A Study of Fragrance Impressions, Evaluation and Categorization

A STUDY OF FRAGRANCE IMPRESSIONS,
EVALUATION AND CATEGORIZATION

By

NAKANO Yoshiki(中野良樹)[1], KIKUCHI Akio (菊池晶夫)[2]

MATSUI Hiromi (松井裕美)[1], HATAYAMA Toshiteru(畑山俊輝)[1]

and MARUYAMA Kinya (丸山欣哉)[1]

Subjective feelings about the ten fragrances including "lemon" were assessed by a questionnaire composed of a question about preference and 15 adjectives. From the data on the feelings, two factors were extracted by means of a principal factor method; Factor 1 was interpreted as a arousal factor, and the second as a relaxation factor. Lemon and peppermint had a higher factor score for Factor 1. This suggests that the two fragrances were useful to elicit refreshed feelings. On the other hand, the scores of Factor 2 showed higher correlation with the preference (r=0.98) than those of Factor 1. Therefore subjects were thought to feel more relaxed when they smelled the fragrance stimuli which they preferred much more.

Moreover, we used a cluster analysis to categorize the fragrances on the basis of factor scores. This attempt proved that lemon and peppermint could be classified into one group and rose, lavender and marjoram into another. So we inferred that the fragrance stimuli which belonged to the same group would have a tendency to give the subjects common impressions.

Key words: fragrances, perfumes, impressions, questionnaire, factor analysis, cluster analysis.

INTRODUCTION

The purpose of the present study is to investigate whether different fragrances of flowers, herbs or fruits have a different effect on human emotions. For example the fragrance of lemon varieties often refreshes our feelings, and roses or lavenders has been believed to relieve the state of our mind. Fragrances of flowers have been used for perfumes and medicines. These evidences makes us easily imagine that fragrances of flowers or herbs have a psychological effect on human emotions.

Recently Kikuchi et al. (1990) examined heart-rate(HR) changes during a reaction time task while giving some stimulants of a fragrance. They showed that the lemon stimulant produced larger HR deceleration just before a subject's key response than a blank (no fragrance) condition. This result indicated that the lemon facilitated the anticipatory or preparatory process of human information processing. Because previous studies have showed that such a phasic deceleration are related with attention, anticipation, and expectancy function (Hatayama, Yamaguchi, & Ohyama, 1982). Furthermore, Yoshida(1972) analyzed subjective impressions about 96 standard odorant by principal component analysis. Then they found that there are four groups, etherial, musky, minty, and camphoraceous among these

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1. Department of Psychology, Faculty of Arts and Letters, Tohoku University, Kawauchi Aoba-ku. Sendai 980, Japan.
2. Shiseido Product Research Laboratories, 1050 Nippa-cho Kohoku-ku, Yokohama 223, Japan.

odorant. In addition these psychological similarities were consistent with similarities of stereochemical structure.

All these evidences leads us to expect that such fragrances of flowers, herbs, and fruits have an effect upon human emotion or physical state to alter mental processes. We therefore attempt to assess various subjective impressions and to classify fragrances which have similar characteristics into a group. Then we expected to obtain basic findings about psychological effect of fragrances. Such preliminary research would be necessary to conduct laboratory experiments examining the effect of fragrances on mental performances of human.

METHOD

Subjects: Sixty-one naive volunteer subjects, 30 men and 31 women, participated in this study. They were graduate students at Tohoku University including 10 graduates, ranging in their ages between 19 and 27. The only criteria for inclusion were that they must be free from a cold and any other illness.

Stimulus: We used ten essences of a fragrance; lemon, rose, jasmine, lavender, peppermint, vanilla, marjoram[1], camphor, neroli[2] and sandalwood. Filter papers (6×140mm) whose tips were dipped into the liquid odorant were used for stimulus presentation.

Procedure: The subjects were required to smell some of the filter paper with liquid odorant by holding their fingers. The paper was exchanged for every trial. The presentation of the stimulus was randomized among the *S*s. We conducted the experiment over two successive days, in order to prevent the *S*s from decreasing olfactory sensitivity by repeating trials. So the *S*s assessed five stimuli in an experimental day.

