

How brief pre-task breaks shape mood and cognitive performance: Comparing physical activity, conversation, and smartphone use

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Published online: July 31, 2026

Accepted for publication: July 15, 2026

DOI:10.7752/jpes.2026.07139

Abstract:

Purpose: This study examined how brief rest periods during work or study influence subsequent psychological states and task performance; comparing three rest conditions: light physical activity, conversation, and smartphone use. **Methods:** Psychological states and cognitive task performance were assessed before and after brief rest periods involving light physical activity, conversation, or smartphone use. **Results:** The physical activity and conversation conditions led to improvements in mood pleasantness and maintained psychological arousal. In contrast, the smartphone condition produced no change in mood pleasantness and was associated with reduced psychological arousal. Subjective fatigue decreased in post-rest only in the conversation condition, remained unchanged in the physical activity condition, and increased in the smartphone condition. Regarding cognitive task performance, improvements were observed only in the physical activity condition under relatively low-demand task conditions, whereas a tendency toward decreased performance was observed in the conversation condition, and no significant changes were found in the smartphone condition. **Conclusion:** These findings suggest that light physical activity and conversation are effective strategies for regulating psychological states during brief rest periods. Specifically, both activities support mood recovery, while conversation additionally contributes to fatigue reduction. From a cognitive performance perspective, light physical activity appears particularly effective; however, its benefits may vary depending on task difficulty, task characteristics, and the specific nature of the activity performed. In contrast, smartphone use did not improve mood or reduce fatigue and was associated with decreased arousal, suggesting that it may be a less effective recovery strategy in work and study contexts. Overall, these results highlight the importance of selecting active, socially or physically engaging rest strategies rather than passive smartphone use to optimize both psychological well-being and cognitive performance during brief breaks.

Keywords: active rest; psychological arousal regulation; recovery experience; executive function recovery; subjective fatigue recovery; attentional control tasks

Introduction

Effective engagement in prolonged activities within modern workplace and educational settings requires the prevention of fatigue accumulation and the maintenance of physical capacity and attentional resources. In addition to longer breaks such as lunch periods, the inclusion of brief rest periods during work or study is therefore considered important. Previous research has shown that systematically increasing the frequency of short breaks during working hours improves employee performance and well-being (Wendsche et al., 2016). Furthermore, a meta-analysis by Albulescu et al. (2022) demonstrated that micro-breaks—defined as short breaks lasting less than 10 minutes—positively influence well-being by enhancing vigor and reducing fatigue. However, the study also suggested that performance improvements may require rest periods exceeding 10 minutes, reporting that longer breaks tend to yield greater performance benefits (Albulescu et al., 2022).

These findings indicate that rest duration alone does not fully account for the psychological and cognitive benefits of breaks. Rather, according to the Effort-Recovery Model (Meijman & Mulder, 1998), recovery occurs only when activities undertaken during rest do not draw on the same resources depleted by the preceding task. The content of break activities may, therefore, be a key determinant of recovery outcomes. Thus, identifying which types of break activities most effectively restore mood and cognitive readiness is of both theoretical and practical importance. This is especially true given that individuals in workplace and educational settings have considerable discretion over how they spend their brief rest periods.

Beyond rest duration, the activities undertaken during breaks may also substantially influence subsequent task performance and psychological states. With respect to performance enhancement, acute light- to moderate-intensity physical activity has been shown to improve both mood and cognitive function (Byun et al., 2014; Damrongthai et al., 2021). Moreover, stretching exercises have been reported to reduce musculoskeletal discomfort and perceived fatigue among desk-based workers (Lacaze et al., 2010). However, in workplace and

educational settings, rest periods frequently do not involve physical activity. Instead, rest time is more commonly devoted to activities such as conversing with others or using smartphones.

Affiliative and humorous conversations have been reported to reduce negative feelings and indirectly support cognitive recovery (Scheel et al., 2017). In addition, brief social interactions lasting approximately 10 minutes have been shown to facilitate cognitive performance (Ybarra et al., 2008). However, much of this evidence has been derived primarily from studies focusing on older adult populations, raising the question of whether comparable benefits extend to younger populations such as university students, who experience brief rest periods between academic tasks more frequently. Furthermore, although beneficial effects on executive functions have been observed, previous research has reported no clear effects on other cognitive domains, such as memory and attention (e.g., Wei et al., 2024), suggesting that the cognitive benefits of conversation may be domain-specific.

