A Comparison of Psychological and Physiological Responses to Autogenic Training and Autogenic Feedback Training: The Response of Athletes New to Autogenic Training

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This study examined how athletes new to autogenic training (AT) respond to autogenic feedback training (AFT) by comparing their psychological and physiological responses to AT and AFT. It focused on warmth sensation training (WST), a necessary component of AT. The two experimental conditions-the AT condition and AFT condition-were compared using psychological and physiological indices. Psychological indices included the Profile of Mood States (POMS) Brief Form, as well as participants' subjective ratings regarding motivation for WST and sensation of warmth. Physiological indices were skin temperature, respiration rate, and the electrocardiogram R-R interval. A Lorenz plot was constructed from the R-R interval to visualize the cardiac autonomic nervous activity. It was found that the POMS Brief Form value for vigor decreased after training under the AT condition, but it did not change under the AFT condition. The subjective evaluation score regarding motivation for WST was higher under the AFT condition than the AT condition. The subjective evaluation score regarding warmth sensation was higher under the AT condition than the AFT condition. Sympathetic nerve activity was more inhibited during and after training under the AT condition; in the AFT condition, it remained constant. Therefore, for athletes new to AT, AFT neither leads to greater relaxation nor a greater sensation of warmth compared to AT; nonetheless, AFT effectively increases athletes' motivation for AT.

Key words: POMS, warmth sensation, motivation, Lorenz plot

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1. Introduction

Autogenic training (AT) is a psychological and physiological therapeutic technique devised by the German psychiatrist J. H. Schultz in 1932. AT is currently used not only in the medical field, but also in fields such as education, healthcare, industry, and sports.

In sports, many athletes conduct autogenic training (AT) as a relaxation technique included in their mental training. AT has been shown to improve athletes' ability to compete and prevent athletes from "psyching

out," or succumbing to the pressure of performing at a tournament. However, it generally takes about one to two months to become sensitive to the warmth and weight of one's body, both of which are necessary for practicing AT (Matsuoka & Matsuoka, 1989). As a result, it is important to maintain athletes' motivation until such abilities are acquired (Irie et al., 1996), especially because athletes prefer to obtain fast results (Kusumoto, 2000). Autogenic feedback training (AFT), a method that combines AT with biofeedback, may help athletes maintain their motivation to practice AT because biofeedback enables athletes to track the

psychological and physiological changes that occur as they practice AT.

Biofeedback provides information about an individual's physiological state to that particular individual and therefore enables him/her to better understand and control those functions. Shimizu (1992) defines biofeedback as a "general term for the technique of enabling an organism to consciously control its physiological processes. This is done by using technological equipment to convert data about the organism's physiological processes—which usually cannot be perceived and are considered to be either beyond the organism's conscious control or else extremely difficult to control—into signals that can be perceived; the signals are then presented to the organism." In the field of sports, biofeedback is mainly used as a technique for motor learning (Araki & Sakuma, 1982), but it is believed that continuous use of biofeedback can lead to a reduction in nervousness or anxiety (e.g., Hashimoto et al., 1984; Kodama & Takamatsu, 1989; Tokunaga & Hashimoto, 1986; Tokunaga & Hashimoto, 1987).

AFT uses biofeedback to enable athletes to track the psychological and physiological changes taking place while practicing AT (Kasai, 2000). Thus, it is conceivable that AFT would increase the individual's motivation to conduct AT. In other words, it can be perceived that AFT would greatly assist athletes new to AT to carry out AT. This means that AFT could be crucial for athletes who prefer to obtain fast results (Kusumoto, 2000). However, there is yet to be any experimental studies that investigate this motivational aspect of AFT by researching how athletes new to AT react psychologically and physiologically to AFT. If it can be shown that AFT helps the AT-novice athlete continue with AT, then that would greatly promote the use of AFT.