We provided the *S*s with fifteen adjectives to learn the subject's judgement on how he felt about a given fragrance. These adjectives were as follows; cozy, comfortable, refreshed, nervous, drowsy, excited, easy, wakeful, vigorous, dull, jittery, tired, rested, energetic, relaxed. Each item of them was composed of question containing the adjectives and a rating scale with eleven points. The Ss were requested to report what degree a given adjective represented their emotions when they smelt the fragrance, by marking the number on the scale.

RESULTS AND DISCUSSION

All the *S*s assessed magnitude of their subjective feelings caused by the 10 fragrances each on the rating scales corresponding to the 15 adjectives. The data which were arithmetic means of raw rating scores among *S*s were used for factor analysis. As a result of principal factor method, the 15 variables were reduced to two factors which had a cumulative proportion of 0.95. The result of Varimax rotation was showed in Table 1. The highest loading on the first factor (Factor 1) were words of "refreshed", "wakeful", "dull" or "tired". These words suggests that the Factor 1 represents an arousal factor. On the other hand the second factor

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1. Marjoram is an aromatic herb used in cookery.
2. Neroli is distilled from the flowers of the bitter orange.

Table 1. Factor loadings of each items.

key word	Factor 1 (arousal)	Factor 2 (relaxation)	Communality
cozy	.261	.954	.978
comfortable	−.348	.928	.984
refreshed	.968	.190	.972
nervous	.742	−.623	.939
drowsy	−.865	.492	.995
excited	.758	−.015	.583
easy	−.182	.971	.978
wakeful	.978	−.073	.961
vigorous	.790	.596	.993
dull	−.928	.310	.956
jittery	−.152	−.984	.990
tired	−.956	−.206	.959
rested	.590	.796	.977
energetic	.696	.713	.994
relaxed	−.356	.931	.994

(Factor 2) was a relaxation factor, because the highest loading of adjectives were words of "easy", "cozy", "relaxed" or "jittery".

We focused attention on the factor scores to examine a relationship among the fragrances. Figure 1 exhibits the factor scores (Table 2) for each fragrances, in which horizontal axis represents Factor 1 and vertical one is Factor 2. So Fig. 1 indicated how the fragrances elicited

Table 2. Factor scores and mean scores of Item 1 (Preference) which questioned about subjects' preference for a given fragrance.

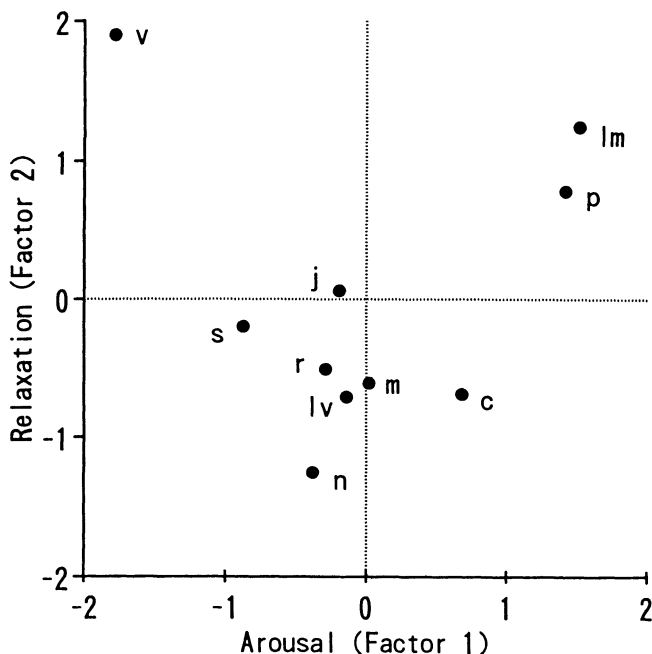| ragrance	Factor 1	Factor 2	Preference
lemon	1.52	1.24	2.36
rose	−.29	−.51	−0.98
jasmine	−.19	.06	0.19
peppermint	1.42	.78	1.71
lavender	−.14	−.70	−1.34
vanilla	−1.78	1.90	2.67
marjoram	.02	−.61	−1.19
comphor	.69	−.69	−0.93
neroli	−.38	−1.26	−2.26
sandalwood	−.87	−.20	−0.5

