Effect on Sleepiness and Relaxation of Doing Yoga upon Waking with a Smartphone Yoga Application

Masashi Sugano and Mami Ueno

School of Knowledge and Information Systems, Osaka Prefecture University, Osaka, Japan

Email: sugano@kis.osakafu-u.ac.jp; st703003@edu.osakafu-u.ac.jp

Abstract—**Stress reduction and maintaining regular daily routines are important for prevention of lifestyle diseases. Traditionally, yoga is practiced upon waking, and is effective for stress relief. Yoga mastery generally requires formal instruction, which entails a large commitment of time and money. Thus, we evaluated the effect of yoga upon waking by using a simple smartphone yoga application with university students. Sleepiness decreased significantly before and after yoga as a result of the experiment. However, no significant difference was observed for degree of relaxation.**

Index Terms—**yoga, sleepiness, relaxation, smartphone**

I. INTRODUCTION

Stress has been implicated in the development of lifestyle diseases, and stress management is a major component of a healthy lifestyle [1]. Because biological rhythm disorders have been associated with lifestyle diseases [2], maintaining regular life routines is important for health. Yoga is an effective technique for reducing stress and relaxing the mind and body. Previous research has examined the effect of yoga-based relaxation techniques on memory scores and anxiety [3, 4], and the relaxing effects of yoga on pregnant women [5]. However, disseminating these benefits to the public is difficult due to the cost and time constraints of formal yoga classes. Therefore, this study evaluated a smartphone yoga application as a tool for easily doing yoga as a self-practice anywhere. Because a smartphone is carried at all times, [6] it is easy to do yoga by using a smartphone upon waking each morning. Thus, we examined the effect on relaxation and sleepiness of doing yoga upon waking using a smartphone yoga application.

II. METHOD

A. Target Yoga Application

A survey of smartphones owned by university students showed the highest percentage contained Android applications. Therefore, this study used a yoga application that runs on Android application: The Sukkiri Asa Yoga (Refreshing morning yoga) published by AU by KDDI Corporation [7]. This application has the following features:

1) Works in any Android terminal and is available for 99 yen.

2) Have five poses performed easily in a single 5-min session.

3) Provides animation and voice-guided pose and breathing cues.

4) Has an animated "breathing gauge" that directs the user to breathe in or out and use abdominal or thoracic breathing (Fig. 1).

5) Has animated poses that rotate 360 degrees and allows the user to touch the screen to examine a pose from any direction.

6) Displays calorie consumption at the end of the session (Fig. 2).

7) Has a calendar to record a user's history of past yoga poses and calorie consumption, which can be posted to a social networking service such as Facebook or Twitter (Fig. 3).

B. Evaluation Measures

To evaluate sleepiness, we used the Stanford Sleepiness Scale (SSS) [8] developed at Stanford University. The SSS is a simple self-rating scale that measures seven levels of sleepiness (Table I).

To evaluate relaxation, we used the RE scale proposed by Nedate and Uesato [9] to measure degree of relaxation. The RE scale rates emotional states in terms of relaxation [10, 11]. We did not use the Profile of Mood States (POMS) scale, which is another method for measuring emotional states as determinants of relaxation. Although POMS is the most commonly used measure of relaxation, it contains many questions and is time-consuming. Fig. 4 shows the RE scale, which has only four items corresponding to 11 levels of emotion by pairwise comparison. Therefore, we considered the RE scale more suitable for subjects to use upon waking.
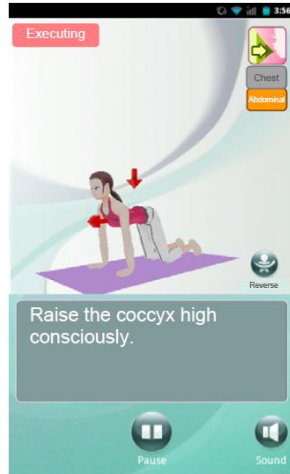
Figure 1.   Screenshot of a yoga pose: Animation and voice-guided cues help user perform a yoga pose. Respiratory gauge is displayed at the upper right-hand corner.
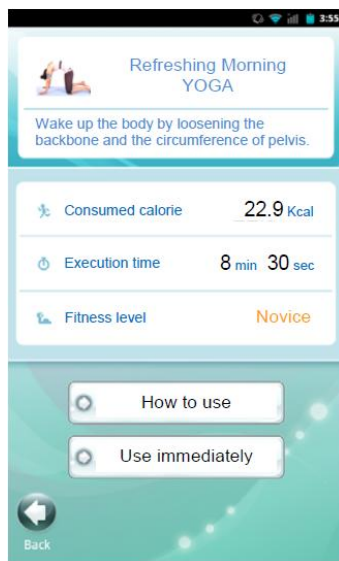

Figure 2.   End-of-session screenshot displays calorie consumption, elapsed time, and fitness level.