The present study thus compared how athletes new to AT psychologically and physiologically react to both AFT and AT. This study specifically investigated warmth sensation training (WST)—the ability to sense the warmth of one's body—which is crucial when athletes perform AT (Tachiya et al., 2005). There were two experimental conditions: the AT condition (closed eyes, AT warmth sensation training carried out on the right hand) and the AFT condition (open eyes, AT warmth sensation training carried out on the right hand while the athlete watches a display of the right palm captured by a thermo tracer). The two experimental conditions were examined and compared using

psychological and physiological indices. The psychological indices were the Profile of Mood States (POMS) Brief Form, which measures change in mood, as well as the subjective evaluation score regarding motivation for WST, and the subjective evaluation score regarding sensation of warmth. The Visual Analogue Scale was used to record the above two subjective evaluation scores. It is generally perceived that AT triggers a relaxation response, increases skin temperature (Sakano et al., 1997), reduces respiratory rate (Benson et al., 1974; Matsuoka & Matsuoka, 1999), and increases vagal nerve activity (Sakakibara et al., 1994). Thus, the physiological indices were skin temperature, respiration rate, and the electrocardiogram R-R interval. A Lorenz plot was constructed from the electrocardiogram R-R interval in order to visualize the cardiac autonomic nervous activity. By using the above physiological indices, this study thoroughly examined whether a relaxation response is indeed brought about by AT.

2. Method

2.1. Experimental participants

The participants of this study were 18 males (ages: 20.3 ± 1.7 years) belonging to sports clubs (judo club, karate club, kendo [Japanese fencing] club, table tennis club, baseball club) at a university in Tokyo, Japan. All participants were new to AT, and none were regularly using another relaxation technique.

2.2. Experimental location and environment

The experiment was performed in the shield room of the university's psychology laboratory. The shield room had a temperature of 24.5-26.7°C, humidity of 36.4-51.3%, and illuminance of 35.0 lx.

2.3. Experimental conditions

Two experimental conditions were used: the AT condition (closed eyes, AT warmth sensation training carried out on the right hand) and the AFT condition (open eyes, AT warmth sensation training carried out on the right hand while the athlete watches a display of his right palm captured by a thermo tracer). The display used in the AFT condition was positioned approximately 70 cm from the seated participant, as conducted by Okouchi (1991). In the AFT condition,

skin temperature information was presented as a visual signal with real-time feedback using a proportional method (Shiwa, 1997), in which feedback information is presented successively and proportionally to the changes that occur in the physiological response.

Both during the experiment briefing and immediately prior to conducting the experiment, participants were instructed to continually recite “My right hand is warm” in their minds during the AT. In both conditions, participants were then required to carry out warmth sensation AT on their right hand during the experiment. The experiment was a within-subjects design, and the order of the two experimental conditions was counterbalanced among the participants. As a result, the two experimental conditions were conducted within eight to eleven days of each other.

2.4. Psychological indices

2.4.1. Questionnaire sheet

Measurements were made using the following six scales of the Profile of Mood States (POMS) Brief Japanese Version (Urakawa & Yokoyama, 2005): tension-anxiety, depression-dejection, anger-hostility, vigor, fatigue, and confusion. For this study, the explanatory note to the answer section of the POMS Brief Form was altered. To have participants rate their mood during the study, the phrase “past week’s mood” was replaced with “current mood.”

2.4.2. Subjective evaluation scores

Subjective evaluations of motivation for WST and sensation of warmth were scored using a visual analogue scale (VAS).

The experimental participants were instructed to rate their degree of motivation for WST and the degree to which they felt a sensation of warmth by marking the appropriate point on a 10 cm line labeled “Not at all” at one end and “Extremely” at the other. The distance from “None at all” to each participant’s mark was measured in millimeters, and these values were defined as the subjective evaluation scores of motivation for WST and sensation of warmth. To evaluate participants’ motivation for WST, participants were required to rate how much they agree with the statement, “I felt motivated to take part in the warmth sensation training” as conducted by Okouchi (1991); to evaluate participants’ sensation of warmth, participants were required to rate how much they agree with the statement, “I felt a sensation of warmth.”

