scientific reports

OPEN

Daily use of self-leadership strategies and employee work engagement while working from home and the office

Ada Sil Patterer[1✉], Anita C. Keller[2], Katharina Woharcik[1] & Jana Kühnel[1,3]

Employees' work engagement may vary by work location (office vs. home office), assuming that working at home requires greater self-regulation. Hence, self-leadership may play an important role when employees work at home. The present study investigates whether employees use self-leadership strategies (self-goal setting, self-reward, self-punishment, self-cueing, and visualization of successful performance) more often on home days than on office days. We also examine how these strategies are related to daily work engagement, and whether they are more effective for promoting work engagement depending on the work location. One hundred and one employees completed daily questionnaires on office and home days, resulting in 514 observations. Multilevel analyses revealed that employees reported higher use of self-goal setting, self-reward, and visualization on home days than on office days. Furthermore, we found that applying these strategies was positively related to day-specific work engagement. Nevertheless, self-cueing had no effect and self-punishment was detrimental to work engagement. Moreover, we found no support for the idea that the effectiveness of self-leadership strategies for promoting work engagement depends on the work location. These findings contribute to our understanding of self-leadership strategies promoting work engagement on home and office days.

The COVID-19 pandemic has made working from home a popular choice for many employees, often as part of a hybrid arrangement, which typically allows for work outside the office one or two days a week[1]. The proportion of employees working remotely around the world has been on the rise in recent years, from 20 percent in 2020 to 28 percent in 2023[2]. Moreover, remote and hybrid work arrangements continue to be favored by most employees worldwide, with 91 percent indicating a preference for either a fully remote or predominantly remote work arrangement[2].

From a scientific point of view, the home office offers numerous advantages to both organizations and employees and has been linked to higher job satisfaction[3], lower work-family conflict[4], and higher job performance[5]. Nonetheless, past research on the impact of the home office on employees' work engagement has remained inconclusive. For example, Masuda et al.[6] found that working from home can increase work engagement, whereas Sardeshmukh et al.[7] found a decrease in work engagement. Interestingly, both studies suggested that the supervisor plays a crucial role because the positive and negative effects of the home office seem to depend on the supervisor's support[6] and feedback[7].

In the absence of external monitoring and oversight from supervisors, employees face a new challenge in the home office: they must lead and motivate themselves[8–10]. Without the daily work routines found in traditional work environments (e.g., fixed working hours, designated lunch breaks, and spatial separation between personal and professional life), employees must apply self-leadership strategies to perform optimally and stay engaged[9,10]. Self-leadership refers to individuals using strategies to exhibit self-directed and self-motivated behaviors[11]. Accordingly, the use of specific behavioral and cognitive strategies can contribute to the resourcefulness of the work environment[11] and, thereby, positively affect work engagement[10,12]. Work engagement refers to work-related well-being and has been linked to several beneficial outcomes, including enhanced performance outcomes[13]. Using checklists for maintaining focused attention (self-cueing) and establishing engaging goals for the day (self-goal setting) exemplify self-leadership strategies that employees can use to accomplish work tasks[9].

[1]Faculty of Psychology, University of Vienna, Vienna, Austria. [2]Faculty of Behavioural and Social Sciences, University of Groningen, Groningen, The Netherlands. [3]Psychology and Sports Sciences, Goethe University Frankfurt, Frankfurt am Main, Germany. ✉email: ada.sil.patterer@univie.ac.at
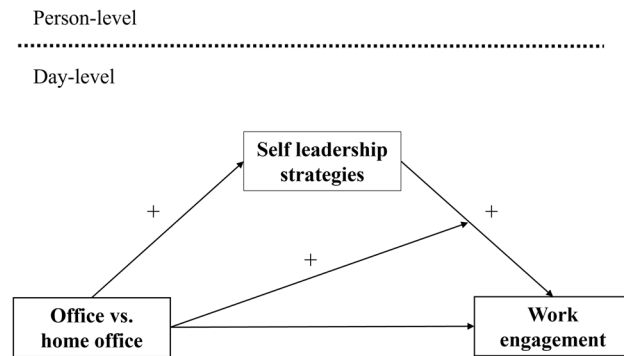
Fig. 1. Conceptual model showing relationships between work location (office vs. home office), self-leadership strategies, and work engagement.

In the present study, we investigated the daily use of self-leadership strategies and daily work engagement in two different settings: the employee's traditional office and their home. By applying the job demands-resources (JD-R) model[14], we identified the work location as a precursor that affects the presence of job demands and resources. Because a supervisor is absent when one works from home, employees need to take on personal responsibility by engaging in proactive strategies to improve their work environment[15]. Hence, we investigated whether employees use self-leadership strategies more often on home days (i.e., days when employees work remotely from their home) compared to office days (i.e., days when employees work from their regular office). As shown in previous studies (e.g. Müller and Niessen[9]), we expect employees to report higher use of self-leadership strategies on home days than on office days. We also investigate whether more frequent use of self-leadership strategies is associated with higher work engagement. Based on the JD-R model, we argue that individuals who engage in self-leadership behavior are better able to enhance their work engagement[10]. Thus, we posit that employees are more engaged on days with higher use of self-leadership strategies. Therefore, we propose that self-leadership explains why employees show higher work engagement when they work from home than in the office. Additionally, we investigate whether certain self-leadership strategies are beneficial for day-specific work engagement depending on the setting where they are applied, that is, the setting in which employees operate on a specific day (home vs. office). Figure 1 illustrates our conceptual model.

The present study makes three contributions: First, it contributes to research by adding to the growing body of literature on flexible work arrangements and providing valuable practical implications for organizational contexts. Even after the end of COVID-19 restrictions, a considerable number of employees continue to work from home and the share of employees with hybrid arrangements is expected to increase[16]. Offering work design suggestions that can enhance employee well-being and productivity in the form of increased work engagement is crucial in both home office and traditional office settings. By understanding the strategies that are most beneficial in remote work and office-based work, organizations can provide targeted resources and support to hybrid workers. Thus, examining the use of self-leadership strategies in different work contexts provides a comprehensive understanding of proactive approaches that employees can implement themselves in remote and office-based environments.

Second, the present study adds to the hybrid work arrangement literature by focusing on work engagement[17] as a direct outcome of self-leadership. Work engagement has received little attention in the remote work research, which typically has focused on employee well-being or job satisfaction among remote workers (for exceptions see, for example Mäkikangas et al.[18] and Costantini and Weintraub[19], who investigated the antecedents of work engagement, such as job-related self-efficacy and job crafting, respectively, in remote work)[18,20]. Work engagement is desirable in remote workers, characterized by energy and a focused effort[18], a positive experience for the employee that is also relevant for organizational performance[21].

Third, the present study broadens self-leadership research in the context of new ways of working by investigating within-person variations concerning home and office days. By analyzing diary data collected from employees who work both from home and the office, this study allows for a within-person comparison of work locations (i.e., home vs. office days) and identifies the circumstances under which employees can benefit from self-leadership strategies to positively influence their daily work engagement[22]. Moreover, this study contributes to the field by separately investigating distinct self-leadership strategies, leading to specific recommendations for their application. By doing so, we not only investigate how the *use* of self-leadership strategies varies in different work contexts but also the *effectiveness* of these strategies in promoting work engagement.

Theoretical background

When employees work remotely, they largely operate independently. The increasing prevalence of flexible work arrangements, such as working from home, has led to the growing popularity of self-leadership concepts with an emphasis on how to empower employees while they manage work on their own schedule[23]. The concept of self-leadership is rooted in several interconnected theories, such as self-management[24], self-control[25], and self-regulation[26] theories, which generally propose that individuals apply specific strategies to direct behavior in desirable and goal-oriented ways[27]. Self-leadership describes the process by which individuals employ behavioral and cognitive strategies to guide and motivate themselves to perform optimally[27,28].

Various self-leadership strategies have been identified in the literature[11,23]: Behavior-focused strategies aim at increasing an individual's responsibility through behaviors such as setting specific goals (self-goal setting), acknowledging one's achievements (self-reward), criticizing oneself (self-punishment), self-assessing performance (self-observation), and using reminders (self-cueing). Constructive thought pattern strategies serve to identify dysfunctional thought patterns and modify them desirably. These strategies include envisioning the accomplishment of work tasks before initiation (visualization of successful performance), engaging in internal dialogue to address challenges (self-talk), and evaluating the suitability of beliefs when faced with problems (evaluation of beliefs and assumptions). Natural reward strategies include incorporating inherently motivating elements into work activities and shifting the focus toward the inherent reward aspects within the work. This can include planning enjoyable activities as part of the work tasks.

