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Short-Time Non-Work-Related Computing and Creative Performance

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Abstract

It has been argued that non-work-related computing (NWRC) takes time away from work and, hence, decreases work productivity. On the other hand, it has also been claimed that short-time non-work-related computing (STNWRC) (a maximum of 15 minutes), has a positive impact on work productivity, including relief from boredom, higher creativity, and the underlying recovery mechanisms. To examine the impact of STNWRC on creative performance, we draw on Fredrickson's broaden-and-build theory, the concept of recovery with mental well-being and low cognitive effort. A 2×2 factorial experiment with 40 subjects was conducted. The results indicate that STNWRC has a positive effect on creative performance, when people have mental fatigue. In the post hoc analysis, STNWRC with low cognitive effort has a greater positive effect on creative performance. As a research implication, we suggest that organizations need to encourage employees to use STNWRC as a recovery tool when employees have mental fatigue.

1. Introduction

Non-work-related computing (NWRC) has been increasing over the past few years, with IT artifacts (e.g., computers, tablets, and smartphones, etc.) diffusion in the workplace. By using several kinds of IT artifacts, employees have easier access to the Internet, which has raised some concerns. The primary concern is that NWRC takes employees' time away from their work and, hence, decreases their productivity. As a consequence, some scholars even count NWRC as a deviant behavior [14, 15, 18]. An alternative view suggests that NWRC has a positive impact on employees by alleviating stress and improving their creativity [3, 6, 17, 25].

These contradictory results may be partly explained by two significant societal changes that have occurred during the last five years. The first change is the

generational difference that has occurred in terms of attitudes toward IT artifact use. The second change is the birth of social media [25]. These two developments have completely changed attitudes toward IT usage involving NWRC. Specifically, in the case of the generational differences, the younger generation, who were born in the digital age, commonly uses social media in their everyday lives by checking their friends' status as well as a visiting a variety of social information sites [26]. This kind of Internet use allows them to engage in cognitive playfulness [1]. Therefore, some research has argued that if social media is not overused, it may promote relaxation and have a recovery effect [4, 11].

Specifically, previous NWRC research has mentioned the beneficial effect of STNWRC on employees' creative performance and they assumed that the NWRC works as a medium of recovery activity [2, 25]. However, this research lacks a theoretical explanation that not only explains the phenomenon, but also provides the nomological network. There are no studies that examine which types of NWRC are beneficial, and when to use STNWRC in order to maximize its positive impact as a recovery tool. As a step toward closing this gap, this study examined the impact of STNWRC activities in NWRC sessions lasting for up to a maximum 15 minutes. It examined the relationship between cognitive effort and creative performance, and explored how time (morning vs. afternoon) moderates those relationships. Theoretically, the relationship between STNWRC and creative performance is based on the broaden-and-build theory [7] and the concept of recovery [20]. To test the hypothesized relationships, this current study conducted a laboratory experiment. A total of 40 subjects were randomly assigned to one of four conditions in a 2×2 factorial between-subjects design ANOVA experiment.

The rest of the paper is organized as follows. In the next section, the broaden-and-build theory, the concept of recovery, and the hypotheses are introduced. Next, the results of the data analysis of the laboratory experiment will be presented. Then, based on the

results, the NWRC management model as a recovery tool is suggested. Finally, this paper will discuss the findings and implications for practice and research.

2. Theoretical Background

The key argument of this study is that STNWRC provides a recovery tool that promotes mental well-being and positive emotions. Consequently, this recovery will have a positive effect on employees' performance, and especially their creative performance. The broaden-and-build theory is employed to support this argument.

2.1. Broaden-and-build theory

According to the broaden-and-build theory [9], positive emotions contribute to an individual's well-being and creative performance. This broadens the array of possible thoughts and actions that come to mind, by experiencing an activity that leads to having a positive emotion [9, 10]. To demonstrate the impact of positive emotion on creativity, Fredrickson [9] conducted experiments and revealed that positive emotions led to the discovery of novel ideas, actions, and social bonds by momentarily broadening attention and thinking [8]. These findings support the argument that positive emotions can increase creative performance.