2.5. Physiological indices

The physiological indices were skin temperature, respiration rate, and an electrocardiogram. Skin temperature was measured using a thermo tracer (TH5108ME; NEC San-ei Instruments, Ltd.), which took readings from the palm of the right hand every second and recorded them at 10-second intervals. Respiration rate was measured using a respiratory belt transducer, which was attached near the diaphragm of each participant. The electrocardiogram was produced using a heart rate sensor (DL-310; 4Assist, Inc.) attached via a bipolar chest lead. Respiration rate and electrocardiogram signals were fed to an amplifier, sampled by an analogue-to-digital converter (PowerLab; AD Instruments Pty Ltd.) at a sampling frequency of 1 kHz, and recorded.

2.6. Procedure

Participants were first given a briefing about the experiment, and after consenting to participate, they were asked to sign a consent form. The consent form explained that data obtained from the experiment would be used only for research purposes, the participants’ privacy would be maintained, and that the participants have the right to abandon the experiment at anytime.

Electrodes for measuring respiratory rate and producing the electrocardiogram were attached to the participants. In order for the participants to become accustomed to the experimental environment, they then sat relaxed with their open eyes for approximately 10 minutes. To begin the experiment, participants sat upright in the position most commonly used for AT (Luthe, 1971). The experiment consisted of three phases: (1) pre-experimental rest for three minutes (“pre-experiment”), (2) experimental condition (AT or AFT) for three minutes (“experiment”), and (3) post-experimental rest for three minutes (“post-experiment”). The experiment’s duration was three minutes because of the results from a pilot study. In this pilot study, AT was first conducted for five minutes and was subsequently conducted for three minutes. When AT was conducted for five minutes, the participants’ arousal level decreased and a few participants reported that they could not discern whether they were properly conducting AT. But when AT was conducted for three minutes, there was no such report from the participants. In this way, it was deemed adequate to conduct the AT experiment for three minutes. During the pre-

experiment and post-experiment phases, participants sat relaxed with their closed eyes. After the pre-experiment phase, participants were asked to complete the POMS Brief Japanese Version; after the experiment phase, they were asked to record their subjective evaluations regarding motivation for WST and sensation of warmth; and after the post-experiment phase, they were asked to fill in the POMS Brief Japanese Version. After all the procedures were completed, the electrodes were removed from the participants.

2.7. Analysis

2.7.1. Psychological indices

To analyze the data obtained with the POMS Brief Japanese Version, *T*-scores were calculated for the linear scales of tension-anxiety, depression-dejection, anger-hostility, vigor, fatigue, and confusion. A two-way repeated-measures analysis of variance was performed on each scales' *T*-scores for the following two factors: experimental condition (AT, AFT) and phase of the experiment (pre-experiment, post-experiment). The subjective evaluation scores regarding motivation for WST and the subjective evaluation scores regarding sensation of warmth were analyzed using paired *t*-tests for experimental condition (AT, AFT).

2.7.2. Physiological indices

Both skin temperature and respiratory rate were analyzed by taking the mean value from each of the three phases of the experiment and performing a two-way repeated-measures analysis of variance for the following two factors: phase of the experiment (pre-experiment, experiment, post-experiment) and experimental condition (AT, AFT). A multiple comparison was subsequently performed using Ryan's method at a 5% level of significance. The

electrocardiogram R-R interval was analyzed using the quantitative measurement method of Toichi et al. (1997). Accordingly, two indices were calculated from a Lorenz plot: 1) the cardiac sympathetic index (CSI), an index of cardiac sympathetic nerve activity, and 2) the cardiac vagal index (CVI), an index of vagal nerve activity. The CSI and CVI values were analyzed in the same way as the other physiological indices.

3. Results

3.1. Psychological indices

3.1.1. Questionnaire

Each experimental conditions' mean *T*-scores for every scale of the POMS Brief Japanese Version, together with the results from the analysis of variance, are shown in **Table 1**. An analysis of variance between the pre- and post-experiment *T*-scores for the two experimental conditions shows that the post-experiment scores significantly decreased in depression-dejection ($F(1, 17)=18.45, p<.001$), anger-hostility ($F(1, 17)=15.89, p<.001$), fatigue ($F(1, 17)=16.52, p<.001$), and confusion ($F(1, 17)=13.01, p<.005$). The post-experiment score for vigor also significantly decreased ($F(1, 17)=6.36, p<.05$), and there was a significant interaction between the experimental condition and the phase of the experiment ($F(1, 17)=4.51, p<.05$). By performing a simple main effect test, it was found that the decrease in the post-experiment score of the AT condition was significant ($F(1, 34)=10.87, p<.005$).

