Original article

The effects of flower therapy on the EEG activity of the frontal lobe in university students

Sukyoung Yun¹, Hyejung Choi¹ and Mijin Kim²

¹ Department of Horticulture, Daegu Catholic University, Gyeongsan, Korea

² Mellia, Susung-gu, Daegu, South Korea

Summary

This study was conducted from November 18 to December 20, 2019, with 62 students at D University to explore the effects of Flower therapy on the activity of theta, alpha, beta and gamma waves in the frontal lobe. The flower therapy program was conducted in three stages after selecting flowers of their preferred colors. The preparation stage was to look at the wall for 2 minutes, the work stage was to plant flowers for 5 minutes, and the appreciation stage was to look at the flowers they had placed for 3 minutes. Brainwave measurements were taken while attaching a 2-Channel Computerized EEG Measurement Analysis System (BTS-3000) and implementing the program. In the raw data, the total relative values of preparation, work, and appreciation sections were analyzed excluding delta waves that increase during sleep. In the working stage, theta waves decreased (left: $p < .001$, right: $p < .001$) and alpha waves increased (left: $p < .001$, right: $p < .001$) compared to the preparation and appreciation stages. As a result of gender analysis, there was a significant change in all male students except gamma waves, and the alpha waves increased in women at the working stage (left: $p < .001$, right: $p < .001$). As a result of examining the change by color, when working with red, orange, yellow, and purple flowers, there was an increase in alpha waves rather than the preparation and appreciation stages (red: left ($p = .001$), right ($p = .001$), orange: left ($p < .001$), right ($p < .001$), yellow: left ($p < .001$), right ($p < .001$), purple: left ($p < .001$), right ($p < .001$)). However, there was no significant change in the case of green (left: $p = .053$, right: $p = .069$). The findings indicate that the effects of flower therapy on activity types could be realized by dividing the brain waves into stages of work and comparing the differences by gender and color.

Keywords

alpha waves, appreciation, preparation, theta waves, work

Introduction

Horticultural therapy is a remedial treatment in which plants and activities related to gardening are utilized to improve the spirits of people, brain health and body health. Horticulture therapy is believed to be a valuable and active psychological treatment for all types (abilities, age and background) of people. The therapeutic advantages of horticulture environments have been seen since old times (Mizuno-Matsumoto et al., 2008).

Significance of this study

What is already known on this subject?

- Horticultural activities by using plants improve the overall quality of human life. There are many factors such as psychological and emotional aspects which have relationships with horticultural therapy. EEG is a significant tool to determine human psychological phenomena. Activation and changes in alpha and beta waves indicate the mental health condition. Therefore, horticulture therapy along with EEG-type tools are a tremendous application to study the impact of horticulture activity on human health.

What are the new findings?

- This study analyzed EEG by classifying the activity of flower arrangement into periodic way (preparation-work-appreciation stage). The alpha wave increased, and theta wave decreased in the work stage rather than in the simple viewing stage. Undeniably, the healing effect of the flower itself is also great. However, it was found that being active is more effective for human mental health.

What is the expected impact on horticulture?

- activities provide mental relaxation and health improvement benefits. Horticulture therapy can also be a tool to protect the health of modern people who want to pursue wellness. Using flower decoration activity can give health benefits to humans.

Horticultural activity through live plants improves the overall quality of human life (Son et al., 1997). There are many effects appearing in the psychological and emotional aspects, and various studies have recently been conducted to find out the physiological changes in emotional function. Electroencephalogram (EEG) test is a method of examining human physiological phenomena, and objective review is possible. Therefore, it provides quantitative data for statistical comparative analysis for psychophysiology research on quantitative brain function (Chang and Chen, 2005). Electroencephalography, an excellent tool, which records electrical activity happening within the brain, is usually utilized in clinical and research processes. It is fully easy to handle and without invasive drawback. Electroencephalography (EEG) tool is quite low in cost. Electroencephalography illustrates electrical variations in the waves form, generally called as brainwaves (Nakamura and Fujii, 1990).

Electroencephalography is being these days utilized to determine brain health disorders related to anxiety and

stress (Angelucci et al., 2014) and it has an important part in solving stress-type issues and other mind related functions. It is the most accurate and accepted way of evaluating stress through mind activity.

