

Skin as a mirror of the mind: A novel multisensorial skincare procedure brings higher self-awareness for well-being

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Abstract

The modern world is awash with information and stimulation, directing our attention to the outside world, away from ourselves. This reduction in self-awareness can impair our understanding of our thoughts and emotions and lead to emotional dysregulation and poor decision-making. The Japanese expression *hada wa kokoro no kagami* (skin is a mirror of the mind) expresses the wisdom that one's skin condition reflects their psychological state. Therefore, feeling one's own skin through skincare may be a good opportunity to pay attention, not only to our skin condition but also our mental state. Here, we propose a multisensory skincare procedure to enhance self-awareness in two steps. STEP 1 explores factors that enhance self-awareness. The effectiveness of the formulations, application methods, containers, fragrances, and behaviors with Japanese-style wooden box was evaluated. STEP 2 uses the findings of STEP 1 to create the multisensory skincare procedure, aiming to

enhance self-awareness. Evaluation of STEP 2 revealed that this procedure improves self-awareness compared with conventional skincare. It also improves interoception, sleep, and high-frequency heart rate variability, which are necessary for well-being. This study revealed multiple new insights into skincare.

Keywords: Self-awareness; Skincare procedure; Multisensory design; Well-being.

Introduction.

In today's increasingly digitalized world, humans pay more attention to external information. For example, the time spent on smartphones, in which people encounter global information, has been steadily increasing. In 2021, individuals in Brazil spent more than five hours daily on apps, an increase of 15% from that in 2019 [1]. This trend is mirrored globally.

However, with the increase in the consumption of external information, attention to our internal sensations, emotions, and awareness has decreased. This lack of self-awareness can lead to several problems. For example, individuals may overlook changes in their internal states. To address this issue, self-monitoring, a technique aimed at increasing self-awareness, has been employed in depression treatment [2]. Psychologist Susan David emphasizes self-awareness as a crucial aspect of daily life. She advocates "emotional agility," wherein individuals acknowledge and accept their sensations and feelings, enabling them to make life decisions without preconceived notions [3]. These facts suggest that increased self-awareness may help achieve well-being (Figure 1a).

In such a social environment, skincare can be appropriate to enhance self-awareness in daily life. In Japan, there is a saying, "*hada wa kokoro no kagami*," which translates to "skin is a mirror of the mind." For example, increased stress causes rough skin [4]. Therefore, feeling the skin through skincare is a good opportunity to pay attention to not only the condition of your skin but also your mental state. As skincare is a part of our daily routine, it offers a continuous opportunity for self-awareness.

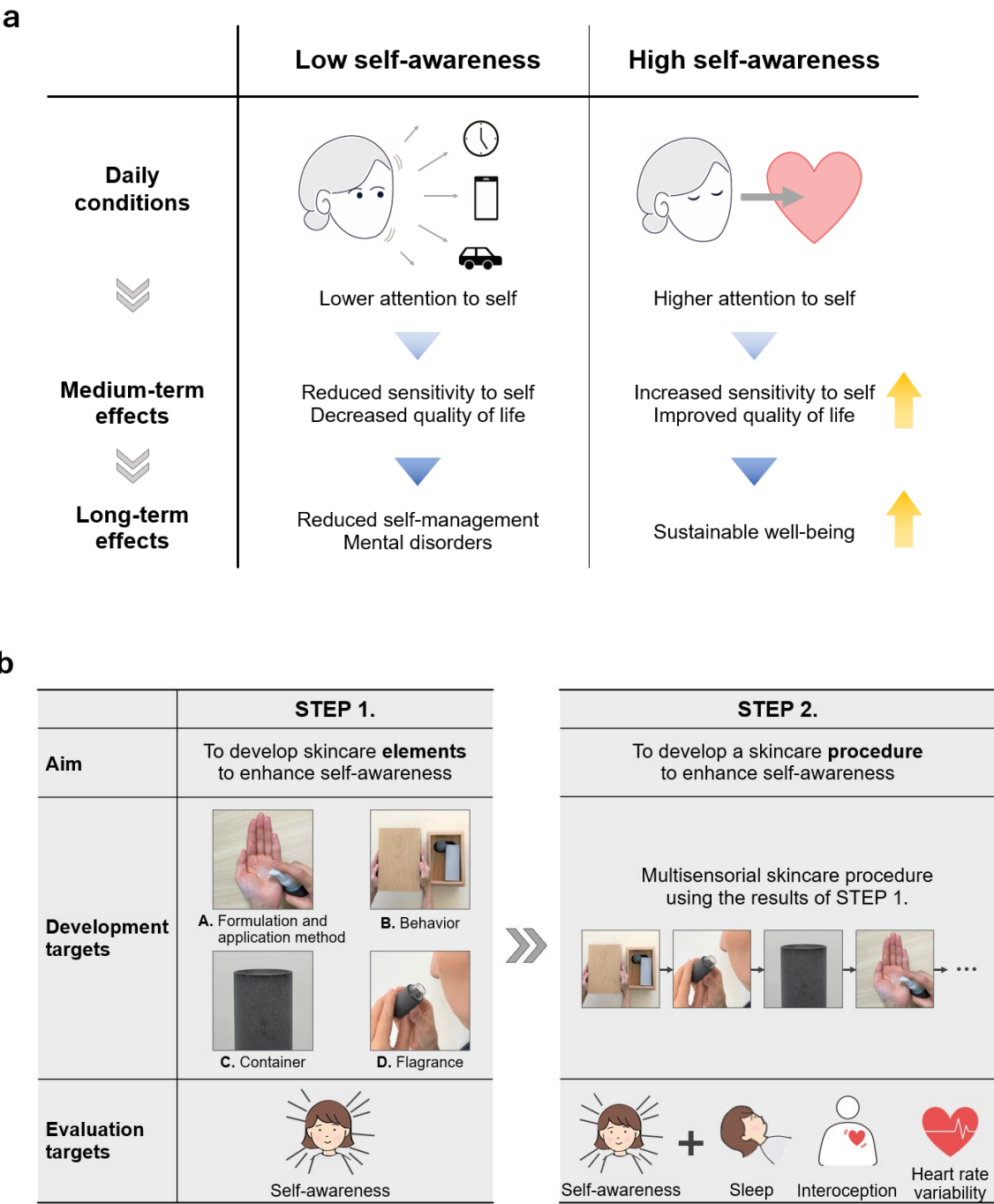


Figure 1. Overview of the study. (a) Significance of self-awareness. (b) Structure of this paper.

However, no known skincare procedure focuses on and aims to enhance self-awareness. Although some studies have explored the mind-cosmetics connection [5], the precise relationship between skincare and self-awareness remains elusive. Additionally, although mindfulness practices enhance self-awareness, and the beauty industry has developed related applications [6], it requires specialized habits. Consequently, the creation of a novel skincare procedure that promotes greater self-awareness could reveal untapped “mind beauty” potential in skincare, emphasizing mental well-being alongside physical beauty.

