

# Measuring broad self-regulatory skills in multi-locational knowledge work

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## About the authors

**Kirsi Sjöblom** is a psychologist (M.A.) and doctoral researcher. Apart from the academic context, she has been working in clinical psychology, training, coaching and suitability assessments. She currently specialises in research and applied work on topical phenomena related to motivation, learning, productivity and well-being, such as 21st century skills and the future of work. In this study, she had the leading role in planning the study and writing this article. She collected the data together with the colleagues mentioned in the acknowledgements section. She designed the questionnaire and collaborated with Lauri Hietajärvi in designing the methodology of the study.

**Lauri Hietajärvi** (PhD) is a postdoctoral researcher in educational psychology at the Faculty of Educational Sciences, University of Helsinki, Finland. He has been working with various cross-sectional and longitudinal datasets utilizing several statistical methods, including between and within-person variable- and person-oriented approaches. Lauri is primarily interested in studying adolescents' academic well-being and digital media. He is also interested in general issues of study and work-related motivation and well-being. In this study, he collaborated with Kirsi Sjöblom in designing the methodology of the study. He had the leading role in conducting the statistical analyses and presenting the results.

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## Abstract

Due to the growing proportion of knowledge work and the work taking place in complex digital, physical and social surroundings employees are facing increasing demands to manage their own work and the psychological resources available to them. This study firstly presents the scientific background for why these skills, also called

21<sup>st</sup> century skills, are required by current working life, and secondly the process of developing and piloting a new questionnaire instrument to measure individuals' broad self-regulation in knowledge work. Our questionnaire (N=202) measured behavioural self-regulation, cognitive-emotional self-regulation, and self-regulation of recovery. We used confirmatory factor analysis to specify and test the structure of the scale, and independent samples t-test and MANOVA to examine the differences between subgroups. The initial three-factor model showed a good fit. Latent variable correlation analyses indicated expected relations between self-regulation factors and established scales of well-being at work (work engagement, burnout). These results imply that this scale is suitable for measuring the self-regulatory skills of knowledge workers. This study underlines the importance of broad self-regulatory skills in supporting productivity and well-being in contemporary knowledge work. It operationalises the topical questions of how to assess and support proactive employee functioning in today's increasingly complex physical, digital and social surroundings.

*Keywords:* Knowledge work, self-regulation, multi-locational work, 21<sup>st</sup> century skills, digitalization, scale

## Introduction

As knowledge work increases and the complexity of the digital, physical and social work environments grows, employees face increasing demands in managing their own work and their psychological resources. While modern work environments come with much potential for development there are also risks to employee productivity and well-being (e.g., Bosch-Sijtsema, Ruohomäki & Vartiainen, 2009; Landy & Conte, 2016; Sparks, Faragher & Cooper, 2001). We are now able to work across time and distances in ways that could not have been imagined a few decades ago, but we still need to develop well-functioning practices to do so (Hyrkkänen, Putkonen & Vartiainen, 2007).

Knowledge work is cognitively and socially demanding, and it includes a high level of mental regulation (Vartiainen, 2014). Furthermore, identifying and managing the mental workload factors related to mobile multi-locational work is needed (Vartiainen & Hyrkkänen, 2010). Multi-locational knowledge work requires substantial employee autonomy and self-regulatory skills, also in the use of mobile surroundings and digital tools. These skills are part of new competencies required by current society and working life; also known as *21<sup>st</sup> century skills* (Ananiadou & Claro, 2009; Lonka et al., 2015). While these skills are increasingly included in school curricula worldwide the

workplace development of these skills is not always acknowledged or supported. The fact that the majority of knowledge workers are high-functioning experts may falsely lead one to assume that they inherently possess specific abilities to self-regulate and manage their mental resources. However, these skills are distinct from the specific professional abilities of each employee. Just like students at school, employees also have varying abilities in terms of the required 21st century skills, and many employees need to consciously practice and learn these skills in order to acquire them.

A large research literature currently exists on both the supporting and hindering aspects of productive and sustainable knowledge work, such as physically and socially distributed cognition (e.g., Hakkarainen, Palonen, Paavola & Lehtinen, 2004; Hutchins, 2000), sufficient recovery (Vartiainen & Hyrkkänen, 2010; Zijlstra & Sonnentag, 2006), distractions and multi-tasking (Bosch-Sijtsema, Ruohomäki & Vartiainen, 2010; Salo, Salmela, Salmi, Numminen & Alho, 2017). However, the various ways in which employees can and need to proactively regulate their psychological resources has received little attention. Furthermore, measures for studying and assessing these skills are lacking.

This paper focuses on the skills and strategies that are available and essential for individuals to manage their psychological resources in order to support both productivity and well-being in knowledge work. As the prior literature is lacking sufficient tools to assess this phenomenon, a focal aim was to develop and introduce a novel self-report instrument and examine its functionality in studying modern-day workplace productivity and well-being. Our study presents a theoretical foundation and an empirical pilot for a scale that measures broad self-regulatory skills in multi-locational knowledge work.