By contrast, smartphone use is highly prevalent among university students, particularly during breaks between classes; however, numerous studies have reported adverse effects on psychological and cognitive functioning. For example, the mere presence of a smartphone in learning contexts has been shown to impair memory performance (Tanil & Yong, 2020). Additionally, university students have been reported to excessively use short-video applications (Zhang et al., 2023b), and exposure to such content has been associated with detrimental effects on attentional functions (Yan et al., 2024).

Taken together, previous studies have examined the effects of physical activity, conversation, and smartphone use on psychological and cognitive outcomes largely in isolation, often within different populations, task contexts, and experimental paradigms. This makes it difficult to determine which of these break activities are most beneficial—or least detrimental—when compared under equivalent conditions. Given that physical activity, conversation, and smartphone use are the most commonly chosen options during brief resting periods in daily work and academic life; a direct, within-study comparison could provide practical guidance to optimize them. To address this gap, the present study directly compared the short-term effects of three pre-task break activities—light physical activity, conversation, and smartphone use—on mood, subjective fatigue, and cognitive task performance within a single experimental design.

Methods

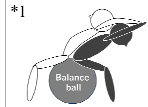
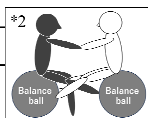
Participants

A total of 28 healthy university students (17 men and 11 women; mean age = 21.10 ± 0.86 years) participated after providing informed consent. Participation was voluntary, and participants were informed that they could withdraw at any time without penalty. This study was conducted in accordance with the ethical standards of the institutional research ethics committee for studies involving human participants at the authors' affiliated institution and was approved by the committee (approval number: H25-0102).

Rest Conditions

Three rest conditions were implemented. In the light physical activity condition, participants performed exercises using a balance ball for 10 minutes, followed by sitting on a cushion for an additional 5 minutes. In the conversation condition, participants sat on a cushion and engaged in conversation with a friend for 15 minutes. Conversation topics were provided by the experimenters to standardize content across pairs. In the smartphone condition, participants sat on a cushion and watched short-form videos on TikTok or YouTube for 15 minutes. Each participant used their own smartphone, and the viewed content was videos typically displayed on their personal accounts and regularly watched in daily life. In all conditions, participants were paired with the same close friend with whom they frequently spent time. The specific content of the physical activities and conversation topics is presented in Table 1, and representative scenes of each condition are shown in Figure 1.

Table 1. The content of the light physical activities and the conversation topics.

Category	Description		Frequency
Light physical activity	Stretching exercise* ¹	Sit back-to-back on a single balance ball. One participant raises their arms overhead and grasps the other participant's wrist. One participant bends forward to perform a stretch, and the roles are alternated, with each stretch lasting approximately 15 seconds.	*1  2 times each (15 s per stretch)
	Light bouncing exercise	Bounce simultaneously while matching the timing.	10 repetitions
		Bounce alternately with staggered timing.	10 repetitions
	Balance exercise* ²	While lightly bouncing, play rock-paper-scissors using both legs.	*2  10 repetitions
		Sit facing each other on balance balls and hold hands. Place one leg on the partner's balance ball and maintain balance.	2 times each
Conversation	Topic1	What are your plans for the year-end and New Year holidays?	
	Topic2	If you could obtain one of Doraemon's secret gadgets, which one would you like to try?	
	Topic3	If you could be reborn, what would you like to become?	