In this study, we proposed a novel multisensorial skincare procedure designed to increase self-awareness in two steps (Figure 1b). We expected that precise touch during skincare can amplify attention to our senses and emotions, building on the concept that “skin is a mirror of the mind.” Accordingly, in STEP 1, we attempted to develop formulations and application methods to precisely sense skin condition with high self-awareness. Drawing inspiration from the Japanese tea ceremony which mentions mind beauty, we also explored the behavior, containers, and fragrances that enhance self-awareness. In STEP 2, we used the results of STEP 1 and developed a novel skincare procedure and verified its contribution to self-awareness by investigating its psychological and physiological effects. Throughout the study, self-awareness was defined as paying attention to one’s own sensations and emotions. In the subjective evaluation, responses to the items “I paid attention to my senses” and “I paid attention to my emotions” were obtained and analyzed through exploratory factor analysis.

Our research unveiled the relationship between skincare and self-awareness, methods to enhance self-awareness, and its impact on daily life.

Materials and Methods.

STEP 1: Development of Skincare Elements and Evaluation.

The purpose of STEP 1 was to investigate the impact of various factors on self-awareness to create a novel skincare procedure. Specifically, we examined the effects of formulations and application methods, behavior, containers, and fragrances on self-awareness.

Based on the saying “skin is a mirror of the mind,” we hypothesized that precise skin sensing would enhance self-awareness of both skin and mind. Skincare formulations and application methods were developed for this purpose.

Behaviors, containers, and fragrances were chosen as development targets based on the hypothesis that they contribute to self-awareness. This was based on the existing literature [7-9] that showed that individual sensory stimuli and tea ceremonies that incorporate behaviors can change human psychological and physiological states.

STEP 1-A: Formulation and Application Method.

Development.

Formulations and application methods were developed and evaluated based on the hypothesis that precisely sensing skin conditions would enhance self-awareness.

The formulation aimed to develop a lotion that could precisely sense the macro- and micro-states of the skin using a single content. A previous study found that the ability to precisely sense macro information related to shape (i.e., lines and comedones) was masked by micro information, such as friction and vibration [10]. Therefore, reducing the micro information using film thickness is desirable to enhance macro skin perception. In contrast, to develop the perception of micro-skin conditions such as roughness, a thin film is necessary to allow the finger to feel micro-vibrations of the skin while protecting it from friction caused by the finger.

Figure 2a shows the behavior of the developed formulation. The formulation was applied to the inner forearm, and friction and vibration were measured using a proprietary finger-like sensor [11]. The sensor allowed us to quantitatively measure physical qualities that humans feel with

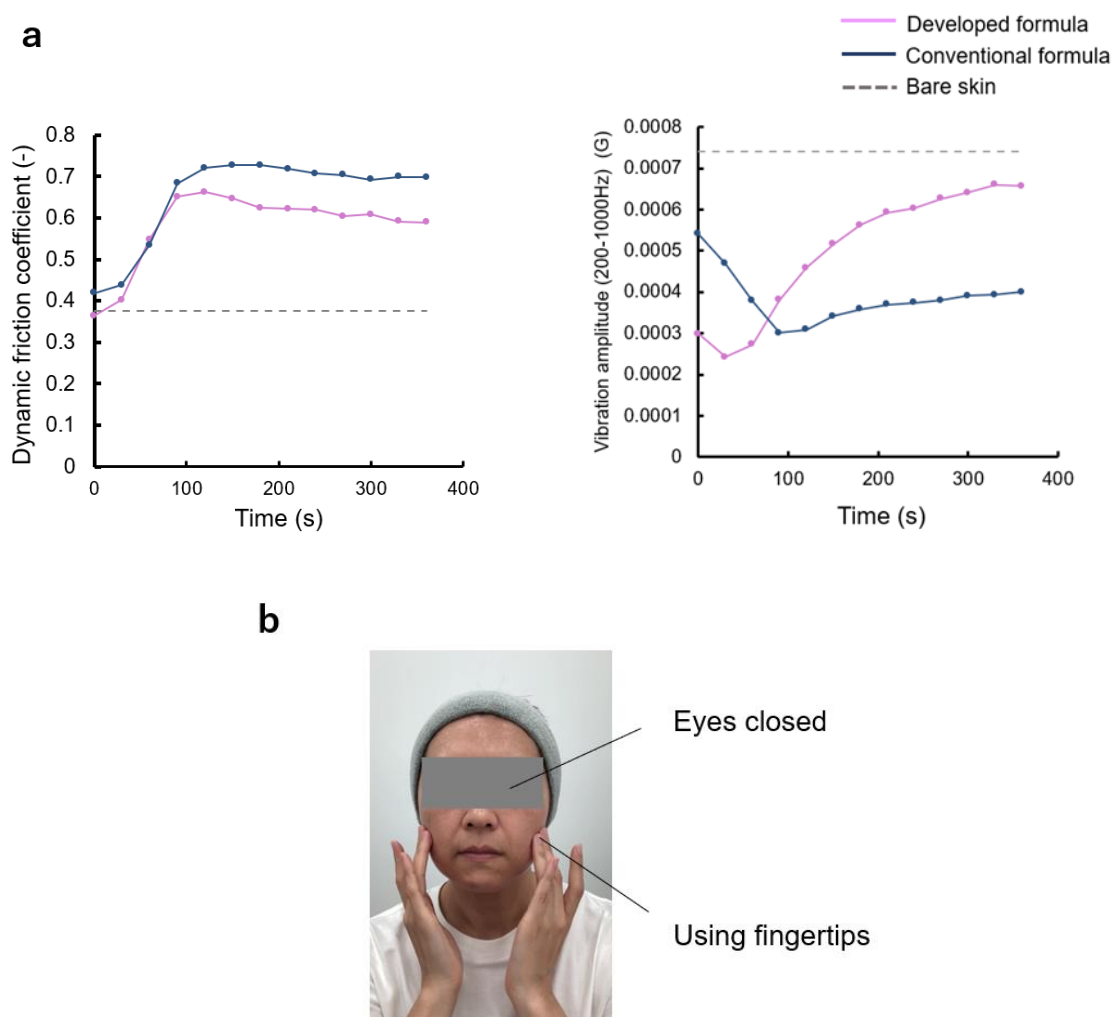


Figure 2. Developed formulation and application method. (a) Friction and vibration on the skin when each formula was applied. At the time of each plot, the motor was moved for 4s for application and sensing. The time change was slower than for normal facial application with the finger. (b) A scene of the developed application method.

their fingers. As shown in Figure 2a, the behavior of the developed formulation (pink line) was significantly different from that of a conventional formulation (blue line) in terms of friction and vibration. Initially, friction and vibration of the developed formulation were lower owing to the macro-skin perception. Over time, the film became thinner and allowed for perceiving skin vibrations close to that of bare skin while protecting the skin. The developed formulation was containing a small amount of low viscosity oil emulsified by amphiphilic polymer and 8% moisturizing agents. The conventional product was containing no high molecular weight compounds and 10% moisturizing agents. Formulation and application methods for the cream were developed separately based on the same concept. All formulations were unscented.

