NEUROPSYCHOLOGICAL REHABILITATION
2010, 20 (4), 624–636

Psychology Press
Taylor & Francis Group

Structured floral arrangement programme for improving visuospatial working memory in schizophrenia

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Several cognitive therapies have been developed for patients with schizophrenia. However, little is known about the outcomes of these therapies in terms of non-verbal/visuospatial working memory, even though this may affect patients' social outcomes. In the present pilot study, we investigated the effect of a structured floral arrangement (SFA) programme, where participants were required to create symmetrical floral arrangements. In this programme, the arrangement pattern and the order of placing each of the natural materials was predetermined. Participants have to identify where to place each material, and memorise the position temporarily to complete the floral arrangement. The schizophrenic patients who participated in this programme

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We would like to thank Mr. H. Mogi, NIFS-NARO for helping us in developing the tools used in the floral arrangement programme. We are also grateful to staff at the two facilities (Ibaraki Prefectural University of Health Sciences Hospital, psychiatric day-care room and Mitsukaido Kosei Hospital day-care room) for their cooperation.

This work was supported by the National Agriculture and Food Research Organisation (NARO), Japan. This study was also partly supported by a Grant-in-Aid for scientific research to H. Mochizuki-Kawai from the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT/KAKENHI) (No. 20688001).

http://www.psypress.com/neurorehab DOI:10.1080/09602011003715141

showed significant improvement in their scores for a block-tapping task backward version; whereas, non-treated control patients did not show such an improvement. The present results suggest that the SFA programme may positively stimulate visuospatial working memory in patients.

Keywords: Rehabilitation; Visuospatial working memory; Floral arrangement.

INTRODUCTION

Cognitive deficits may restrict the social participation of patients with schizophrenia (e.g., Bowie et al., 2008; Green, 1996). On the basis of the relationship between poor cognitive and social functions, several therapies have been established that have successfully demonstrated cognitive improvements (Bell, Bryson, Greig, Corcoran, & Wexler, 2001; Hogarty et al., 2004; Medalia & Richardson, 2005; Wykes et al., 2007).

In schizophrenic patients, Prouteau et al. (2005) showed that non-verbal visual memory can predict improvement in autonomy in daily living activities. Other studies have also reported positive correlations between spatial working memory ability and social functioning in schizophrenia (Aubin, Stip, Gélinas, Rainville, & Chapparo, 2009; Takahashi et al., 2005). These findings suggest that in schizophrenic patients, non-verbal/visuospatial (working) memory is an important target and should be treated through cognitive training (Bell et al., 2001; Hogarty et al., 2004; Wykes et al., 2007). However, to the best of our knowledge, there are few studies that have reported improvements in visuospatial working memory in schizophrenic patients.

In the present study, we demonstrate a stimulation programme of visuospatial memory, and examine the effects on schizophrenic patients. This programme involved a floral arrangement task, and was named the structured floral arrangement (SFA) programme. We developed tools (Figure 1) that allow the easy creation of symmetrical floral arrangements systematically. In this programme, the arrangement pattern, and production procedure (order and location of placing each of the natural materials) were predetermined and shown in an instruction sheet. Based on the sheet, participants had to identify the placement order and position of each item, and memorise it temporarily to put the item correctly on an absorbent sponge. The SFA structure resembles that of a pegboard, which has been widely used in physical and cognitive rehabilitation for brain damaged patients (Ashman et al., 2008; Burdea, 2003), in which patients place pegs into uniform slots. However, there are two differences between the methods. First, the SFA procedure includes three-dimensional visual manipulations that require more complex visuospatial processes than pegboard work. Second, in the SFA