3.1.2. Subjective evaluation scores

Each experimental conditions' mean subjective evaluation scores regarding motivation for WST and sensation of warmth, along with the results from the *t*-tests, are shown in **Table 2**. The results of the *t*-test regarding motivation for WST in both experimental conditions show that the AFT condition scores were

Table 1 Each experimental conditions' pre- and post-experiment mean *T*-scores for POMS Brief Japanese Version and ANOVA results.

Measure	AT		AFT		Result of ANOVA (<i>F</i> value)		
	Pre-Experiment	Post-Experiment	Pre-Experiment	Post-Experiment	Experimental condition	Pre- and Post-Experiment	Interaction
Tension-Anxiety	44.9 (± 7.9)	42.8 (±10.8)	45.2 (±11.0)	42.1 (± 8.1)	$F(1, 17)=0.01$	$F(1, 17)=1.97$	$F(1, 17)=0.25$
Depression-Dejection	47.8 (±10.2)	45.3 (± 6.6)	48.9 (± 9.5)	44.6 (± 4.8)	$F(1, 17)=0.01$	$F(1, 17)=18.45****$	$F(1, 17)=0.39$
Anger-Hostility	39.1 (± 4.3)	37.9 (± 2.5)	41.7 (± 5.5)	37.9 (± 2.5)	$F(1, 17)=1.26$	$F(1, 17)=15.89****$	$F(1, 17)=2.62$
Vigor	38.2 (± 8.9)	34.3 (± 6.1)	38.1 (± 7.7)	37.3 (± 8.7)	$F(1, 17)=0.94$	$F(1, 17)=6.36*$	$F(1, 17)=4.51*$
Fatigue	45.2 (± 5.4)	40.9 (± 4.0)	47.2 (± 5.4)	41.4 (± 4.2)	$F(1, 17)=0.82$	$F(1, 17)=16.52****$	$F(1, 17)=0.50$
Confusion	42.7 (±10.9)	40.1 (± 7.7)	44.8 (± 9.9)	39.6 (± 6.8)	$F(1, 17)=0.18$	$F(1, 17)=13.01***$	$F(1, 17)=0.85$

* $p<.05$, *** $p<.005$, **** $p<.001$

Table 2 Each experimental conditions' mean (standard deviation) subjective evaluation scores regarding motivation for WST and sensation of warmth, and results of paired *t*-test.

	AT	AFT	Result of <i>t</i> -test (<i>t</i> value)
Motivation for WST	63.6 (± 15.8)	70.4 (± 14.9)	$t(17)=2.17^*$
Warmth sensation	60.2 (± 16.5)	52.3 (± 19.5)	$t(17)=2.19^*$

* $p < .05$

significantly higher than AT condition scores ($t(17)=2.17$, $p < .05$). The results of the *t*-test for sensation of warmth in both experimental conditions show that the AT condition scores were significantly higher than the AFT condition scores ($t(17)=2.19$, $p < .05$).

3.2. Physiological indices

3.2.1. Skin temperature

The mean skin temperatures of the right palm in each phase of both experimental conditions are shown in **Figure 1**. An analysis of variance reveals the main effect of the phase of the experiment to be significant ($F(2, 34)=12.94$, $p < .001$). The results of a multiple comparison test show a significant increase in skin temperature from the pre-experiment phase to the experiment phase ($MSe=0.12$, $p < .05$), as well as from the pre-experiment phase to the post-experiment phase ($MSe=0.12$, $p < .05$). Additionally, the skin temperature during the post-experiment phase was significantly higher than that of the experiment phase ($MSe=0.12$, $p < .05$).

