional component, too [25]. Further studies may focus on this relationship, considering the impact of individual inhibitors (e.g., mindfulness) on secondary appraisal process. The significance of cognitive strain is underlined by its effects on both work engagement and individual work performance, confirming the implication of the attentional dimension on job performance. Even if this result is not new to traditional working literature, few studies addressed the topic in remote working research. Since other seminal papers in stress coping research state that the ability to effectively cope with an external stressor is determined by a specific cognitive appraisal process [43], it may be possible that cognitive burnout caused by techno-stressors could influence the individual's attitude toward the negative stimulus' extent, creating negative feedback loops.

The present study raises several relevant implications for academicians, practitioners, and policymakers. First and foremost, it contributes to extant literature concerning technostress in remote working settings by highlighting how specific techno-stressors influence work engagement and job performance. Moreover, it emphasises the mediating effect of individual psychological responses both from a cognitive and affective viewpoint, providing a three-step framework that can be adopted in future research. These findings are in line with previous literature in psychology about reasoned-action approach, stating that attitudes toward technology are based on a person's beliefs about that topic and those beliefs - cognitive and affective - can influence their behaviour [44]. Under this light, our results suggest that the adoption of remote working practices may influence users' attitude towards the technological facility, affecting employees' behaviour and the organisation's results.

Second, extant literature suggests practitioners to exploit three levels of action to contrast the loss of individual performance caused by techno-stressors: (i) primary interventions (acting on the factor creating stress), (ii) secondary interventions (influencing the individual's coping response to such conditions), and (iii) tertiary interventions (namely leveraging on the outcomes that the individual experiences) [4]. To reduce the impact of techno-stressors at its source, our study suggests minimising the negative effect of techno-overload, invasion, and complexity. For instance, managers may employ workers' task load reduction in order to improve job performance in the long term and to working environment redesign with the aim to reduce ICT-related complexity.

Regarding secondary interventions, managers should correctly identify efficient inhibitors to reduce technostress impact on the individual strain. A consistent literature stream has already investigated the elements that can reduce strain caused by technostress in "offline" contexts, but these inhibitors may demonstrate less efficacy in the domestic environment because of the context-specificity of technostress. Hence, we suggest practitioners to focus on those inhibitors that are more concentrated on individuals rather than organisations. Given the importance of affective strain in the technostress process, mindfulness [45] may lead employees to increase their capacity for objectivity in relation to an internal or external experience, reducing, in turn, negative thoughts and feelings like anxiety and worry. For these reasons, we suggest practitioners to find effective ways to foster mindfulness practices among employees, such as meditation routines and stress reduction programs during working hours.

Finally, our results suggest leveraging both affective and cognitive components to monitor employees' psychological strain conditions. Indeed, affective computers equipped with cameras, microphones, and sensors may recognise physiological components of emotions. Moreover, monitoring individual real-time performance such as time of task accomplishment and quality of the work produced may contribute to indirectly assessment of mental fatigue and exhaustion. Then, the measure of these two dimensions may result in the deduction of a real-time individual psychological condition allowing the determination of real-time adaptive responses. For instance, after identifying an increasing worker's strain condition, the computer can interact with the user, suggesting quick breaks or providing encouraging feedback or advice. In this regard, wearable devices may offer a twofold contribution since they can measure many physiological responses over time and they can draw user's attention through haptic or sound notifications, creating positive feedback loops to enhance individual wellbeing [46].

This study proposes interesting outcomes for policymakers too. Indeed, given the significant effect of working conditions on individual psychological health, governments should regulate on working time and workload of employees adopting remote-working practices. For example, considering the influential effect of techno-invasion, it may be beneficial in terms of workers' wellbeing to consolidate the debate on the right to disconnect, by guaranteeing a clear, juridical distinction between private and professional life.