Furthermore, an application method was developed to spread the formulation using only the fingertips with closed eyes (Figure 2b). These features utilize human perception mechanisms to perceive the skin precisely. Previous studies have shown that fingertips have high tactile sensitivity [12] and that closing the eyes makes directing attention solely to the sense of touch easier [13].

Evaluation Experiment.

We experimentally tested whether the developed formulations (lotion and cream) and application methods improved self-awareness.

All experiments (not only STEP 1-A but others) in this study were conducted in compliance with the ethical principles based on the Declaration of Helsinki and were approved by the Human Testing Ethics Review Board of our company. All participants gave informed consent prior to each experiment.

The participants were 16 women aged 29–64 years (mean age 46.5). They performed the skincare at home using the developed formulas and application methods instead of their usual skincare products and methods. They answered a questionnaire on day 0 (the day before they started using the developed formulas) and on days 3 and 6 after they started using them. Participants responded to the survey immediately after the skincare procedure.

The questionnaire comprised 37 questions related to sensation, emotion, and consciousness. It was developed by adding several questions to an existing questionnaire on feelings of using cosmetics [14]. In the questionnaire, 37 questions, including “I paid attention to my senses” and “I paid attention to my emotions” were rated on a 7-point Likert scale. The self-awareness factor was derived from the responses using exploratory factor analysis (least squares methods (LSD), promax rotation), in which commonalities were grouped and interpreted. Subsequently, the factor scores were evaluated.

Statistical analysis was performed by SPSS ver. 29 for all experiments in this study. Multiple comparisons were performed by t-test with pooled SD adjusted for Bonferroni correction.

STEP 1-B: Behavior.

Development.

We hypothesized the behaviors that increase self-awareness and examined them with reference to the Japanese tea ceremony, which is thought to be related to mindfulness. One of the most important elements in the ceremony is carefully handling and preparing the items. Therefore, a wooden box like that used in the ceremony was created (Figure 3). A behavior was designed in which all care items would be removed from the box before use and returned after use. Inspired by traditional Japanese culture, the box was made of cherry wood with a double lid. Although previous studies have investigated the effects of the tea ceremony on heart rate [9], none have specifically focused on self-awareness and the behavior of removing and returning items to the box .

Evaluation Experiment.

An experiment was conducted to evaluate whether implementing skincare practices using the created box increased self-awareness.

The participants were 12 women aged 28–63 years. They performed the method with the wooden box (box condition) and without it (no-box condition); six participants performed the



Figure 3. Wooden box for the skincare behavior.

box condition first, and the remaining six performed the no-box condition first. In the box condition, the participants opened the wooden box lids, removed commercially available lotion, milky lotion, and cream from the box, applied them to their skin, returned them to the box, and closed the lids. In the no-box condition, skincare was performed using the same three items as in the box condition, laid out on a table. In each condition, the participants completed a questionnaire after the skincare completion.

The questionnaire was almost the same as in STEP 1-A and consisted of 33 questions on sensation, emotion, and consciousness. The responses were evaluated by calculating factor scores related to self-awareness through exploratory factor analysis (maximum likelihood method (MLM), promax rotation).

STEP 1-C: Container.

Development.

Based on the assumption that the tactile impression of a container contributes to self-awareness, we developed cylindrical containers (outer layers that cover the exterior of plastic containers in which cosmetics are sealed) made of various materials. The containers' tactile

perceptions and physical properties that contributed to self-awareness were quantitatively evaluated. This allowed us to select the appropriate materials for the proposed skincare procedure.

Sixteen cylindrical containers (Figure 4) with an outer diameter of 45 mm, inner diameter of 41 mm, height of 140 mm, and different materials or surface treatments were created using a 3D printer or by cutting. In the experiment, these were evaluated as stimuli to determine their contribution to self-awareness, focusing only on tactile differences between the materials.

Evaluation Experiment.

An experiment was conducted to clarify the relationship between the physical properties of the container material and its contribution to self-awareness.

The participants were 21 women aged 27–62 years. In the experiment, they held one of the 16 cylindrical stimuli for 10 s and answered the questionnaires. This procedure was repeated to evaluate all the stimuli. The stimuli were mounted on flask stands to exclude the influence of

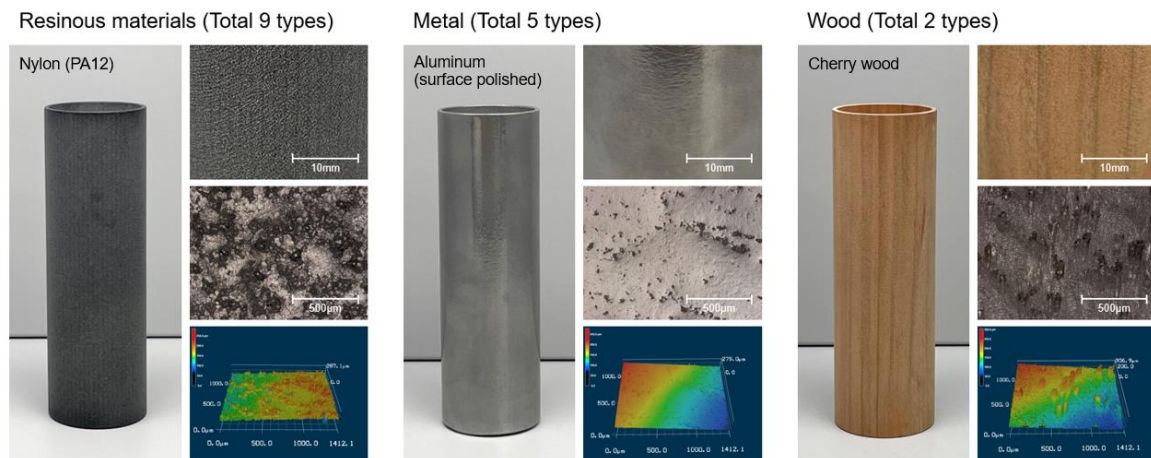


Figure 4. The three examples of developed containers with the materials and surface properties. Photographs were taken with a common digital camera, and imaging data was acquired with a laser microscope.

their weight. They were placed in a box-like cover that was not directly visible to the participants. The participants held the stimuli with closed eyes and only their dominant hand in the cover.

Similar to the experiments in previous steps, the questionnaire consisted of 23 questions on sensation, emotion, and consciousness. However, in this experiment, the “introvert” scale score, identified in an existing study [14], was used to evaluate self-awareness. In addition, responses to the six items corresponding to the perceptual dimension of tactile sensation[15], such as “smooth–rough,” were also measured on a 7-point Likert scale to quantify the tactile impression of each stimulus through exploratory factor analysis (MLM, varimax rotation).

The height (Ra) and kurtosis (Rku) of the created stimulus surface, which was replicated, were measured using a laser microscope (VK-9710, KEYENCE) to clarify the surface properties of each stimulus.

We attempted to model the hypothesis that the measured physical properties affect tactile impression, which, in turn, contributes to self-awareness.

STEP 1-D: Fragrance.

Development.