According to the JD-R framework[14], job demands can result in strain and health impairment, whereas job resources can foster motivation and productivity[29]. Focusing on the motivational process, the work environment (i.e., work location) provides resources instrumental in attaining work goals and stimulating a positive state related to work, such as increased work engagement[29]. Work engagement is a positive, work-related emotional and cognitive state[30] that fluctuates within individuals from day to day[31]. Work engagement is characterized by high energy levels and effort at work, a strong involvement in one's work, and being absorbed by its tasks[30]. In this context, we argue that self-leadership strategies are proactive responses that employees initiate when they encounter situations requiring them to make an effort to align their abilities with the external demands of their environment, thereby enhancing their work environment and reestablishing this alignment[15]. Accordingly, when individuals manifest self-leadership behaviors, they are more likely to experience increased work engagement[10]. Employees who actively apply self-leadership strategies manage and impact their work environment in a way that becomes instrumental in achieving their goals, which, in turn, increases their levels of engagement[10].

Self-leadership strategies and work location

In everyday tasks, individuals engage in self-leadership behavior to a certain degree[24]. Individuals set certain standards and reward or punish themselves according to their performance assessments according to these standards[24]. The extent of self-leadership opportunities available to employees depends on the specific work context. The traditional office environment includes both physical elements, such as rooms, tools, and equipment, as well as psychosocial aspects like supervision and monitoring, that provide structures and cues to control and reinforce employee behavior externally[32]. By contrast, the home office removes the structural properties of the office, allowing for more freedom in deciding when and how to work[9,33]. Employees experience increased autonomy when working from home[9,33]. In the context of work design, this relates to their degree of flexibility in how they schedule and execute work tasks and manage their daily working routines[9]. Moreover, in the absence of external cues, employees are more likely to substitute formal leadership by exercising self-leadership to optimally guide and motivate themselves[28]. Therefore, while the home office offers increased opportunities for self-leadership, it also entails more private life demands (e.g., household or childcare responsibilities, or other family or personal responsibilities, such as caring for the elderly, dog walking, etc.), for which employees must assume additional responsibility and initiative by showing self-leadership behavior[11,34]. In line with this, Müller and Niessen[9] conducted a study with 195 employees who worked periodically in both a traditional office and a home office and found that these employees applied certain self-leadership strategies more frequently on the days spent at home compared to those spent at the office. In particular, the authors observed an increase in self-goal setting, self-rewards, and the visualization of successful performance because of higher job autonomy on home days compared to office days.

Thus, we posit that employees demonstrate more self-leadership on home days than on office days because the working environment at home *provides* more self-leadership opportunities and *demands* that employees apply self-leadership strategies.

Hypothesis 1 The work location (coded 0 for office and 1 for home office) is positively related to day-specific use of self-leadership strategies, such that employees use self-leadership strategies more extensively on home days than on office days.

Self-leadership strategies and work engagement

Self-leadership is associated with many beneficial outcomes, including job satisfaction, individual performance, and long-term career success (for an overview, see Stewart et al.[35]). Based on the JD-R model[14], employees who use self-leadership strategies take proactive steps to make their work more resourceful and rewarding, ensuring alignment between their ability and the demands of their environment[15,36]. Thus, self-goal setting, self-cueing, self-observation, and the visualization of successful performance keep employees focused on their path to goal attainment, which allows them to leverage additional job resources[37], resulting in the inherent gratification of overcoming challenges[38]. Self-talk and evaluations of beliefs and assumptions help employees feel more optimistic and certain about their abilities to positively influence their environment[39]. Furthermore, self-reward and self-punishment act as motivators to direct employees' behavior[35]. Both strategies aim to ensure improved performance by reinforcing desirable behaviors while preventing and correcting undesirable behaviors[10,37,40]. In addition, natural rewards let employees create situations where they perceive their work as a source of pleasure and motivation, resulting in work engagement[27].

Some studies have suggested that self-leadership positively relates to work engagement. For example, Breevaart et al.[10] found that employees felt more vigorous, dedicated, and absorbed in their work—three indicators of work engagement—on days when they practiced more self-leadership. Specifically, they demonstrated that self-leadership enhances work engagement by increasing the availability of job resources such as skill variety,

feedback, and developmental opportunities[10]. In another study, Gomes et al.[12] reported a positive relationship between self-leadership, as a general combination of a set of behavioral, cognitive, and rewarding strategies, and work engagement. The authors argue that self-leadership triggers affective-motivational responses and improves positive affective states like work engagement[12]. In a similar vein, Costantini and Weintraub[19] demonstrated that when employees use self-leadership strategies, they create a more resourceful work environment for themselves, which triggers a motivational process leading to more work engagement. Considering the above, we postulate the following hypothesis:

Hypothesis 2 The day-specific use of self-leadership strategies is positively related to day-specific work engagement.

Based on our arguments that employees apply self-leadership strategies more extensively on home days than on office days (Hypothesis 1), and that using self-leadership strategies fosters work engagement (Hypothesis 2), we propose that employees experience higher work engagement on home days than on office days because they apply self-leadership strategies more extensively on home days. Behavior-focused strategies, such as self-reward, are likely to be important in promoting higher work engagement during home days. For example, employees may be able to self-reward themselves if they have the adequate means to do so by indulging in enjoyable activities while working from the convenience of their homes and having direct access to the things they find pleasurable, which, in turn, should increase work engagement. Regarding constructive thought patterns, at home, when there is no external monitoring by a supervisor, employees more frequently visualize the successful completion of work tasks before starting to work, which helps them to stay dedicated and immersed in their work. For natural reward strategies, the lack of external regulation by a supervisor allows employees at home to determine how to perform a specific task. They can incorporate enjoyable elements into their work, such as listening to music while working, leading to higher levels of work engagement.

Hypothesis 3 Employees experience greater work engagement on home days than on office days through the increased use of self-leadership strategies.

Effectiveness of self-leadership strategies in promoting work engagement depending on work location

Complementary to the reasoning behind Hypothesis 3, we ask whether self-leadership strategies are beneficial for daily work engagement depending on the specific setting where such strategies are employed, that is, the setting where employees operate on a specific day (home vs. office setting). Important distinctions may exist between these two work locations, including the physical presence or absence of colleagues and supervisors, and the extent of available workplace resources[8]. We hypothesize that self-leadership strategies are more effective in an environment where direct leadership and external structure are less present (i.e., at home). Based on the JD-R model[14], resources are crucial, especially in demanding situations. Here, self-leadership strategies—considered proactive strategies—should gain salience, especially in the home setting, because there is less direct leadership and external structure in the home office setting compared to the office setting. In other words, gaining salience means that self-leadership strategies should be more conducive for work engagement in the home office context, that is, they should be more strongly related to work engagement in the home office setting versus in the office setting.

For instance, self-reward may be more beneficial on home days than in the office as the *same* activity may be more self-rewarding in the home than in the office setting: For example, indulging in a short nap in one's own bed may be more self-rewarding compared to napping in one's office chair, preparing a delicious snack at home may be more self-rewarding compared to buying a ready-made snack in the office, and going for a walk after accomplishing a task in a forest nearby one's home may be more self-rewarding compared to going for a walk around the office building. In addition, the *specific* activities that employees choose may differ in the home vs. in the office setting and chosen activities may differ in their potential to be self-rewarding: For example, employees may rather engage in a short nap when being at home vs. when being in the office, while they may rather get a delicious coffee when being in the office vs. when being at home as a professional barista coffee machine may be available in the office. Similarly, self-goal setting may be more effective in the home setting than in the office setting because people may face more potential distractions at home. Thus, self-goal setting may be crucial to staying focused on work tasks and experiencing engagement in the home setting. Furthermore, we argue that self-cueing becomes particularly effective if external environmental cues are missing. If more *external* cues and structure are provided (e.g., supervisors, colleagues, and objects present at the office), whether *self*-cueing is applied should make less of a difference regarding work engagement. If external cues are less present (at home), then it is even more important for work engagement that employees employ self-cueing. Likewise, if supervisors exert punishment, whether self-punishment is applied is less important. On the other hand, if external punishment by others is less present (e.g., at home), self-punishment becomes crucial for work engagement. In addition, the visualization of successful performance can be substituted by colleagues who can be observed while performing well in the office setting. If employees are less able to observe others' successful performance in their work environment (which is more likely when working from home), the visualization of successful performance becomes essential. Based on this reasoning, we propose the following competing hypothesis:

Hypothesis 4 Daily self-leadership strategies are more effective in promoting daily work engagement on home days than on office days.