## **6 Limitations and Future Research**

The discussed results might be subjected to some limitations. First, work performance has been measured with a validated scale reflecting respondents' perception of their performance while working at home, thus not considering independent assessments made by peers or supervisors. Hence, employees' perceptions and supervisors' valuation might differ. Furthermore, even if the pandemic has provided a unique chance to conduct the present study during the highest pick of work-from-home adoption, it may have had consequences on individuals' work and stress processes. Indeed, the emotional distress directly related to the emergency situation has not been investigated separately in the study. Finally, since some studies have theorised that stressors may lead to positive outcomes at the individual and organisational level [47], future investigations may adopt our framework to evaluate how positive stress (namely, eustress) may enhance specific job performance by investigating the possible mediator positive effect of affective and cognitive strain.

## Appendix

**Table 1.** List of all items employed in the survey

Construct	Indicator	Item
Techno-Overload (Molino et al., 2020)	TO1	<i>I am forced by this technology to work much faster.</i>
	TO2	<i>I am forced by this technology to do more work than I can handle.</i>
	TO3	<i>I am forced by this technology to work with very tight time schedules.</i>
Techno-Invasion (Molino et al., 2020)	TI1	<i>I spend less time with my family due to this technology.</i>
	TI2	<i>I have to be in touch with my work even during my vacation and weekend time due to this technology.</i>
	TI3	<i>I feel my personal life is being invaded by this technology.</i>
Techno-Complexity (Molino et al., 2020)	TC1	<i>I do not know enough about this technology to handle my job satisfactorily.</i>
	TC2	<i>I need a long time to understand and use new technologies.</i>
	TC3	<i>I do not find enough time to study and upgrade my technology skills.</i>
	TC4	<i>I often find it too complex for me to understand and use new technologies.</i>
Affective Strain (Pejtersen et al., 2010)	AS1	<i>How often have you had problems relaxing?</i>
	AS2	<i>How often have you been irritable?</i>
	AS3	<i>How often have you been tense?</i>
	AS4	<i>How often have you been stressed?</i>
Cognitive strain (Pejtersen et al., 2010)	CS1	<i>How often have you had problems concentrating?</i>
	CS2	<i>How often have you found it difficult to think clearly?</i>
	CS3	<i>How often have you had difficulty in taking decisions?</i>
	CS4	<i>How often have you had difficulty with remembering?</i>
Work Performance (Koopmans et al., 2012)	WP1	<i>I managed to plan my work so that it was done on time.</i>
	WP2	<i>I was able to separate main issues from side issues at work.</i>
	WP3	<i>I was able to perform my work well with minimal time and effort.</i>
Work Engagement (Seppälä et al., 2009)	WE1	<i>At my work, I feel bursting with energy.</i>
	WE1	<i>At my job, I feel strong and vigorous.</i>
	WE3	<i>When I get up in the morning, I feel like going to work.</i>
	WE4	<i>I am enthusiastic about my job.</i>
	WE5	<i>My job inspires me.</i>
	WE6	<i>I am proud on the work that I do.</i>
	WE7	<i>I feel happy when I am working intensely.</i>

**Table 2.** Descriptive statistics, reliability, and validity measures for the model constructs

Construct	Estimates			Indicators	Final Model			
	Cronbach $\alpha$	rho_A	CR		AVE	Loadings	Mean	Std. Dev.
Techno-Overload	0.861	0.863	0.915	0.783	TO1	0.870	3.289	1.761
					TO2	0.884	3.689	1.930
					TO3	0.900	3.363	1.810
Techno-Invasion	0.729	0.754	0.846	0.649	TI1	0.709	3.363	1.810
					TI2	0.854	3.807	2.053
					TI3	0.845	4.222	1.984
Techno-Complexity	0.856	0.885	0.902	0.699	TC1	0.766	2.156	1.414
					TC2	0.916	2.156	1.530
					TC3	0.749	2.822	1.634
					TC4	0.901	2.074	1.449
Affective Strain	0.921	0.925	0.944	0.809	AS1	0.895	4.037	1.641
					AS2	0.874	3.933	1.441
					AS3	0.916	4.119	1.502
					AS4	0.912	4.237	1.551
Cognitive Strain	0.781	0.786	0.859	0.604	CS1	0.810	3.622	1.520
					CS2	0.761	2.785	1.307
					CS3	0.728	2.896	1.378
					CS4	0.807	2.733	1.339
Work Performance	0.709	0.716	0.837	0.631	WP1	0.789	3.844	1.365
					WP2	0.821	3.756	1.438
					WP3	0.771	3.800	1.505
Work Engagement	0.905	0.948	0.923	0.632	WE1	0.813	4.296	1.388
					WE1	0.816	4.074	1.364
					WE3	0.814	4.585	1.230
					WE4	0.828	4.037	1.374
					WE5	0.765	5.281	1.331
					WE6	0.763	4.578	1.368
					WE7	0.762	3.978	1.432