2.2. Recovery effect and positive emotions

In terms of sustaining personal resources and further stimulating creativity and innovative thinking, the concept of positive emotion is based on mental well-being [5, 23]. According to Sonnentag [21], in order to maintain a physical and mental balance, the need for recovery occurs when people lack energy and suffer from fatigue or poor mental well-being. Daily fluctuations are a factor that affect a person's energy level, and they have a significant influence on the performance of employees [27]. If employees are not allowed an opportunity to recover through an event or experience that provides fun and elicits positive emotions, their performance could decrease due to fatigue [19]. In addition, circadian research has shown that, after lunchtime, people tire more easily than they do during the morning. Hence, in accordance with previous findings of circadian rhythm research, after lunch time, performing STNWRC, which is an activity that can lead to eliciting positive emotions, might increase the employees' creative performance through the recovery process. Based on this argument, the current study hypothesizes that:

H1: STNWRC has a positive effect on creative performance.

H2: STNWRC has a higher effect on creative performance in the afternoon in comparison to the morning.

According to Sonnentag and Fritz [22], to get the recovery effect, it is better to practice such an activity than to just take a break without engaging in any activity. Furthermore, they noted that to maintain the recovery effects, the activity should (1) not be related to work and (2) not require high levels of effort. In the case of office workers, the problem of NWRC may be more acute than it is in the case of workers engaged in manual labor, since the former usually work with computers and the constant connectivity to the Internet is natural in the workplace. Due to the fact that NWRC is easy to do and there is no need to put in any additional effort, it might work well as a recovery tool [12]. Consistent with this argument, employees state that NWRC promotes positive emotions and creativity [3, 13, 17]. In particular, in regard to social media NWRC, which is a habitual IT use behavior especially with the younger generation, studies have shown that with low cognitive effort, users experience cognitive playfulness [25]. Because it is easy to have a positive impact from NWRC, employees even argue that it should be encouraged as an appropriate activity.

Specifically, as different NWRC activities exert different levels of cognitive effort, using social media and browsing the Internet can be considered to be a form of low cognitive effort NWRC [13] because it is not related to decision-making or finishing one's tasks. However, in the case of e-shopping, people exert a considerable amount of cognitive effort due to the fact that they are making decisions about purchasing desired items [24]. Therefore, research has noted that high cognitive effort NWRC will not work as a recovery tool as it is not a low cognitive effort activity. Consequently, the present study hypothesizes that:

H3: Low cognitive effort STNWRC has a higher positive effect on creative performance than high cognitive effort STNWRC.

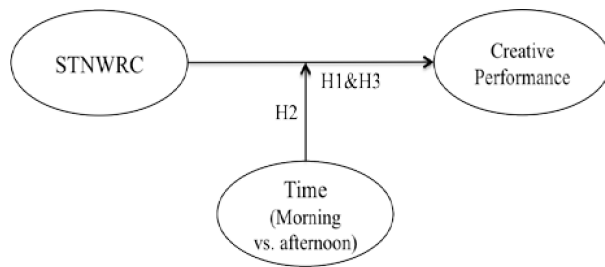


Figure 1. Conceptual model

3. Research Methodology

We employed a 2×2 factorial between-subject experimental design in order to (1) examine the impact of STNWRC on creative performance (idea generation), (2) compare the impact of STNWRC on creative performance with the impact of No-STNWRC, and (3) compare that impact in the morning and in the afternoon (see Table 1).

Table 1. 2×2 factorial research design

Time	No-STNWRC	STNWRC
Morning	<p>Group 1</p> <ul style="list-style-type: none"> -Pre-test of creative performance -Treatment: No-STNWRC -Post-test of creative performance 	<p>Group 2</p> <ul style="list-style-type: none"> -Pre-test of creative performance -Treatment: STNWRC -Post-test of creative performance
Afternoon	<p>Group 3</p> <ul style="list-style-type: none"> -Pre-test of creative performance -Treatment: No-STNWRC -Post-test of creative performance 	<p>Group 4</p> <ul style="list-style-type: none"> -Pre-test of creative performance -Treatment: STNWRC -Post-test of creative performance

3.1. Experimental procedure and treatment

The present study used the following experimental procedures. To measure the participants' initial creative performance, we administered the Test 1 questionnaire one hour after the beginning of the exercise class. Before handing out Test 1, a research assistant explained how to answer the questions and had the participants write their initials (name) on the upper-right corner of the questionnaires. The instructions were:

List all the ideas to solve the following problem. Please write on the sheet of paper as many ideas as you can think of in response to this question. Please number each idea separately. You have 10 minutes. Any question? Please begin. Think as freely and as imaginatively as possible when you write the ideas you have in response to the problem. We are looking for quantity; the more ideas the better.