Fig. 1 The distribution of fragrances on the basis of the factor scores.
The horizontal axis is the factor scores for Factor 1 which is
interpreted as a arousal factor, and vertical one is Factor 2
which is a relaxation factor.
v: vanilla, lm: lemon, p: peppermint, j: jasmine,
s: sandalwood, r: rose, m: marjoram, c: camphor,
lv: lavender, n: neroli.

the subjects aroused and relaxed feelings, and interrelationship of properties having each
fragrances for the two factors.   Figure 1 showed that the two fragrances of lemon and
peppermint had higher score in Factor 1 than the others.   Thus it suggests that these
fragrances aroused mental states of the subjects.   Furthermore lemon, peppermint and vanilla
showed higher scores in Factor 2, while lavender and neroli showed lower ones.

Now we mention about the mean scores of Item 1 which questioned the subjects'
preference for the fragrances (Table 2).   The mean score of Item 1 showed that the subjects
had a tendency to prefer lemon, vanilla or peppermint, while neroli, marjoram and lavender
were not preferred.   In addition there were high correlation coefficient (Pearson's $r = 0.98$)
between factor scores of Factor 2 which represented relaxation and the mean scores for Item 1.
Thus the relaxed feelings induced by the fragrances probably attributed to a degree of which
extent the subjects preferred a given fragrance.   But Henion (1971) pointed out that some
pleasantness caused by n-amyl acetate which was a fragrance of banana depended on a
concentration of the stimulus.   So it should be noted that this is the case for the preference for
fragrances, too.

To examine the closeness in relationships among the fragrances, we used cluster analysis, named Ward method, based on the two of factor scores in Fig. 1. This analysis showed that lemon and peppermint could be categorized into the same group,and rose, lavender and marjoram into another one (Fig. 2). Figure 1 also showed that the fragrances in the same group had closer relationships for the two factors, thus the subjects had similar impressions for these fragrances. On the other hand, obviously vanilla had a very different character from the rest. This is possibly because, out of the stimuli used in the present study, the vanilla was a unique stimulus characterized by an expression "very sweet" or "smell like ice cream" based on the *Ss'* introspection. Consequently the factor scores for Factor 2 were very high due to the subjects' preference for the vanilla.

This study indicated that subjective impressions elicited by the fragrances could be interpreted the two factors labelled arousal and relaxation, and these fragrances could be categorized into at least two groups. Thus we found them useful for changing human emotional states. Recently some attempts have been made for further understanding of psychological effects of fragrances on human information processing. Warm, Dember and
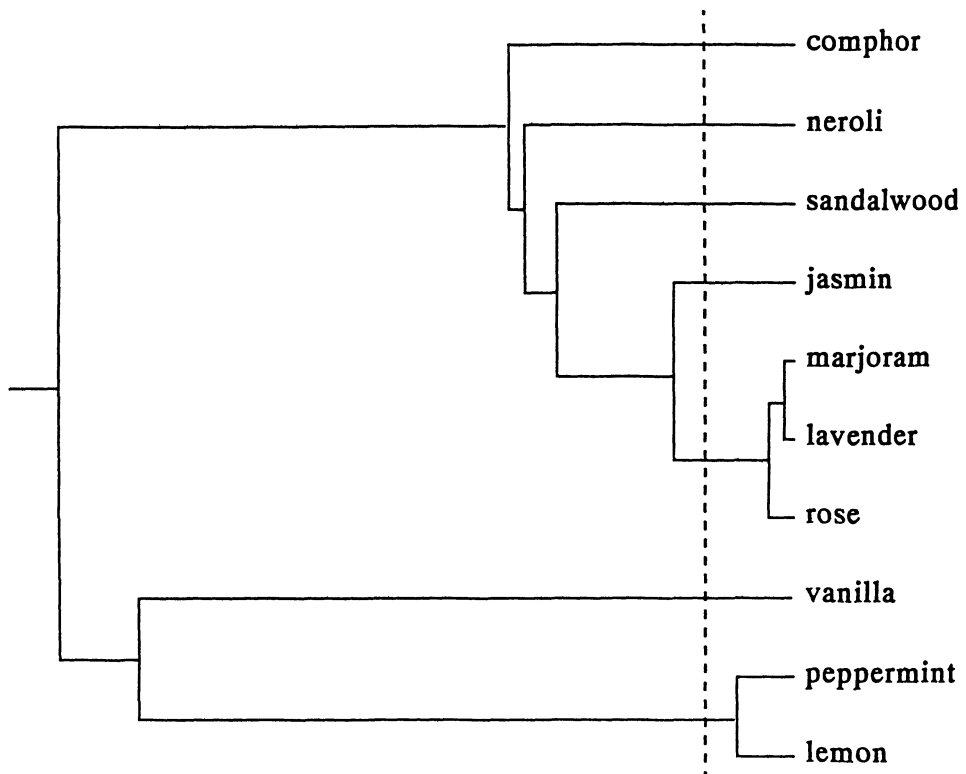