## References

1. Tarafdar, M., Pirkkalainen, H., Salo, M., Makkonen, M.: Taking on the “Dark Side” - Coping with Technostress. *IT Prof.* 22, 82–89 (2020). <https://doi.org/10.1109/MITP.2020.2977343>
2. Oksanen, A., Oksa, R., Savela, N., Mantere, E., Savolainen, I., Kaakinen, M.: COVID-19 crisis and digital stressors at work: A longitudinal study on the Finnish working population. *Comput. Human Behav.* 122, 106853 (2021). <https://doi.org/10.1016/j.chb.2021.106853>
3. Brod, C.: *Technostress - The human cost of the computer revolution*. Addison-Wesley Publishing Company, Reading, USA. (1984)
4. Tarafdar, M., Tu, Q., Ragu-Nathan, B.S., Ragu-Nathan, T.S.: The impact of technostress on role stress and productivity. *J. Manag. Inf. Syst.* 24, 301–328 (2007). <https://doi.org/10.2753/MIS0742-1222240109>
5. Ragu-Nathan, T.S., Tarafdar, M., Ragu-Nathan, B.S., Tu, Q.: The consequences of technostress for end users in organizations: Conceptual development and validation. *Inf. Syst. Res.* 19, 417–433 (2008). <https://doi.org/10.1287/isre.1070.0165>
6. Gartner Statistics, <https://www.gartner.com/en/newsroom/press-releases/2020-04-14-gartner-hr-survey-reveals-41--of-employees-likely-to->
7. Nilles, J.M.: Telecommunications and Organizational Decentralization. *IEEE Trans. Commun.* 23, 1142–1147 (1975). <https://doi.org/10.1109/TCOM.1975.1092687>
8. Cooper, C.L., Dewe, P.J., O’Driscoll, M.P.: *Organizational stress: A review and critique of theory, research, and applications*. Sage Publ. Inc. (2001)
9. Tarafdar, M., Tu, Q., Ragu-Nathan, T.: Impact of technostress on end-user satisfaction and performance. *J. Manag. Inf. Syst.* 27, 303–334 (2010). <https://doi.org/10.2753/MIS0742-1222270311>
10. Weil and Rosen, L.: *TechnoStress: Coping with Technology*. New York John Wiley Sons. 1998 (1997)
11. Yaverbaum, G.J.: Critical factors in the user environment: An experimental study of users, organizations and tasks. *MIS Q. Manag. Inf. Syst.* 12, 75–88 (1988). <https://doi.org/10.2307/248807>
12. Bhagat, R.S., Krishnan, B., Nelson, T.A., Leonard, K.M., Moustafa, K., Billing, T.K.: Organizational stress, psychological strain, and work outcomes in six national contexts: A closer look at the moderating influences of coping styles and decision latitude. *Cross Cult. Manag.* 17, 10–29 (2010). <https://doi.org/10.1108/13527601011016880>
13. Kalakoski, V., Selinheimo, S., Valtonen, T., Turunen, J., Käpykangas, S., Ylisassi, H., Toivio, P., Järnefelt, H., Hannonen, H., Paajanen, T.: Effects of a cognitive ergonomics workplace intervention (CogErg) on cognitive strain and well-being: A cluster-randomized controlled trial. A study protocol. *BMC Psychol.* 8, 1–16 (2020). <https://doi.org/10.1186/s40359-019-0349-1>
14. Feldman Barrett, L., Bliss-Moreau, E.: Affect as a psychological primitive. *Adv. Exp. Soc. Psychol.* 41, 167–218 (2009). [https://doi.org/10.1016/S0065-2601\(08\)00404-8](https://doi.org/10.1016/S0065-2601(08)00404-8). Affect
15. Lazarus, R.S.: *Stress and emotion: A new synthesis*. Springer Publishing Co, New York, NY, US (1999)
16. Ommen, N.O., Heußler, T., Backhaus, C., Michaelis, M., Ahlert, D.: The impact of country-of-origin and joy on product evaluation: A comparison of Chinese and German intimate apparel. *J. Glob. Fashion. Mark.* 1, 89–99 (2010).