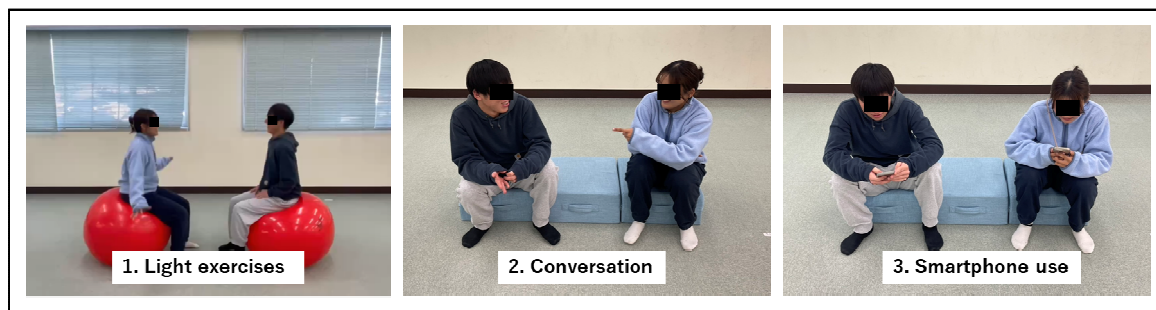


Figure 1. Overview of the rest conditions.

Measures

Two-Dimensional Mood Scale (TDMS)

Psychological mood states were assessed using the Two-Dimensional Mood Scale (TDMS) (Sakairi et al., 2013). The scale consists of eight items based on the dimensions of pleasure and arousal, with responses recorded on a six-point Likert scale. The TDMS assesses momentary mood states and is widely used to evaluate short-term psychological changes.

Subjective Fatigue

Subjective fatigue was assessed using a visual analogue scale (VAS). The VAS comprised a 100-mm horizontal line anchored with the descriptors “Not at all fatigued” and “Extremely fatigued.” Participants were instructed to mark a point corresponding to their current perception of fatigue. Scores were calculated as the distance (mm) from the left anchor to the marked point.

Visual Stroop Test

Changes in executive function were assessed using the Visual Stroop Test (hereafter referred to as the Stroop test). The Stroop test evaluates attentional and inhibitory control by requiring participants to suppress automatic responses in favor of goal-directed responses. In this study, the most commonly used color–word Stroop task was employed. The test consisted of 60 trials: 20 neutral trials, 20 incongruent trials with word-based responses, and 20 incongruent trials with color-based responses. Stimuli were presented on a computer screen, and participants responded using a keyboard. Reaction times were recorded automatically in milliseconds. Trial order was counterbalanced across conditions. Stroop interference scores were calculated by subtracting the mean reaction time of the neutral condition from that of each incongruent condition.

Procedure

All experimental sessions were conducted in pairs, with the same partner assigned across sessions. During each session, participants completed the Stroop test, the TDMS, and the subjective fatigue assessment individually in separate experimental rooms, and they shared only the rest period in the same room. At the beginning of each session, participants completed 15 practice Stroop trials (five per condition) to familiarize themselves with the task. Subsequently, participants completed the first assessment of the TDMS and subjective fatigue, followed by the 60-trial Stroop test and the second assessment. After completing one of the three rest conditions for 15 minutes, participants completed the third assessment of the TDMS and subjective fatigue, followed by another 60-trial Stroop test and the fourth assessment. Rest condition order was counterbalanced across participants. Sessions were separated by intervals of at least one day and no more than seven days. The overall protocol is illustrated in Figure 2.