Fig. 2   A dendrogram obtained by a cluster analysis(Ward method). Under the dashed line, lemon and peppermint can be classified into the same group, and rose, marjoram and lavender into another.

Parasuraman (1991) reported that two fragrances, peppermint and muguet, would enhance effectively the sensitivity to visual signals in a vigilance task. They suggested that the fragrances could facilitate the workings of some mental process such as signal detection. Considering the above experiment and other related studies, for example about nicotine (Hindmarch, Kerr & Sherwood, 1990), caffeine (Lieberman et al., 1987) and drugs (Halliday et al., 1990), further experiments need to be made to clarify the positive aspects of fragrance effects on human information processing.

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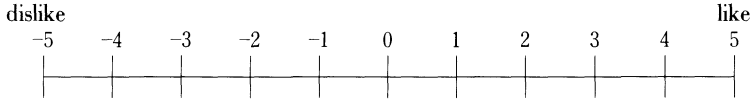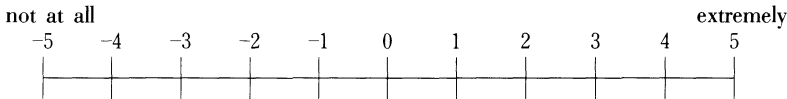
NOTES

Answer following questions and mark the number about this fragrance.

1.   How do you like this fragrance?

dislike   like
     −5   −4   −3   −2   −1   0   1   2   3   4   5

2.   How *cozy* do you feel, when you smell this fragrance?

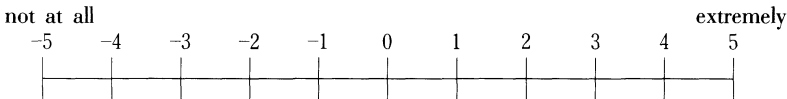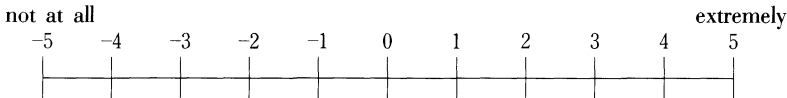not at all   extremely
     −5   −4   −3   −2   −1   0   1   2   3   4   5

3.   How *comfortable* do you feel, when you smell this fragrance?

not at all   extremely
     −5   −4   −3   −2   −1   0   1   2   3   4   5
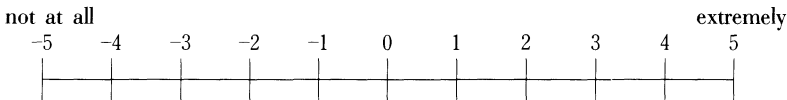
4.   How *refreshed* do you feel, when you smell this fragrance?

not at all   extremely
     −5   −4   −3   −2   −1   0   1   2   3   4   5

5.   How *nervous* do you feel, when you smell this fragrance?

not at all   extremely
     −5   −4   −3   −2   −1   0   1   2   3   4   5

6.   How *drowsy* do you feel, when you smell this fragrance?

not at all   extremely
     −5   −4   −3   −2   −1   0   1   2   3   4   5
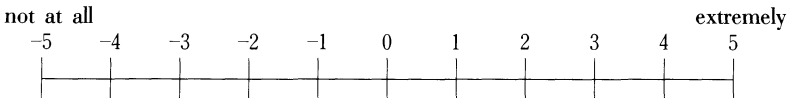
7.   How *excited* do you feel, when you smell this fragrance?