Participants listed their ideas on the sheet of paper for 10 minutes, and then they engaged in the treatment activity (Groups 1 and 3 took a 15-minute break without NWRC and Groups 2 and 4 took a 15-minute break with NWRC). In the case of Groups 2 and 4, we suggested that the participants use the Internet without any restriction regarding the type of web activity. They then answered the post-creative performance test questions for 10 minutes.

Finally, after performing the pre-test (Test 1), treatment and the post-test (Test 2), the participants completed a questionnaire that asked information about their demographics and the web activities they engaged in during the break time. By using an open-ended questionnaire, we asked them to be as specific as possible when explaining what they did on the Internet during their break time, so we could determine the relationship between STNWRC activities and creative performance. We coded the STNWRC activities on a nominal scale as follows: 1. E-shopping; 2. Communication (e-mail and chatting); 3. Information searching; 4. Internet browsing; and 5. Using social media.

Moreover, in order to control the order of the effects that easily occur within the subject factor, we used a different test in pre-test and post-test periods to eliminate the bias of learning effect on the quiz. The two tests required the same level of ability to generate ideas. The first question was: "How can the city of Helsinki attract more tourists?" The second question was: "A restaurant that is used by students is losing customers. What can the restaurant do to retain its customers?"

3.2. Measurement of the dependent variable

To measure the quantity of the participants' creative ideas, we used the previous validated measures recommended by Hender et al. [11]. These were used to measure creative performance at the group level within the group support system context. Although we applied that measurement at the individual level, our purpose in using these measures was ultimately the same in terms of measuring the creative performance (idea generation).

In this study, in order to examine the effect of STNWRC on creative performance, we measured the number of ideas as an indicator of creative performance by only counting non-redundant ideas. Since the quality of ideas is highly related to measuring people's inherent intelligence and their accumulated existing knowledge, this study only considered the quantity of the ideas in order to accurately measure the STNWRC effect.

3.3. Participants

The participants were 40 graduate students from a large university in Finland. All the participants were randomly assigned at the beginning of the class by dividing them into four groups; each group consisted of 10 participants. Of all the participants, 70% were in their twenties; 60% were male, and 80% were Finnish. By checking the ANOVA on the pre-test scores between the four groups (morning STNWRC, afternoon STNWRC, morning no-STNWRC, and afternoon no-STNWRC), we checked the equality of variance of the subject.

Since the purpose of this research is to investigate the effect of STNWRC on creative performance (idea generation), the unit of analysis is the individual level. Additionally, the validity of the choice of participants is justified by the fact that they matched the demographics of the so-called Y generation, born between the early 1980s and the early 2000s [16].

4. Empirical Results

First, to investigate the effect of STNWRC behavior on creative performance, we compared the improvement of creative performance between the STNWRC groups and the no-STNWRC groups. Second, to investigate the effect of STNWRC on creative performance along with daily fluctuations, we compared the improvement of creative performance (pre-test and post-test) between morning and afternoon by conducting 2-way ANOVA. Third, to find out which STNWRC was most beneficial as a recovery activity, we compared the improvement of creative performance between the STNWRC groups, by conducting one-way ANOVA and post hoc analysis.

4.1. STNWRC impact on creative performance

To examine the effect of STNWRC on the improvement of creative performance, a paired sample t-test was conducted. There was a significant difference in the pre-test and post-test STNWRC scores, both in the morning (mean = 1.00, SD = 0.82, t

(9) = 3.87, p = 0.004) and in the afternoon (mean = 1.3, SD = 1.5, t (10) = 3.01, p = 0.013). This shows that STNWRC does have a positive effect on creative performance. On the other hand, there was no significant difference between pre-test and the post-test in the no-STNWRC groups. Figure 2 shows the results of the improvement of creative performance between the STNWRC and the no-STNWRC groups. This means that the creative performance of the participants who engaged in STNWRC activities during the break time was significantly improved. Therefore, our H1 was supported.