Figure 3.   Screenshot of the recording function displays the total number of past yoga repetitions and calorie consumption. Note: Users can share this information with social networking services.

TABLE I.   STANFORD SLEEPINESS SCALE

| Degree of Sleepiness	Scale Rating
Feeling active, vital, alert, or wide awake	1
Functioning at high levels, but not at peak; able to concentrate	2
Awake, but relaxed; responsive but not fully alert	3
Somewhat foggy, let down	4
Foggy; losing interest in remaining awake; slowed down	5
Sleepy, woozy, fighting sleep; prefer to lie down	6
No longer fighting sleep, sleep onset soon; having dream-like thoughts	7
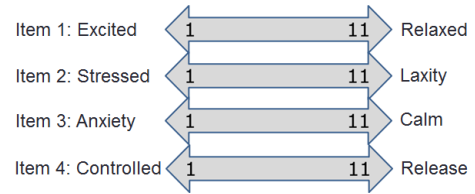
Figure 4.   RE Scale.

C. Experiment Method

We recruited 11 university students (men, 1; women, 10) to serve as research subjects in this study. After installing the yoga application on their smartphones, subjects were requested to (2) use the application to do yoga upon waking every morning for five weeks; and (3) on the first and the last days of the experiment, complete the RE scale and SSS before and after doing yoga.

Before the experiment began, subjects completed a questionnaire concerning the image of yoga and past experience of doing yoga. At the end of the experiment, subjects completed a second questionnaire on their experiences using the yoga application.

III.   RESULTS AND DISCUSSION

A.   Change in Sleepiness and Relaxation

As shown in Fig. 5, we compared the results of the SSS completed before and after doing yoga, and found that sleepiness was significantly reduced on both the first and last days of the experiment (Wilcoxon signed-rank test: $p < 0.05$).

The RE scale results revealed a tendency for items 1 and 2 to decrease, and items 3 and 4 to increase after doing yoga (Fig. 6). Items 1 and 2 are believed to indicate heightened feelings and more physical energy. Together, these results showed that degree of relaxation decreased after doing yoga. However, after totaling all four RE scale items, increases and decreases of individual items balanced out. Thus, we could not conclude a significant change in degree of relaxation.

Next, we analyzed the characteristics of the significant difference observed in the SSS before and after doing yoga. Fig. 7 displays the relationship between the number of days yoga was performed and the SSS difference before and after doing yoga (Spearman's rank correlation coefficient: $R_s = 0.53$, $p = 0.09$). Although the correlation was not statistically significant, we do not