Method

Sample and procedure

Participants were recruited in Austria through convenience sampling during the COVID-19 pandemic. Students enrolled in a psychology Master's program at the University of Vienna facilitated recruitment by inviting friends, relatives, and acquaintances to participate in the study, primarily using social media platforms such as Facebook. The recruitment took place prior to three measurement periods: March 27 to April 20, September 7 to 25, and November 5 to 20, 2020. During these times various physical distancing measures were in place, including people maintaining a minimum distance of two meters from each other when in public, encouraging working from home (with the option to also work in the office), and wearing face masks to prevent the spread of the virus. Before the daily surveys, participants were asked to complete a general survey, which aimed to gather information about their ability to work from home according to company policy. The survey also inquired about their working-from-home practices, their frequency of home office days before the pandemic, and whether they planned to work from home at least twice during the data collection period. Additionally, demographic details such as gender, age, highest level of education completed, weekly working hours, and number of children were collected. Employees had to be at least 18 years old to be eligible for the study. Furthermore, participants had to have worked both at the office and at home at least once during the data collection period. Following the general survey, participants were instructed to fill out a daily survey at the end of as many days as possible for both home days and office days. Participants had the opportunity to fill out these daily surveys for an average of 14 days during the three measurement periods mentioned above. This data collection strategy aimed to ensure that participants could fill out the daily survey on both home and office days, even when they only sporadically worked in either setting. Automated email reminders were dispatched throughout the daily data collection period.

Informed consent was obtained from all participants before their inclusion in the study. We closely followed the guidelines of the German Psychological Association[41]. This study was conducted according to the model code of ethics of the European Federation of Psychologists' Associations[42] and complied with the current American Psychological Association (APA) Ethical Principles of Psychologists and Code of Conduct. Ethical approval was obtained from the Ethics Committee of the Department of Psychology and Sports at Goethe University Frankfurt.

We initially recruited 240 employees. However, due to a dropout rate of 57.9%, the final sample was reduced to 101 employees (65.3% female), who reported a total of 514 workdays, consisting of 245 office days and 269 home days. The participants' age ranged from 21 to 64 years ($M = 41.06$, $SD = 12.97$). Their weekly working hours varied between nine and 50 ($M = 38.23$, $SD = 8.33$). Regarding the participants' highest level of education completed, most held a university degree (70.5%), followed by academic secondary school/higher vocational education/post-secondary vocational education and training courses (25.3%), apprenticeship (2.1%), and other (2.1%). Participants in the study were employed in diverse fields, including legal (16.0%), executive and management roles (15.8%), education and research (11.9%), human resources (8.9%), engineering and technical roles (5.9%), communications and public relations (5.0%), and finance and real estate (4.0%). Furthermore, some participants were in various other sectors or unspecified job sectors (21.8%), and some did not provide job information (5.9%).

Daily measures

All daily constructs were measured at the end of the workday and referred to the current working day. All items were in German.

Work location

We used a single question that asked whether employees worked from home or the office on a given day to assess the work location. If the respondents indicated the home as their work location, we asked them to provide reasons for using the home office in the form of a comment.

Self-leadership

The use of self-leadership strategies was assessed using 18 items of the German version of the Revised Self Leadership Questionnaire[11]. Following Müller and Niessen[9], we used two items for each of the nine self-leadership dimensions (i.e., self-goal setting, self-reward, self-punishment, self-observation, self-cueing, visualization of successful performance, self-talk, evaluation of beliefs and assumptions, and natural rewards; see Andreßen and Konradt[11]). We performed multilevel confirmatory factor analyses (MCFAs) using Mplus to evaluate the structure of the self-leadership measure. Unfortunately, we replicated issues with the psychometric qualities of four of the nine sub-dimensions of the scale (see also Müller and Niessen[9]). Specifically, we had to exclude the two items that measured each of self-observation, self-talk, evaluation of beliefs and assumptions, and natural rewards due to low internal consistencies (Cronbach's alpha < 0.6 across days) and low within-person (Level 1) intercorrelations between the two respective items of the sub-dimension ($r < 0.4$, specifically, $r = 0.38$ for self-observation, $r = 0.17$ for self-talk, $r = 0.21$ for evaluation of beliefs and assumptions, and $r = 0.28$ for natural rewards). The final five-factor model for self-goal setting, self-reward, self-punishment, self-cueing, and visualization of successful performance showed a better fit than alternative models (Supplementary Table 1), and we observed sufficient within-person (Level 1) intercorrelations between the two respective items of each sub-dimension (self-goal setting: $r = 0.57$, self-reward: $r = 0.68$, self-punishment: $r = 0.46$, self-cueing: $r = 0.71$, and visualization of successful performance: $r = 0.51$). Example items are "Today, I established specific goals for my own performance" (self-goal setting), "Today, when I successfully completed a task, I rewarded myself with something" (self-reward), "Today, I tended to get down on myself when I performed poorly" (self-punishment), "Today, I used written notes to remind myself of what I need to accomplish" (self-cueing), "Today, I pictured in my mind a successful

performance before I actually performed a task" (visualization of successful performance). The statements could be answered on a 5-point scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*).

Work engagement

Work engagement was measured using the day-specific, 9-item German version[31] of the Utrecht Work Engagement Scale (UWES)[30]. An example item is "Today at my work, I felt bursting with energy." The items were answered on a 7-point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Cronbach's alpha ranged between 0.91 and 0.95 across days.

Measure for exploratory analyses: Usual frequency of working from home

To assess the usual frequency of working from home, in the general survey, we asked employees to indicate their usual home office use (in percent) before the pandemic. The usual frequency of working from home ranged from 0 to 90% ($M = 13\%$, $SD = 19.6\%$).

Results
Data analysis

Table 1 presents the means, standard deviations, and correlations for the study variables. We examined intraclass correlations (ICCs) to gain insights into the variance components of our variables at the within-person and between-person levels. ICCs (Table 1) ranged between 0.40 and 0.57, indicating that between 60 and 43% of the total variance resided at the within-person level. We built multilevel path models with Mplus 8.2 to account for data nesting (i.e., day-level data being nested within persons) and to test our hypotheses[43]. We simultaneously modeled paths at the within-person (Level 1) and between-person (Level 2) levels, using Bayes estimation. We person-mean-centered (group-mean-centered) all predictor variables at the within-person level, and used person-mean aggregates of Level-1 predictor variables at the between-person level. This procedure partitions the day-level (Level 1) variables into their within and between components and ensures unbiased estimates. To test Hypotheses 1 to 3, we modeled the indirect effects on the within-person level (work location predicting work engagement via self-leadership strategies). To test Hypothesis 4, we built interaction terms between person-mean-centered Level-1 variables and used these interaction terms as additional work engagement predictors.