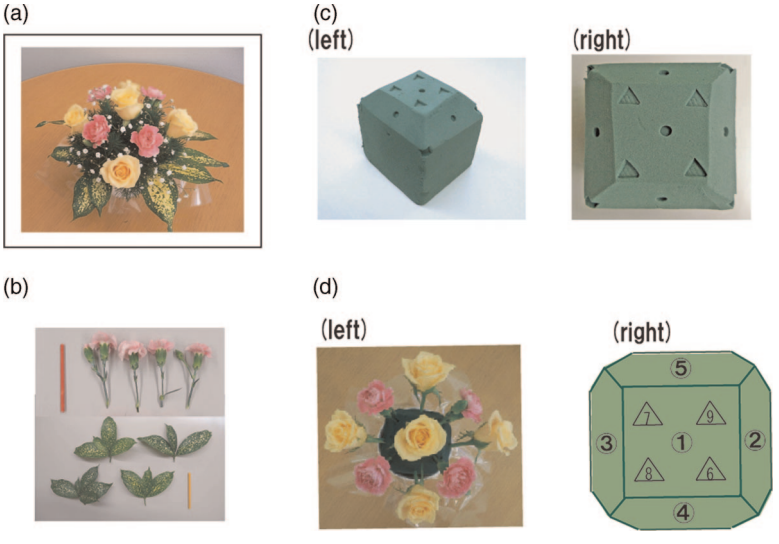

Figure 1. Materials and procedures used in the SFA programme. (a): An example of a floral arrangement pattern. (b): Materials used in the SFA. (c): A polygonal shaped absorbent sponge with impressions of various shapes: overall view (left) and overhead view (right). (d): Floral arrangement pattern (left) and diagram of the absorbent sponge (right). This was provided in the instruction sheet as the second stage of the floral arrangement task. The circles and triangles correspond to the impressions on the sponge (c: right). The shapes are a guide to which materials should be placed; the materials were placed vertically to the plane of the shaped sponge (e.g., four lateral roses were placed on the 45-degree angled plane of the sponge marked by a circle). The numbers denote the sequence in which the items were to be placed (right). On the basis of the diagrams in the instruction sheet, the participants were able to identify the placement position for each item, which they memorised temporarily, and subsequently followed step-by-step. Finally, after placing three types of materials (roses, carnations, and variegated leaves) on predetermined positions, small leaves and/or flowers were arranged randomly to fill up the remaining area on the absorbent sponge. [To view this figure in colour, please visit the online version of this Journal.]

programme, participants have to memorise three-dimensional information, and use it to create floral arrangements.

Block-design training has been reported as one of the effective interventions for remediation of visuospatial ability (Diller et al., 1974; Young, Collins, & Heren, 1983), where brain damaged patients are required to arrange painted blocks according to a model. Treated patients showed improvement in reading and writing words as a result of enhancement of their visual information scanning ability (Young et al., 1983). The SFA programme procedure appears similar to that of block-design training where materials are arranged based on instructions, making it possible that the present SFA programme will improve visuospatial ability. However, there are few studies on the effect of block-design training in patients with schizophrenia. It is also unclear whether visuospatial working memory may be

affected positively by using such an arrangement procedure. The purpose of this study is to demonstrate the potential of the SFA programme for developing working memory, as well as visuospatial manipulation. The SFA programme involves complex analysis of visuospatial information, and requires participants to store and use the information correctly to create floral arrangements. We predicted that the SFA programme would stimulate positively an individual's visuospatial manipulation and memory process.

Additionally, the use of natural materials may reduce tension and anxiety and increase motivation among schizophrenic patients during their rehabilitation programme (Sullivan, 1979). A previous study involving horticultural therapy reported an increase of activity through flower arrangement work in a patient with schizophrenia, who usually displayed severe difficulty in socialising (Pereira & Pereira, 2009). Recently, other studies have reported that natural flowers and leaves decrease anxiety and fatigue, and increase positive feelings in hospitalised patients and healthy employees (Dravigne, Waliczek, Lineberger, & Zajicek, 2008; Park and Mattson, 2009). Our previous study with schizophrenic patients also found that a horticultural programme (vegetable cultivation) had comparatively higher attendance (mean, 45.3%) than other daily programmes such as cooking, exercise and so on (30–40 %) (Yamakawa et al., 2008). The SFA programme may have a positive impact on motivation, and induce improvement in visuospatial ability. We believe that the findings of the present study may contribute to the improvement of cognitive rehabilitation in schizophrenic patients.

METHODS

Participants

We recruited 20 patients from two psychiatric day-care facilities who were diagnosed with schizophrenia or schizoaffective disorder, according to the criteria described in the DSM-IV-TR (American Psychiatric Association, 2004). The criteria for participation included having no history of cognitive deficits of organic origin or due to mental retardation, no major physical handicap, and no current substance abuse. Both facilities were the same size and connected to general hospitals. In these facilities, users were usually engaged in one or two different activities, such as singing, cooking, and light exercise as psychological therapy in a day programme. All the participants provided their written informed consent before participating in the study. This study was approved by the Ethics Committees of the hospitals in which it was conducted. The SFA group comprised 10 patients (6 men and 4 women). We selected the 10 experimental participants from one facility to compare the attendance rate for the SFA programme to that of a previous study conducted