- <https://doi.org/10.1080/20932685.2010.10593061>
17. Pejtersen, J.H., Kristensen, T.S., Borg, V., Bjorner, J.B.: The second version of the Copenhagen Psychosocial Questionnaire. *Scand. J. Public Health.* 38, 8–24 (2010). <https://doi.org/10.1177/1403494809349858>
  18. Salanova Soria, M., Psicología, D., Llorens, S., Cifre, E., De Investigación, E., Psicosocial, W.: Tecnoestrés: concepto, medida e intervención psicosocial [Technostress: Concept, Measurement and Prevention], [https://www.insst.es/documents/94886/327446/ntp\\_730.pdf/55c1d085-13e9-4a24-9fae-349d98deeb8a](https://www.insst.es/documents/94886/327446/ntp_730.pdf/55c1d085-13e9-4a24-9fae-349d98deeb8a), (2007)
  19. Heinssen, R.K., Glass, C.R., Knight, L.A.: Assessing computer anxiety: Development and validation of the Computer Anxiety Rating Scale. *Comput. Human Behav.* 3, 49–59 (1987). [https://doi.org/10.1016/0747-5632\(87\)90010-0](https://doi.org/10.1016/0747-5632(87)90010-0)
  20. Ayyagari, R., Grover, V., Purvis, R.: Technostress: Technological Antecedents and Implications. 35, 831–858 (2011)
  21. Lewis, C.: Dying for information? : an investigation into the effects of information overload in the UK and worldwide. Reuters, London (1996)
  22. Fisher, W., Wesolkowski, S.: Tempering technostress. *IEEE Technol. Soc. Mag.* 18, 28–42 (1999). <https://doi.org/10.1109/44.752243>
  23. Tarafdar, M., Tu, Q., Ragu-Nathan, T.S.: Recommended Citation *Journal of Management Information Systems.* 24, 301–328 (2007)
  24. Nimrod, G.: Technostress: measuring a new threat to well-being in later life. *Aging Ment. Health.* 22, 1–8 (2017). <https://doi.org/10.1080/13607863.2017.1334037>
  25. Kahn, W.A.: Psychological conditions of personal engagement and disengagement at work. *Acad. Manag. J.* 33, 692–724 (1990). <https://doi.org/10.2307/256287>
  26. Fredrickson, B.L.: The role of positive emotions in positive psychology: The broaden-and-build theory of positive emotions. *Am. Psychol.* 56, 218–226 (2001). <https://doi.org/10.1037/0003-066X.56.3.218>
  27. Campbell, J.P.: Modeling the performance prediction problem in industrial and organizational psychology. In: *Handbook of Industrial and Organizational Psychology* (1990)
  28. Koopmans, L., Bernaards, C., Hildebrandt, V., Van Buuren, S., Van Der Beek, A.J., de Vet, H.C. w.: Development of an individual work performance questionnaire. *Int. J. Product. Perform. Manag.* 62, 6–28 (2012). <https://doi.org/10.1108/17410401311285273>
  29. Bélanger, F.: Workers' propensity to telecommute: An empirical study. *Inf. Manag.* 35, 139–153 (1999). [https://doi.org/10.1016/S0378-7206\(98\)00091-3](https://doi.org/10.1016/S0378-7206(98)00091-3)
  30. Hackman, J.R., Vidmar, N.: Effects of Size and Task Type on Group Performance and Member Reactions. *Sociometry.* 33, 37 (1970). <https://doi.org/10.2307/2786271>
  31. Molino, M., Ingusci, E., Signore, F., Manuti, A., Giancaspro, M.L., Russo, V., Zito, M., Cortese, C.G.: Wellbeing costs of technology use during Covid-19 remote working: An investigation using the Italian translation of the technostress creators scale. *Sustain.* 12, 1–20 (2020). <https://doi.org/10.3390/SU12155911>
  32. Seppälä, P., Mauno, S., Feldt, T., Hakanen, J., Kinnunen, U., Tolvanen, A., Schaufeli, W.: The construct validity of the Utrecht Work Engagement Scale: Multisample and longitudinal evidence. *J. Happiness Stud.* 10, 459–481 (2009). <https://doi.org/10.1007/s10902-008-9100-y>