3.2.2. Respiratory rate

Although an analysis of variance was conducted for the respiratory rate in each phase of the two experimental conditions, neither the phase of the experiment nor the experimental condition was significant. Furthermore, there was no significant interaction between the phase of the experiment and experimental condition (**Figure 2**).

3.2.3. Lorenz plot

The mean CSI values in each phase of both experimental conditions are shown in **Figure 3**. An analysis of variance was conducted regarding the CSI values for different phases of the experiment. The main effect of the phase of the experiment was found to be significant ($F(2, 34)=3.52$, $p < .05$), and the interaction between the experimental condition and phase of the experiment was also significant ($F(2, 34)=3.70$,

Figure 1 Each experimental conditions' mean (standard deviation) skin temperature of the right palm during each phase of the experiment. **Figure 2** Each experimental conditions' mean (standard deviation) respiratory rate during each phase of the experiment. **Figure 3** Each experimental conditions' mean (standard deviation) CSI value during each phase of the experiment.

$p < .05$). A simple main effect test was therefore performed. The phase of the experiment was not significant in the AFT condition; however, the phase of

Figure 4 Each experimental conditions' mean (standard deviation) CVI value during each phase of the experiment.

the experiment was significant in the AT condition. A multiple comparison was subsequently performed and made evident that the AT conditions' CSI values were significantly higher in the pre-experiment phase than in the experiment phase ($MSe=0.21$, $p<.05$) or the post-experiment phase ($MSe=0.21$, $p<.05$).

An analysis of variance of the CVI values was similarly carried out, but there was neither a significant main effect nor significant interaction between the experimental condition and phase of the experiment (Figure 4).

4. Discussion

This study examined how athletes' psychological and physiological response to WST differs depending on whether they perform AT or AFT.

An analysis of the psychological and physiological indices for both experimental conditions indicate that in regards to the psychological indices (scores recorded using the POMS Brief Japanese Version's scales for depression-dejection, anger-hostility, fatigue, and confusion) and physiological indices (respiratory rate, skin temperature, and Lorenz plot CVI values), there were no differences between the two experimental conditions—both conditions brought about the same changes. Therefore, it may be stated that the use of biofeedback in conjunction with AT had no effect on these indices. Scores recorded using the POMS Brief Japanese Versions' scales for depression-dejection, anger-hostility, fatigue, and confusion all decreased in the post-experiment phase. These results resemble those of previous studies (Masamoto et al., 2003; Tachiya et al., 2005), and thus, it can be stated that the present study illustrates the changes in mood typically brought about by AT.

It is generally perceived that AT triggers a relaxation

response, thereby reducing the respiratory rate (Benson et al., 1974; Matsuoka & Matsuoka, 1999) and increasing vagal nerve activity (Sakakibara et al., 1994). But in this study, the physiological indices of respiratory rate and the CVI values from the Lorenz plot, which are an index of vagal nerve activity, remained constant throughout the different phases of the experiment. This may be because all the participants of this study were new to AT—it has been speculated that compared to athletes who have acquired AT techniques, athletes new to AT are less likely to experience a relaxation response (Masamoto et al., 2003). Skin temperature increased as the experiment progressed, and this finding that AT leads to an increase in skin temperature confirms previous reports (Sakano et al., 1997). Let it be noted, however, that skin temperature can increase with time as participants sit relaxed (Sugie, 1991). Therefore, the increase in skin temperature observed in the current study may not necessarily be an outcome of AT. In addition, previous AFT studies indicate that AFT does not increase skin temperature any more than AT (Keefe et al., 1980; Surwit et al., 1978). The results of this current study support such findings.

Differences between the two experimental conditions were observed in the Lorenz plot CSI value, a physiological index, as well as the following psychological indices: the value obtained using the vigor scale from the POMS Brief Japanese Version, the subjective evaluation score regarding motivation for WST, and the subjective evaluation score regarding sensation of warmth. Looking at the value obtained using the POMS Brief Japanese Version scale for vigor, this value for the AT condition decreased in the post-experiment phase as all other POMS measures. But in the AFT condition, there was no difference between the values obtained from the pre-experiment and post-experiment phase.