TABLE 1
Characteristics of SFA and Control Groups

	SFA ($n = 10$)		*Control* ($n = 10$)	
	M	(*SD*)	*M*	(*SD*)
Age	32.4	(10.0)	36.0	(10.3)
Years of education	13.0	(1.3)	12.2	(1.3)
Age of onset	19.7	(3.1)	20.3	(4.7)
MMSE score	27.8	(2.3)	26.2	(2.3)
Medication*	498.5	(275)	662.7	(528)
PANSS				
PANSS total	39.7	(7.5)	41.3	(11.0)
PANSS positive	15.5	(3.6)	17.4	(5.7)
PANSS negative	20.9	(6.9)	24.7	(5.0)

MMSE: Mini-Mental State Examination (Folstein et al., 1975).
* medication in milligrams per day, total chlorpromazine-equivalent neuroleptic dose.

in the same facility (Yamakawa et al., 2008). The control group also comprised 10 patients (4 men and 6 women), 4 of whom were from one facility and the remaining 6 from another facility. No significant differences were observed between the patients in the SFA and control groups in terms of their characteristics (Table 1).

Materials

We provided cut flowers, small branches with leaves (Figure 1b), and polygonal shaped absorbent sponges marked with impressions of various shapes (Figure 1c) for the SFA programme. Participants were asked to put each natural material in the correct impression in the sponge based on an instruction sheet which indicated the procedure for creating a particular flower arrangement; the procedure was divided into four or five stages, each of which involved the arrangement of a different flower or leaf (Figure 1d). A neuropsychologist decided the arrangement design (round type), and fundamental treatment procedure based on the advice of a floral arrangement teacher. Programme tools, including the marked sponge and the instruction sheets, were developed by the staff, including a psychiatrist and occupational therapist belonging to the day-care facility.

Procedure

The SFA programme involved four sessions (each of which was scheduled as a half-day programme and lasted for about one hour) that were spaced out over a period of two weeks. We asked participants to attend all four sessions.

In each session, the participants had to make floral arrangements twice. Thus, the present programme involved making eight floral arrangements. We prepared three floral arrangement patterns with differing levels of difficulty. The patients were instructed to execute the easiest pattern on the first two sessions of the programme, and the more complex designs were used for the latter two sessions in order of increasing difficulty.

The SFA programme was conducted in a group setting. All the natural materials, the absorbent sponge and the instruction sheet were placed in front of each participant. The instruction sheet was available to the participants throughout the SFA work, however, they could not concentrate on the sheet and the other materials simultaneously, since they were beyond their central eye field. Participants needed to shift their attention from the materials to the instruction sheet and absorbent sponge to create the floral arrangement. Each session was divided into two phases with a short rest period of about 10 minutes in the middle. During the first half of the session, participants followed the step-by-step instructions provided by a staff member. The steps were based on the stages of the instruction sheet. The instruction sheet and impressions on the sponge showed which material should be used and where, and how to put it on the sponge. Three staff members (a nurse, occupational therapist, and clinical psychologist/neuropsychologist) assisted participants who completed the task more slowly than others. None of the assistants was an expert in floral arrangement. One of the three had practised creating the floral arrangement according to the SFA method and instructed the other two assistants on the treatment procedure. In the second half of the session, the participants completed the flower arrangement without the assistance of the staff by referring to the instruction sheet.

Cognitive outcome measurements

As a measure of the cognitive outcome, we used block-tapping, digit span tests according to the Wechsler Memory Scale–Revised (Wechsler, 1987), and Rey-Osterrieth Complex Figure Test (copy and immediate recall version) (Osterrieth, 1944; Rey, 1941). These assessments were made twice, immediately before and after the four sessions of the SFA programme. A pre-test of the Rey-Osterrieth complex figure was executed about two months before the SFA programme in the SFA group. Control participants were also assessed twice using the same assessments at an interval of two weeks. A neuropsychologist, clinical psychologist, and voluntary worker assessed cognitive outcomes. One of three testers conducted one of three cognitive tests for each participant both in the pre- and post-test phases.

The participants' attendance was recorded and this was used as a variable representing their motivation towards completing the SFA programme.