Table 2. Paired t-test

Group		Mean	SD	Std. Error Mean	t	df	Sig.
1. No-STNWRC [Morning]	Test 2 (Post)-Test 1 (Pre)	1.40	2.12	0.67	2.09	9	.066
3. No-STNWRC [Afternoon]	Test 2 (Post)-Test 1 (Pre)	-0.11	0.93	0.31	-0.36	8	.729
2. STNWRC [Morning]	Test 2 (Post)-Test 1 (Pre)	1.00	0.82	0.26	3.87	9	.004
4. STNWRC [Afternoon]	Test 2 (Post)-Test 1 (Pre)	1.36	1.50	0.45	3.01	10	.013

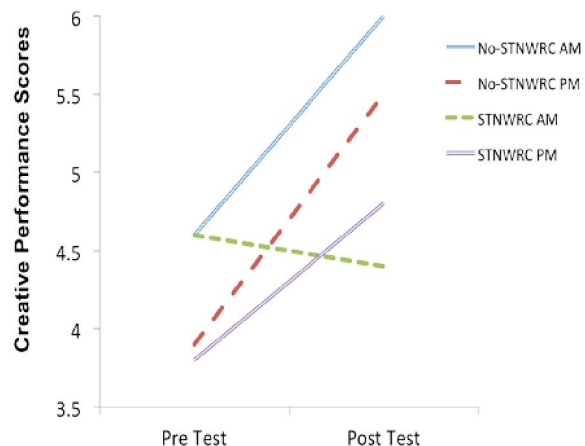


Figure 2. Pre-(1) and post-(2) creative performance test results between groups

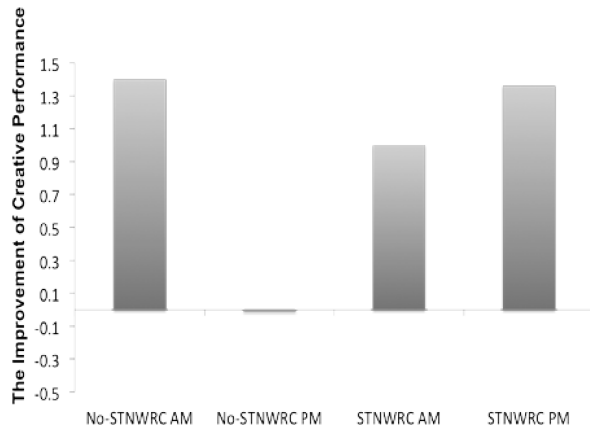


Figure 3. Improvement of creative performance between groups

4.2. STNWRC's impact on creative performance depending on time of day

To examine the impact that interaction effect between NWRC (STNWRC, No-STNWRC) and time of day (morning, afternoon) has on improving creative performance, we conducted 2-way ANOVA. Table 3 shows the results at the .05 significance level.

The main effects of STNWRC and time were not significant, $F(1,36) = 1.55$, $p > 0.05$, and $F(1,36) = 1.36$, $p > 0.05$. However, the interaction effect was significant, $F(1,36) = 4.15$, $p < 0.05$. Additionally, in the no-STNWRC group, in the afternoon, the change in creative performance was negative. This shows that time of day moderates the effect of STNWRC on creative performance. Therefore, H2 is supported by our data.

Table 3. Between-subjects effects

Source	Dependent Variable	df	Mean Square	F	Sig.
Corrected Model	Improvement of Creative Performance	4	12.54	5.95	.001
Time		1	3.28	1.56	.220
STNWRC		1	2.87	1.36	.251
Time * STNWRC		1	8.74	4.15	.049
Error		36	2.11		
Total		40			

a. R-Squared = .398 (Adjusted R-Squared = .331)

* 0.05 level of significance

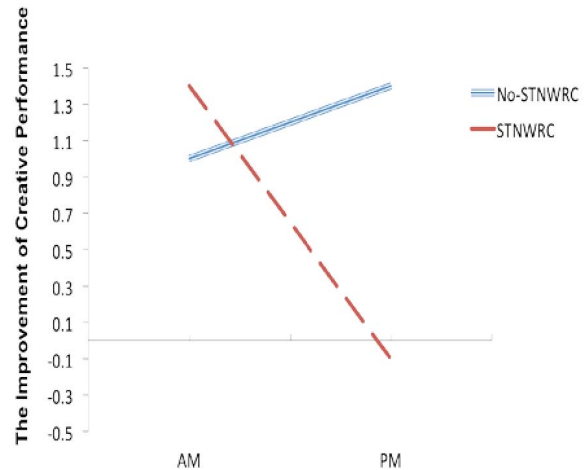


Figure 4. Interaction effects depicted graphically

4.3. The nature of STNWRC activity and creative performance

To compare the impact that each STNWRC activity has on creative performance, we conducted a one-way between-subjects ANOVA by using only the dataset of Group 2 and Group 4 (who used the Internet as a recovery tool). There was a significant difference in creative performance from each STNWRC at the $p < 0.05$ level ($F(2,18) = 3.33$, $p = 0.05$), suggesting differences in improvement of creative performance between the three activities (e-shopping, browsing, and social networking).