The Lorenz plot CSI value, which is an index of cardiac sympathetic nerve activity, was higher in the AT condition's pre-experiment phase than in its experiment or post-experiment phase. However, the AFT condition's Lorenz plot CSI value remained constant throughout the experiment. It may be concluded that cardiac sympathetic nerve activity was suppressed in the AT condition, but was not effected in the AFT condition. Both Fredrikson (1990) and Mishima et al. (1995) have described the suppressive effect of AT on cardiac sympathetic nerve activity, and this characteristic outcome of AT appears to have

occurred even among athletes new to AT. The use of a visual signal for biofeedback requires the information to be consistently processed, and it is believed to induce relatively high levels of arousal (Hoshino & Kodama, 1996). One may surmise that the POMS value for vigor and the CSI value did not decrease in the AFT condition's post-experiment phase because a visual signal was used to display skin temperature. Also, because the AFT condition requires biofeedback in conjunction with AT, this biofeedback can be seen as an extra task. And it is possible that the need to perform this extra task may have caused stress. There is, in fact, some doubt as to whether biofeedback actually has a greater relaxation effect than other relaxation techniques (Green & Shellenberger, 1986; Kewman & Roberts, 1983). Thus, it may be conjectured that the AFT condition did not bring about a greater relaxation effect than the AT condition.

Regarding the subjective evaluation scores for motivation towards WST, it may be stated that motivation for WST was higher in the AFT condition than the AT condition. The use of biofeedback in the AFT condition is believed to enable participants to track their own psychological and physiological changes more easily than in the AT condition (Kasai, 2000). This may be the reason why the AFT condition increased the participants' motivation for WST. Regarding the subjective evaluation scores for sensation of warmth, it seems that participants felt a greater sensation of warmth under the AT condition than under the AFT condition. During the experiment, participants under the AT condition had their closed eyes, while participants under the AFT condition had their open eyes. Schultz and Naruse (1963) state that AT may be carried out with closed eyes, half-closed, or fully open, but they suggest that closed eyes work best for those new to AT (p. 82). This particular feature common to individuals new to AT seems to have manifested itself in the present study.

Let us summarize the advantages and disadvantages of both the AT condition and the AFT condition. The AT condition is favorable because its POMS Brief Japanese Version value for vigor decreased after the experiment, its subjective evaluation score regarding warmth sensation was higher than that of the AFT condition, and sympathetic nerve activity was inhibited during and after the experiment. The drawback of the AT condition is that its subjective evaluation score regarding motivation for WST was lower than that of the AFT condition. In contrast, the AFT condition is

favorable because its subjective evaluation score regarding motivation for WST was higher than that of the AT condition. Disadvantages of the AFT condition include how its POMS Brief Japanese Version value for vigor did not change, its subjective evaluation score regarding warmth sensation decreased more than that of the AT condition, and sympathetic nerve activity did not change throughout the experiment. AT is a self-control technique that needs to be practiced over a relatively long period of time with simple set phrases (Matsuoka & Matsuoka, 1989). Whether it is individuals new to AT or athletes who prefer obtaining fast results (Kusumoto, 2000), it is important to first increase one's interest for and awareness of AT and then develop a sense of determination to continue AT. AFT increased the participants' motivation for WST in the current study, so it seems probable that AFT is a valid method for nurturing athletes' perseverance to conduct AT, especially for athletes who are new to AT. However, as AFT does not have any more of a relaxation effect than AT, and as the AFT condition did not enable participants to feel a greater sensation of warmth, AT should be used in preference to AFT for obtaining a relaxation effect and experiencing a sensation of warmth. As athletes' psychological and physiological responses to AT and to AFT differ, it is crucial for athletes new to AT to keep these differences in mind so he/she can maximally benefit from both training techniques.

5. Conclusion

The purpose of this study was to examine the use of autogenic feedback training (AFT) on athletes who are new to autogenic training (AT) by comparing their psychological and physiological responses to AT and AFT.