## **Characteristics of multi-locational knowledge work environments**

Knowledge work involves: a) the creation, distribution or application of knowledge as task contents; b) work by highly skilled and/or trained workers, who have autonomy in their work; c) the use of tools (e.g., information and communications technology) and theoretical concepts; d) production of complex, intangible and tangible results; and e) the provision of competitive advantage or some other benefit contributing towards the goals of an organization (Bosch-Sijtsema et al., 2009; Bosch-Sijtsema et al., 2010). Multi-locational work, on the other hand, is characterised by work being carried out in many different locations, such as the office, home, public spaces (such

as cafes or airports), and mobile locations (such as cars or trains) (Hislop & Axtell, 2009). Typically, a substantial part of knowledge work in general (Harrison, Wheeler & Whitehead, 2004), and multi-locational work more specifically, is digitally mediated.

Both the physical environment and tools contribute to human performance. Human cognition does not occur separately from the surroundings; it is distributed both physically and socially (Hakkarainen, Palonen, Paavola & Lehtinen, 2004; Hutchins, 2000). These diverse environments and tools have the potential to both elevate and impair human abilities (Hutchins, 2000; Norman, 1993) and should be utilised thoughtfully. In multi-locational knowledge work, this is particularly prominent: digital tools and changing physical environments hold considerable potential for both supporting and hindering productivity and well-being. Challenges posed by modern environments and tools may include, for example, inadequate work environments or tools for different types of tasks (Bosch-Sijtsema et al., 2010), adverse effects of multi-tasking on productivity (Moisala et al., 2016), or insufficient boundaries between work and rest (Vartiainen & Hyrkkänen, 2010; Zijlstra & Sonnentag, 2006). For example, the fact that work is constantly potentially present through different information channels via mobile devices, or that employees do not have fixed working hours, may challenge sufficient rest and recovery from work. In contrast, opportunities of this way of working include, for example, better networking with experts in one's own field, regardless of geographical location (Hakkarainen et al., 2004), more suitable work environments for different types of tasks (Huber, 2015; Lonka, 2018); and opportunities to minimise unnecessary transitions during the day (Vartiainen & Hyrkkänen, 2010).

The support or challenges related to modern tools and environments does not, however, depend on the tools and environments alone; but also the social practices of how these resources are utilised play a crucial role (Hakkarainen, 2009). For example, if there is an implicit belief at the workplace that high-paced, nonstop work is the most efficient way of working, this is likely to challenge individuals' attempts to proactively arrange sufficient breaks in the working day, even if it is unintentional. Thus, it is necessary to first acknowledge the importance of these practices and second to consciously develop practices that support productivity and well-being on both individual and community of practice levels. This paper focuses on the individual level: the everyday strategies that employees are able to utilise in order to harness the potential of modern environments and tools to support their psychological resources, cognitive functioning and well-being in multi-locational knowledge work.

## The need for broad self-regulatory skills in multi-locational knowledge work

Self-regulation processes enable individuals to guide their goal-directed activities over time and across changing circumstances. Regulation implies the modulation of thought, affect, behaviour, or attention (Karoly, 1993; Vancouver, 2000). Individuals can set standards or goals to strive towards, monitor their progress toward these goals, and then adapt and regulate their cognition, motivation and behaviour to reach these goals. (Pintrich, 2000). Self-regulation is an ongoing process, in which an individual regulates the cognitive, motivational and emotional aspects of their activity as well as the environment in which it occurs (Boekaerts, Pintrich & Zeidner, 2000).

As work is primarily a context for goal-directed behaviour, the need for self-regulation in any work context is evident. However, modern work environments entail certain aspects that make self-regulation even more focal than before. Multi-locational knowledge work environments are much less clearly defined than traditional ones; for example, the work is not tied to a particular time or physical space. At the same time, these environments are more complex and include more stimuli and information overflow through various modalities; such as numerous digital devices and applications. The less the environment provides structure and regulation, and the more it pulls the individual in different directions, the more the individual needs to self-regulate and utilise deliberately chosen strategies to guide their own functioning (e.g., balancing between internal and external regulation, Vermunt & Verloop, 1999).

The need for individuals to manage their energy and resources is not new, being recognised in several research traditions. For example, partly overlapping skills and strategies, for which measurement scales have also been developed, include self-leadership, energy management, vitality management and job crafting (e.g., Fritz, Lam & Spreitzer, 2011; Houghton & Neck, 2002; Op den Kamp, Tims, Bakker & Demerouti, 2018; Slemp, & Vella-Brodrick, 2013; Tims, Bakker & Derks, 2012). However, in present-day knowledge intensive work, the need to self-regulate is more important than before, as work is more autonomous, and conditions more abstract and complex. Without proactive strategies (Grant & Ashford, 2008; Parker, Bindl & Strauss, 2010), individuals are at risk of applying a large part of their mental resources to secondary tasks and distractions, reacting to various immediate stimuli emerging from the environment rather than proactively choosing to focus on what is important. Self-regulation now also includes managing and utilising complex environments and

tools in meaningful, deliberate ways (e.g., Moisala et al., 2016; Vartiainen & Hyrkkänen, 2010). As work tasks are often collaborative and occur in shared environments, self-regulation related to collaboration and co-regulation are crucial (Miller, Järvelä & Hadwin, 2017). Moreover, in addition to behavioural, cognitive and emotional self-regulation, deliberate attention to well-being and recovery is now a significant part of the required self-regulation. Certain aspects of novel work environments have been found to potentially risk employee health and well-being (Hyrkkänen, Putkonen & Vartiainen, 2007; Sparks, Faragher & Cooper, 2001; Vartiainen & Hyrkkänen, 2010), and mental overload and stress have been shown to be one of the most prevalent health risks worldwide (WHO, 2013). Both working life and other life domains call for new competencies (21st century skills), such as stress management, cognitive load management, and the skills for using modern tools (Ananiadou & Claro, 2009).