Post hoc comparisons using the Turkey HSD test indicated that the mean score for the social networking condition (mean = 2.67, SD = 1.53) was significantly different from e-shopping (mean = 0.67, SD = 0.57) and browsing (mean = 1.0, SD = 1.0). However, the browsing condition does not show a difference from the e-shopping condition. Figure 5 clearly shows the impact that each of the web activities has on the improvement of creative performance.

Table 4. One-way ANOVA between NWRC activities on improvement of creative performance

Web Activities	N	Mean	SD	SE
E-shopping	3	0.66	0.58	0.33
Browsing	15	1.00	1.07	0.28
Social Networking	3	2.67	1.53	0.88

Web Activities	N	Mean	SD	SE
E-shopping	3	0.66	0.58	0.33
Browsing	15	1.00	1.07	0.28
Social Networking	3	2.67	1.53	0.88
Total	21	1.19	1.21	0.26

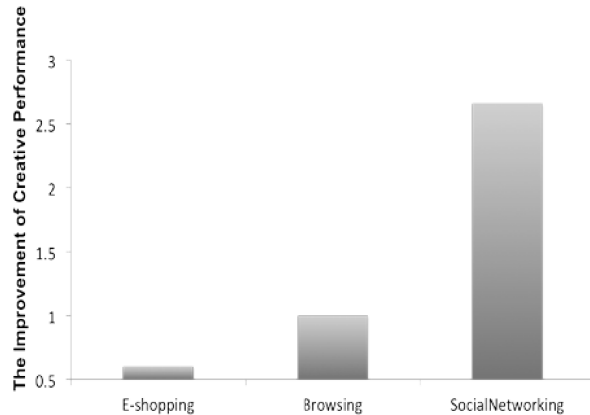


Figure 5. The improvement of creative performance of each STNWRC activity

5. Discussion

As a new contribution to this field, we demonstrate that STNWRC has an impact on creative performance. More precisely, our three proposed hypotheses were supported by our empirical results. They reveal that STNWRC has an impact on creative performance in the afternoon (STNWRC = 1.3) and in the morning (STNWRC = 1.00) (see Table 2). More interestingly, when comparing STNWRC with no-STNWRC, the present study reveals that time of day moderates the relationship. While in the morning just taking a break without engaging in STNWRC increased creative performance more than taking a break and engaging in STNWRC (mean change for no-STNWRC in the morning was 1.40 and mean change for no-STNWRC in the morning was -1.11 and mean change for STNWRC in the afternoon was 1.36).

This shows that time of day is an important issue when considering guidance about the time period in which STNWRC should be allowed and controlled. Furthermore, this suggests that if employees cannot use STNWRC in the afternoon, their creative performance might decrease. The likely reason for this is that people are more tired in the afternoon based on the circadian rhythm, since their mental well-being is impaired by the cognitive attention required of them in the morning. Therefore, there is a higher need to recover from

mental fatigue by performing activities that are easy to do and are fun during their break time. It seems that STNWRC activities are more effective in this recovery than no-STNWRC activities.

Second, there was a relatively high performance improvement when STNWRC consisted of the use of social media when compared with browsing and e-shopping (social networking: 2.67, browsing: 1.0, e-shopping: 0.67). This is consistent with finding that social STNWRC with low cognitive effort can be useful as a recovery tool, which boosts employee creativity through mental well-being. In previous research, employees argued that they get the effect of mental recovery and brainstorming from STNWRC [3]. Our results clearly support the employees' perceptions about the outcomes of NWRC, especially when NWRC is used for a short time with low cognitive effort, such as when engaging in social networking. That is not necessarily so in the case of STNWRCs with high cognitive effort, such as e-commerce, which involves mainly the process of decision-making and, consequently, demands high cognitive effort [24].

Inspired by our research results, we suggest a model of an IT-enabled recovery tool (see Table 5).