Looking at previous studies related to EEG, the ratio of stable alpha waves was high as a result of applying the color of the Waldorf classroom (Shin and Kim, 2018). And according to the data that studied the color sensibility of the indoor space, the alpha wave increased significantly in the color space of yellow and purple (Ha and Park, 2018). Looking at the results of the analysis of brain waves using the scent of plants, the relative value of the alpha wave is determined by the scent of jasmine (Kim, 2013a). In the group with low academic stress, after inhalation of fragrance, alpha wave increased and low-beta wave decreased. It has been seen that inhalation of fragrance helps reduce mental stress and improves learning efficiency (Ko and Shim, 2019). As described above, various studies of human brain waves related to plants have been conducted. On contrary, stress or weakened arousal feelings because of poor concentration at the time of interaction with stimuli are related to lower value of alpha activity. Furthermore, EEG is currently being used in experiments on human interfaces (Ajiro et al., 2009).

On the other hand, flower decoration not only provided emotional stability but also helped relieve stress through actions such as trimming, cutting, bending, placing, knotting, and winding flowers (Jeong and Han, 2008). Flower decoration increased the subject's sense of stability and was effective in relieving stress (Tak, 2006). According to the Yin-Yang and the Five Elements theory that is the basis of Eastern medicine, the energy ("qi") of the colors, scents and shapes of flowers is combined with the energy of humans to heal people, and plants have distinctive effects depending on their type (Katakiri, 1996). Colors of flowers also induce psychological change in humans, showing effects of color therapy. Color sensation obtained with panesthesia has a remarkable effect on determining or perceiving human behavior with consciously and unconsciously stored memory or experience (Kim, 2013b). Young people, especially having 18 years of age, are seriously affected by stress (Breland-Noble et al., 2006). Hence, demands for using nature-related practices such as gardening-based or horticultural activities to relieve stress and anxiety is increasing and these activities are also known as promoters of health (Frumkin, 2001). Various researches have shown that gardening and horticultural activities reduce stress and increase social contacts, self-respect, and brain health (Kaplan and Kaplan, 1989; Cimprich, 1993;

Cammack et al., 2002).

Objective of this study was to determine the impact of flower therapy on psychological activities of humans. The process was divided into a preparation stage, a work stage, and an appreciation stage to investigate changes occurring in human brain waves by activity stage.

Materials and methods

Research subject

This study was conducted in the Daegu Catholic University, Republic of Korea. In current research experiment, 62 university students participated as subjects. Subjects were selected in their 20's, when the prefrontal lobe was completed (Ha and Park, 2018), and were controlled as those with no special pituitary brain disease or color perception problem. Furthermore, subjects were those who agreed to participate in the study after explaining the purpose, method, and time required for the study.

Research tools

1. Program design. The flower therapy program was designed in three stages or treatments: preparation stage, work stage, and appreciation stage. Subjects were allowed to select a flower of their preferred color; the preparatory stage in which they are looking at the wall for 2 minutes because it is an important mode of brain intention to start floral design. Work stage is comprised of arranging flowers in the floral form (decoration) for 5 minutes because maximum time need to think for making floral art and theme and brain required enough time during this stage. The last is an appreciation stage which was comprised of allowing subjects to look at the flowers they have placed for 3 minutes duration because it needs to see the results of designing effort (Figure 1).

Subjects wrote a research agreement and were asked to read the experiment procedure manual. After reading the precautions during measuring EEG parameter, subjects participated in the experiment. Before starting the experiment, students who were trying to arrange flower arrangements for the first time were given a brief explanation of the flower shape and design method so that the work could be performed smoothly. Subjects wore EEG measurement equipment for 10 minutes and performed preparation, work, and appreciation stages. In the working stage, flowers selected for each color were inserted radially in a floral form (10 × 10 × 10 cm). At the beginning of each step, a small sound was given, saying 'Start', 'Arrange flowers', 'Stop and look'.

FIGURE 1. Step-by-step activities and time taken description of flower therapy study.

2. EEG measurement. EEG measurement was performed using a 2-Channel Computerized EEG Measurement Analysis System (BTS-3000, Laxtha Inc., Korea). Electrodes were attached to the left and right frontal lobes, Fp1 and Fp2, according to the international 10/20 electrode system, and the EEG of the frontal lobe was measured by the activity stage (preparation-work-appreciation stage). In order to analyze the analog raw data measured using the EEG, the frequency information of the EEG was obtained through frequency conversion using Telescan 2.99 (Laxtha Inc., Korea), and then Power Spectrum analysis. The frequency range of EEG was set to Theta (4~8 Hz), Alpha (8~13 Hz), Beta (13~30 Hz), and Gamma (30~50 Hz). EEG values were calculated for three types of subject's distribution, *i.e.* (i) total number of subjects during activity stages; (ii) based on gender; (iii) based on flower color type.