Current research offers extensive information on aspects that support or hinder well-being and productivity in knowledge work, and can be applied in practice by utilising various proactive strategies. Practical examples of these kinds of self-regulatory strategies that employees can utilise are *behavioural strategies*, such as limiting multi-tasking (Pashler, 1994; Salo, Salmela, Salmi, Numminen & Alho, 2017) and choosing an environment that supports the work task (Lonka, 2018; Vartiainen & Hyrkkänen, 2010). In modern multi-locational knowledge work this may mean, for example, deliberately turning off notifications of different digital applications in order to enable periods of focused and uninterrupted work, or choosing to carry out quiet individual work remotely in case the work environment does not sufficiently accommodate for it.

*Cognitive strategies* that employees can utilise may include, for example, actively directing one's own work to be more engaging and meaningful (Wrzesniewski & Dutton, 2001) and aligned with one's interests and values (Deci & Ryan, 2000; Ryan & Deci, 2017). Further cognitive strategies may involve recognising and utilising collaborative potential and actively seeking advice from others when needed (Hutchins, 2000; Miller, Järvelä & Hadwin, 2017).

As knowledge work relies on how well one can focus one's mental potential on the essential tasks; *emotional strategies* are a focal part of self-regulation in this kind of work. For example, emotional intelligence and the ability to deal with difficult emotions at work (Donaldson-Feilder & Bond, 2004; Newman, Joseph & MacCann, 2010) are increasingly important, especially as a substantial part of knowledge work is

collaboration with coworkers (El-Farr, 2009). As knowledge work is highly abstract and often consists of numerous tasks overlapping and spread out over long periods of time, concrete indications of completion and success are much more infrequent than in more tangible jobs. Thus, emotional strategies such as actively noticing accomplishments (Baas, De Dreu & Nijstad, 2008; Manz & Neck, 1991) may be helpful in maintaining motivation and well-being at work.

Finally, many aspects related to physical recovery have been found to directly impact on cognitive functioning. Sufficiently maintaining and replenishing one's mental and physical resources are important to fostering cognitive capacity in knowledge work. Thus, *self-regulatory strategies related to recovery* include, for example, paying attention to the effects of nutrition and exercise on cognition by having regular, healthy meals and moving around frequently enough (Gómez-Pinilla, 2008; Hillman, Erickson & Kramer, 2008; Scholey, Harper & Kennedy, 2001), taking sufficient breaks and rest (Zacher, Brailsford & Parker, 2014; Zijlstra & Sonnentag, 2006) and making use of restorative environments in supporting recovery (Berto, 2005).

In the next section, we explain how these aspects, that have been scientifically proven to contribute to productivity and well-being, have been incorporated into a new questionnaire measuring broad self-regulatory skills in multi-locational knowledge work.

## Method

This study was carried out to develop a means to assess knowledge workers' self-regulatory skills related to productivity and well-being, and to identify needs for learning these skills. More specifically, the aim of this study was to: a) develop and pilot a new questionnaire to measure broad self-regulatory skills in multi-locational knowledge work; and b) start the scale validation process by examining its relations with established scales of well-being at work. Aligned with the theoretical background and empirical evidence on the relations between self-regulatory strategies, productivity and well-being described in the previous section, we expected the subscales of self-regulation to be positively related to work engagement and negatively related to job burnout.

## Participants

A total of 203 participants from two large public organizations in the Finnish metropolitan area responded to an online questionnaire (environmental services;  $N=143$  and education;  $N=60$ ). These organizations were taking part in a developmental programme (the European Social Fund project 3SPACES – Towards Inspiring Workplaces) and the questionnaire formed part of a broader survey included in the programme.

The participants worked mainly in offices and their job descriptions included varying levels of multi-locational work. The data represented both female (70,1%) and male respondents working in different organizational positions (26.4% employees, 53.2% officials, 20.4% superiors). Although the age distribution leaned more towards mature age groups and presumably more experienced professionals, different age groups were represented in the data (14.3% were 34 years old or less, 56.2% were between 35–54 years, and 29.5% were 55 years or older).

## Instruments

### Scale development

We assessed *Broad self-regulatory skills in multi-locational knowledge work* using a scale developed for this study. Items were based on cognitive, emotional and behavioural areas of self-regulation (Karoly, 1993; Vancouver, 2000), as well as factors found to potentially challenge productivity and well-being in multi-locational knowledge work (such as multi-tasking or unsupportive physical work environment). In addition, background research was carried out on the existing scales for related phenomena measuring skills and strategies such as self-leadership, energy management and job crafting (e.g., Fritz, Lam & Spreitzer, 2011; Houghton & Neck, 2002; Slemp & Vella-Brodrick, 2013; Tims, Bakker & Derks, 2012),

More specifically, five items were developed to assess *behavioral self-regulation* (e.g., “I deliberately restrict factors that take my attention away from the main task at hand”), four items measuring *cognitive self-regulation* (e.g., “I aim to work in a way that is meaningful to me”), and three items assessing *emotional self-regulation* (e.g., “I pay attention to successes and things that I have accomplished at work”). Further, aligned with the specific challenges of self-regulation in present day knowledge work, five items measuring *self-regulation of recovery* were included in the scale (e.g., “I pay attention to physical well-being at work”). Responses to these items were measured on a scale from 1=’not at all true’, to 5=’completely true’.