Hypotheses testing

Table 2 shows the results of the multilevel path model, specifically, all direct effects and the individual components of the indirect effects. Table 3 presents the indirect and total effects on the within-person level (Level 1). The results in Table 2 reveal that the work location (office vs. home office, coded *office* = 0 and *home office* = 1) was a significant and positive predictor of self-goal setting, self-reward, and visualization of successful performance. The work location did neither significantly predict self-punishment nor self-cueing. Thus, Hypothesis 1—stating that employees use self-leadership strategies more often on home days than on office days—was partially supported (for three of the five self-leadership strategies: self-goal setting, self-reward, and visualization of successful performance). The results in Table 2 partially support Hypothesis 2, which states that using self-leadership strategies fosters work engagement. Self-goal setting, self-reward, and visualization of successful performance were positive and significant predictors of work engagement. In contrast to our expectations, self-cueing was not a significant predictor of work engagement, and self-punishment was a significant and negative predictor of work engagement. Table 3 shows that work location was positively and indirectly related to work engagement via self-goal setting, self-reward, and visualization of successful performance, partially supporting Hypothesis

Variable	M	SD	ICC[a]	1	2	3	4	5	6	7	8	9
1. Day-specific work engagement	4.07	1.22	0.395		0.32***	0.22***	− 0.06	0.15*	0.24***	0.10*		
2. Day-specific self-goal setting	3.64	0.82	0.420	0.58***		0.24***	0.07	0.32***	0.38***	0.13**		
3. Day-specific self-reward	2.18	0.83	0.440	0.27*	0.16		0.07	0.09	0.31***	0.13***		
4. Day-specific self-punishment	1.93	0.69	0.475	0.07	0.09	0.35***		0.10*	0.06	0.02		
5. Day-specific self-cueing	3.12	1.16	0.574	0.15	0.44***	0.05	0.23*		0.25***	0.02		
6. Day-specific visualization	2.56	0.88	0.492	0.43***	0.45***	0.28*	0.24*	0.16		0.08*		
7. Day-specific work location: Office vs. home office[b]	0.52	0.12	< 0.001	− 0.16	− 0.14	0.06	− 0.10	0.15	− 0.05			
8. Proportion of home office in percent	13.59	19.55	–	− 0.13	0.01	− 0.11	− 0.15	< 0.01	− 0.12	− 0.10		
9. Age	41.06	12.90	–	0.18	0.07	− 0.17	− 0.16	− 0.20	0.11	− 0.05	< − 0.01	
10. Gender[c]	0.65	0.48	–	0.16	0.10	0.04	0.08	0.15	− 0.13	− 0.01	0.08	− 0.31*

Table 1. Means, standard deviations, and correlations of variables. The day-level correlations ($N = 514$) are depicted above the diagonal, person-level correlations ($N = 101$) are depicted below the diagonal. Day-level (within person) correlations are calculated with group-mean (person-mean) centered variables, person-level (between person) correlations are calculated with day-level variables 1 to 7 aggregated for each person. [a]Intraclass correlation (ICC) = ratio of the between-person variance to the total variance, 1-ICC = ratio of the within-person variance to the total variance. [b]Day-specific work location: 0 = *office*, 1 = *home office*. [c]Gender: 0 = *male*, 1 = *female*. *$p < 0.05$. **$p < 0.01$. ***$p < 0.001$.

Predictor variables	Self-goal setting Est. (SD)	95% CI	Self-reward Est. (SD)	95% CI	Self-punishment Est. (SD)	95% CI
Level 1: Within-person level						
Work location: Office vs. home office	0.20 (0.06)***	[0.090, 0.315]	0.19 (0.06)***	[0.063, 0.312]	0.01 (0.05)	[− 0.069, 0.117]
Self-goal setting						
Self-reward						
Self-punishment						
Self-cueing						
Visualization						
Level 2: Between-person level						
Intercept	4.14 (0.38)***	[3.141, 4.810]	2.00 (0.35)***	[1.278, 2.727]	2.26 (0.33)***	[1.451, 2.929]
Work location: Office vs. home office	− 0.93 (0.73)	[− 2.465, 0.360]	0.29 (0.66)	[− 0.922, 1.711]	− 0.61 (0.65)	[− 1.928, 1.046]
Self-goal setting						
Self-reward						
Self-punishment						
Self-cueing						
Visualization						
Level 1 R^2	0.02	[0.003, 0.040]	0.01	[0.002, 0.040]	0.00	[0.000, 0.009]
Level 2 R^2	0.02	[0.000, 0.113]	0.01	[0.000, 0.056]	0.01	[0.000, 0.078]

Predictor variables	Self-cueing Est. (SD)	95% CI	Visualization Est. (SD)	95% CI	Work engagement Est. (SD)	95% CI
Level 1: Within-person level						
Work location: Office vs. home office	0.03 (0.07)	[− 0.114, 0.148]	0.12 (0.07)*	[0.013, 0.248]	0.07 (0.07)	[− 0.087, 0.191]
Self-goal setting					0.30 (0.05)***	[0.184, 0.395]
Self-reward					0.17 (0.06)*	[0.042, 0.253]
Self-punishment					− 0.13 (0.07)*	[− 0.266, − 0.029]
Self-cueing					0.05 (0.05)	[− 0.046, 0.148]
Visualization					0.13 (0.05)*	[0.042, 0.233]
Level 2: Between-person level						
Intercept	2.34 (0.50)***	[1.470, 3.538]	2.71 (0.43)***	[1.944, 3.713]	2.40 (0.52)***	[1.283, 3.280]
Work location: Office vs. home office	1.51 (0.96)	[− 0.733, 3.237]	− 0.36 (0.79)	[− 2.275, 1.034]	− 0.77 (0.70)	[− 2.035, 0.885]
Self-goal setting					0.44 (0.12)***	[0.246, 0.730]
Self-reward					0.18 (0.12)	[− 0.026, 0.512]
Self-punishment					− 0.11 (0.15)	[− 0.428, 0.210]
Self-cueing					− 0.06 (0.08)	[− 0.223, 0.108]
Visualization					0.19 (0.10)	[− 0.053, 0.353]
Level 1 R^2	.00	[0.000, 0.007]	.01	[0.000, 0.028]	0.11	[0.072, 0.169]
Level 2 R^2	.02	[0.000, 0.106]	.01	[0.000, 0.079]	0.40	[0.236, 0.572]

Table 2. Results of multilevel path model (direct effects and individual components of indirect effects). $N_{\text{Level1(within person)}} = 514$. $N_{\text{Level2(between person)}} = 101$. Est. = unstandardized estimates; SD = posterior standard deviation. Day-specific work location: 0 = *office*, 1 = *home office*. Two-tailed *p*-values. *$p < 0.05$. **$p < 0.01$. ***$p < 0.001$.

Independent variable	Mediating variables	Dependent variable	Est. (SD)	95% CI	p
Indirect effects (a × b)					
Office vs. home office	Self-goal setting	Work engagement	**0.058** (0.021)	[0.026, 0.106]	0.000
Office vs. home office	Self-reward	Work engagement	**0.031** (0.015)	[0.001, 0.061]	0.020
Office vs. home office	Self-punishment	Work engagement	− 0.001 (0.007)	[− 0.022, 0.009]	0.880
Office vs. home office	Self-cueing	Work engagement	0.001 (0.005)	[− 0.012, 0.012]	0.780
Office vs. home office	Visualization	Work engagement	**0.016** (0.012)	[0.001, 0.040]	0.040
Total effect (c)					
Office vs. home office		Work engagement	**0.176** (0.072)	[0.001, 0.291]	0.040