Data analysis

The collected data was analyzed using the SPSS (v. 19.0, IBM, U.S.A., 2012) program. The average value of the EEG measured by each program stage was compared through ANOVA and means were compared by and treatment means were compared according least significant difference test (LSD) at 5% level of probability.

Results and discussion

EEG change of the subjects by activity stage

The results of analyzing the relative values by dividing the preparation (2 minutes), work (5 minutes), and appreciation (3 minutes) sections from the raw data of 62 university students were obtained as shown in Table 1. Theta waves decreased from $.75 \pm .10$ (left) and $.75 \pm .11$ (right) in the preparation stage to $.70 \pm .09$ (left) and $.70 \pm .09$ (right) in the work-

ing stage. Theta waves in appreciation stage showed $.76 \pm .09$ (left) and $.76 \pm .10$ (right) EEG relative values (left: $p < .001$, right: $p < .001$). In case of alpha waves, EEG value significantly increased to $.17 \pm .03$ (left) and $.17 \pm .03$ (right) during the working stage rather than preparation stage which has $.11 \pm .03$ (left) and $.11 \pm .03$ (right) EEG values. In the appreciation stage, subjects showed expressed $.12 \pm .03$ (left) and $.12 \pm .03$ (right) EEG values (left: $p < .001$, right: $p < .001$). In the case of beta and gamma waves, significant changes in relative values were not found in preparation, work, and appreciation. Despite the need to generate alpha waves at rest in the cortical electrical activity of adolescents with Attention-Deficit Hyperactivity Disorder (ADHD), abnormal increases in theta waves and decreases in beta waves showed psychological anxiety symptoms. A decrease in theta wave and an increase in alpha wave were confirmed through neuro feedback training (Byun, 2017). In this study, the positive effects of flower therapy were quantified by confirming a decrease in theta wave and an increase in alpha wave during the flower arrangement. A study was conducted to find out the psychological and physiological effects of horticultural therapy in adults. Participants were guided to make and decorate a flower basket and during this task activity was analyzed by EEG program. In the EEG results, differences in the brainwaves were observed. Results indicated that horticultural therapy was psychological and physiological easing in adult participants, and improved brain health (Tao et al., 2020).

Changes in EEG based on gender type

Results of analyzing the change in the relative value of EEG for each activity stage for male students are described in Figure 2. In the case of theta, alpha, and beta wave, there were significant changes according to the activity stage in both the

TABLE 1. Changes in EEG of the subjects by each activity stage.

EEG		Activity stage			p
		Preparations	Work	Appreciation	
θ wave (4~8 Hz)	Left	$.75 \pm .10$	$.70 \pm .09$	$.76 \pm .09$	.000***
	Right	$.75 \pm .11$	$.70 \pm .09$	$.76 \pm .10$	.000***
α wave (8~13 Hz)	Left	$.11 \pm .03$	$.17 \pm .03$	$.12 \pm .03$	.000***
	Right	$.11 \pm .03$	$.17 \pm .03$	$.12 \pm .03$	.000***
β wave (13~30 Hz)	Left	$.10 \pm .09$	$.10 \pm .05$	$.08 \pm .05$	.024*
	Right	$.10 \pm .08$	$.10 \pm .05$	$.08 \pm .06$	.052 ^{ns}
γ wave (30~50 Hz)	Left	$.04 \pm .03$	$.04 \pm .03$	$.04 \pm .03$	.303 ^{ns}
	Right	$.04 \pm .03$	$.04 \pm .02$	$.04 \pm .03$	.195 ^{ns}

*** = $p < .001$, * = $p < .05$, ^{ns} = $p > .05$. Data was analyzed by repeated measures design ANOVA.

TABLE 2. Changes in EEG by each activity stage of students who chose a red flower ($n = 10$).

