

The therapeutic effect of taking in the atmosphere of a forest

Norimasa Takayama

Abstract — The concept of “Taking in the atmosphere of a Forest” (*shinrin-yoku*, in Japanese) was proposed in 1982 by the Japanese Forestry Agency to help people to relax and revitalize their body and soul (therapeutic effect). Previously, the therapeutic effect had been based on only empirical evidence. However, thanks to the rapid improvement of measurement technology and equipment, the government has been scientifically examining the therapeutic effect of forests and using the resulting data for the benefit of the public. The effect is thought to differ depending on the kinds of trees, the spatial structure and the specific atmosphere of the forest environment. Therefore, we decided to study the therapeutic effect of two old-growth forests. As a control, we selected a well-maintained artificial forest. We measured and compared the therapeutic effect on the subjects, paying attention to 1) their impression of the forest space and 2) how their feeling changed after walking through each forest. Consequently, we found that subjects considered the old-growth forests with huge trees as more sacred, more comfortable, more serene and more natural than the control forest. Moreover, in the control forest there was no difference in any of the indicators used in the survey, while in the old-growth forests the therapeutic effect was confirmed by several indicators.

Index Terms — Profile of mood states, Semantic differential method, Taking in the atmosphere of the forest (Sinrin-yoku), Therapeutic effect

1 INTRODUCTION

It is often said many people living in cities feel stressed for various reasons, lose their sense of the seasons, and lack sufficient physical activity. The concept of “Taking in the atmosphere of a forest” (*shinrin-yoku* in Japanese) was proposed in 1982 by the Japanese Forestry Agency to help people to relax and revitalize their body and soul [1]. In Japan, many people visit forests every year to alleviate stress, to feel refreshed or to improve their health, and have high expectations for the effect of *shinrin-yoku*.

Previously, the therapeutic effect of *Shinrin-yoku* had been based on only empirical evidence. However, due to the rapid improvement of measurement technology

and equipment, the government and some universities have been examining it scientifically by physiological or psychological methods, and using the resulting data for the benefit of the public [2], [3], [4].

The therapeutic effect is thought to differ depending on the kinds of trees, the spatial structure and the specific atmosphere of the forest environment [5]. Against this backdrop, research was conducted on two old-growth forests and one control forest, for the following purposes: 1) to reveal the distinguishing features of the psychological effects of taking in the atmosphere of an old-growth forest, and 2) to examine the relationships among *shinrin-yoku* effect, spatial impressions, and forest environment.

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2 MATERIAL AND METHODS

2.1 Study sites

We chose two old-growth forests as study sites (Fig. 1). The first is a forest in Koya Town, Wakayama Prefecture owned by a temple, consisting mainly of Japanese cedars 250 years old or older. Located on Koya Mountain, it was planted by Kukai in 816 and has been managed by Kongobuji Temple, the head temple of the Shingon sect of Buddhism (Fig. 2). The second is the Akazawa Recreation Forest in Agematsu Town, Nagano Prefecture, which consists of around 300-year-old Japanese cypresses, giving the illusion of a virgin forest with a mysterious atmosphere (Fig. 3).

As a control, we selected a well-maintained artificial forest in Gero City, Gifu Prefecture of Japanese cedars and cypresses planted about 50 years ago (Fig. 4). We measured and compared the effects on the subjects, paying attention to 1) their impression of the forest space and 2) how their feeling changed after walking through a forest.

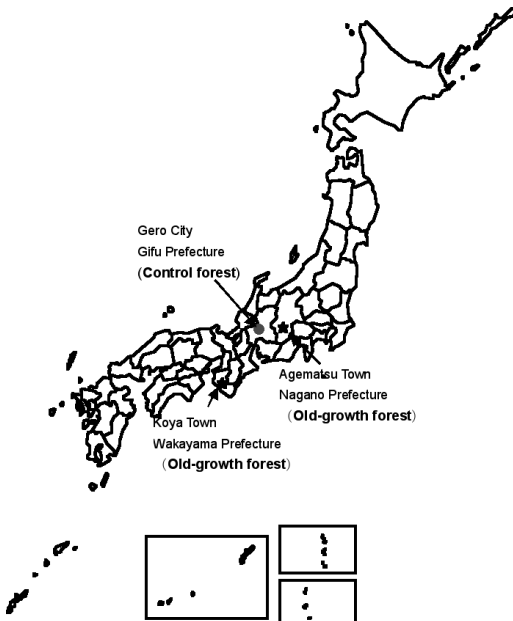


Fig. 1. The Locations of study sites.