During item development, the items were expected to separately reflect the behavioural, emotional, cognitive, and recovery dimensions. The pool originally contained 22 items. However, based on preliminary investigations of the item properties and exploratory factor analyses, we excluded five items. The final model contains 17 items (see Figure 1) representing three dimensions, in which the items originally designed to reflect cognitive and emotional regulation separately reflect a joint cognitive–emotional dimension.

Figure 1  
The self-regulatory skills in multi-locational knowledge work questionnaire

**Instructions:** Please think of your everyday work routines and assess the extent to which the following statements are true using the 1-5 scale where 1=not at all true and 5=completely true.

QUESTION	QUESTIONNAIRE ITEM
1	I plan and schedule my primary weekly tasks. (B)
2	I schedule my tasks according to my typical flow of vigour during the day (for example: work on tasks requiring concentration early in the day). (B)
3	I pay attention to things that maintain healthy vigour for work (for example: starting the day with a good personal routine, utilizing beneficial work strategies, refreshing myself with proper breaks). (R)
4	I pay attention to physical well-being at work (for example: ergonomics, exercise, breaks, nutrition). (R)
5	I aim to minimise unnecessary transitions during the working day. (B)
6	I deliberately restrict factors that distract my attention from the main task at hand (for example: interruptions originating from the work environment, messages from digital devices). (B)
7	I choose an environment that supports my work (for example: a calm environment for focused work, more freely defined surroundings for brainstorming or collaborative work). (B)
8	I aim to be around people who support my work (for example: inspiring or encouraging colleagues or those who can support me in content-related issues). (C-E)
9	I pay attention to successes and the things that I have accomplished at work. (C-E)
10	I find that I am able to deal with challenging feelings and experiences at work. (C-E)
11	I think about the purpose of my work and aim to work in a way that is meaningful to me. (C-E)
12	I develop my work practices. (C-E)
13	In my work community, we discuss work practices and aim to find effective ways to organise work. (C-E)
14	I pay attention to how I approach my work (for example: set reasonable expectations of the quality of my work). (C-E)
15	I make sure that I take sufficient breaks during the working day. (R)
16	I pay attention to sufficient rest in my everyday life. (R)
17	I spend time in restorative environments, such as nature or my own favourite places. (R)

Note: Abbreviations stand for B=behavioral self-regulation CE=cognitive-emotional self-regulation R=self-regulation of recovery. They are included here for information and should not be included in the questionnaire.

### Existing scales

*Work engagement* was assessed using the Utrecht Work Engagement Scale with nine items (UWES-9; Schaufeli, Bakker & Salanova, 2006). The scale measures three dimensions: *vigour* (e.g., “When I get up in the morning, I feel like going to work”), *dedication* (e.g., “I am enthusiastic about my work”) and *absorption* (e.g., “I am immersed in my work”). These items were measured on a scale of 1 to 7 where 1=’never’ and ‘7’=daily. The construct validity of the short version of the UWES has been shown to be better than the longer version for Finnish occupational groups (Seppälä et al., 2009). For the purposes of the analyses, we used the total composite score of UWES (Schaufeli & Bakker, 2010; Schaufeli, Bakker & Salanova, 2006).

*Burnout* was assessed using the Bergen Burnout Indicator (BBI-9; Salmela-Aro et al., 2011; Feldt et al., 2013). This scale consists of nine items measuring three core dimensions of burnout: *exhaustion at work* (emotional component; e.g., “I am snowed under with work”), *cynicism toward the meaning of work* (cognitive component; e.g., “I feel dispirited at work and I think of leaving my job”) and *sense of inadequacy at work* (behavioural component; e.g., “I frequently question the value of my work”). The items were measured on a scale of 1 to 6 where 1=’strongly disagree’ and ‘6’= strongly agree. The three components of the scale measure the core dimensions of burnout, the emphasis and sequential progression of which has received mixed results (Maslach, Schaufeli & Leiter, 2001). For the purposes of the analyses, we used the subscales of exhaustion, inadequacy and cynicism (see Table 1).

Table 1  
Raw descriptive values and Cronbach’s Alphas

Raw descriptive values and Cronbach’s Alphas				
	Mean	SD	Cronbach’s Alpha 95% Confidence Interval	
Behavioural	3.46	0.70	0.60	0.75
Cognitive - Emotional	3.61	0.61	0.73	0.84
Recovery	3.55	0.73	0.71	0.83
Engagement	5.76	0.98	0.89	0.95
Exhaustion	2.57	1.05	0.57	0.74
Cynicism	2.08	1.08	0.72	0.85
Inadequacy	2.45	1.26	0.70	0.83

Note: Confidence interval bias-corrected and accelerated bootstrap.