consider this result conclusive because the SSS is a subjective measure. We believe the frequency of doing yoga is related to the effectiveness of doing yoga with the smartphone application. Certainly, this is a topic for further investigation.
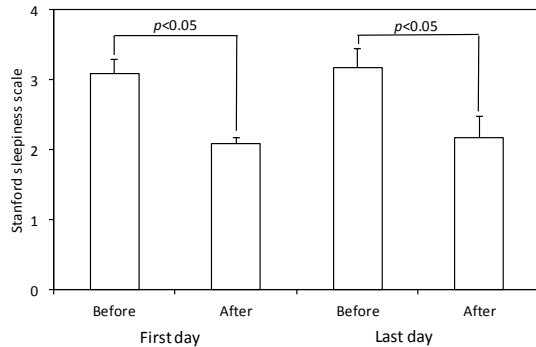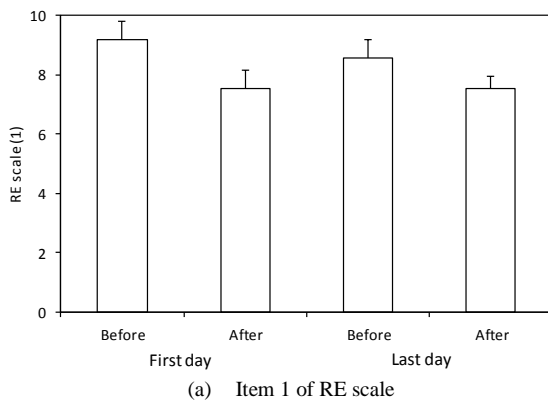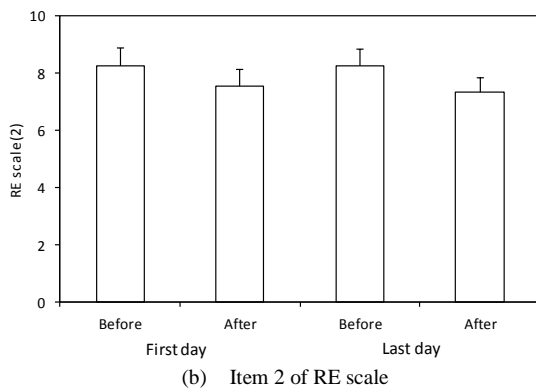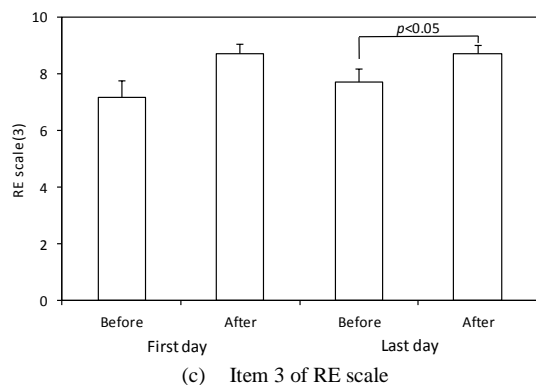

Figure 5.   Change in Stanford sleepiness scale before and after yoga.
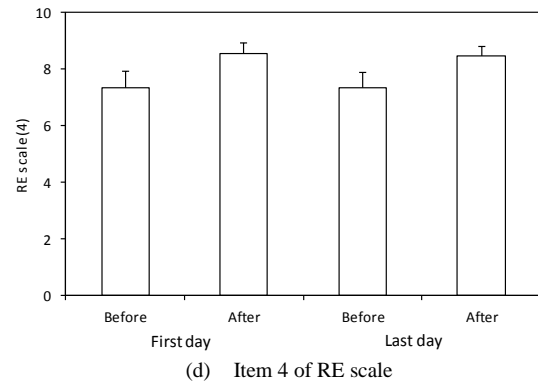

(a)   Item 1 of RE scale

(b)   Item 2 of RE scale

(c)   Item 3 of RE scale

(d)   Item 4 of RE scale

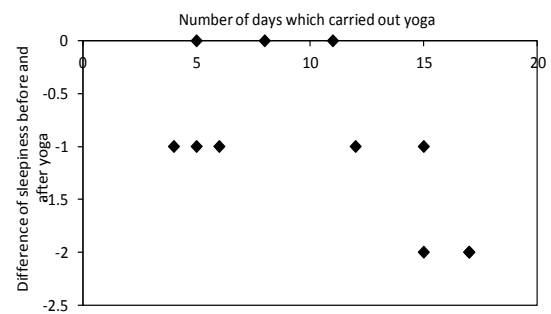Figure 6.   Change in RE Scale before and after yoga

Figure 7.   The relationship between the number of days yoga was performed and the difference in the sleepiness measure before and after yoga (Spearman's rank correlation coefficient: Rs=-0.53, p=0.09).

B.   Questionnaire Resuls

We conducted a questionnaire survey before and after the experiment. In the post-experiment questionnaire, five subjects answered "yes" to the question "Do you want to continue doing yoga using the smartphone application?" and six subjects answered "no." The reasons for wanting to continue yoga included "Waking up to do yoga feels good," "yoga is good for my health," and "yoga feels good and it refreshes me." The reasons given for wanting to stop were "It is hard for my body to do yoga upon waking in the morning," "I prefer to do yoga before going to sleep," and "doing yoga with a smartphone application was troublesome."

In addition, as a function of the desired subjects was the most frequent answer was that they want to introduce more pauses. Because the application used in this experiment was developed only for short time yoga for awakening, the pose that is recorded is limited. Therefore, subjects are considered to get bored with performing the yoga of the same pause every day. In order to have raised the use frequency of application, it was suggested by containing more pauses that it is also important to raise a user's motivation.