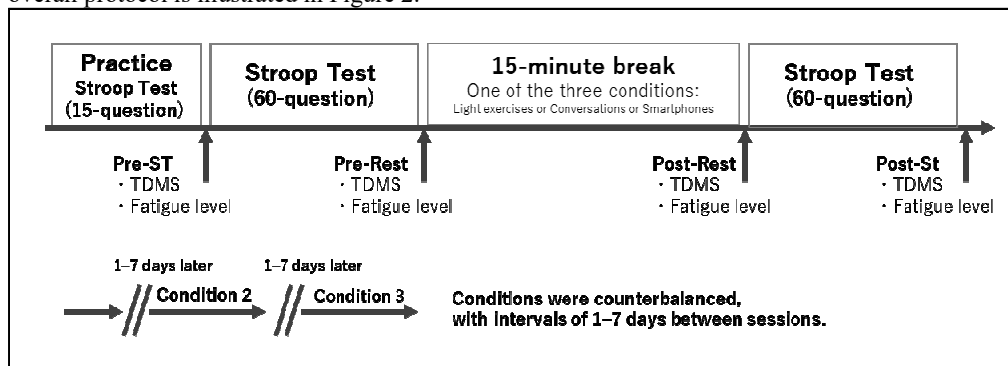


Figure 2. Summary of the experimental procedure. Each participant completed three experimental sessions with the same partner. In each session, participants completed practice trials of the Stroop test, followed by baseline assessments of mood and subjective fatigue. They then performed the Stroop test before and after a 15-min rest period under one of three rest conditions, with mood and fatigue assessed at each time point. The order of rest conditions was counterbalanced across sessions, which were conducted with intervals of 1–7 days.

Analysis

For the TDMS and subjective fatigue, two-way repeated-measures analyses of variance (ANOVAs) were conducted with time (pre-Stroop, pre-rest, post-rest, and post-Stroop) and rest condition (light physical activity, conversation, and smartphone use) as within-subject factors. For the Stroop test, interference scores were calculated separately for reaction time and accuracy in the word and color response conditions. Two-way repeated-measures ANOVAs were conducted with time (pre- and post-rest) and rest condition as within-subject factors. To examine differences in interference between response types, a three-way repeated-measures ANOVA was conducted with time, rest condition, and response type (word vs. color) as within-subject factors. Statistical significance was set at $p < .05$, and values of $p < .10$ were considered to indicate a statistical trend. Effect sizes were calculated as generalized eta squared (η_G^2) for ANOVA effects and Cohen's d (Cohen, 1992) for post hoc comparisons. All statistical analyses were performed using IBM SPSS Statistics software (version 28).

Results

Mood and Subjective Fatigue

A significant interaction between time and rest condition was observed for mood pleasantness ($F(6, 162) = 2.696, p = .016, \eta_G^2 = .060$). Post hoc analyses revealed that mood pleasantness significantly increased from pre-rest to post-rest in both the light physical activity and conversation conditions (physical activity: $p = .046, d = 0.54$; conversation: $p = .013, d = 0.68$). Furthermore, mood pleasantness remained significantly higher in these two conditions than in the smartphone condition at post-rest (physical activity: $p = .001, d = 0.98$; conversation: $p < .001, d = 1.22$) and post-Stroop (physical activity: $p < .001, d = 1.09$; conversation: $p < .001, d = 0.96$) (Figure 3-1). A significant interaction between time and rest condition was also observed for mood arousal ($F(6, 162) = 4.418, p < .001, \eta_G^2 = .096$). Post hoc analyses indicated that arousal increased significantly from pre-Stroop to pre-rest in the conversation and smartphone conditions (conversation: $p < .001, d = 1.00$; smartphone: $p = .016, d = 0.66$), whereas the physical activity condition showed a trend toward increased arousal ($p = .070, d = 0.55$). Subsequently, only the smartphone condition showed a significant decrease in arousal from pre-rest to post-rest ($p = .003, d = 0.70$), followed by a significant increase from pre- to post-Stroop ($p = .013, d = 0.54$). At post-rest, arousal was significantly higher in the physical activity and conversation conditions than in the smartphone condition (physical activity: $p < .001, d = 1.27$; conversation: $p = .007, d = 0.81$), with a trend toward higher arousal in the physical activity condition than in the conversation condition ($p = .085, d = 0.47$). At post-Stroop, arousal remained significantly higher in the physical activity and conversation conditions than in the smartphone condition (physical activity: $p = .026, d = 0.54$; conversation: $p = .007, d = 0.64$) (Figure 3-2).

A significant interaction between time and rest condition was observed for subjective fatigue ($F(6, 162) = 4.650, p < .001, \eta_G^2 = .073$). Post hoc analyses showed a significant decrease in subjective fatigue from pre-rest to post-rest in the conversation condition ($p < .001, d = 0.79$). At post-rest, subjective fatigue was significantly lower in the conversation condition than in the smartphone condition ($p = .019, d = 0.69$). By contrast, subjective fatigue in the smartphone condition increased significantly from pre- to post-Stroop ($p = .004, d = 0.36$). In the physical activity and conversation conditions, subjective fatigue did not change significantly across time points and remained significantly lower than in the smartphone condition (physical activity: $p = .037, d = 0.59$; conversation: $p = .002, d = 0.79$) (Figure 3-3).