Assuming that fragrances contribute to self-awareness, 12 natural fragrances for cosmetics were chosen and evaluated. While evaluating, we attempted to model the relationship between fragrance impression and self-awareness to select appropriate fragrances for the novel skincare procedure.

Through preliminary testing, fragrances were selected to be widely distributed on Russell's circumplex (a method of expressing emotions on two axes) because human awareness was assumed to be closely related to emotions. As a result, peppermint + citrus, coriander + citrus, galbanum, and several other fragrances were used. The fragrance development practitioner

adjusted the concentration to achieve a consistent intensity regardless of the type of fragrances.

Evaluation Experiment.

The participants were 29 women aged 27–64 years (mean age 44.4). With their eyes closed, they smelled a screw-tube bottle containing cotton smeared with one of the 12 fragrances for 30 s. Subsequently, they completed the questionnaire. This procedure was repeated to evaluate all the stimuli. The order of the stimulus presentation was random.

The questionnaire consisted of 37 questions on sensation, emotion, and consciousness, similar to other evaluations. Self-awareness scores were calculated using exploratory factor analysis (LSM, promax rotation).

Consistent with the above evaluation, participants answered 13 questions, based on preliminary research [16] regarding their impressions of each fragrance. These responses were also factor-analyzed (LSM, varimax rotation) to determine the impressions that characterized each fragrance. This allowed each fragrance to be scored using impression factors.

Thus, we attempted to clarify the relationship between self-awareness and impressions of fragrances to model their contributions to self-awareness.

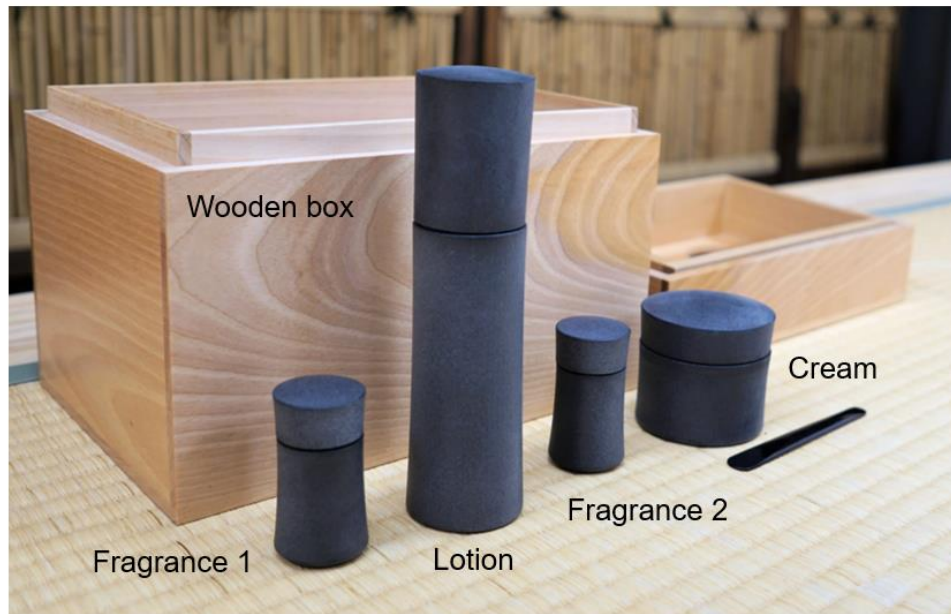
STEP 2: Development of the New Skincare Procedures and Evaluation.

In STEP 2, the novel multisensorial skincare procedure was developed using each element from STEP 1. It was hypothesized to strongly increase self-awareness, leading to subjective and physiological effects.

Development.

Based on the results of STEP 1, skincare items were developed (Figure 5a) for the new skincare procedure as illustrated (Figure 5b) and as below:

a



b

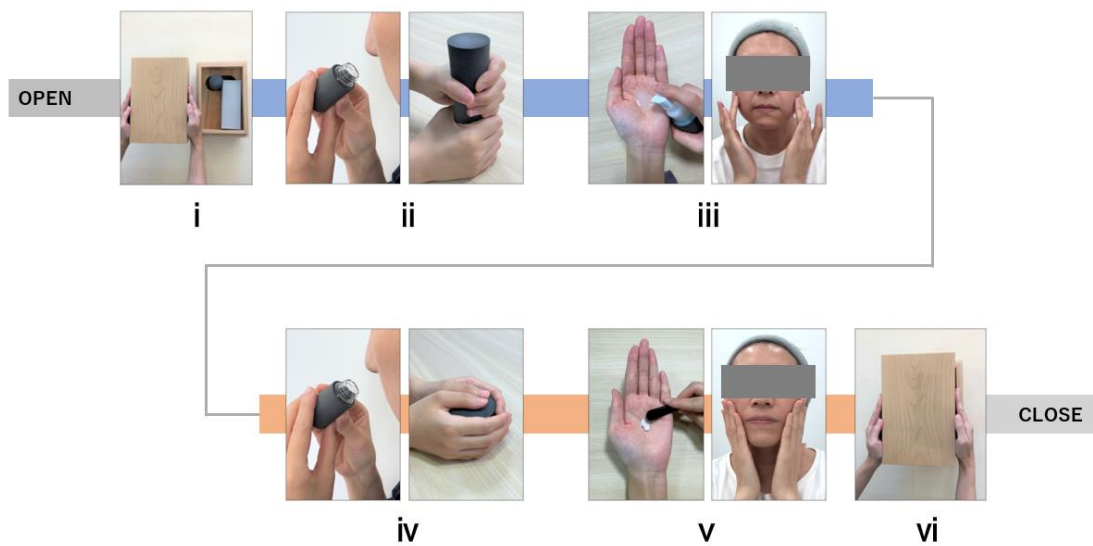


Figure 5. The novel procedure. (a) Developed items for the novel procedure.

(b) The developed novel skincare procedure.

- i. Opening the lids of the wooden box and picking up skincare items from the box.
- ii. Deeply inhaling the first fragrance for 30 s and feeling the lotion container texture for 10 s with eyes closed.
- iii. Applying the developed lotion on the skin using the application method.
- iv. Deeply inhaling the second fragrance for 30 s and feeling the cream container texture for 10 s with eyes closed.
- v. Applying the cream on the skin following the application method.
- vi. Putting the items back in the box and closing the lids.

The fragrances and containers were selected by considering the results of STEP 1 and mass productivity. Both the lotion and cream containers were made of nylon (PA12) (steps ii and iv). The fragrances peppermint + citrus (step ii) and coriander + citrus (step iv) were selected because the cleanliness scores of fragrances with a high correlation to self-awareness were high. The lotion and cream were unscented.

Evaluation Experiment.

We tested the hypothesis that the developed skincare procedure would increase self-awareness more than the conventional skincare procedures. The experimental design assumed that increased self-awareness increases sensitivity to self-state and leads to daily habitual and physiological changes.