EEG		Activity stage			p
		Preparations	Work	Appreciation	
θ wave (4~8 Hz)	Left	$.72 \pm .10$	$.68 \pm .07$	$.73 \pm .10$	.226 ^{ns}
	Right	$.75 \pm .08$	$.69 \pm .07$	$.76 \pm .09$	.113 ^{ns}
α wave (8~13 Hz)	Left	$.11 \pm .02$	$.17 \pm .03$	$.12 \pm .03$	.001**
	Right	$.10 \pm .02$	$.17 \pm .03$	$.12 \pm .03$	.001**
β wave (13~30 Hz)	Left	$.17 \pm .17$	$.11 \pm .05$	$.10 \pm .06$	.399 ^{ns}
	Right	$.16 \pm .15$	$.11 \pm .05$	$.09 \pm .06$	.449 ^{ns}
γ wave (30~50 Hz)	Left	$.05 \pm .03$	$.05 \pm .02$	$.05 \pm .04$	.777 ^{ns}
	Right	$.05 \pm .03$	$.05 \pm .02$	$.04 \pm .03$	.894 ^{ns}

** = $p < .01$, * = $p < .05$, ^{ns} = $p > .05$. Data was analyzed by repeated measures design ANOVA.

FIGURE 2. Changes in EEG of male students by three activity stages, *i.e.*, preparations, work, appreciation. (a) θ wave (4~8 Hz); (b) α wave (8~13 Hz); (c) β wave (13~30 Hz); (d) γ wave (30~50 Hz). $n = 13$. *** = $p < .001$, * = $p < .05$, $^{ns} = p > .05$.

FIGURE 3. Changes in EEG of female students by three activity stages, *i.e.*, preparations, work, appreciation. (a) θ wave (4~8 Hz); (b) α wave (8~13 Hz); (c) β wave (13~30 Hz); (d) γ wave (30~50 Hz). $n = 49$. *** = $p < .001$, * = $p < .05$, $^{ns} = p > .05$.

left and right sides (theta: $p = .015$ (left), $p = .026$ (right), alpha: $p < .001$ (left), $p < .001$ (right), beta: $p = .026$ (left), $p = .048$ (right)). Interestingly, it has been seen that EEG value was higher during appreciation stage than during working and preparation stage in theta waves range. However, in alpha and beta waves range, EEG value was higher during working stage than preparation and appreciation stage respectively.

In female students, there were significant changes in the theta wave in the left brain ($p < .001$) and the alpha wave in the left and right brains ($p < .001$ (left), $p < .001$ (right), Figure 3). Regardless of gender, it was confirmed that alpha waves increased in the working stage rather than in the preparation stage, so that emotional stability can be obtained in the process of arranging flowers. In the case of beta waves, it is reported that they appear when studying or performing tasks in a state of low intensity tension or stress (Lee et al., 2019). There was no change in beta waves in female students, but in male students, the process of arranging flowers increased. It can be observed that little stress was confirmed in male students. Moreover, beta waves (β waves) are fast in nature and are utilized to take part in decision making and brain related activities (Neuper and Pfurtscheller, 2001). There were non-significant results in gamma rays' range for female students as well as for male students.

Changes in EEG based on flower color type

Analyzing the change in the relative value of the EEG at each activity stage according to the color of the flower was interpreted in this section. Results were shown for subject group who chose red color flower in Table 2. Results showed that theta wave, beta wave, and gamma wave did not show any significant change in each work step. Only in the case of alpha waves, there was a significant improvement in the

work stage rather than the preparation and appreciation stages ($p = .001$ (left), $p = .001$ (right)).

For subject group selecting orange flowers, results for EEG are shown in Table 3. Compared to other stages, theta wave significantly decreased and alpha wave increased significantly in the working stage (theta: $p = .029$ (left), $p = .033$ (right), alpha: $p < .001$ (left), $p < .001$ (right)). On the other hand, in case of beta wave and gamma wave, there was no significant change in both the left and right brains.

EEG results for subjects choosing yellow flowers are shown in Table 4. Compared to other stages, theta wave significantly decreased and alpha wave increased significantly in the working stage (theta: $p = .014$ (left), $p = .034$ (right), alpha: $p < .001$ (left), $p < .001$ (right)). There was no significant change in beta wave by activity stage. In the case of gamma waves, the left brain was significantly increased in the appreciation stage than in the preparation and working stages ($p = .006$).

For green flowers selection subjects, there was no significant change in theta wave, alpha wave, beta wave, and gamma wave results (Table 5). Similar response was observed in case of subjects choosing purple flowers in beta and gamma waves (Table 6). In addition, compared to other stages, theta wave significantly decreased and alpha wave increased significantly in the working stage (theta: $p = .033$ (left), $p = .026$ (right), alpha: $p < .001$ (left), $p < .001$ (right)). In case of beta wave and gamma wave, there was no significant change in both the left and right brains.