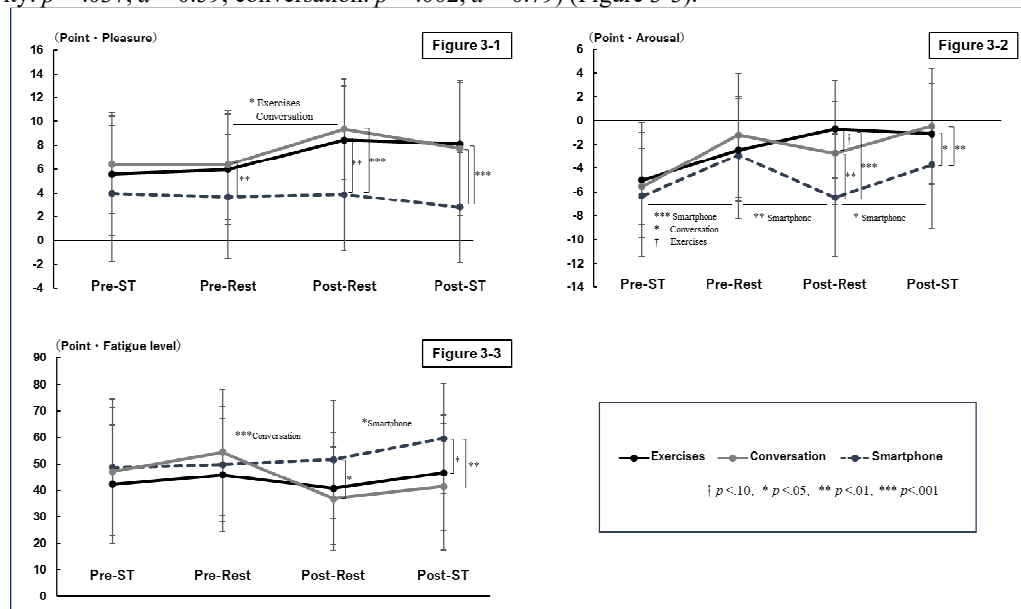


Figure 3. Changes in mood and subjective fatigue. Mood pleasantness increased from pre- to post-rest in the light physical activity and conversation conditions and remained higher than in the smartphone condition after

the rest period and after the Stroop task (Figure 3-1). Mood arousal decreased after the rest period in the smartphone condition, whereas it remained elevated in the light physical activity and conversation conditions after both the rest period and the Stroop task (Figure 3-2). Subjective fatigue decreased after the rest period only in the conversation condition, whereas it increased after the Stroop task in the smartphone condition and remained lower in the light physical activity and conversation conditions than in the smartphone condition (Figure 3-3).

Cognitive Task Performance

Regarding changes in Stroop interference from pre-rest to post-rest, a trend toward a significant interaction between time and rest condition was observed for reaction time ($F(2, 54) = 2.552, p = .087, \eta_G^2 = .052$) (Figure 4-1) and accuracy ($F(2, 54) = 2.502, p = .091, \eta_G^2 = .033$) (Figure 4-2) in the word-response condition. No significant interactions were observed in the color-response condition for reaction time ($F(2, 54) = 0.738, p = .483, \eta_G^2 = .014$) (Figure 4-3) or accuracy ($F(2, 54) = 0.796, p = .456, \eta_G^2 = .019$) (Figure 4-4). Post hoc comparisons in the word-response condition indicated that, in the light physical activity condition, Stroop interference for reaction time decreased significantly from pre-rest to post-rest ($p = .037, d = 0.31$), and accuracy increased significantly ($p = .028, d = 0.58$).

A significant main effect of response type was observed for interference reaction time, with greater interference in the color-response condition than in the word-response condition ($F(1, 27) = 142.92, p < .001, \eta_G^2 = .356$). No significant difference between response types was observed for accuracy ($F(1, 27) = 0.031, p = .862, \eta_G^2 = .000$).