The participants were 43 women aged 28–59 years. Those who met the two criteria of “not using lotions and creams routinely” and “not wanting to spend time and effort on daily routines” were excluded from the recruitment. They were randomly divided into two groups: conventional skincare (n=23, hereinafter “conventional group”) and novel skincare (n=20, “novel group”). The conventional group used an unscented lotion (same in STEP 1-A) and cream with a general skincare texture at home in the morning and at night for 29 days, without any specific application method for the lotion and with conventional application method for the cream. The

novel group was asked to follow the new skincare procedure (Figure 5b) using the items and methods developed in STEP 1 at home in the morning and night for 29 days. Both groups were asked to carefully apply the skincare while facing their own physical and mental state.

All participants visited the laboratory three times, before the start of continuous use (first visit), on the 15th day (second visit), and on the 29th day (third visit, the last day of continuous use), to understand and confirm the skincare procedures and be measured psychological and physiological states. The skincare procedures designed for each group were taught during the first visit and performed in the laboratory at the time of each visit. At the second visit, the experimenters checked whether the specified procedures had been completed and provided feedback on any modifications to each participant. During the third visit, they checked whether the specified procedures had been completed. Participants who failed to master the instruction method, for example, skipped a procedure during the third visit, were excluded from data analysis. Consequently, 22 and 17 participants in the conventional and novel groups, respectively, were analyzed.

The questionnaire evaluating sensation, emotion, and consciousness was completed before and after the skincare procedure at each visit and after the skincare procedure at home once a week. The questionnaire structure was the same as in STEP 1 and included 37 questions. A self-awareness score was calculated from the responses using exploratory factor analysis (LSD, promax rotation).

To verify the effects of self-awareness on sensitivity to self-state, the Multidimensional Assessment of Interoceptive Awareness (MAIA [17]), a generalized questionnaire, was used to evaluate interoceptive sensitivity (sensations inside the body, such as heartbeat, body temperature, and related emotions). The questionnaire was completed immediately after each visit.

To see the effects on sleep as a daily habit, the 3-Dimensional Sleep Scale (3DSS) [18,19] was answered on day 1, day 14, and day 28 at home to assess the phase, quantity, and quality

of sleep. In 3DSS, “phase” implies the regularity of sleep time, “quality” means ease and continuity of sleep, and “quantity” indicates whether sleep interferes with daytime activities.

To observe the physiological effect of self-awareness, the power of high-frequency (HF) from heart rate variability was measured (Kiritsu-Meijin, Crosswell) at rest before the skincare procedure during the visit. The HF reflects the parasympathetic activity related to relaxation. The HF was evaluated using the natural logarithm of HF (lnHF). Three participants (2 in the conventional group and 1 in the novel group) with measurement errors were excluded from the analysis.

Results.

STEP 1: Skincare Elements.

STEP 1-A: Formulation and Application Method.

A factor analysis was conducted on the responses to clarify the impact of the developed formulations and application methods on self-awareness. The results showed that the questions “I paid attention to my senses” and “I paid attention to my emotions” were derived as one factor. This was referred to as the self-awareness factor.

Following the general calculation method, the self-awareness factor score was calculated by weighting the factor loadings of self-awareness to each normalized response in the questionnaire. The scores on day 0 (the day before start) and days 3 and 6 after using the developed formulations and application methods are shown in Figure 6a. Multiple comparisons of the scores showed that self-awareness significantly improved on day 3 ($t(15)=7.40$, $d=1.75$, $p_{\text{Bonferroni}}<0.001$) and day 6 ($t(15)=4.89$, $d=1.69$, $p_{\text{Bonferroni}}<0.001$) compared to that on day 0.

Therefore, the developed formulations and application methods aimed at accurately sensing skin conditions improved self-awareness compared to daily skincare items and methods.

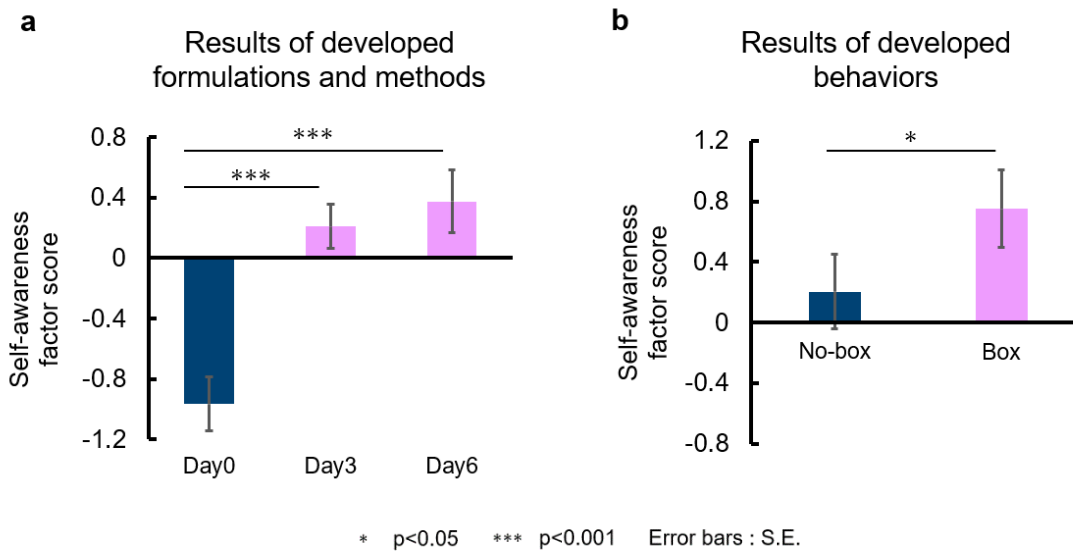


Figure 6. Results of the evaluation of self-awareness. (a) Evaluation of formulations and application methods. (b) Evaluation of behaviors with box.

STEP 1-B: Behavior.

Self-awareness of skincare behaviors using the box was compared to that without using it. The self-awareness factor included “I paid attention to my emotions.” The factor scores in the no-box and box conditions were calculated similarly as in STEP 1-A and compared (Figure 6b). Figure 6b shows a significant difference (paired t-test, $t(11)=2.32$, $d=0.64$, $p<0.05$) between the two conditions, with self-awareness being significantly higher in the box condition. In contrast, “I paid attention to my senses” was included in another factor, which did not have significantly different scores between the two conditions.

STEP 1-C: Container.

The contribution of the physical properties of the containers to self-awareness was evaluated by assuming a two-step model in which the physical properties affected the tactile impression of the container, and the tactile impression affected self-awareness. Factor analysis of the

responses on tactile impression of the 16 stimuli revealed two factors: temperature-hardness and smoothness.

Multiple regression analysis using the forced-entry method showed that the smoothness factor score increased with an increasing Rku ($p < 0.05$) and contributed to an improvement in self-awareness ($p < 0.05$) (Figure 7a).

