

fNIRS-based brain-function research

Objective Evaluation of Human Body Odor Using fNIRS

Brain Function Measurement in the Cosmetics Industry

Joint Research with Mandom Corporation

Key Points

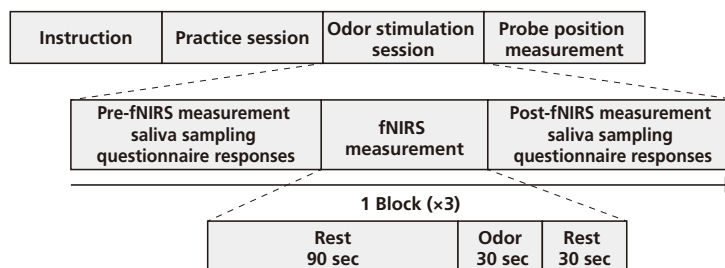
- (1) The research clearly showed that human body odor can be evaluated objectively using fNIRS in relation to cortical processing based on the olfactory pathway.
- (2) Because middle-aged female scalp model odor (MFS model odor) is an unfamiliar stimulus, the semantic interpretation and verbalization process associated with its perception is mediated by subjective perceptual experience, suggesting that it may activate a different neural network.
- (3) Through multifaceted analysis of physiological indices, questionnaires, and brain activity, human body odor can be evaluated objectively, and application to product development is expected.

Regions of Measurement

- Number of subjects: 18 healthy individuals in their 40s (who passed an olfactory test)
- Measured region: Prefrontal cortex (43 channels)
- Oxyhemoglobin (Oxy-Hb) signals used for analysis
- Hemodynamic separation using an LPF (0.1 Hz)
- The average OxyHb values during odor stimulation were calculated for four areas of interest based on the functional pathways of the olfactory system (Fig. 1).



Task



The tasks involved odor stimulation with isovaleric acid, MFS model odor, and lavender odor. fNIRS, heart rate, nose-tip skin temperature, and fingertip blood flow were measured simultaneously, and saliva sampling and questionnaires were conducted (covering odor intensity, pleasantness / unpleasantness, preference, and temporary mood scales).

Data

- Results from physiological and endocrinological stress markers suggested that there was no significant stress during fNIRS measurement.
- The subjective evaluation results showed significant differences in odor intensity, pleasantness / unpleasantness, and preference between unpleasant odors (MFS model odor and isovaleric acid) and pleasant odor (lavender) (Table 1).
- In fNIRS, OxyHb concentration increased significantly more for MFS model odor than for lavender only in the TPC-ROI, which is related to language (Fig. 2).
- These results mean that subjective evaluation could only distinguish between categories such as unpleasant and pleasant odors, whereas fNIRS could evaluate odors by type.
- Furthermore, a mixed-effects repeated-measures analysis of OxyHb, with subjective evaluation adjusted as a covariate, suggested that the neural response to human body odor does not simply reflect odor type, but also mediates subjective perception.

Table 1 Relationship between Subjective Odor Intensity of Different Odors

Odor Type	Mean ± SD
Isovaleric acid	4.1±0.7 *
MFS model odor	4.2±0.6 *
Lavender	3.3±0.6

*p < 0.05 vs Lavender (Bonferroni-corrected)

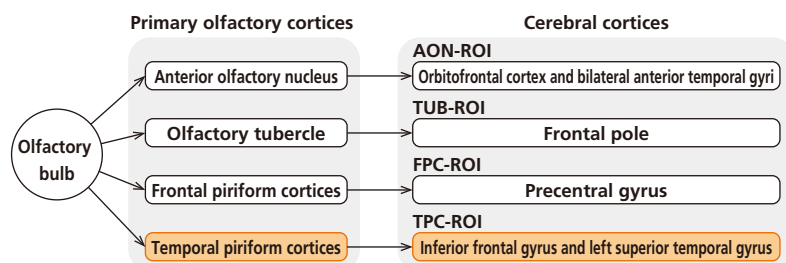


Fig. 1 Diagram of Parallel Functional Pathways in the Human Olfactory System

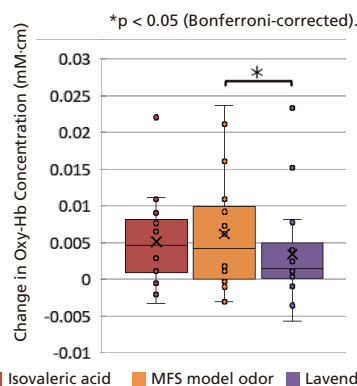
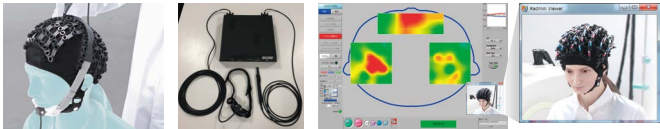


Fig. 2 Relationship between OxyHb Concentration Changes within TPC-ROI of Different Odors

Reference

Y. Inoue, K. Osaki, S. Yomota et al. (2026). Evaluation of human body malodor using functional near-infrared spectroscopy with regions of interest based on functional pathways in the olfactory system. *Front. Neurosci.*, doi.org/10.3389/fnins.2026.1808067

The study data was obtained using the following system configuration.
 This configuration is recommended for use in a wide range of research applications.

Product Name	Appearance
LABNIRS™ main unit, 16 sets (52 channels, type L optic fibers)	
Holder, type A	
3D position measurement system Video system	

Please also consider the following compact, more affordable portable system,
 which can perform similar measurements to the full system configuration
 (although measurable brain regions are limited).

Product Name	Appearance
LIGHTNIRS™ two-unit system • LIGHTNIRS main unit × 2 (52 channels) • Coupled two-unit kit	
Holder, type A 2 m dedicated LIGHTNIRS optic fiber cables (8 sets) × 2	

Brain function imaging
 (fNIRS)



LABNIRS and LIGHTNIRS are trademarks of Shimadzu Corporation or its affiliated companies in Japan and/or other countries.



Shimadzu Corporation
www.shimadzu.com/an/

For Research Use Only. Not for use in diagnostic procedures.
 This publication may contain references to products that are not available in your country. Please contact us to check the availability of these products in your country.
 Company names, products/service names and logos used in this publication are trademarks and trade names of Shimadzu Corporation, its subsidiaries or its affiliates, whether or not they are used with trademark symbol “TM” or “®”.
 Third-party trademarks and trade names may be used in this publication to refer to either the entities or their products/services, whether or not they are used with trademark symbol “TM” or “®”.
 Shimadzu disclaims any proprietary interest in trademarks and trade names other than its own.
 The contents of this publication are provided to you “as is” without warranty of any kind, and are subject to change without notice.
 Shimadzu does not assume any responsibility or liability for any damage, whether direct or indirect, relating to the use of this publication.