These results are concluded to have a positive effect on emotional stability when working with immersion rather than simply appreciating. Regardless of gender, alpha waves increased in the working stage rather than in the preparation stage. In the case of male students, it was found that EEG

TABLE 3. Changes in EEG by each activity stage of students who chose an orange flower ($n = 20$).

EEG		Activity stage			p
		Preparations	Work	Appreciation	
θ wave (4~8 Hz)	Left	.73 $\pm$.12	.69 $\pm$.09	.74 $\pm$.10	.029*
	Right	.73 $\pm$.14	.69 $\pm$.09	.74 $\pm$.12	.033*
α wave (8~13 Hz)	Left	.11 $\pm$.03	.17 $\pm$.03	.12 $\pm$.03	.000***
	Right	.10 $\pm$.03	.17 $\pm$.03	.12 $\pm$.03	.000***
β wave (13~30 Hz)	Left	.10 $\pm$.06	.10 $\pm$.05	.10 $\pm$.06	.764 ^{ns}
	Right	.10 $\pm$.08	.10 $\pm$.05	.10 $\pm$.07	.756 ^{ns}
γ wave (30~50 Hz)	Left	.04 $\pm$.03	.04 $\pm$.03	.06 $\pm$.03	.593 ^{ns}
	Right	.04 $\pm$.03	.03 $\pm$.02	.04 $\pm$.03	.239 ^{ns}

*** = $p < .001$, * = $p < .05$, ^{ns} = $p > .05$. Data was analyzed by repeated measures design ANOVA.

TABLE 4. Changes in EEG by each activity stage of students who chose a yellow flower ($n = 16$).

EEG		Activity stage			p
		Preparations	Work	Appreciation	
θ wave (4~8 Hz)	Left	.76 $\pm$.09	.73 $\pm$.12	.78 $\pm$.09	.014*
	Right	.76 $\pm$.10	.73 $\pm$.11	.80 $\pm$.08	.031*
α wave (8~13 Hz)	Left	.11 $\pm$.03	.16 $\pm$.03	.12 $\pm$.05	.000***
	Right	.11 $\pm$.03	.16 $\pm$.03	.11 $\pm$.03	.000***
β wave (13~30 Hz)	Left	.09 $\pm$.05	.10 $\pm$.07	.07 $\pm$.04	.076 ^{ns}
	Right	.08 $\pm$.05	.09 $\pm$.06	.07 $\pm$.05	.346 ^{ns}
γ wave (30~50 Hz)	Left	.04 $\pm$.03	.04 $\pm$.03	.07 $\pm$.04	.006**
	Right	.04 $\pm$.02	.04 $\pm$.03	.03 $\pm$.03	.887 ^{ns}

*** = $p < .001$, ** = $p < .01$, * = $p < .05$, ^{ns} = $p > .05$. Data was analyzed by repeated measures design ANOVA.

TABLE 5. Changes in EEG by each activity stage of students who chose a green flower ($n = 5$).

EEG		Activity stage			p
		Preparations	Work	Appreciation	
θ wave (4~8 Hz)	Left	.80 $\pm$.10	.75 $\pm$.11	.80 $\pm$.08	.103 ^{ns}
	Right	.78 $\pm$.14	.74 $\pm$.13	.80 $\pm$.10	.215 ^{ns}
α wave (8~13 Hz)	Left	.10 $\pm$.01	.15 $\pm$.02	.12 $\pm$.02	.053 ^{ns}
	Right	.10 $\pm$.01	.14 $\pm$.03	.11 $\pm$.02	.069 ^{ns}
β wave (13~30 Hz)	Left	.06 $\pm$.07	.08 $\pm$.06	.06 $\pm$.04	.198 ^{ns}
	Right	.08 $\pm$.10	.09 $\pm$.08	.06 $\pm$.05	.341 ^{ns}
γ wave (30~50 Hz)	Left	.03 $\pm$.03	.03 $\pm$.03	.06 $\pm$.04	.234 ^{ns}
	Right	.05 $\pm$.04	.04 $\pm$.03	.03 $\pm$.03	.454 ^{ns}

*** = $p < .001$, ** = $p < .01$, * = $p < .05$, ^{ns} = $p > .05$. Data was analyzed by repeated measures design ANOVA.

TABLE 6. Changes in EEG by each activity stage of students who chose a purple flower ($n = 11$).