Fig. 2. The Old-growth forest - Koya Town, Wakayama Pref. (Giant Japanese Cedar).



Fig. 3. The Old-growth forest - Agematsu Town, Nagano Pref. (Giant Japanese Cypress).



Fig. 4. The Control forest - Gero City, Gifu Pref. (Typical Man-made Cedar and Cypress).

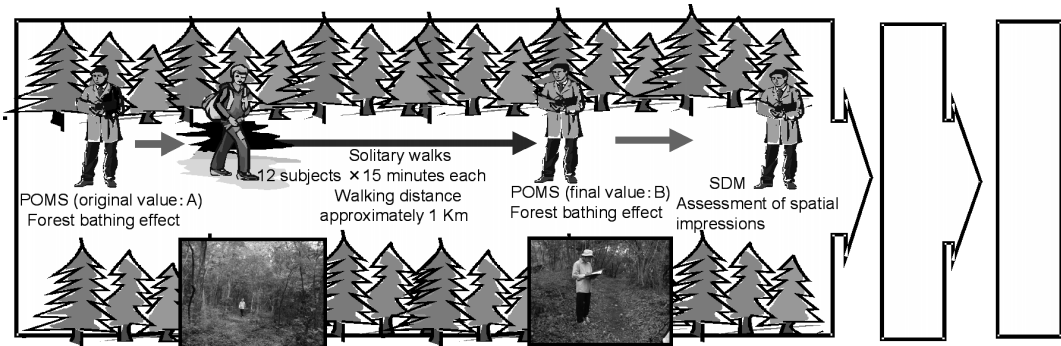


Fig. 5. The flow of the psychological experiment.

TABLE 1
OVERVIEW OF THE SHINRIN-YOKU EXPERIMENT

Study area	Koya Town Wakayama Pref.	Agematsu Town Nagano Pref.	Gero City Gifu Pref.
Category	Old-growth forest	Old-growth forest	Control forest
Period of forest bathing experiment	2006/1-3	2005/6-8	2004/11/3-5
Forest study area	Three-Cedar Trolley Trail	Akacavia Recreational Trail	Shimi Hiking Trail
Number of subjects	12	12	12
Affiliation of subjects	Wakayama University (graduate and undergraduate)	Shinshu University (graduate and undergraduate)	Gifu University (graduate and undergraduate)
Gender of subjects	Male	Male	Male
Average age of subjects	21.5±1.1	21.8±1.3	23.0±0.9

All subjects in the experiments were male national university students in their 20' (12 subjects per experiment).

2.2 Subjects

The subjects were 12 male university students aged from 20 to 24 in each study area. They were 36 subjects in total (Table 1).

2.3 Experiment method

After strolling in the forest for 15 minutes, the Semantic Differential Method (SDM) and Profile Of Mood Status (POMS) were used to learn 1) the subjects' impression of the forest space (SDM) and 2) how their feeling changed after walking through the forest (Fig. 6).

3 ANALYTICAL RESULTS

3.1 Analysis of *shinrin-yoku* results

There was no significant difference in *shinrin-yoku* effects between the two

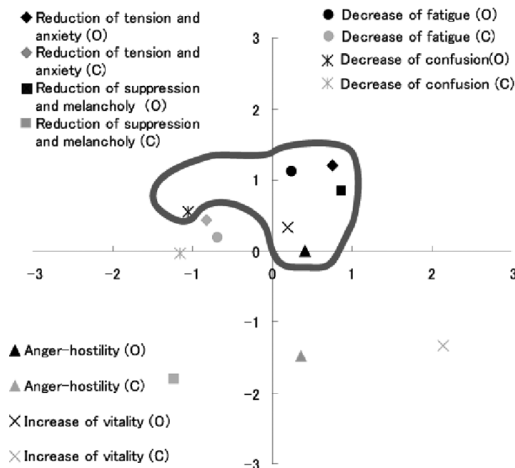


Fig. 6. Factor axes (Axes: I - IV) and factor scores of POMS criteria (O= Old-growth forest; C= Control forest).

old-growth forests. But compared with the control forest, vitality significantly increased in the old-growth forests. The old-growth forests also showed a significant reduction of tension and anxiety (Table 2).