The following four differences were observed between the two experimental conditions. (1) The POMS Brief Japanese Version value for vigor decreased after training under the AT condition, but it did not change under the AFT condition. (2) The subjective evaluation score of motivation for the warmth sensation training (WST) was higher under the AFT condition than under the AT condition. (3) The subjective evaluation score of warmth sensation was higher under the AT condition than under the AFT condition. (4) The Lorenz plot showed sympathetic nerve activity to be more inhibited during and after training under the AT condition; in the AFT condition,

there was no change.

In conclusion, for athletes new to AT, AFT is not more effective for relaxation than AT. Moreover, AFT does not enable athletes to feel a greater sensation of warmth than AT; nonetheless, AFT effectively increases athletes' motivation for AT.

References

- Araki, M. & Sakuma, H. (1982). A study on the application of EMG biofeedback technique in motor learning. *Japan Journal of Physical Education, Health and Sport Sciences*, 27 (3): 207-215 (in Japanese).
- Benson, H., Beary, J. F., & Carol, M. P. (1974). The relaxation response. *Psychiatry*, 37: 37-46.
- Fredrikson, M. (1990). Effects of autogenic training on cardiovascular and electrodermal reactivity to mental stress: An exploratory study. *Journal of Psychophysiology*, 4: 289-294.
- Green, J. A. & Shellenberger, R. D. (1986). Biofeedback research and the ghost in the box: A reply to Roberts. *American Psychologist*, 41: 1003-1005.
- Hashimoto, K., Tokunaga, M., Tatano, H., & Kanezaki, R. (1984). A study on reducing competitive anxiety in sport (1): Changes in trait anxiety before contests and the results of biofeedback. *Reports of the Electronics Research Laboratory Fukuoka Institute of Technology*, 1: 77-86 (in Japanese).
- Hoshino, S. & Kodama, M. (1996). A test of biofeedback training using a simple wristwatch-style heart rate monitor. *Japanese Journal of Biofeedback Research*, 23: 1-6 (in Japanese).
- Irie, M., Mishima, T., & Nagata, S. (1996). Psychophysiological effect of first-time autogenic training on healthy beginners. *Japanese Journal of Psychosomatic Medicine*, 36 (4): 299-305 (in Japanese).
- Kasai, J. (2000). *Autogenic Training to Overcome Stress*. Kodansha: Tokyo (in Japanese).
- Keefe, F. J., Surwit, R. S., & Pilon, R. N. (1980). Biofeedback, autogenic training, and progressive relaxation in the treatment of Raynaud's disease: a comparative study. *Journal of Applied Behavior Analysis*, 13 (1): 3-11.
- Kewman, D. G. & Roberts, A. H. (1983). An alternative perspective on biofeedback efficacy studies: A reply to Steiner and Dince. *Biofeedback and Self-Regulation*, 8: 487-497.
- Kodama, M. & Takamatsu, M. (1989). A study of the effects by mental training on sports: The differences of the effects of autogenic training and biofeedback training. *Waseda Studies in Human Sciences*, 2 (1): 69-74 (in Japanese).
- Kusumoto, Y. (2000). Applications in the field of sports. In: Kasai, J. and Sasaki, Y. (Eds.) *Modern-day Spirit* (396). Autogenic Training Method. Shibundo: Tokyo, p. 184 (in Japanese).
- Luthe, W. (1971). Standard autogenic training exercises. In: Uchiyama, K. (Trs.) and Ikemi, Y. (Ed.) *Autogenic Training Method I: Autogenic Training Method*. Seishin Shobo: Tokyo (in Japanese).
- Masamoto, K., Saito, M., Yoda, A., & Kuga, R. (2003). Psychological reactions and cardiac autonomic nervous function accompanying first-time autogenic training. *Japanese Journal of Hypnosis*, 47: 15-22 (in Japanese).
- Matsuoka, Y. & Matsuoka, M. (1989). Standard training. In: Sasaki, Y. (Ed.) *Autogenic Training Method*. Nihon Bunka Kagakusha: Tokyo (in Japanese).
- Matsuoka, Y. & Matsuoka, M. (1999). *Autogenic Training Method*. Nippon Hyoronsha: Tokyo (in Japanese).