RESULTS

The mean attendance in the SFA programme was 2.5 sessions (attendance rate, 62.5%). Two patients did not attend the SFA programme; their data were excluded from the analysis. The mean attendance of 8 participants (4 men and 4 women, mean age: 32.4 years, mean age of onset: 19.9 years, mean Positive and Negative Syndrome Scale total score: 37.5) was 3.1 sessions. On average, they created floral arrangements 6.2 times over a period of 2 weeks. The first half of the programme lasted 20–30 minutes each session, and the second half commenced after a short break; in the second half, all participants individually completed the floral arrangement programme within approximately 20 minutes.

Four of the eight SFA treated participants had difficulties in making floral arrangements according to the instruction sheet in the early sessions. For instance, they placed roses in the incorrect positions on the sponge where carnations should have been placed, or stopped work when they were unable to proceed to the next part of the task. However, almost all of the four participants showed improvements in their arrangement skills in the final session. Figure 2 shows samples of floral arrangements made by the same participant. In Figure 2a, the four carnations were arranged in a disorderly way, whereas they should have been placed in a square shape (line). While, in the fourth session, the four roses were correctly placed in each corner of a square (Figure 2b). Mean times required to place one material in the second half of each session were 18.1 seconds ($SD = 6.9$: session 1), 16.3 seconds ($SD = 5.1$: session 2), 11.2 seconds ($SD = 4.5$: session 3), and 14.0 seconds ($SD = 7.1$: session 4). One-way ANOVA showed no significant differences between sessions, $F(3, 21) = 1.30$.

Cognitive outcomes

To clarify the pre to post change of scores in each group, we subtracted the individual pre score from the post score in each test, and examined the Mann-Whitney U test by using the mean score changes in the SFA and control groups. We found significant differences in the block-tapping task of backward version (Figure 3a *left*, $z = -2.14$, $p < .05$) and Rey-Osterrieth Complex Figure Copy Test (Figure 3b *left*, $z = -2.25$, $p < .05$). In the block-tapping task, the mean score of SFA participants significantly increased compared to that of controls after treatment. On the other hand, control participants showed a significant decline compared with SFA participants in the scores of the Rey-Osterrieth Complex Figure Test. Additionally, the Mann-Whitney U test showed significant differences between SFA treated and control group only in the post-test copy score (Figure 3b *right*, $z = 2.90$, $p < .01$). SFA treated patients showed significantly superior performance to

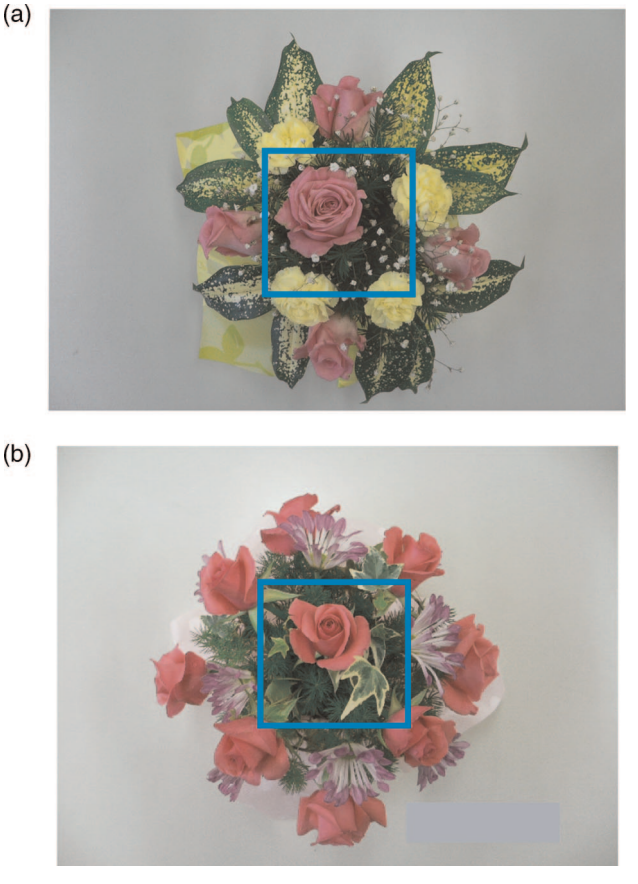

Figure 2. Sample of floral arrangements made by the same participant in the second (a) and fourth (b) day sessions. According to the instruction sheets, participants were required to arrange four carnations (a) and roses (b) in a square shape like the line. Although the carnations were not arranged in a square shape (a), the roses were arranged in good order (b). [To view this figure in colour, please visit the online version of this Journal.]

the control patients in the post-test. In other tests, there was no significant difference (Table 2).