not at all   extremely
     −5   −4   −3   −2   −1   0   1   2   3   4   5
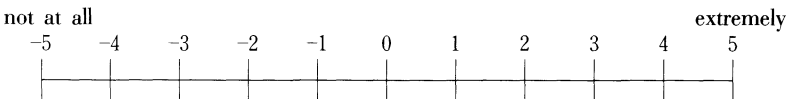
8.   How *easy* do you feel, when you smell this fragrance?

not at all   extremely
     −5   −4   −3   −2   −1   0   1   2   3   4   5
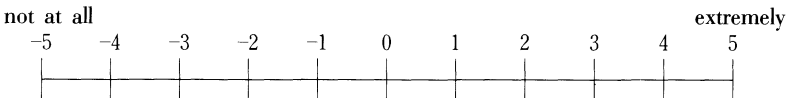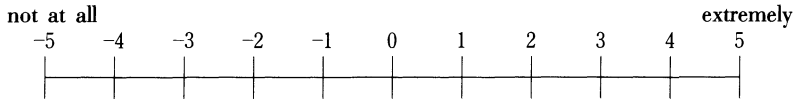
9.   How *wakeful* do you feel, when you smell this fragrance?

not at all   extremely
  −5   −4   −3   −2   −1   0   1   2   3   4   5
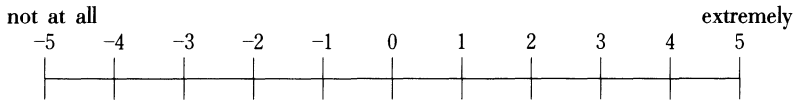
10.   How *vigorous* do you feel, when you smell this fragrance?

not at all   extremely
  −5   −4   −3   −2   −1   0   1   2   3   4   5

11.   How *dull* do you feel, when you smell this fragrance?

not at all   extremely
  −5   −4   −3   −2   −1   0   1   2   3   4   5
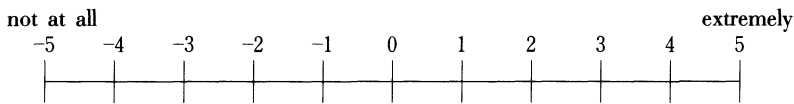
12.   How *jittery* do you feel, when you smell this fragrance?

not at all   extremely
  −5   −4   −3   −2   −1   0   1   2   3   4   5
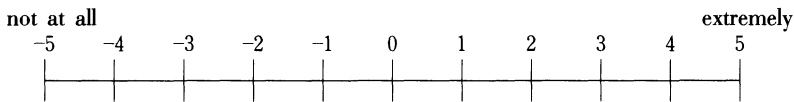
13.   How *tired* do you feel, when you smell this fragrance?

not at all   extremely
  −5   −4   −3   −2   −1   0   1   2   3   4   5
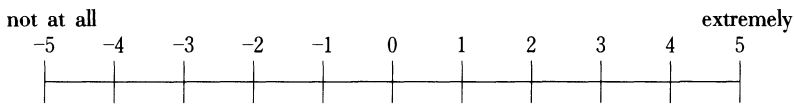
14.   How *rested* do you feel, when you smell this fragrance?

not at all   extremely
  −5   −4   −3   −2   −1   0   1   2   3   4   5
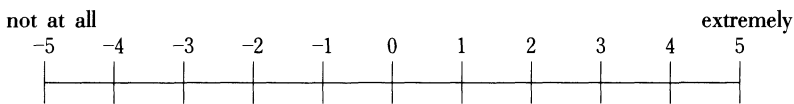
15.   How *energetic* do you feel, when you smell this fragrance?

not at all   extremely
  −5   −4   −3   −2   −1   0   1   2   3   4   5
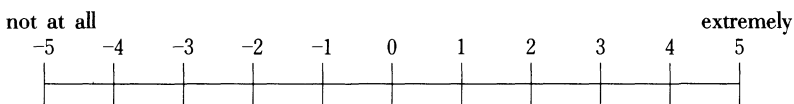
16.   How *relaxed* do you feel, when you smell this fragrance?

not at all   extremely
  −5   −4   −3   −2   −1   0   1   2   3   4   5