- Mishima, T., Kubota, S., & Nagata, S. (1995). Autonomic nervous function in autogenic training practitioners. *Japanese Journal of Autogenic Therapy*, 15: 40-48 (in Japanese).
- Okouchi, H. (1991). Effects of feedback and changing criterion on the control of skin temperature. *Japanese Journal of Psychology*, 62 (5): 301-307 (in Japanese).
- Sakakibara, M., Takeuchi, S., & Hayano, J. (1994). Effect of relaxation training on cardiac parasympathetic tone. *Psychophysiology*, 31: 223-228.
- Sakano, Y., Sato, K., & Nishizaki, T. (1997). Fluctuation of autonomic responses and characteristics of psychological changes through autogenic training. *Japanese Journal of Autogenic Therapy*, 16: 34-45 (in Japanese).
- Schultz, J. H. & Naruse, G. (1963). *A Practical Method of Autogenic Training: Self-Hypnotism*. Seishin Shobo: Tokyo, pp. 77-82 (in Japanese).
- Shimizu, N. (1992). *Biofeedback*. Heibonsha's Psychological Dictionary (New Edition). Heibonsha: Tokyo, p. 679 (in Japanese).
- Shiwa, S. (1997). Basics of biofeedback therapy. In: Miyata, Y. (Ed.) *New Physiological Psychology* (2nd): Fields of Application of Physiological Psychology. Kitaohji: Kyoto, p. 159 (in Japanese).
- Sugie, M. (1991). Changes of peripheral finger temperature during autogenic training and its implication for treatments. *Japanese Journal of Autogenic Therapy*, 12: 16-24 (in Japanese).
- Surwit, R. S., Pilon, R. N., & Fenton, C. H. (1978). Behavioral treatment of Raynaud's disease. *Journal of Behavioral Medicine*, 1: 323-335.
- Tachiya, Y., Mimura, S., Sugo, T., Kusumoto, Y., & Osada, K. (2005). Comparison of the physiological and psychological results of warmth sensation formulas and warmth sensation suggestions in autogenic training in competitive sports. *Japanese Journal of Hypnosis*, 49 (1): 9-17 (in Japanese).
- Toichi, M., Sugiura, T., Murai, T., & Sengoku, A. (1997). A new method of assessing cardiac autonomic function and its comparison with spectral analysis and coefficient of variation of R-R interval. *Journal of the Autonomic Nervous System*, 62: 79-84.
- Tokunaga, M. & Hashimoto, K. (1986). A study on training of psychological competitive ability for athletes (2): On relaxation training by skin temperature biofeedback. *Journal of Health Science, Kyushu University*, 8: 65-77 (in Japanese).
- Tokunaga, M. & Hashimoto, K. (1987). A study on training of psychological competitive ability for athletes (3): The mental training of tennis players. *Journal of Health Science, Kyushu University*, 9: 79-87 (in Japanese).
- Urakawa, K. & Yokoyama, K. (2005). Introduction to Brief Japanese Version of POMS. In: Yokoyama, K. (Ed.) *The Brief Japanese Version of POMS: Guide and Case Comments*. Kaneko Shobo: Tokyo, pp. 1-9 (in Japanese).

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Main Works:

- Takai, H. & Kusumoto, Y. (2008). Performing push-ups as a procedure to assist the sensitivity of heaviness in AT. Japanese Journal of Hypnosis, 50 (2): 5-12 (in Japanese).
- Takai, H., Saijo, O., & Kusumoto, Y. (2009). Physiological and psychological changes caused by archery athletes monitoring their own heartbeat in shooting situation, and the effects on performance. Japanese Journal of Sport Psychology, 36 (1): 13-22 (in Japanese).
- Takai, H. (2009). The psychological and physiological changes to heartbeat-listening while in a resting state. Japanese Journal of Biofeedback Research, 36 (2): 57-65 (in Japanese).

Membership in Learned Societies:

- Japan Society of Physical Education, Health and Sport Sciences
 - Japanese Society of Sport Psychology
 - The Japanese Association of Applied Psychology
 - Japanese Society of Hypnosis
 - Japanese Society of Biofeedback Research
 - Japan Society of Human Growth and Development
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