Table 3. Indirect effects and total effect on the within-person level (level 1). $N_{\text{Level1(within person)}} = 514$. $N_{\text{Level2(between person)}} = 101$. Est. = unstandardized estimate; SD = posterior standard deviation; 95% CI = 95% Bayesian credibility interval. Day-specific work location: 0 = *office*, 1 = *home office*. Two-tailed *p*-values. Significant effects appear in boldface.
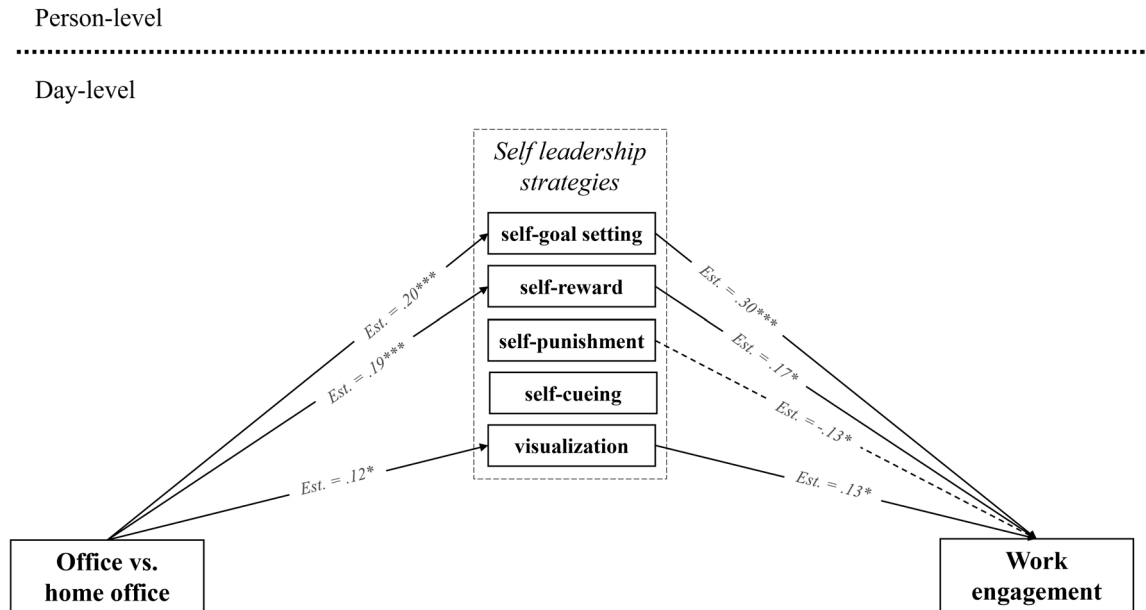
Fig. 2. Tests of hypotheses: results of multilevel path model. *Note* Significant effects on the within-person level (Level 1) are shown, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. Solid lines indicate positive relationships, dashed lines indicate negative relationships. Day-specific work location was coded 0 = *office* and 1 = *home office*. Paths were also modelled on the between-person level (Level 2), but are not depicted.

3 (indirect effects). When working at home (vs. in the office), employees more often applied self-leadership strategies, self-goal setting, self-reward, and visualization of successful performance; thus, they demonstrated higher work engagement. Hence, employees were more engaged on the days they worked at home compared to the days they worked in the office (the total effect).

Hypothesis 4 states that self-leadership strategies should have a stronger effect on work engagement in the home office compared to the office setting. The results from multilevel analysis revealed that none of the interaction terms were significant: work location (office vs. home office), self-goal setting (estimate = -0.112, $SD = 0.108$, $p = 0.280$), self-reward (estimate = -0.154, $SD = 0.116$, $p = 0.200$), self-punishment (estimate = 0.017, $SD = 0.146$, $p = 0.920$), self-cueing (estimate = 0.050, $SD = 0.045$, $p = 0.280$), and visualization of successful performance (estimate = -0.049, $SD = 0.118$, $p = 0.620$). Thus, the results demonstrate that the effectiveness of self-leadership strategies for work engagement did *not* vary by day-specific work location, and Hypothesis 4 had to be rejected. Figure 2 presents an overview of the results of our hypotheses.

Exploratory analyses

The non-significant results for Hypothesis 4 indicate that the effectiveness of self-leadership strategies for work engagement does not vary by *day-specific* work location. In response to these findings, we explored whether the effectiveness of self-leadership strategies for work engagement varies depending on employees' *general* work location. Specifically, we tested whether self-leadership strategies were more effective in promoting day-specific work engagement for employees who generally work less often in the home office compared to those who generally work more often in that setting. In other words, we tested whether the day-specific coupling of self-leadership strategies and work engagement was stronger for employees who generally work less often in the home office compared to those who generally work more often in that setting. To test this idea, the within-person paths between self-leadership strategies and work engagement (*b* paths) were allowed to vary between persons (random slopes), and these random slopes were predicted by the usual frequency of working from home (cross-level interactions). The usual frequency of working from home was grand-mean-centered for analysis. We also modeled the direct effect of the (cross-level moderator) usual frequency of working from home on the (outcome variable) work engagement at the between-person level. Table 4 presents the conditional indirect effects on the within-person level, in particular, the day-specific work location (home office vs. office) predicting work engagement via self-leadership strategies for employees who generally work more often (upper part of the table, labeled "frequent home office users") vs. less often (lower part of the table, labeled "infrequent home office users") in the home office setting. Figure 3 provides a graphical overview of the results of these explanatory analyses.

The results revealed that the slope variances of self-goal setting (estimate = 0.045, $S.D. = 0.041$, $p < 0.001$), self-reward (estimate = 0.095, $S.D. = 0.053$, $p < 0.001$), self-punishment (estimate = 0.039, $S.D. = 0.041$, $p < 0.001$), self-cueing (estimate = 0.029, $S.D. = 0.025$, $p < 0.001$), and visualization of successful performance (estimate = 0.085, $S.D. = 0.039$, $p < 0.001$) were significant. The usual frequency of working from home was a marginally significant cross-level moderator of the path between self-goal setting and work engagement (estimate = -0.005, $SD = 0.003$, $p = 0.052$), and a significant cross-level moderator of the path between self-reward and work engagement (estimate = -0.010, $SD = 0.003$, $p < 0.001$), self-punishment and work engagement (estimate = -0.005, $SD = 0.003$,

Predictor	Mediators	Outcomes	Est. (*SD*)	95% CI	*p*
Conditional indirect effects for frequent home office users (+1SD)					
Office vs. home office	Self-goal setting	Work engagement	**0.032** (0.020)	[0.001, 0.079]	0.030
Office vs. home office	Self-reward	Work engagement	− 0.011 (0.019)	[− 0.057, 0.021]	0.440
Office vs. home office	Self-punishment	Work engagement	− **0.039** (0.025)	[− 0.105, − 0.004]	0.020
Office vs. home office	Self-cueing	Work engagement	0.003 (0.016)	[− 0.028; 0.036]	0.798
Office vs. home office	Visualization	Work engagement	− 0.011 (0.019)	[− 0.057, 0.022]	0.426
Conditional indirect effects for infrequent home office users (-1SD)					
Office vs. home office	Self-goal setting	Work engagement	**0.062** (0.029)	[0.013, 0.126]	0.012
Office vs. home office	Self-reward	Work engagement	**0.045** (0.023)	[0.007, 0.096]	0.014
Office vs. home office	Self-punishment	Work engagement	− 0.008 (0.021)	[− 0.039, 0.057]	0.482
Office vs. home office	Self-cueing	Work engagement	0.011 (0.013)	[− 0.007, 0.045]	0.208
Office vs. home office	Visualization	Work engagement	**0.032** (0.021)	[0.003, 0.087]	0.022

Table 4. Conditional indirect effects between work location (office vs. home office) and work engagement via self-leadership strategies on the within-person level (level 1). $N_{\text{Level1(within person)}} = 501$. $N_{\text{Level2(between person)}} = 96$. Est. = unstandardized estimates; SD = posterior standard deviation; 95% CI = 95% Bayesian credibility interval. Day-specific work location: 0 = *office*, 1 = *home office*. Two-tailed *p*-values. Statistically significant estimates are shown boldface.

$p < 0.05$), and visualization of successful performance and work engagement (estimate = -0.008, $SD = 0.003$, $p < 0.01$). The usual frequency of working from home was not a significant cross-level moderator of the relationship between self-cueing and work engagement (estimate = -0.002, $SD = 0.003$, $p = 0.468$). For all significant cross-level interactions, the cross-level moderator statistically *reduced* the day-specific relationship between using self-leadership strategies and work engagement. That is, the coupling of self-leadership and work engagement was less strong for frequent home office users than for less frequent users. In other words, the benefits of self-leadership strategies for work engagement were less pronounced for frequent home office users than for less frequent users (self-goal setting predicting work engagement: simple slope for frequent home office users: estimate = 0.192, $SD = 0.082$, $p < 0.05$, simple slope for less frequent home office users: estimate = 0.366, $SD = 0.082$, $p < 0.001$; self-reward predicting work engagement: simple slope for frequent home office users: estimate = − 0.070, $SD = 0.094$, $p = 0.428$, simple slope for less frequent home office users: estimate = 0.260, $SD = 0.075$, $p < 0.01$; self-punishment predicting work engagement: simple slope for frequent home office users: estimate = − 0.232, $SD = 0.094$, $p < 0.01$, simple slope for less frequent home office users: estimate = − 0.056, $SD = 0.110$, $p = 0.472$; self-cueing predicting work engagement: simple slope for frequent home office users: estimate = 0.026, $SD = 0.081$, $p = 0.786$, simple slope for less frequent home office users: estimate = 0.074, $SD = 0.065$, $p = 0.204$; visualization of successful performance predicting work engagement: simple slope for frequent home office users: estimate = − 0.069, $SD = 0.097$, $p = 0.412$, simple slope for less frequent home office users: estimate = 0.193, $SD = 0.088$, $p < 0.05$).