## Analyses

First, we specified and tested the structure of the scale, i.e., the dimensions of behavioural self-regulation, cognitive-emotional self-regulation and self-regulation of recovery, using the confirmatory factor analysis approach (CFA). All items were allowed to load on their corresponding factor only. No residual covariance between different items was allowed. The analyses were conducted using R and RStudio (R Core Team, 2018). We used maximum likelihood with standard errors robust for non-normality (MLR) as the estimator and handled missing data using the full information maximum likelihood estimation (FIML).

Second, we utilised a method of visualising the correlations between the three dimensions of self-regulation and established scales of well-being at work (work engagement, job burnout). In order to do this, we added work engagement and the three subscales of job burnout (exhaustion, inadequacy and cynicism) as latent variables to the model to examine the relations between broad self-regulation and well-being at work (i.e., criterion validity).

To describe the method more specifically, both the correlations and partial correlations among the self-regulation factors, work engagement and the three subscales of burnout were visualised and examined. We did this by exporting the latent variable correlation matrix of the model and visualising the cross-sectional correlations by plotting the latent variables as nodes in a correlation and partial correlation network (Epskamp & Fried, 2018). We used R-package qgraph (Epskamp, Cramer, Waldorp, Schmittmann & Borsboom, 2012), similarly to a latent variable network model (see, e.g., Epskamp, Rhemtulla & Borsboom, 2017).

The edges in the latent partial correlation network can be interpreted similarly to regression coefficients, as they are controlled for each other, but without assuming any direction of effects. The figures display the strength of correlations between the different components (behavioural self-regulation, cognitive-emotional self-regulation, self-regulation of recovery, work engagement and the three subscales of job burnout) as well as whether it is negative or positive. The strength of this particular type of modelling is that it allows for powerful measurement error-corrected modelling of undirected structural relations between latent variables (Guyon, Falissard & Kop, 2017).

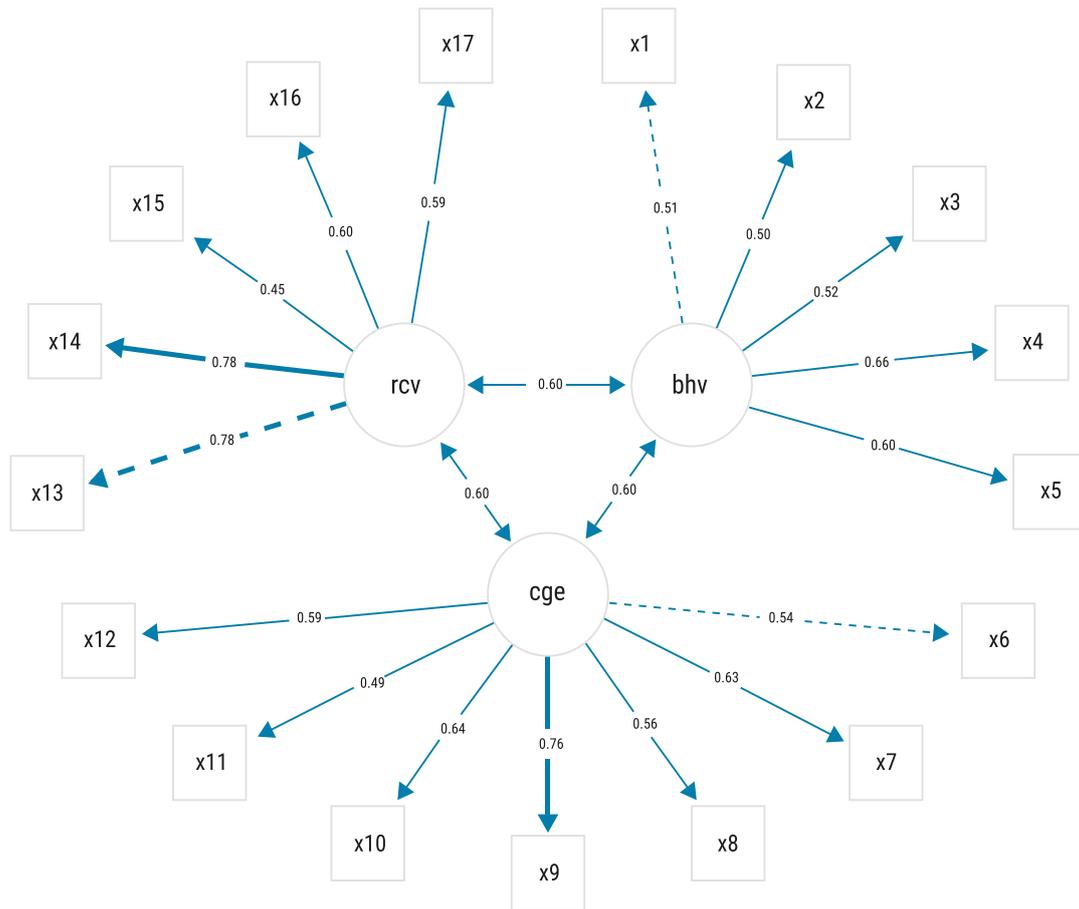
## Results

The initial three-factor model (see Table 2 and Figure 2), specified according to the theoretical background, fitted the data well:  $X^2(116)=158.61$ ,  $p=.005$ ,  $CFI=.944$ ,  $RMSEA=.043$ . All factor loadings were significant and no post-hoc modifications were necessary.