3.2 Analysis of physical environment

The old-growth forests had fewer trees and less basal area at breast height, meaning that the views were less cluttered. They also had a higher relative light intensity than the control forest, meaning that their light environment had a more soothing effect (Table 3).

TABLE 2

COMPARISONS OF EVALUATIONS BETWEEN OLD-GROWTH AND CONTROL FORESTS

Category	Study area	Tension/ anxiety	Suppression/ melancholy	Anger/ hostility	Vitality	Fatigue	Confusion
Old-growth forest	Koya town Wakayama Pref.	-1	-0.33	0	6.17	-3.67	-0.5
	Net value (B-A*)	low	low	low	high	medium	low
	Agematsu town Nagano Pref.	-1.08	0.33	0.08	5.58	-1.67	-1.33
	Net value (B-A)	low	low	low	high	medium	low
Control forest	Gero City Gifu Pref.	-5.75	-1.83	-3.17	-0.83	-0.83	-2.42
	Net value (B-A)	high	medium	medium	low	low	medium
Established level of significance							
* : Koya Town - Gero City		**			*		
☆ : Agematsu Town- Gero City		☆☆	☆☆		☆		
※ : Koya Town- Agematsu Town							
** x, ☆☆☆, ※※※: p<0.01 * , ☆, ※: p<0.05% ANOVA-Fisher		B-A* = Final value minus original value					

TABLE 3

CHARACTERISTICS OF FORESTS IN THE STUDY AREA AND CLIMATIC CONDITIONS

Study area	Koya Town	Agematsu Town	Gero City
Category	Old-growth forest	Old-growth forest	Control forest
Date of environmental measurements	2006/8/3	2005/7/8	2004/11/5
Weather	Fair	F air	F air
Temperature (°C)	24.5	19.2	20.1
Humidity (%)	83.1	86.1	44
Radiant heat (°C)	24.7	18.9	20.1
Wind speed (m/s)	0.4	0.62	0.4
Species composition	Coniferous (Cedar)	Coniferous (Cypress)	Mixed coniferous (Cedar and Cypress)
Forest age	40-200	300	30-60
Relative light intensity (%)	19.1	22.6	26.4
Number of trees per unit area	6.6	8.6	9.6
Breast height basal area (m ²)	26.6	34.6	38.5
	low	low	high

3.3 Evaluations of forest impressions

There was no significant difference between the two old-growth forests. However, compared to the control forest, SD criteria for the old-growth forests showed highly significant differences in naturalness, beauty, sense of spirituality, soothing ability, and wholesomeness (Table 4).

3.4 Analysis of differences in impressions

Four factor axes were obtained as a result of the factor analysis (Table 5): Comfort-aesthetics (Axis I), Mystique (Axis II), Understandability (Axis III), and Gentle coolness (Axis IV).

TABLE 4

COMPARISON OF EVALUATIONS OF IMPRESSIONS OF FOREST INTERIORS

Category	Study area	Artificial-natural	Ugly-beautiful	Vulgar-spiritual	Unnerving-relaxing	Unhealthy-healthy
Old-growth forest	Koya town Wakayama Pref.	6.67 high natural	6.33 high beautiful	5 high spiritual	6 high relaxing	5 high healthy
	Agematsu Town Nagano Pref.	6.67 high natural	6.17 high beautiful	4.33 medium spiritual	6.33 high relaxing	6.33 high healthy
	Gero City Gifu Pref.	4.83 medium natural	4.83 medium beautiful	3.25 medium spiritual	5.08 medium relaxing	4.17 medium healthy
	Net value (B-A)	high	high	medium	medium	medium
Established level of significance		5/21 sets of adjectives				
* : Koya Town - Gero City		**	**	**	*	*
☆ : Agematsu Town- Gero City		☆☆	☆☆	☆	☆☆	☆☆
※ : Koya Town- Agematsu Town						
** x, ☆☆☆, ※※※: p<0.01 * , ☆, ※: p<0.05% ANOVA-Fisher		7 levels: 1 (low)-2-3-4-5-6-7 (high)				