Consequently, the indirect effects linking work location (office vs. home office) to work engagement via self-leadership strategies (Table 4) were stronger for infrequent home office users than for frequent users. For frequent home office users, there was even a negative indirect effect via self-punishment, indicating that frequent home office users applied more self-punishment on days when they worked from home compared to days when they worked in the office, and that applying self-punishment *reduced* day-specific work engagement.

Discussion

This study investigated the daily use of self-leadership strategies and their relationship with daily work engagement in the context of home versus office days. Employees reported higher use of self-goal setting, self-reward, and visualization of successful performance on home days than on office days. Furthermore, we demonstrated that these strategies were positively correlated with day-specific work engagement, whereas self-cueing had no effect, and self-punishment was detrimental to work engagement. Thus, indirect effects were identified for working at home regarding work engagement via self-goal setting, self-reward, and visualization of successful performance. We found no support for the idea that the effectiveness of self-leadership strategies for promoting work engagement depends on the day-specific work location.

Similar to the findings of Müller and Niessen[9], we found that among the five self-leadership strategies examined, self-goal setting, self-reward, and visualization of successful performance are used more often when employees work from home. By contrast, self-punishment and self-cueing do not show a consistent pattern based on the work location and vary across days independently of whether participants work in the office or at home [42]. This implies that working in both settings offers comparable possibilities and needs for applying self-punishment and self-cueing techniques.

Our results revealed that not all self-leadership strategies are beneficial for daily work engagement. Self-cueing was unrelated to daily work engagement, whereas self-punishment was detrimental to it. Previous research has regarded self-punishment in the form of self-sanctions for underperforming as less effective than other self-leadership strategies in motivating goal accomplishment. This is attributed to the disruptive nature of the negative
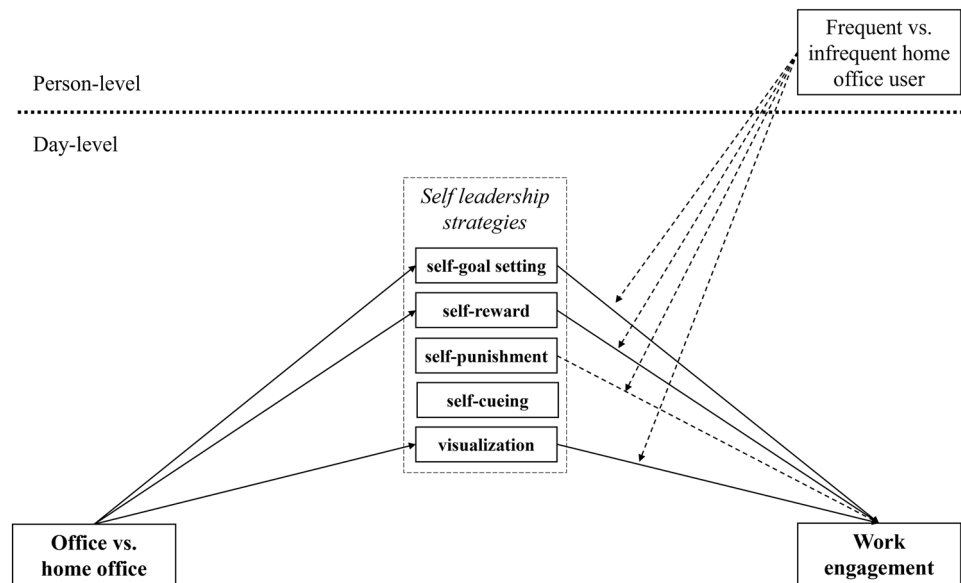
Fig. 3. Exploratory analyses: results of multilevel path models. *Note* Significant effects on the within-person level (Level 1) and significant and marginally significant cross-level interaction effects are shown. Solid lines indicate positive relationships, dashed lines indicate negative relationships. Day-specific work location was coded $0 = $ *office* and $1 = $ *home office*.

emotions and thoughts that typically follow self-punishment behavior[44]. In line with this, self-punishment can negatively affect performance[9], leading to a decrease in work engagement[10].

Furthermore, our results partially support the indirect effects linking work location to work engagement through self-goal setting, self-reward, and visualization of successful performance. Employees felt more engaged on home days than on office days because they more extensively used these self-leadership strategies when they worked at home. We found no indirect effect linking working location to work engagement through self-cueing or self-punishment. Based on the JD-R model[14] self-goal setting, self-reward, and visualization of successful performance seem to play a crucial role in establishing a resourceful work environment that boosts the motivation of employees working both from home and the office.

Finally, our results do not support the idea that the effectiveness of self-leadership strategies in promoting work engagement depends on the day-specific work location (home office vs. office) where the strategies are employed. In additional exploratory analyses, we investigated whether working at home most of the time (i.e., frequent home office users) or using the home office infrequently (i.e., infrequent home office users) affects the effectiveness of the self-leadership strategies used by employees. Overall, the positive relationship between self-leadership strategies and work engagement appears more pronounced among infrequent home office users. As a result, employees with limited experience in the home setting seem to gain the most from using self-leadership strategies. In particular, self-goal setting, self-reward, and visualization of successful performance seem effective for increasing work engagement for infrequent home office users. For frequent home office users, we also found a smaller positive effect of self-goal setting on work engagement and a negative day-specific effect of self-punishment on work engagement. Therefore, compared to frequent home office users, infrequent home office users may find certain self-leadership strategies more beneficial in navigating the less structured and less organized home environment to enhance their self-motivation.

The current study extends research on flexible working arrangements by focusing on an important outcome variable concerning remote work: being engaged when working from home. Our results suggest that self-leadership strategies should not be lumped together indiscriminately, as their effect on work engagement varies. In particular, self-punishment exhibits a negative effect on work engagement, which should be distinguished from the other, more beneficial, self-leadership strategies. In our model, the five self-leadership strategies were tested simultaneously, meaning that the incremental effect of each strategy on work engagement is depicted. Self-cueing did not significantly predict work engagement, although the within-person correlation between self-cueing and work engagement was significant and positive ($r = 0.15$, $p < 0.05$). Furthermore, our explorative analysis indicates that the connection between self-leadership strategies and work engagement depends on person-level characteristics, as we found stronger effects among infrequent home office users. Although this is speculative, this effect might change with time as employees establish a home-working routine, potentially diminishing the role of self-leadership strategies in promoting work engagement. Future research could investigate whether the use of certain self-leadership strategies changes over time with increasing experience in working from home.

Theoretically, our study contributes to research on flexible work arrangements and work engagement by elucidating the role of self-leadership strategies in the workday of a group of hybrid workers. Based on the JD-R framework, we provide a nuanced view of the effectiveness of various self-leadership strategies in enhancing a resourceful work environment, thereby increasing work engagement. Similarly to Kruyen et al.[45], our study

suggests that working from home should not be seen merely as a benefit but rather as a work arrangement that is demanding. This is because employees working from home must manage their tasks on their own without the temporal and spatial structure provided by fixed working hours, scheduled breaks, separation from private life demands, and supervision, which typically organize and facilitate their daily routines[9]. Thus, the more demanding home office setting (compared to the office setting) requires proactive strategies for employees to perform optimally and stay engaged, particularly for those who work remotely less frequently. Similarly to Niessen and Müller[9], we argue that self-leadership not only acts as a resource in a demanding work environment, but also possibly plays a crucial role in actively securing resources, a strategy that becomes paramount when working from home. Our analysis reveals that certain self-leadership strategies are more frequently used on home days (i.e., self-goal setting, self-reward, and visualization of successful performance), suggesting a greater need (and opportunity) to engage in self-directed behaviors while working remotely. However, we must acknowledge that our study did not specifically investigate the resources available in the home versus traditional office settings.