Table 2  
Standardised factor loadings and explained variance ( $R^2$ ) of the measurement model

	Behavioural	Cognitive-Emotional	Recovery	R-squared
x1 = q1	0.51	0.00	0.00	0.26
x2 = q2	0.50	0.00	0.00	0.25
x3 = q5	0.52	0.00	0.00	0.27
x4 = q6	0.66	0.00	0.00	0.43
x5 = q7	0.60	0.00	0.00	0.36
x6 = q8	0.00	0.54	0.00	0.29
x7 = q9	0.00	0.63	0.00	0.39
x8 = q10	0.00	0.56	0.00	0.31
x9 = q11	0.00	0.76	0.00	0.58
x10 = q12	0.00	0.64	0.00	0.41
x11 = q13	0.00	0.49	0.00	0.24
x12 = q14	0.00	0.59	0.00	0.34
x13 = q3	0.00	0.00	0.78	0.61
x14 = q4	0.00	0.00	0.78	0.61
x15 = q15	0.00	0.00	0.45	0.20
x16 = q16	0.00	0.00	0.60	0.36
x17 = q17	0.00	0.00	0.59	0.35

Figure 2  
Confirmatory factor analysis model of self-regulatory skills in multi-locational knowledge work



We then added the scales for well-being at work as latent variables for Model 2. Model 2 fit the data acceptably ( $X^2(536)= 799.89, p<.001, CFI=.907, RMSEA=.049$ ) when three residual covariances were estimated between the items in the work engagement scale.

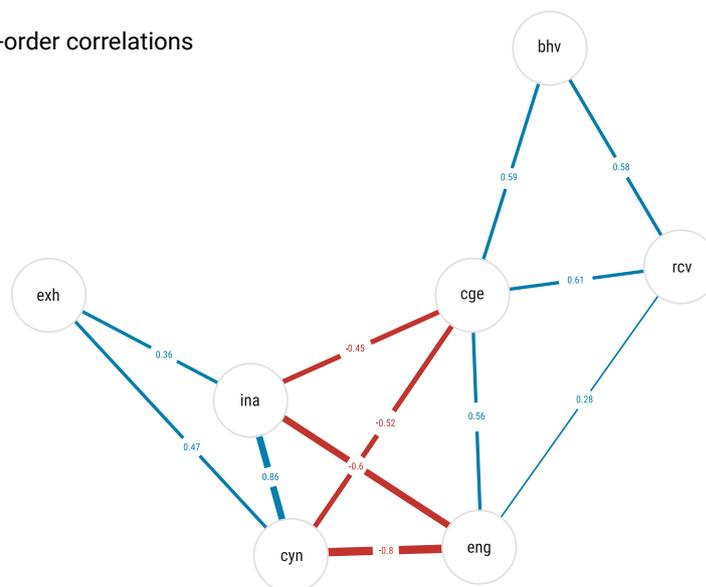
Regarding the relations between the new broad self-regulation factors and indicators of well-being at work, the model indicated that the measured self-regulatory skills were positively related to well-being at work and negatively related to ill-being at work, as expected (see Table 3).

Table 3  
Latent variable correlations

	1	2	3	4	5	6	7
Behavioural	1.00						
Cognitive-Emotional	0.59	1.00					
Recovery	0.58	0.61	1.00				
Engagement	0.19	0.56	0.28	1.00			
Exhaustion	0.02	-0.05	-0.13	-0.12	1.00		
Cynicism	-0.04	-0.52	-0.21	-0.80	0.47	1.00	
Inadequacy	-0.03	-0.45	-0.11	-0.60	0.36	0.86	1.00

More specifically, latent variable zero-order correlations indicated positive relations between work engagement and cognitive-emotional self-regulation, as well as self-regulation of recovery. These correlations also indicated negative relations between cognitive-emotional self-regulation, inadequacy and cynicism. These relations are demonstrated in Figure 3: blue edges indicate positive correlations and red edges negative ones, and the width of the edges corresponds to the absolute value of the correlations: the higher the correlation, the thicker the edge (see Espkamp et al., 2012).

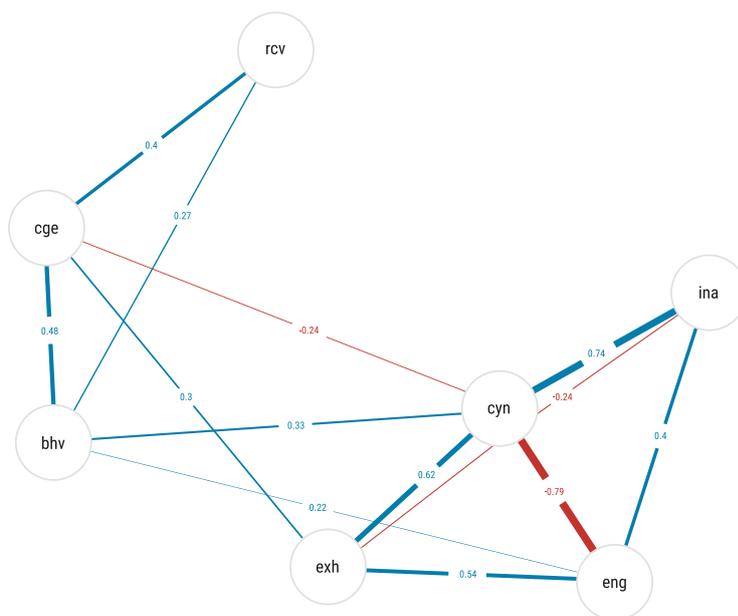
Figure 3  
Latent variable zero-order correlations