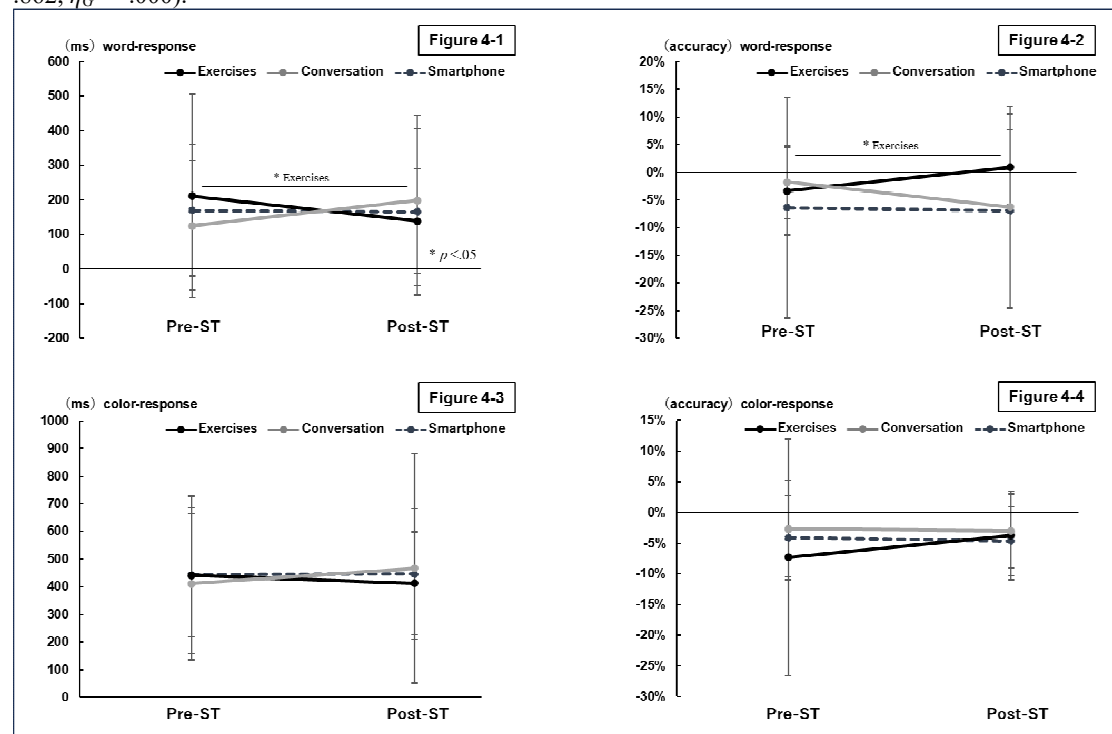


Figure 4. Changes in Stroop interference. In the word-response condition, Stroop interference decreased and accuracy increased from pre-rest to post-rest in the light physical activity condition (Figures 4-1 and 4-2). In contrast, no significant changes were observed in the color-response condition (Figure 4-3 and 4-4). Reaction time interference was greater in the color-response condition than in the word-response condition.

Discussion

Mood and Subjective Fatigue

Improvements in mood pleasantness and maintenance of psychological arousal occurred only in the light physical activity and conversation conditions. By contrast, mood pleasantness did not change in the smartphone condition and, additionally, psychological arousal decreased exclusively. Furthermore, recovery from subjective fatigue between pre- and post-rest was evident only in the conversation condition, whereas subjective fatigue increased in the smartphone condition. These findings indicate that the nature of activities undertaken during brief rest periods plays a critical role in modulating both affective states and perceived fatigue.