Our study also has practical implications. With leaders no longer being constantly present and employees having the flexibility to choose when and where to work, the focus should be shifted from the conventional notion of leadership toward self-leadership to create an effective work environment for employees[10]. Flexible work arrangements are increasingly prevalent and employees need to be ready to navigate the opportunities and risks that lie ahead. Supporting employees, regardless of whether they work from home or in the office, can empower them in their day-to-day work. Professionals in work design should acknowledge the differences between the working conditions in traditional office setups and home offices. When guiding employees interested in working from home part- or full-time, they may encourage proactive behavior by promoting the use of a specific set of self-leadership strategies. Implementing initiatives such as employee training sessions or leadership interventions may facilitate this process[46].

A strength of this study is that the hypotheses were examined using diaries susceptible to within-person behavior fluctuations. Thus, we can exclude the idea that self-leadership strategies are simply habits, and attest that the use of self-leadership strategies by employees fluctuates from day to day[10]. However, like Müller and Niessen[9] we had to exclude the self-leadership dimensions of self-observation, self-talk, and natural rewards, as well as the evaluation of beliefs and assumptions because of their low psychometric qualities. Although Breevaart et al.[10] used a different scale—developed by Houghton and Neck[23]—to assess five self-leadership strategies, they also had to omit two of them (self-reward and self-punishment), resulting in a focus on self-goal setting, self-cueing, and self-observation. The requirement to exclude certain strategies underscores the need for further research on the content and measurement of self-leadership to assess both general and day-to-day experiences related to it[10].

Regarding limitations, the generalizability of our results is restricted to employees with "hybrid" work arrangements, meaning they can work both from home and in the office. Our sample mainly consists of individuals in positions that do not require them to be physically present in a workplace on every workday, who are allowed by their supervisors to work from home[47], and who may already possess certain qualities that facilitate productivity and motivation in the home setting, such as the ability to work autonomously[9]. The participants in this study held positions in various sectors, including legal, executive, management, and higher-education roles, where remote work is often feasible because of the nature of such jobs. Furthermore, the contextual factors influencing employees' work engagement during the study period should be considered, especially the mitigated exposure to COVID-19 through reduced commuting and office interactions, and efforts to protect vulnerable individuals. Although working from home offers advantages like increased flexibility for personal tasks or childcare during work hours, and a potentially quieter environment enhancing focus for some, the effectiveness of remote work varies based on individual preferences, job demands, and organizational culture. We recognize that, although we propound differences between working from home and the conventional office environment—particularly suggesting that remote work allows for more flexible daily schedules and less direct supervision[48]—these assertions were not assessed in our study. Thus, employees may replicate the on-site work structure at home and supervisors may find it challenging to adjust their management approaches to a remote context, potentially resulting in increased micromanagement[49]. Moreover, we collected data from employees who encountered new challenges as a result of the COVID-19 pandemic and its restrictions. It is plausible that today's experiences of voluntary choices and personal preferences regarding working from home differ from those at the initial stages of the mandatory home office in response to the outbreak[18,50]. Accordingly, we acknowledge that the work-from-home experiences today differ from those encountered during the COVID-19 pandemic, which necessitates a cautious approach in interpreting the conclusions derived from this study. Furthermore, despite using a diary design, all study constructs were measured simultaneously, making our approach cross-sectional. This method did not temporally separate a presumed outcome (e.g., work engagement) from its possible cause (e.g., self-leadership)[51].

Thus, a study design with more than one measurement occasion per day may be beneficial for future studies investigating the possible predictors and outcomes of day-specific self-leadership[52]. This approach would allow for stronger evidence regarding the direction of causality, as it could account for the possibility of reversed causality. For example, regarding our proposed effects, certain self-leadership strategies like self-punishment might also be the result of lower levels of work engagement. Another area of research may focus on examining the moderating factors influencing the relationship between the daily use of self-leadership strategies and daily work engagement. This could entail examining specific contextual factors, including daily job characteristics such as autonomy and flexibility or schedule control, as well as daily affective experiences like positive and negative affects[53]. Furthermore, considering the emergence of new management approaches and competencies, such as virtual leadership, integrating aspects of self-leadership to increase self-motivation may become essential. Moreover, the role of reattachment to work as a mental strategy to connect to work in the morning has been shown to greatly influence work engagement throughout the day[54]. Applying self-leadership strategies might be part of reattachment to work, which enables high levels of work engagement.

Conclusion

This study investigated the daily use of self-leadership strategies and their relationship with daily work engagement in the context of working in the office versus working from home. Our findings indicate that certain self-leadership strategies, such as self-goal setting, self-reward, and visualization of successful performance, are more often used when working from home. Furthermore, not all self-leadership strategies benefit daily work engagement. Self-goal setting, self-rewards, and visualization of successful performance are positively related to work engagement, whereas self-cueing demonstrates no impact on work engagement, and self-punishment hampers it. Finally, our exploratory analyses suggest that the effectiveness of self-leadership strategies is more pronounced for less frequent home office users.

Data availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

References

1. Barrero, J. M., Bloom, N. & Davis, S. J. *Why Working from Home Will Stick*. www.wfhresearch.com (2021).
2. Sherif, A. Work from home: Remote & hybrid work - Statistics & Facts. *Statista* (2024).
3. Wheatley, D. Employee satisfaction and use of flexible working arrangements. *Work Employ Soc.* **31**, 567–585 (2017).
4. Gajendran, R. S. & Harrison, D. A. The good, the bad, and the unknown about telecommuting: Meta-analysis of psychological mediators and individual consequences. *J. Appl. Psychol.* **92**, 1524–1541 (2007).
5. Delanoeije, J. & Verbruggen, M. Between-person and within-person effects of telework: A quasi-field experiment. *Eur. J. Work Organ. Psy.* **29**, 795–808 (2020).
6. Masuda, A. D., Holtschlag, C. & Nicklin, J. M. Why the availability of telecommuting matters. *Career Dev. Int.* **22**, 200–219 (2017).
7. Sardeshmukh, S. R., Sharma, D. & Golden, T. D. Impact of telework on exhaustion and job engagement: A job demands and job resources model. *New Technol. Work Employ* **27**, 193–207 (2012).
8. Hill, E. J., Ferris, M. & Märtinson, V. Does it matter where you work? A comparison of how three work venues (traditional office, virtual office, and home office) influence aspects of work and personal/family life. *J. Vocat. Behav.* **63**, 220–241 (2003).
9. Müller, T. & Niessen, C. Self-leadership in the context of part-time teleworking. *J. Organ. Behav.* **40**, 883–898 (2019).
10. Breevaart, K., Bakker, A. B. & Demerouti, E. Daily self-management and employee work engagement. *J. Vocat. Behav.* **84**, 31–38 (2014).
11. Andreßen, P. & Konradt, U. Messung von Selbstführung: Psychometrische Überprüfung der deutschsprachigen Version des Revised Self-Leadership Questionnaire. *Zeitschrift für Personalpsychologie* **6**, 117–128 (2007).
12. Gomes, C., Curral, L. & Caetano, A. The mediating effect of work engagement on the relationship between self-leadership and individual innovation. *Int. J. Innov. Manag.* **19**, 1550009 (2015).
13. Xanthopoulou, D., Baker, A. B., Heuven, E., Demerouti, E. & Schaufeli, W. B. Working in the sky: A diary study on work engagement among flight attendants. *J. Occup. Health Psychol.* **13**, 345–356 (2008).
14. Demerouti, E., Bakker, A. B., Nachreiner, F. & Schaufeli, W. B. The job demands-resources model of burnout. *J. Appl. Psychol.* **86**, 499–512 (2001).
15. van den Heuvel, M., Demerouti, E., Bakker, A. B. & Schaufeli, W. B. Personal resources and work engagement in the face of change. in *Contemporary Occupational Health Psychology* 124–150 (Wiley, 2010). https://doi.org/10.1002/9780470661550.ch7.
16. Eurofound. *The Rise in Telework: Impact on Working Conditions and Regulations*. www.eurofound.europa.eu (2022) https://doi.org/10.2806/956428.
17. Schaufeli, W. B. Work engagement: What do we know and where do we go?. *Roman. J. Appl. Psychol.* **14**, 3–10 (2012).
18. Mäkikangas, A., Juutinen, S., Mäkiniemi, J.-P., Sjöblom, K. & Oksanen, A. Work engagement and its antecedents in remote work: A person-centered view. *Work Stress* **36**, 392–416 (2022).
19. Costantini, A. & Weintraub, J. The benefits of being proactive while working remotely: Leveraging self-leadership and job crafting to achieve higher work engagement and task significance. *Front. Psychol.* **13**, 833776 (2022).
20. Charalampous, M., Grant, C. A., Tramontano, C. & Michailidis, E. Systematically reviewing remote e-workers' well-being at work: A multidimensional approach. *Eur. J. Work Organ. Psychol.* **28**, 51–73 (2019).
21. Bailey, C., Madden, A., Alfes, K. & Fletcher, L. The meaning, antecedents and outcomes of employee engagement: A narrative synthesis. *Int. J. Manag. Rev.* **19**, 31–53 (2017).
22. Biron, M. & van Veldhoven, M. When control becomes a liability rather than an asset: Comparing home and office days among part-time teleworkers. *J. Organ. Behav.* **37**, 1317–1337 (2016).
23. Houghton, J. D. & Neck, C. P. The revised self-leadership questionnaire. *J. Manag. Psychol.* **17**, 672–691 (2002).
24. Manz, C. C. & Sims, H. P. Self-management as a substitute for leadership: A social learning theory perspective. *Acad. Manag. Rev.* **5**, 361–367 (1980).
25. Muraven, M. & Baumeister, R. F. Self-regulation and depletion of limited resources: Does self-control resemble a muscle?. *Psychol. Bull.* **126**, 247–259 (2000).
26. Kanfer, R. Self-regulation research in work and I/O psychology. *Appl. Psychol.* **54**, 186–191 (2005).
27. Neck, C. P. & Houghton, J. D. Two decades of self-leadership theory and research: Past developments, present trends, and future possibilities. *J. Manag. Psychol.* **21**, 270–295 (2006).
28. Breevaart, K., Bakker, A. B., Demerouti, E. & Derks, D. Who takes the lead? A multi-source diary study on leadership, work engagement, and job performance. *J. Organ. Behav.* **37**, 309–325 (2016).
29. Schaufeli, W. B. & Taris, T. W. A critical review of the job demands-resources model: Implications for improving work and health. in *Bridging occupational, organizational and public health: A transdisciplinary approach* 43–68 (Springer, Dordrecht, 2014). https://doi.org/10.1007/978-94-007-5640-3_4.
30. Schaufeli, W. B., Bakker, A. B. & Salanova, M. The measurement of work engagement with a short questionnaire: A cross-national study. *Educ. Psychol. Meas.* **66**, 701–716 (2006).
31. Kühnel, J., Sonnentag, S. & Bledow, R. Resources and time pressure as day-level antecedents of work engagement. *J. Occup. Organ. Psychol.* **85**, 181–198 (2012).
32. Mills, P. K. Self-management: Its control and relationship to other organizational properties. *Acad. Manag. Rev.* **8**, 445–453 (1983).
33. Allen, D. G., Renn, R. W. & Griffeth, R. W. The impact of telecommuting design on social systems, self-regulation, and role boundaries. in *Research in Personnel and Human Resources Management* vol. 22 125–163 (JAI Press, 2003).