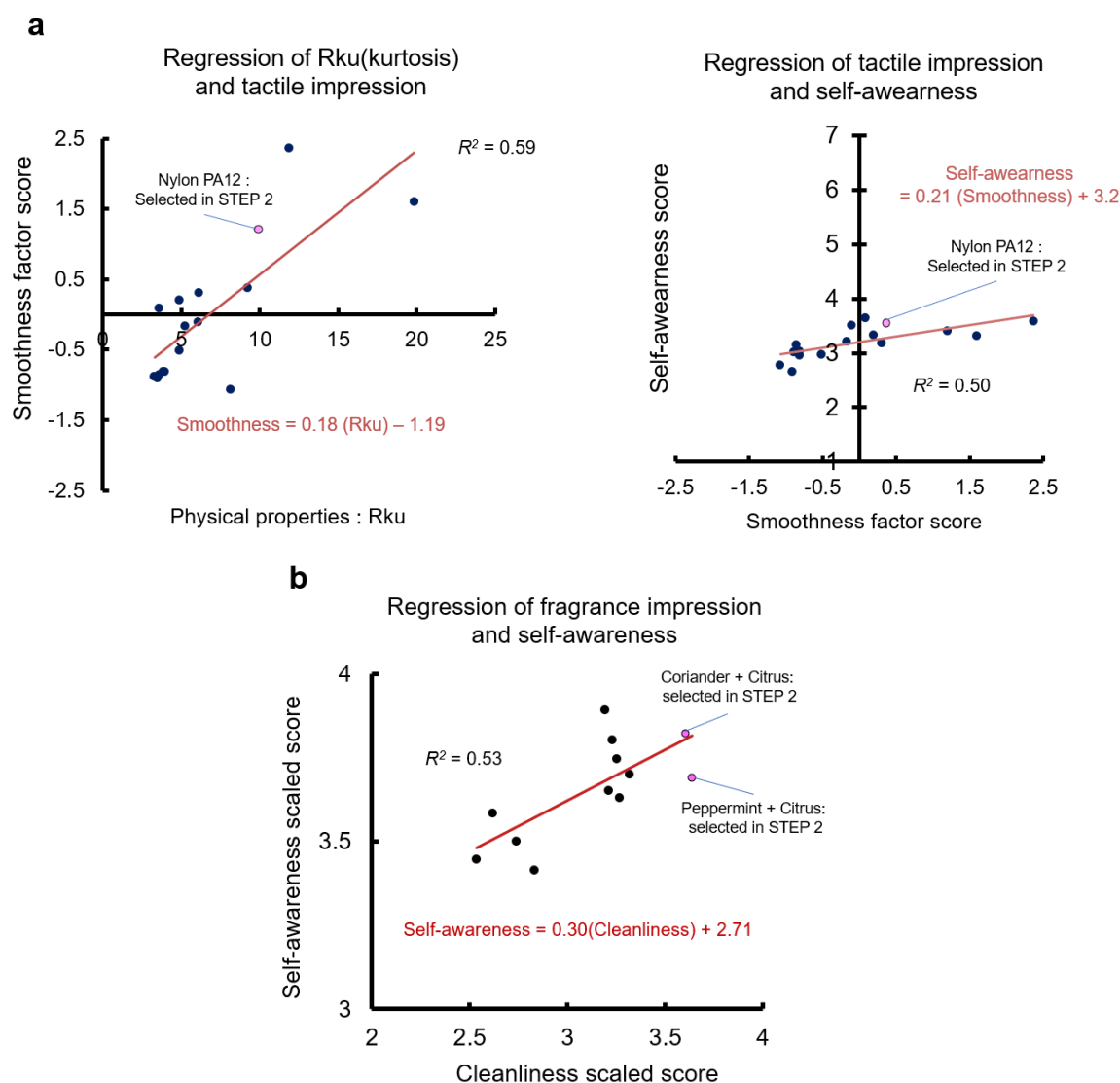


Figure 7. Regression results of self-awareness. (a) Regression of self-awareness by physical properties and tactile impression for container selection. (b) Regression of self-awareness by fragrance impression for fragrance selection

The above model enabled the selection of appropriate container materials for self-awareness based on physical properties. Uneven noise on smooth surfaces tends to increase kurtosis value. Therefore, the high kurtosis in this experiment indicated overall uniformity of the surface, contributing to improve smoothness impression. This smoothness allowed the users to focus on themselves, similar to the skin perception in STEP 1-A.

STEP 1-D: Fragrance.

We modeled the impact of the impression of a fragrance on self-awareness. Exploratory factor analysis results of the answer to the items “I paid attention to my senses” and “I paid attention to my emotions” were attributed to one self-awareness factor. In addition, the factor analysis of fragrance impression revealed three factors: “cuteness,” “cleanliness,” and “gorgeousness.”

Figure 7b shows the results of a stepwise regression analysis of self-awareness scaled scores with fragrance impression scaled scores. Self-awareness was positively related to the impression of cleanliness ($p < 0.05$).

Based on these results, we finalized a fragrance with a higher impression of cleanliness for use in the new skincare procedure.

STEP 2: New Skincare Procedure.

The novel skincare procedure developed in STEP 2 (Figure 5) was analyzed to clarify the enhancement of self-awareness and identify ripple effects.

Factor analysis revealed that five items, “I paid attention to my emotions,” “I paid attention to my senses,” “I am aware of my state of mind,” “I was in touch with myself,” and “It is easy for me to express my feelings” were associated with one factor, which was defined as the self-awareness factor of skincare procedures. Self-awareness scaled scores were the average of the responses to these five questions weighted by their respective self-awareness factor loadings.

Figure 8a compares the self-awareness scaled scores between the conventional and novel groups before and after skincare on day 29 (third visit). The results showed a significant increase in both groups after skincare. However, the significance level was $p_{\text{Bonferroni}} < 0.05$ ($t(37)=2.52$, $d=0.48$) for the conventional group and $p_{\text{Bonferroni}} < 0.001$ ($t(37)=4.31$, $d=0.68$) for the novel group, indicating a higher likelihood of increasing self-awareness in the novel group than in the conventional group.

Figure 8b shows the extent to which self-awareness was improved by the skincare treatment before and after every visit. Self-awareness did not change since the first visit in the conventional group but increased significantly with visit time in the novel group ($t(37)=2.80$, $d=0.86$, $p_{\text{Bonferroni}} < 0.05$). These results suggest that the participants gained stronger self-awareness according to their degree of mastery of the novel skincare procedure.

In addition, three of the eight MAIA subscales for interoception, “Noticing (awareness of discomfort, comfort, and neutral body sensations)”, “Attention regulation (ability to maintain attention and control over body sensations)” and “Emotional awareness (awareness of the relationship between body sensations and emotional states)” showed an increasing trend only in the novel group ($p_{\text{Bonferroni}} < 0.01$ or $p_{\text{Bonferroni}} < 0.05$) (Figure 8c). Figure 8d shows the changes in each MAIA subscale score between days 1 and 29. Three subscales showed a significant improvement trend in the novel group compared with those in the conventional group. Since the MAIA was obtained before skincare at the venue and was used to ascertain daily status, the novel group had improved interoception ability daily, not just immediately after the skincare procedure.

As an effect on sleep, the results of the 3DSS responses at home on days 1, 14, and 28 before skincare application are shown in Figure 8e. The results showed that only the novel group had a significant increase in phase ($t(37)=2.75$, $d=0.38$, $p_{\text{Bonferroni}} < 0.05$) and quantitative ($t(37)=3.80$, $d=0.61$, $p_{\text{Bonferroni}} < 0.01$) sleep scores in the 3DSS.