Note: Non-significant edges ( $p > .05$  with Bonferroni correction) were omitted. Nodes were placed by Fruchterman-Reingold algorithm (Fruchterman & Reingold, 1991)

Overall, the latent variable correlations confirmed the expected relations between self-regulation factors and established scales for well-being at work. However, latent variable partial correlations (see Figure 4) indicated both expected and unexpected relations. Similarly to Figure 3, the thickness of the edges demonstrates the level of correlation between variables, blue edges indicating a positive and red edges indicating a negative relation. These correlations indicated a positive relation between work engagement, exhaustion and inadequacy. They indicated a positive relation between behavioural self-regulation and work engagement, but also between behavioural self-regulation and cynicism; a negative relation between cognitive-emotional self-regulation and cynicism, but also a positive relation between cognitive-emotional self-regulation and exhaustion. Self-regulation of recovery was positively related to work engagement (zero-order correlations), but no statistically significant relations were found with dimensions of burnout.

Figure 4  
Latent variable partial correlations



Note: Non-significant edges ( $p > .05$  with Bonferroni correction) were omitted. Nodes were placed by Fruchterman-Reingold algorithm (Fruchterman & Reingold, 1991)

Finally, we examined possible differences in broad self-regulation components between subgroups. Welch t-tests and analyses of variance showed only very minor or no differences across organization, employee position, gender and age (more detailed results of these analyses as well as additional study materials can be found at open science framework platform: <https://osf.io/v6r5e/>).

Overall, the measurement model showed a good fit and the analyses of relations to well-being at work indicated that the broad self-regulation scale had the expected and meaningful relations with the established measures of well-being at work. Thus, the results presented here are promising in terms of using this scale to measure self-regulatory skills in multi-locational knowledge work. Regarding the few unexpected relations between self-regulation factors and indicators of well-being at work, the scale can be further improved by the measures explained in the discussion section.

## Discussion

This study focused on the importance of broad self-regulatory skills in contemporary knowledge work. It aimed to develop a scale for measuring multi-locational knowledge workers' self-regulatory skills related to productivity and well-being. The purpose of the scale was to offer a means with which to assess the individual state of required skills, as well as to determine how these skills may need to be developed.

The study indicated promising results regarding the use of this scale for measuring the self-regulatory skills related to productivity and well-being in multi-locational knowledge work. However, in the item development we failed to design items that would reflect the cognitive and emotional aspects of self-regulation separately. It appears that these types of regulative activities, although conceptually distinct, are not empirically separated, at least not with the items used in this study. It is, however, debatable whether these dimensions need to be separated at all; for example, aspects such as connecting with the meaning of work, or acknowledging accomplishments, are likely to tap into both cognitive and emotional experiences and strategies. Within the contexts of learning and motivation it is already established knowledge that cognition and emotion are in many ways intertwined (e.g., Mega, Ronconi & De Beni, 2014; Pekrun, Goetz, Titz & Perry, 2002). More work and subsequent piloting is needed to be able to understand the interplay of cognitive and emotional components in this context. However, at this point, as the measurement model showed a good fit and the latent variable correlation analyses indicated the expected relations between self-regulation factors and established scales of well-being at work, it can be considered a promisingly useful tool for studying well-being at work.

To elaborate on the more specific relations between each of the self-regulation factors, work engagement and the three subscales of job burnout, firstly, behavioural self-regulation was related to both work engagement and cynicism. This factor's items

measure ways of creating fruitful circumstances for productivity as well as deliberately limiting unneeded burden (e.g., the item with the highest factor loading “I deliberately restrict factors that take my attention away from the main task at hand”). It may be that the current focus and phrasing of the items capture the underlying motivational orientations of both proactivity and avoidance (e.g., Elliott & Church, 1997). Thus, future research should even more clearly define the focus and phrasing of the items and further examine the resulting relations.

Secondly, cognitive–emotional self–regulation was, as expected, negatively related to cynicism, but also positively related to exhaustion. This may indicate, like the positive relation between work engagement, exhaustion and inadequacy, a co–occurrence of positive and negative phenomena, namely engagement and proactive behaviour and an overly consuming work routine (for similar results on work engagement, see also Bakker, Albrecht & Leiter, 2011a; Bakker, Albrecht & Leiter, 2011b). On the other hand, the results indicated a rather strong positive relation between the cognitive–emotional self–regulation factor and work engagement. This factor’s items measure the proactive mental management of work through various cognitive and emotional strategies. They partly overlap with certain practices of job crafting, such as increasing job resources (e.g., developing one’s capabilities, asking others for advice) or decreasing hindering job demands, both cognitive and emotional (Tims, Bakker & Derks, 2012). It has been noted that there often are virtuous circles between actively making changes to work and being engaged – engaged employees are also active in their everyday practices, and vice versa (see Bakker, Albrecht & Leiter, 2011a). However, in addition to the co–occurrence of virtuous work life phenomena, this kind of approach may also have a tiring dimension. A more accurate picture of this phenomenon requires further research. Overall, the cognitive–emotional self–regulation factor was related to established indicators of well–being at work in various meaningful ways, and as such appeared to be important for employee well–being and productivity.