TABLE 5

FACTOR ANALYSIS OF CORRELATION COEFFICIENTS

Interpreted Axis Name	Axis-I Comfort-aesthetics	Axis- II Mystique	Axis-III Understandability	Axis-IV Gentle coolness
Evaluation Criteria				
3-dimensional-2-dimensional	0.911	-0.151	-0.157	0.200
Ugly- beautiful	0.872	0.220	-0.273	0.223
Gloomy- cheerful	0.856	0.181	-0.290	0.134
Friendly-unfriendly	-0.833	-0.417	0.281	-0.039
Comfortable-uncomfortable	-0.758	0.128	0.229	-0.504
Likeable-dislikeable	-0.756	-0.492	0.328	-0.192
Good smelling-bad smelling	-0.717	-0.524	0.355	-0.067
Quiet-noisy	-0.702	-0.056	0.277	-0.516
Artificial-natural	0.701	0.269	-0.530	0.380
Unnerving-relaxing	0.669	0.132	-0.507	0.492
Healthy-unhealthy	-0.663	-0.307	0.560	-0.357
Bright-dark	-0.130	0.864	-0.155	-0.359
At ease-uneasy	-0.374	-0.815	0.100	-0.231
Inactive-lively	-0.178	0.720	0.352	-0.327
Sparse-luxuriant	-0.241	-0.706	0.489	-0.230
Orderly-disordered	-0.392	-0.690	0.161	-0.265
Open-closed	-0.358	-0.314	0.874	-0.074
Generic-individual	0.507	-0.018	-0.777	0.215
Spiritual-vulgar	-0.854	0.056	0.688	-0.296
Stimulating-sedating	0.366	-0.131	-0.038	0.914
Warm-cool	0.101	0.178	-0.489	0.757
Contribution rate	0.376	0.193	0.190	0.150
Total contribution rate	0.376	0.569	0.759	0.909

For the control forest, all factor scores of all criteria occurred within the negative range of at least one negative factor axis (Fig. 6).

For the old-growth forests, numerous criteria were located within the positive ranges of both Comfort-aesthetics (Axis I; x-axis) and Gentle coolness (Axis IV; y-axis).

4 DISCUSSION

4.1 Characterizing the psychological results of *shinrin-yoku* in old-growth forests

According to the analytical results (Table 2), taking in the atmosphere of an old-growth forest significantly increased the vitality criterion compared with the control forest. Furthermore, tension and anxiety were reduced, albeit at a low level of significance. However, because there was no significant difference in the values for tension and anxiety between the control forest and old-growth forests after the walks, it appears that before walking in an old-growth forest, subjects felt neither tense nor uneasy.

4.2 Understanding the interrelationship among *shinrin-yoku* effect, spatial impression, and forest environment

According to the analytical results, the old-growth forests had a much better viewing environment, and more soothing light conditions, than did the control (Table 3), and gave better feelings of spirituality, naturalness, and calmness (Table 4). Differences in impressions were especially reflected in the increase in vitality (Table 2).

According to the analytical results (Tables 5, 6), the distinctive spatial structure of the old-growth forests gave subjects greater impressions of comfort, beauty, gentleness and coolness than did the control (50-year-old) forest, and may have helped to relieve the emotional tensions, anxieties, feelings of suppression, melancholy, and fatigue of forest walkers and increase their vitality.

CONCLUSION

In conclusion, the psychological investigation in the present study has proved the therapeutic effect of taking in the atmosphere of a forest (especially old-growth forest) environment (*shinrin-yoku*). As the psychological effect

suggested, on-demand-*shinrin-yoku* will likely help to decrease the incidence of stress-related illness. Hence, much more research will be required about how *shinrin-yoku* and forest environments help to promote human health and well-being.

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