34. Leroy, S., Schmidt, A. M. & Madjar, N. Working from home during COVID-19: A study of the interruption landscape. *J. Appl. Psychol.* **106**, 1448–1465 (2021).
35. Stewart, G. L., Courtright, S. H. & Manz, C. C. Self-leadership: A paradoxical core of organizational behavior. *Annu. Rev. Organ. Psychol. Organ. Behav.* **6**, 47–67 (2019).
36. van Dorssen-Boog, P., van Vuuren, T., de Jong, J. & Veld, M. Healthcare workers' autonomy: Testing the reciprocal relationship between job autonomy and self-leadership and moderating role of need for job autonomy. *J. Health Organ. Manag.* **36**, 212–231 (2022).
37. Bakker, A. B. Strategic and proactive approaches to work engagement. *Organ. Dyn.* **46**, 67–75 (2017).
38. Weintraub, J., Cassell, D. & DePatie, T. P. Nudging flow through 'SMART' goal setting to decrease stress, increase engagement, and increase performance at work. *J. Occup. Organ. Psychol.* **94**, 230–258 (2021).
39. Inam, A., Ho, J. A., Sheikh, A. A., Shafqat, M. & Najam, U. How self leadership enhances normative commitment and work performance by engaging people at work?. *Curr. Psychol.* **42**, 3596–3609 (2023).
40. Park, Y., Song, J. H. & Lim, D. H. Organizational justice and work engagement: The mediating effect of self-leadership. *Leadership Organ. Dev. J.* **37**, 711–729 (2016).
41. Deutsche Gesellschaft für Psychologie e. V. (DGP) & Berufsverband Deutscher Psychologinnen und Psychologen e.V. Berufsethische Richtlinien [Professional ethics guidelines]. https://www.dgps.de/fileadmin/user_upload/PDF/berufsethik-foederation-2016.pdf (2016).
42. European Federation of Psychologists' Associations (EFPA) Board of Ethics. Model code of ethics. https://www.efpa.eu/model-code-ethics (2015).
43. Muthén, L. K. & Muthén, B. O. Mplus user's guide. *Los Angeles, CA: Muthén & Muthén* (2017).
44. Griffiths, R. Time management in telework and other autonomous work environments. (Dissertation Abstracts International: Section B: The Sciences and Engineering, 64(5-B), 2425, 2003).
45. Kruyen, P. M. *et al.* Homeworking heaven or hell during the COVID-19 pandemic? Lessons for the job demands-resources model in the context of homeworking. *Rev. Public Pers. Adm.* https://doi.org/10.1177/0734371X231198163 (2023).
46. Bakker, A. B., Breevaart, K., Scharp, Y. S. & de Vries, J. D. Daily self-leadership and playful work design: Proactive approaches of work in times of crisis. *J. Appl. Behav. Sci.* **59**, 314–336 (2023).
47. Abgeller, N., Bachmann, R., Dobbins, T. & Anderson, D. Responsible autonomy: The interplay of autonomy, control and trust for knowledge professionals working remotely during COVID-19. *Econ. Ind. Democracy* https://doi.org/10.1177/0143831X221140156 (2022).
48. Prem, R., Kubicek, B., Uhlig, L., Baumgartner, V. & Korunka, C. Development and initial validation of a scale to measure cognitive demands of flexible work. *Front. Psychol.* **12**, 679471 (2021).
49. Parker, S. K., Knight, C. & Keller, A. Remote managers are having trust issues. *Harv. Bus. Rev.* **30**, 6–20 (2020).
50. Syrek, C., Kühnel, J., Vahle-Hinz, T. & Bloom, J. Being an accountant, cook, entertainer and teacher—all at the same time: Changes in employees' work and work-related well-being during the coronavirus (COVID-19) pandemic. *Int. J. Psychol.* **57**, 20–32 (2022).
51. Taris, T. W., Kessler, S. R. & Kelloway, E. K. Strategies addressing the limitations of cross-sectional designs in occupational health psychology: What they are good for (and what not). *Work Stress* **35**, 1–5 (2021).
52. Ohly, S., Sonnentag, S., Niessen, C. & Zapf, D. Diary studies in organizational research: An introduction and some practical recommendations. *J. Pers. Psychol.* **9**, 79–93 (2010).
53. Anderson, A. J., Kaplan, S. A. & Vega, R. P. The impact of telework on emotional experience: When, and for whom, does telework improve daily affective well-being?. *Eur. J. Work Organ. Psychol.* **24**, 882–897 (2015).
54. Sonnentag, S., Eck, K., Fritz, C. & Kühnel, J. Morning reattachment to work and work engagement during the day: A look at day-level mediators. *J. Manage* **46**, 1408–1435 (2020).

Acknowledgements

Author contributions

J.K.—Conceptualization, Formal analysis, Visualization, Supervision. K.W.—Investigation. J.K. and K.W.—Methodology, Data Curation. A.S.P.—Writing—Original Draft. All authors—Writing—Review & Editing.

Competing interests

The authors declare no competing interests.

Additional information

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1038/s41598-024-71432-0.

Correspondence and requests for materials should be addressed to A.S.P.

Reprints and permissions information is available at www.nature.com/reprints.

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.