Regarding physical activity, the present findings align with evidence showing that brief bouts of low- to moderate-intensity exercise can elicit immediate positive mood states (e.g., Reed & Ones, 2006; Ekkekakis, 2003). Although no recovery from subjective fatigue was observed during physical activity, this may be

attributable to transient physical fatigue resulting from muscle activity immediately after exercise. Thus, fatigue perceived as a bodily sensation and the subjective feeling of psychological refreshment may represent distinct dimensions. With respect to conversation, functional magnetic resonance imaging (fMRI) studies have shown that laughter and empathic responses spontaneously activate reward-related neural systems in a context-dependent manner (Panksepp, 2000; Osaka & Osaka, 2005). Social interaction has also been reported to promote oxytocin release, which is associated with feelings of safety and stress reduction (Heinrichs & Domes, 2008). Activation of social-emotional networks through such conversational interactions may therefore underlie the observed improvements in mood pleasantness and recovery from subjective fatigue.

Regarding smartphone use, prior research indicates that even five minutes of smartphone use can adversely affect posture in university students and may lead to serious long-term musculoskeletal problems (including chronic neck, thoracic spine, and lower back pain) headaches, and decreased concentration (Cochrane et al., 2019). Sustained non-ideal postures have also been reported to impair muscular blood circulation, limiting nutrient delivery and contributing to localized pain and fatigue (Kim & Kim, 2015). Furthermore, smartphone use has been shown to induce visual fatigue even over durations of approximately 15 minutes and may not alleviate eye strain, particularly in seated postures (Chen et al., 2024). Visual fatigue has been linked to subjective fatigue and discomfort accompanied by physiological symptoms (Kaur et al., 2022). Collectively, these mechanisms may account for the increased subjective fatigue and reduced psychological arousal observed in the smartphone condition.

Cognitive Task Performance

A reduction in Stroop interference was observed in the light physical activity condition only for the lower-difficulty word-response condition. Previous studies have reported that responding to color information is more cognitively demanding than responding to word information and is more susceptible to interference in the Stroop task (Protopapas et al., 2017; Parris et al., 2022). Consistent with this pattern, Stroop interference for reaction time was greater in the color-response condition than in the word-response condition. Although previous research has demonstrated enhancements in executive function following physical activity (e.g., Byun et al., 2014; Damrongthai et al., 2021), the present findings partially support this body of evidence, as interference reductions were confined to the lower-difficulty task. This pattern may be interpreted in light of the Yerkes-Dodson law, which describes the relationship between arousal and task performance. According to this framework, elevated arousal is more likely to facilitate performance on relatively simple tasks, whereas benefits may diminish as task demands increase (Anderson, 1994; Diamond, 2005). In the more demanding color-response condition, no reduction in Stroop interference was observed, even following physical activity. One possible explanation is that the physical activity tasks incorporated elements of social interaction, which may have increased cognitive demands. Previous studies reporting exercise-related cognitive benefits have typically employed individually performed activities, such as cycling or running (e.g., Byun et al., 2014; Damrongthai et al., 2021), across a range of intensities from very light exercise (e.g., Kuwamizu et al., 2023) to moderate acute exercise (e.g., Yanagisawa et al., 2010). Although individually performed exergames (exercise through video games) have been shown to enhance executive function, the inclusion of social interaction during such activities may lead to cognitive overload and consequently impair performance (Zehnder et al., 2023).

In this study, the physical activity condition involved socially interactive exercises, including partner-based stretching, balance-holding tasks performed in pairs, and light bouncing movements synchronized with a partner. These activities may have increased cognitive load by requiring continuous coordination, monitoring of a partner's movements, and temporal synchronization. Consistent with this interpretation, no reduction in Stroop interference was observed in the conversation condition, which showed a similar pattern of arousal modulation. Social interaction inherent in conversation has been suggested to impose cognitive demands and may lead to cognitive overload (e.g., Kim et al., 2021; Meyer & Lieberman, 2012), which may explain the tendency toward increased Stroop interference observed in this condition. Accordingly, the absence of reduced Stroop interference in the color-response condition under the physical activity condition may reflect elevated cognitive load arising from social interaction embedded within the exercise tasks. These findings suggest that when the goal of brief physical activity during rest periods is to facilitate cognitive recovery, individually performed exercise may be more suitable than socially interactive physical activity.