33. Barclay, D., Thompson, R., dan Higgins, C.: The Partial Least Squares (PLS) Approach to Causal Modeling: Personal Computer Adoption and Use an Illustration. *Technol. Stud.* 2, 285–309 (1995)
34. Wong, K.K.K.-K.: 28/05 - Partial Least Squares Structural Equation Modeling (PLS-SEM) Techniques Using SmartPLS. *Mark. Bull.* 24, 1–32 (2013)
35. Hundleby, J.D., Nunnally, J.: Psychometric Theory. *Am. Educ. Res. J.* 5, 431 (1968). <https://doi.org/10.2307/1161962>
36. Chin, W.W.: The partial least squares approach to structural equation modelling. In Marcoulides G. A. (Ed.). *Mod. Methods Bus. Res.* 295, 295–336 (1998)
37. Fornell, C., Larcker, D.F.: Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. *J. Mark. Res.* 18, 39 (1981). <https://doi.org/10.2307/3151312>
38. Hu, L.T., Bentler, P.M.: Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Struct. Equ. Model.* 6, 1–55 (1999). <https://doi.org/10.1080/10705519909540118>
39. Hair, J.F., Risher, J.J., Sarstedt, M., Ringle, C.M.: When to use and how to report the results of PLS-SEM. *Eur. Bus. Rev.* 31, 2–24 (2019). <https://doi.org/10.1108/EBR-11-2018-0203>
40. Hair, J.F., Ringle, C.M., Sarstedt, M.: PLS-SEM: Indeed a silver bullet. *J. Mark. Theory Pract.* 19, 139–152 (2011). <https://doi.org/10.2753/MTP1069-6679190202>
41. Falk, R.F., Miller, N.B.: A primer for soft modeling. Akron, OH: University of Akron Press. *Open J. Bus. Manag.* 2, 103 (1992)
42. Henseler, J., Fassott, G.: Testing Moderating Effects in PLS Path Models: An Illustration of Available Procedures. In: *Handbook of Partial Least Squares*. pp. 713–735 (2010)
43. Lazarus, R.S.: The Role of Coping in the Emotions and How Coping Changes over the Life Course. In: *Handbook of Emotion, Adult Development, and Aging*. pp. 289–306 (1996)
44. Hill, R.J., Fishbein, M., Ajzen, I.: Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research. *Contemp. Sociol.* 6, 244 (1977). <https://doi.org/10.2307/2065853>
45. Cardaciotto, L., Herbert, J.D., Forman, E.M., Moitra, E., Farrow, V.: The assessment of present-moment awareness and acceptance: The philadelphia mindfulness scale. *Assessment.* 15, 204–223 (2008). <https://doi.org/10.1177/1073191107311467>
46. Chianella, R., Mandolfo, M., Lolatto, R., Pillan, M.: Designing for self-awareness: Evidence-based explorations of multimodal stress-tracking wearables. In: *International Conference on Human-Computer Interaction*. pp. 357–371. Springer, Cham. (2021)
47. Tarafdar, M., Cooper, C.L., Stich, J.F.: The technostress trifecta - techno eustress, techno distress and design: Theoretical directions and an agenda for research. *Inf. Syst. J.* 29, 6–42 (2019). <https://doi.org/10.1111/isj.12169>