Table 5. A model of STNWRC as an IT-enabled recovery tool

	<i>Recovery Activity</i>	
	Low cognitive effort (e.g., Social media)	High cognitive effort (e.g., e-shopping)
Afternoon	<ul style="list-style-type: none"> •Recovery effect: High •Mental status: Fatigue → Recovered state 	<ul style="list-style-type: none"> •Recovery effect: Low •Mental status: Fatigue → Fatigue
Morning	<ul style="list-style-type: none"> •Detrimental effect: High •Mental status: Recovered state → Fatigue 	<ul style="list-style-type: none"> •Detrimental effect: High •Mental status: Recovered state → Fatigue

5.1. Implication for practice

From our empirical finding, a number of important managerial implications arise. First, the important managerial insights were captured by moderating the effect that time of day has on the relationship between STNWRC and creative performance. Specifically, our results suggest that in the afternoon when people are more easily tired, employees can get a beneficial effect from engaging in low cognitive effort STNWRC (e.g.,

social network website). Doing so increases their creative performance. Organizations need to consider this time effect. This means that under the policy that allows employees to only engage in NWRC in the afternoon, organizations can bring about a positive NWRC effect while also prohibiting a detrimental NWRC effect.

Second, the result of our research also demonstrates that the level of cognitive effort in using STNWRC is an important factor that distinguishes between detrimental STNWRC and beneficial STNWRC. Precisely, our results reveal that the low cognitive effort STNWRC remarkably leads to high improvement in creative performance. We conjecture that the low cognitive effort STNWRC might work as a recovery medium and, as a result, it leads to higher creative performance than the high cognitive effort STNWRC. This finding is relevant to determining acceptable STNWRC activities. For example, organizations can reasonably utilize the employee's social networking website use as a recovery activity in the afternoon. However, they need to insist that employees not visit e-shopping sites, which requires high cognitive effort, in the work place context.

In summary, in the afternoon when employees easily tire, to the extent that employees not to have to engage in high cognitive effort, managers do not need to enforce a policy that prohibits employees from engaging in STNWRC activities. If managers enforce a policy that prohibits this type of activity, doing so will have a negative impact on their employees' mental performance because of their impaired mental state. Therefore, the manager could suggest that employees engage in low cognitive effort STNWRC activities, if they want to, in the afternoon.

5.2. Limitations and future research

Our research is subject to the typical limitations. Even though participants represent the younger generation, who are major subjects of the NWRC phenomenon, this can be seen as a limitation, since our participants were not employees and the experimental context was not in a practical working place. Furthermore, laboratory experimentation as a research method is subject to a set of well-known limitations, including generalizability, even though in our research design, the number of participants (40) was enough to conduct a laboratory experiment. In our experiment, our participants engaged in only three kinds of web activities: searching information, e-shopping, and using social media as STNWRC activities. For this reason, we could not investigate the impact that other types of STNWRC activity has on creative performance. Consequently, we recommend that future research

investigate the impact of other NWRC activities on employees' performance. In addition, because we had very limited data to argue that the impact of STNWRC depends on the level of cognitive effort from the NWRC activity, further studies need to extend the findings of this current research by conducting factorial models. Additionally, to measure the improvement of creative performance, we used a quiz, which has commonly been used as a creativity measurement in the IS research field. We recommend that future research use other creativity measurements that are used in the field of creativity research. Furthermore, we also suggest that research subjects in future research should include employees who engage in administrative work because the performance of administrative workers is more proportional to the time spent on work than is the context of creative work.

5.3. Conclusions

Although previous NWRC literature has shown the beneficial impact of STNWRC on creative performance, there was a lack of theoretical explanation to not only explain the relationship between STNWRC and creative performance, but also to provide concrete guidance as to what types of NWRC are beneficial and to identify the right time of day to utilize this phenomenon in order to maximize the positive impact of STNWRC as a recovery tool. In this study, to examine the impact that STNWRC activity has on creative performance and further suggest practical guidance that organizations can implement to utilize the beneficial impact of STNWRC without detrimental effects, we conducted laboratory experiment research based on the broaden-and-build theory and the recovery mechanism. We found that, in the afternoon, engaging in STNWRC activity during break time has a highly positive impact on creative performance. In terms of the cognitive effort of STNWRC activities, we found that low cognitive effort STNWRC activities contribute to creative performance. It is hoped that the empirical results and the model of STNWRC as an IT-enabled recovery tool presented in this study will be helpful in organizations and in future research that addresses this important line of inquiry.

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