In the smartphone condition, no significant changes were observed in cognitive task performance. Previous studies have suggested that increased tendencies toward short-video dependence via smartphone use may impair self-regulation and executive control within attentional domains (Yan et al., 2024). Prolonged smartphone use of approximately 45 minutes has also been reported to increase subjective mental fatigue and sleepiness and to impair cognitive performance (Jacquet et al., 2023). By contrast, the relatively short viewing duration in our study (approximately 15 minutes) may have been insufficient to exert a substantial impact on executive function tasks such as the Stroop task. Supporting this interpretation, research examining social media addiction has reported no clear association with performance on attention-related tasks (e.g., Stroop tasks), but significant associations with emotional and impulse control (Reed, 2023).

Studies involving young adults have further demonstrated significant negative associations between social media addiction and executive function (Zhang et al., 2023a), suggesting indirect impairment through

emotional disturbances and reduced sleep quality. Collectively, these findings indicate that executive function declines are more likely to emerge through long-term social media dependence, emotional dysregulation, and chronic sleep disruption rather than brief, acute exposure. Therefore, the absence of changes in cognitive task performance in this study may be attributed to the short duration of smartphone use.

Limitations

Several limitations of the present study warrant consideration. First, the physical activity condition employed in this study incorporated socially interactive elements, including partner-based stretching and balance-holding tasks performed in pairs. Consequently, it was not possible to fully disentangle the effects of physical activity per se from those of the accompanying social interaction. This limitation may account for the difficulty in determining whether the absence of reduced Stroop interference in the color-response condition reflects the nature of the physical activity itself or the increased cognitive load imposed by social interaction embedded within the task. Second, the relatively short duration of smartphone use examined in the present study (approximately 15 minutes) may have been insufficient to detect the adverse cognitive effects reported in previous studies involving more prolonged use (e.g., approximately 45 minutes; Jacquet et al., 2023). Accordingly, the present findings should be interpreted as applying specifically to brief smartphone use, and generalization to more extended durations should be made with caution. Third, the present study examined acute effects within a single experimental session. The extent to which these effects would persist or change with repeated engagement in these rest activities, and whether they generalize to real-world break-taking contexts, remains to be clarified. Future studies incorporating repeated-measures designs or more ecologically valid settings are needed to address this issue. Finally, the generalizability of the present findings may be constrained by characteristics of the sample, such as age range, gender distribution, and habitual activity levels. Replication in more diverse populations would help to establish the robustness and generalizability of these findings.

Conclusions

This study directly compared three brief rest activities —light physical activity, conversation, and smartphone use—within a single experimental design, examining how each of them shape psychological states and cognitive task performance. Physical activity and conversation both improved mood pleasantness, whereas smartphone use produced no such improvement and was accompanied by reduced arousal. Subjective fatigue decreased only after conversation, remained unchanged after physical activity, and increased after smartphone use. Cognitive performance improved in the physical activity condition under relatively low task demands, while conversation showed a tendency toward decreased performance and smartphone use showed no change.

These findings make two key contributions. Theoretically, by directly comparing three break activities within the same paradigm, this study shows that recovery during brief breaks is not a unitary process. Each activity produced a distinct profile across mood, fatigue, and cognitive performance rather than uniformly positive or negative effects, suggesting that different break activities draw on and restore different psychological resources even within very short rest periods. Practically, these results suggest that conversation may be preferable when fatigue reduction is the priority, while light physical activity may better restore cognitive readiness for low-demand tasks (likely through arousal-related mechanisms). By contrast, despite its convenience, smartphone use neither improved mood nor reduced fatigue and was associated with lower arousal, cautioning against treating it as an adequate substitute for active or social breaks in workplace and educational settings.

Because the cognitive benefits of physical activity emerged only under low task difficulty, future research should clarify how task demand, activity type, and intensity moderate these effects, and should examine whether these findings generalize to repeated, real-world break-taking beyond the present single-session design. Overall, this study offers evidence that the content of brief rest activities meaningfully shapes psychological and cognitive readiness for subsequent tasks, providing a foundation for designing break practices that favor active and social rest over passive smartphone use.

Conflict of Interest

The authors declare that this study was conducted in the absence of any commercial or financial relationships that could be construed as potential conflicts of interest.

Funding This work was supported by the JSPS KAKENHI Grant Number JP23H03294.

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