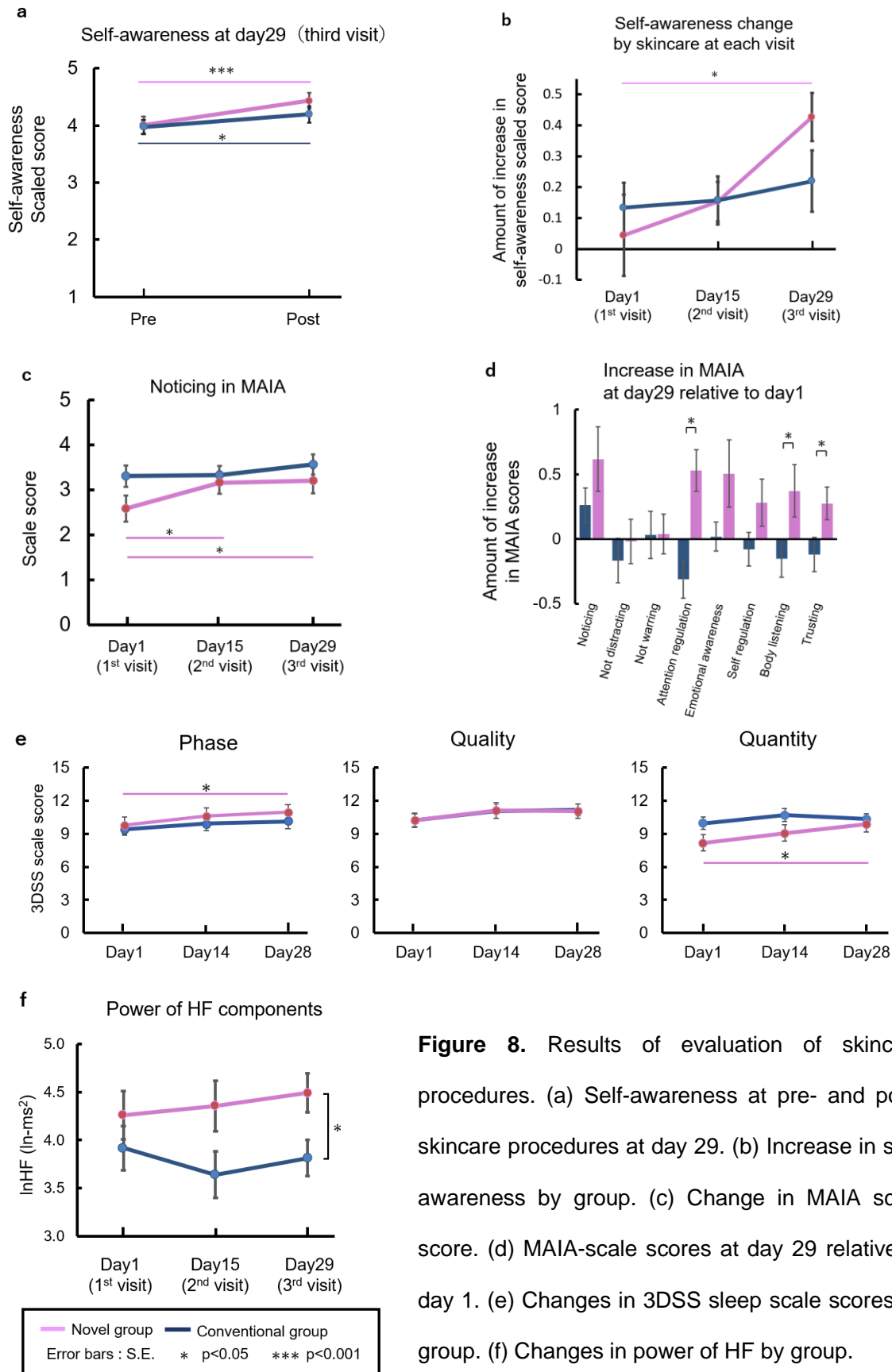


Figure 8. Results of evaluation of skincare procedures. (a) Self-awareness at pre- and post-skincare procedures at day 29. (b) Increase in self-awareness by group. (c) Change in MAIA scale score. (d) MAIA-scale scores at day 29 relative to day 1. (e) Changes in 3DSS sleep scale scores by group. (f) Changes in power of HF by group.

An impact on heart rate was also observed. The power of high frequency from heart rate variability (lnHF) at rest before skincare at the time of visit reflected significantly higher parasympathetic activity in the novel group than in the conventional group on day 29 ($t(33)=2.44$, $d=0.81$, $p<0.05$) (Figure 8f). As with MAIA, HF power, which is related to relaxation, increased in the resting state, meaning the effect was not limited to immediately after skincare. These results indicate that the novel skincare procedure improved self-awareness more than the conventional method. Although the conventional care procedure also improved self-awareness between before and after care, the novel procedure showed a larger quantitative change and positive effects on daily well-being factors, such as proprioceptive sensation, sleep, and HF power at rest.

Discussion.

Although self-awareness has several advantages, it is often overlooked, limiting enhancement opportunities. In this study, we developed and evaluated a novel skincare procedure to enhance self-awareness.

The results of STEP 1 revealed new findings that precisely sensing one's skin condition, deeply feeling a specific sense, and engaging in a specific behavior contribute to self-awareness. In STEP 2, the novel skincare procedure was developed by integrating the results of STEP 1. The experiments showed that self-awareness was enhanced by carefully performing conventional skincare procedures, demonstrating the potential value of the careful act of general skincare. However, the novel skincare procedure was more likely to enhance self-awareness and influenced the sensitivity of interception, sleep, and heart rate variability related to parasympathetic activity. These effects were not observed with conventional skincare. These results demonstrate that this novel skincare procedure contributes to daily well-being.

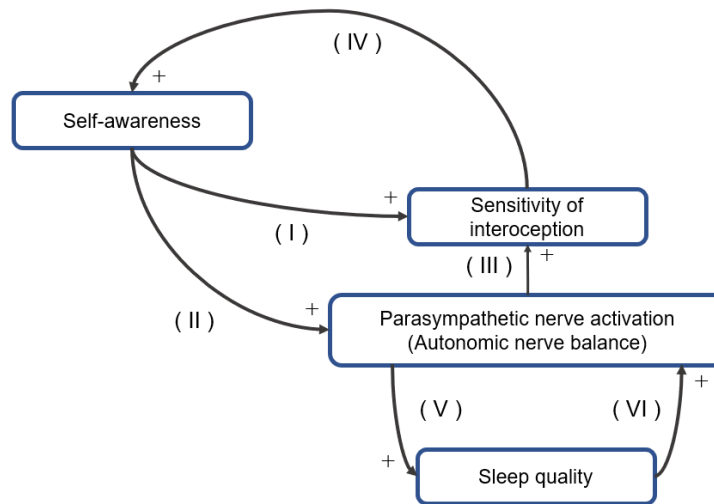


Figure 9. Predicted causal loop for effects centered on self-awareness.

