

# Quantitative Evaluation of Different Impression Induced by Inhalation of Olfactory Stimulus

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## Abstract

The purpose of this study is the pursuance of useful evaluation index which can estimate the different impression obtained by inhalation of several olfactory stimuli. For this purpose, the principal factors which could determine the impression of olfactory stimulus were attempted to identify. Then the heart rate variability and the cerebral nervous activity were monitored as physiological response. Furthermore the relationship among the factor scores of principal factors and these physiological responses were investigated. As the result, the principal factor of ‘relaxation’ could be estimated accurately with the concentration of the oxy haemoglobin in comparison with index of heart rate variability.

*Keywords:* Olfactory Stimulus; Quantitative Evaluation; Autonomic Nervous Activity; Cerebral Nervous Activity

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## 1 Introduction

According to the previous study, it is well known that the changes of autonomic nervous function are largely influenced by conscious or unconscious stress [1]. Hence the scale of hedonic induced by inhalation of odorants has been evaluated quantitatively by power spectral analysis of heart rate variability [2-7]. According to these facts, heart rate variability is one of the effective measurement techniques to assess the inclusive effect reaction obtained from several stimuli. However taking consideration of a practical industrial use, the evaluation method which can estimate not only the scale of hedonic but also the difference of impression induced by inhalation of various odorants.

Therefore an investigation of novel physiological information which can interpret a psychological aspect is necessary. Duan, et al. monitored the cerebral nervous activity by using Positron

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Emission Tomography (PET) in addition to heart rate variability [3, 4]. We have also focused on monitoring the cerebral nervous activity in Near Infrared Spectroscopy (NIRS) with heart rate variability [5]. However in either previous report, kinds of olfactory stimulus have been quite limited.

The purpose of this study is the pursuance of useful evaluation index which can estimate the different impression obtained by inhalation of various olfactory stimuli. For this purpose, the principal factors which could determine the impression of olfactory stimulus were attempted to identify. Then the cerebral nervous activity was monitored with near Infrared Spectroscopy (NIRS). Furthermore the relationship between the factor scores of principal factors and cerebral nervous activity was investigated. Finally usefulness of impression estimation by physiological response such as the autonomic nervous activity or the cerebral nervous activity was discussed.

## 2 Experimental

### 2.1 Olfactory Stimulus and Experimental Protocol

Ten olfactory stimuli which were expected to induce the different ratings of hedonic and impressions were chosen from following three categories (cf. Table 1). Category I involves three olfactory stimuli (i.e. Valeric acid, Nonenal and Indole provided by Lion Co., Tokyo Japan) which are prescribed everyday odors in deodorant processed textiles certification criteria by Japan Textile Evaluation Technology Council. Hence those were expected to induce uncomfortable impression. Category II involves four olfactory stimuli (i.e. Foeniculum, Cupressus, Pogostemon and Osmanthus provided by Diwa chemical industries Co. Ltd, Tokyo Japan) which are originated from natural plants. It was reported that these odorants activate sympathetic nervous system by inhalation of them [8-9]. Category III involves three olfactory stimuli (i.e. Floral herb, Fruity floral and Fruity citrus provided by Lion Co., Tokyo Japan) which are designed as the fragrance of household softener for additional value of products. Hence these were expected to induce comfortable impression.

Table 1: Olfactory stimuli

| Category | No. | Odor stimulus                                   | Volume (ml) | Concentration (wt%)  |
|----------|-----|---|-------------|----------------------|
| I        | ①   | Mimetic odor of sweat                           | 1.0         | $4.0 \times 10^{-2}$ |
|          | ②   | Mimetic odor of excreta                         | 1.0         | $1.0 \times 10^{-3}$ |
|          | ③   | Mimetic odor of Body odor associated with aging | 1.0         | $2.1 \times 10^{-3}$ |
| II       | ④   | Foeniculum                                      | 1.0         | 1.0                  |
|          | ⑤   | Cupressus                                       | 1.0         | 1.0                  |
|          | ⑥   | Pogostemon                                      | 1.0         | 2.0                  |
|          | ⑦   | Osmanthus                                       | 1.0         | $1.0 \times 10^{-1}$ |
| III      | ⑧   | Floral herb                                     | 1.0         | $6.0 \times 10^{-2}$ |
|          | ⑨   | Fruity floral                                   | 1.0         | $6.0 \times 10^{-2}$ |
|          | ⑩   | Fruity citrus                                   | 1.0         | $6.0 \times 10^{-2}$ |