Among the subjects who wanted to continue yoga, the most requested improvement to the smartphone application was that it should present more yoga poses. The application in this experiment contained very few recorded poses because its purpose was to guide yoga for only a brief time after awaking. Even so, subjects might

get bored doing the same limited set of yoga poses every morning. To keep customers motivated to use the application more often, it should contain a greater variety of poses.

IV. CONCLUSION AND FUTURE WORK

In this study, we investigated the impact that doing yoga upon waking has on sleepiness or degree of relaxation when using a smartphone yoga application. The findings of this study showed that sleepiness significantly decreased when doing yoga even for a short time upon waking. Future research is needed to conduct larger-scale investigations and quantitative comparisons of other applications or methods other than yoga.

REFERENCES

[1] M. Nakao, "Psychosocial stress in diseases related to lifestyle," *Jpn J Psychosom Med*, vol. 48, no. 3 pp. 195-203, Mar. 2008.

[2] M. Nagane, "An approach to studying biological rhythms of adolescent students, and future tasks," *Bulletin of the Faculty of Education, Chiba University*, vol. 60, pp. 73-78, Mar. 2012.

[3] J. Merilahti, E. Mattila, J. Plomp, K. Laine, and I. Korhonen, "Short-term relaxation responses to a voice-guided mobile phone relaxation application and self-guided relaxation," in *Proc. of the 9th International Conference on Information Technology and Applications in Biomedicine (ITAB2009)*, Nov. 2009.

[4] P. Subramanya and S. Telles, "Effect of two yoga-based relaxation techniques on memory scores and state anxiety," *BioPsychoSocial Medicine*, vol. 3, no. 8, Aug. 2009.

[5] L. Clark, S. Edwards, J. Thwala, and P. Louw, "The influence of yoga therapy on anxiety," *Journal of Humanities and Social Sciences*, vol. 3, no. 1, pp. 24-31, 2011.

[6] F. Morita, J. Yamamoto, and Y. Hukuyama, "Maternity yoga for elderly women study of stress reduction effect –Verification of the effects of POMS–," *Taisei Gakuin University bulletin*, vol. 14, pp. 155-160, Mar. 2012.

[7] KDDI. Sukkiri Asa Yoga. [Online]. Available: https://play.google.com/store/apps/ details?id=com.kddi.setfit004

[8] E. Hoddes, V. Zarcone, H. Smythe, R. Phillips, and W. C. Dement, "Quantification of sleepiness: A new approach," *Psychophysiology*, vol. 10, no. 4, pp. 431-436, July 1973.

[9] K. Nedate and I. Uesato, "Effects of cognition of physiological state and actual physiological responses upon emotion," *Jap. J. Behav. Ther.* vol. 9, no. 2, pp. 33-39, Mar. 1984.

[10] K. Koitabashi, N. Yanagi, and N. Hishinuma, "Comparison between bed rest and progressive muscle relaxation method using physiological and sensory perceptual markers in health women," *Ann Gunma Health Sci.*, pp. 67-74, 1997.

[11] M. Nakakita and K. Takenoue, "Effect of relaxing back massages on early healthy postpartum mothers –Autonomic nervous system activity and subjective analysis," *J. Jpn. Acad. Midwif.*, vol. 23, no. 2, pp. 230-240, 2009.

Masashi Sugano received the M.E. and D.E. degrees in Information and Computer Science from Osaka University, Japan, in 1988 and 1993, respectively. In April 1988, he joined Mita Industrial Co., Ltd. (currently, Kyocera Document Solutions Inc.) as a Researcher. From 1996 to 2003, he was an Associate Professor in Osaka Prefecture College of Health Sciences. From 2003 to 2005, he was an Associate Professor with the Faculty of comprehensive Rehabilitation, Osaka Prefecture College of Nursing. From 2005 to 2012, he was with the School of Comprehensive Rehabilitation, Osaka Prefecture University, and from April 2009, he has been a Professor. He moved to School of Knowledge and Information System Sciences, Osaka Prefecture University in April 2012.

His current research interests include communication network, wireless and sensor network, health informatics. He is a member of IEEE, ACM, IEICE, and IPSJ.

Mami Ueno received Bachelor of Health Sciences from Osaka Prefecture University in 2014. Her current research interests include yoga and healthcare systems.