To the best of our knowledge, no case study has demonstrated a simultaneous increase in the three factors (interoception, sleep, and parasympathetic activation) centered on self-awareness as this study showed. Previous studies found that mindfulness-based stress reduction training [20], which requires 45 minutes of daily tasks for 8 weeks, improved sleep [21] and blood pressure [22]. Therefore, some benefits of mindfulness could be effectively achieved through skincare. This suggests that skincare can contribute not only to the beauty of the skin but also to mind beauty, ultimately enhancing overall quality of life.

The relationships between self-awareness and interoception, sleep, and parasympathetic activity were predicted (Figure 9) based on the results of previous relevant research. Paying attention to oneself is a concept in mindfulness meditation, and a psychotherapy method incorporating mindfulness has been shown to increase interoceptive sensitivity [23]. Our study's results are also similar to a previous study finding that mindfulness meditation activated the parasympathetic nervous system based on heart rate measurements [24]. Hence, the novel skincare procedure was expected to work similarly to these meditations and

psychotherapies. Therefore, the heightened attention to oneself through skincare increased the interoception sensitivity (I) in Figure 9) while contributing to activating the parasympathetic nervous system (II). Another study discussed the possibility that problems with the autonomic nervous system, including the parasympathetic nervous system, interfere with the control and sensing of interoception [25]. This suggests an improved autonomic nervous system may enhance interoception (III). Evidently, increased interoceptive sensitivity can be considered positive feedback to self-awareness (IV). Furthermore, parasympathetic activation plays an important role in sleeping (V), which, in turn, influences the activation and balance of the autonomic nervous system (VI) [26], which could explain why self-awareness affected sleep in this study. However, understanding these relationships requires further research.

Conclusion.

A novel multisensory skincare procedure, inspired by precise skin contact and traditional Japanese rituals, was developed, and its impact and effectiveness on self-awareness were tested. The new procedure, developed utilizing the results of the element development (STEP 1), improved self-awareness and significantly influenced interoception, sleep, and HF power, which were not achieved with conventional care procedures and mindfulness meditation. Daily skincare that enhances self-awareness is expected to not only help people avoid negative mental health conditions such as stress disorders but also improve self-management skills and other life-enhancing effects. This study shows the evolutionary potential of skincare with ritual and multisensorial methods and proposes its novel and pivotal role in sustainable well-being.

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Conflict of Interest Statement.

NONE.

References.

1. data.ai (2022). Report: Q1 2022 Mobile market pulse top apps and games rankings.
<https://www.data.ai/en/insights/market-data/q1-2022-market-pulse-regional/>
2. Rehm LP, Kaslow NJ, Rabin AS (1987) Cognitive and behavioral targets in a self-control therapy program for depression. *J Consult Clin Psychol* 55(1):60–67.
3. David S (2016) Emotional agility: Get unstuck, embrace change, and thrive in work and life. Avery Publishing Group.
4. Evers AWM, Beugen SV (2021) How stress affects the skin: from designs to mechanisms. *Br J Dermatol* 185(1):12–13
5. Cash TF, Cash DW (1982) Women's use of cosmetics: psychosocial correlates and consequences. *Int J Cosmet Sci* 4(1):1–14
6. Motokawa T, Kato T, Miyamoto H, et al. (2022) Intersection of cosmetic technology and wellness utilizing skin research techniques for stress management. IFSCC2022.
7. Sakuragawa S, Kaneko T, Miyazaki Y (2008) Effects of contact with wood on blood pressure and subjective evaluation. *J Wood Sci* 54:107–113.
8. Warrenburg S (2005) Effects of fragrance on emotions: moods and physiology. *Chem Senses* 30(suppl_1):i248–i249.
9. Ota T, Takeda T, Lu X, et al. (2017) Study of the effects of Japanese tea ceremony will give the peace of mind of guests. *Digital Human Modeling* 10286:348–357.
10. Gordon IE, Cooper C (1975) Improving one's touch. *Nature* 256:203–204.
11. Saito N, Matsumori K, Kazama T, et al. (2023) Skin quality sensor to evaluate vibration and friction generated when sliding over skins. *Int J Cosmet Sci* 45(6):851–861.

12. Stevenes JC, Patterson MQ (1995) Dimensions of spatial acuity in the touch sense: Changes over the life span. *Somatosens Mot Res* 12(1):29–47.
13. Kahneman D (1973) *Attention and effort*. Prentice Hall.
14. Sato C (2020) Changes in emotions and attitudes when using cosmetics. *J Soc Cosmet Chem Japan* 54(4):351–357.
15. Okamoto S, Nagano H, Yamada Y (2013) Psychophysical dimensions of tactile perception of textures. *IEEE Trans Haptics* 6(1):81–93.
16. Shoji K (2018) *Fragrance product proposal system*. PCT International publication No. WO2018-190287
17. Mehling WE, Price C, Daubenmier JJ, et al. (2012) The Multidimensional Assessment of Interoceptive Awareness (MAIA). *PLoS One* 7(11):1–22.
18. Matsumoto Y, Uchimura N, Ishida T, et al. (2014) Reliability and validity of the 3-dimensional sleep scale (3DSS)—day workers version—in assessing sleep phase, quality, and quantity. *Sangyo Eiseigaku Zasshi*. 56:128–140. Japanese.
19. Matsumoto Y, Uchimura N, Ishida T, et al. (2016) Day workers suffering from a wider range of sleep problems are more likely to experience suicidality. *Sleep Biol Rhythms* 14(4):369–376.
20. Kabat-Zinn J (2011) Some reflections on the origins of MBSR, skillful means, and the trouble with maps. *Contemp Buddhism* 12(1):281-306.
21. Gross CR, Kreitzer MJ, Reilly-Spong M, et al. (2011) Mindfulness-based stress reduction versus pharmacotherapy for chronic primary insomnia: A randomized controlled clinical trial. *Explore* 7(2):76–87.
22. Hughes JW, Fresco DM, Myerscough R, et al. (2013) Randomized controlled trial of mindfulness-based stress reduction for prehypertension. *Psychosom Med* 75(8):721–728.

23. Price CJ, Hooven C (2018) Interoceptive awareness skills for emotion regulation: Theory and approach of mindful awareness in body-oriented therapy (MABT). *Front Psychol* 9(798):1–12.
24. Ooishi Y, Fujino M, Inoue V, et al. (2021) Differential effects of focused attention and open monitoring meditation on autonomic cardiac modulation and cortisol secretion. *Front Physiol* 12:675899.
25. Terasawa Y, Fukushima H, Umeda S (2011) How does interoceptive awareness interact with the subjective experience of emotion? An fMRI Study. *Hum Brain Mapp* 34(3):598–612.
26. Castro-Diehl C, Ana V Diez Roux, Redline S, et al. (2016) Sleep duration and quality in relation to autonomic nervous system measures: The Multi-ethnic study of atherosclerosis (MESA). *Sleep* 39(11):1927–1940.