EEG		Activity stage			p
		Preparations	Work	Appreciation	
θ wave (4~8 Hz)	Left	.77 $\pm$.09	.68 $\pm$.06	.75 $\pm$.10	.033*
	Right	.76 $\pm$.08	.68 $\pm$.06	.74 $\pm$.11	.026*
α wave (8~13 Hz)	Left	.12 $\pm$.03	.19 $\pm$.02	.13 $\pm$.03	.000***
	Right	.11 $\pm$.04	.19 $\pm$.03	.13 $\pm$.03	.000***
β wave (13~30 Hz)	Left	.07 $\pm$.04	.10 $\pm$.03	.08 $\pm$.05	.295 ^{ns}
	Right	.85 $\pm$.05	.10 $\pm$.04	.09 $\pm$.05	.542 ^{ns}
γ wave (30~50 Hz)	Left	.04 $\pm$.02	.03 $\pm$.01	.04 $\pm$.03	.768 ^{ns}
	Right	.04 $\pm$.03	.03 $\pm$.02	.03 $\pm$.03	.664 ^{ns}

*** = $p < .001$, * = $p < .05$, ^{ns} = $p > .05$. Data was analyzed by repeated measures design ANOVA.

value was high in working stage at beta wave level, causing some stress. On the other hand, female students were able to confirm the positive effect of flower therapy by reducing the gamma wave of the right brain, which is related to the negative process in the work stage. Alpha waves (α waves) relate to brain and relaxation synchronization (Başar, 2012; Kim et al., 2013). Research on plant therapy with EEG results has recommended that a rise of relaxation and satisfaction triggers in increasing beta (β) and alpha (α) brainwave activities (Qin et al., 2014).

Furthermore, another study about horticultural therapy with and without plants suggested that beta (β) and alpha (α) brainwaves ratio considerably enhanced when participants concentrate their intentions only in the plant group. Horticultural plants have intentionally strong effects on the mental activity through brain activity change (Yamane et al., 2004).

As a result of analyzing the relative value of EEG for each activity stage according to color, the alpha wave level showed significant results when flower color selection was red, orange, yellow, and purple except green color flower type. There were highly significant differences in activity stages at alpha waves level for subject groups choosing yellow and purple flowers, respectively.

Colors are perceived through the visual system and cerebral areas, and specific emotions appeared according to the characteristics of hue, brightness, and saturation. Color emotions appear as a result of psychological and physiological responses to color stimulation (Ha and Park, 2018). According to the data that studied the EEG according to the behavioral emotion system type and the color sensibility of the indoor space, the left prefrontal alpha wave was significantly increased in the yellow and purple color spaces (Ha and Park, 2018).

As a result of analyzing the relative value of EEG for each activity stage according to the flower color, there was no significant change in the beta value. Beta power values are brain waves that respond to external stimuli that cause negative emotions (Güntekin and Başar, 2010), so it can be perceived that flower therapy does not negatively affect external stimuli. Since the gamma power value was also related to the negative emotional process (Luo et al., 2007), there was no significant change in gamma waves in red, orange, green, and purple color flower except for yellow color flower type.

Theta activity enhances and alpha activity reduces through high stress or workload (Hankins and Wilson, 1998). EEG is an excellent and important tool through which brain activities or brain conditions can be determined easily (Hankins and Wilson, 1998). Therefore, a study evaluated the various types of workload or stress by EEG parameters and results indicated that EEG values changed at the time of outer environment contact (Brookings et al., 1996).

Conclusion

By measuring EEG for each activity type, the positive effectiveness of flower therapy was observed. It is concluded that horticultural therapy, particularly flower therapy utilization, has positive impact on human health and psychological aspects. Not only flower decoration, but also changes in brain waves caused by various horticultural activities such as plant growing, and flower crafts would be good to study.

Author's contributions

SY: manuscript writing and data analysis; HC: review research and data analysis; MK: revision and drafting.

Conflict of interest

The authors declare that there is no conflict of interest.

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Addresses of authors:

Sukyoungh Yun¹, Hyejung Choi¹ and Mijin Kim^{2,*}¹ Department of Horticulture, Daegu Catholic University, Gyeongsan 38430, Korea² Mellia, Susung-gu, Daegu 42019, South Korea

* Corresponding author; E-mail: mjk1218@naver.com