Thirdly, self–regulation of recovery was related to work engagement only. This may suggest that paying sufficient attention to recovery and well–being is indeed a matter of proactive employee behaviour related to both productivity and well–being, rather than merely the minimisation of adverse health effects. Perhaps this is embodied in the items with the highest factor loadings: paying attention to physical well–being and maintaining healthy vigour at work. It is also important to point out that the burnout subscales measure actual ill–being at work (Hakanen & Schaufeli, 2012; Iacovides, Fountoulakis, Kaprinis & Kaprinis, 2003; Maslach, Schaufeli & Leiter, 2001). The lack

of found relations between them and self-regulation of recovery does not indicate that the factor would be irrelevant to well-being at work. In fact, the focal basis for developing the scale in the first place was to obtain measures of practices that are related to the everyday fluctuation of well-being and productivity, not their extreme states. Examining the relations with these two established scales for well-being at work offers only one way to study the validity of this scale. In the future, utilising more diverse scales for well-being at work, as well as experiential sampling methods, would be beneficial.

## Practical implications

As described in the introduction, extensive research shows that current working life includes numerous aspects that can potentially hinder both productivity and well-being. These aspects impact all knowledge workers, but their importance is often not recognised or elaborated amidst everyday work routine, although it in fact forms a substantial basis for the work itself. Thus, as to the practical implications of the study, this questionnaire can first of all serve as a concrete tool in raising awareness on the importance of self-regulatory skills and proactive work strategies in knowledge work. This tool is applicable to employees from various multi-disciplinary backgrounds. Presenting the questionnaire and having knowledge workers fill it in serves as a mini intervention in itself: it guides the respondents to recognise and reflect on the impact of the small practices presented in it, possibly even offering an insight that one is in fact able to actively influence one's everyday productivity and well-being at work in these ways.

Secondly, a focal purpose of assessment is naturally to have an understanding of the prevailing situation regarding the level of the skills as well as to recognise and address possible developmental needs. As the challenges to which this scale aims to respond concern all knowledge workers, this scale would be useful as a screening tool and as a means of preventative support for productivity and well-being. The results should be processed together with the respondents and where needed, they should be offered support for learning and practicing these skills. The required support can be offered, for example, in the form of training (e.g., Sjöblom, Lammasaari, Hietajärvi, Mälkki & Lonka, 2019), workshops or one-to-one sessions.

Thirdly, a work and organizational psychology practitioner can help bring the aforementioned perspectives present to both individual and organizational levels,

and this, in fact, is essential in supporting employees in utilising these proactive practices. While there are a number of choices available to employees regarding their daily work practices, the work community also defines the framework of putting them into practice. For example, even if an employee recognises the importance of having uninterrupted work periods in order to have the most important tasks done, if at the same time the shared working culture or management is expecting them to be continuously available via email, the individual has limited possibilities to adapt proactive practices.

It is indeed important to emphasise that although this study focuses on individual skills, the role of the environment and the importance of the support offered by the organization, management and community should not be underestimated. A practitioner can offer valuable support in creating a shared proactive working culture. For example, although knowledge work is typically highly autonomous, it is not a given that employees are encouraged and free to regulate their everyday work practices. Depending on the specific focus in each case, it could also be useful to use this scale combined with measures of working culture, for example, basic psychological needs at work, which also include autonomy at work (Deci et al., 2001).

## Limitations

Regarding the limitations of the study, despite these promising results, the scale needs to be further developed by rephrasing some of the items less ambiguously. At the moment, some of the items reflect aspects of more than one dimension. As noted earlier, this may partly also reflect the nature of the phenomena, but some of the items could be defined more clearly, by for instance deleting or simplifying the examples in parentheses, which were initially included to help the respondents connect with what was being asked. After this modification, a more detailed analysis on the importance of each item on the scale could be carried out. Overall, the results should be confirmed with several representative samples. Assessing predictive validity of the scale with regard to productivity and well-being through a longitudinal study would be highly beneficial. This would also be useful in defining reference values – currently the interpretation of the score is not based on specific values but rather on the practical interpretation of them, low score being an indication of possibly insufficient self-regulatory skills and need for support.

It is also important to point out that we expected the items included in the scale to contribute to employee well-being and productivity; however, our analyses did not include measures of productivity. In general, measuring productivity in knowledge work is considered challenging (Bosch-Sijtsema, Ruohomäki & Vartiainen, 2009; Ramírez & Nembhard, 2004). This study did not permit us to draw conclusions regarding whether the self-regulatory skills measured by this scale were related to productivity. However, as described in the theoretical background, previous studies have shown that the practices included in the questionnaire contribute to either productivity, well-being or both.

## Conclusions

Employees' cognitive potential is the most important and valuable resource in knowledge work. Success in this kind of work, from both the individual and organizational perspective, depends on harnessing human potential in a way that is both productive and sustainable. This study sheds light on how contemporary knowledge work requires broader, more diverse self-regulatory skills of employees than before. It offers new understanding of the current challenges in working life, as well as a practical tool for measuring knowledge workers' self-regulatory skills related to productivity and well-being. The study operationalises topical questions of how to assess and support proactive employee functioning in today's increasingly complex physical, digital and social surroundings.

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