DISCUSSION

We examined the cognitive outcomes of the SFA programme. The scores of participants in the block-tapping test significantly improved after the SFA treatment. Mean score of the Rey-Osterrieth Complex Figure Test (copy) was higher in SFA patients than in control patients after the SFA programme.

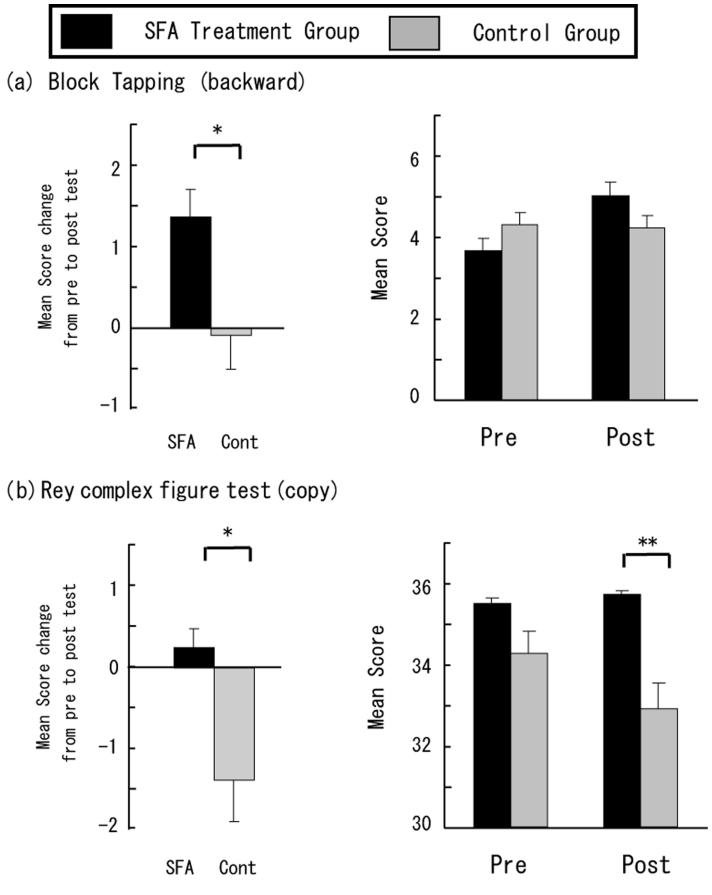

Figure 3. Cognitive outcomes of Block-Tapping task backward version (a) and Rey-Osterrieth Complex Figure Test (copy version) (b). Left: mean score change from pre- to post-test phase, right: mean score of pre- and post-test phase in each group. $^{*}p < .05$, $^{**}p < .01$.

This result reflects the fact that the control group showed a small but significant decrease in mean copy scores from pre- to post-test phase, while the SFA group maintained a high performance throughout the tests. Our results suggest that the SFA programme may be useful in stimulating and enhancing the visuospatial process and spatial working memory ability. The SFA programme can be completed in a short time, and easily incorporated into the existing cognitive rehabilitation therapies for schizophrenic patients. There is a possibility that, by appending the SFA programme, previous therapies may be supplemented in terms of training for visuospatial working memory.

Compared to other visuospatial training (Burdea, 2003; Cagkar, Gurses, Mutluay, & Kiziltan, 2005; Diller et al., 1974), the load on memory

TABLE 2
Cognitive outcomes of SFA treated and non-treated control subjects

		SFA		*Control*	
		Mean	*(SD)*	*Mean*	*(SD)*
Block Tapping					
Forward	Pre	4.8	(1.3)	5.3	(0.8)
	post	5.4	(1.1)	4.8	(1.4)
Digit Span					
Forward	pre	7.4	(1.1)	6.5	(1.0)
	post	6.3	(2.0)	6.5	(1.1)
Backward	pre	4.4	(1.5)	4.8	(1.7)
	post	4.4	(0.7)	4.6	(1.2)
Rey-Osterrieth Complex Figure					
Immediate recall	pre	18.6	(8.9)	12.4	(8.4)
	Post	20.3	(8.4)	13.9	(6.6)

seems to be higher in the SFA programme. The SFA programme requires participants to memorise predetermined placing orders of materials and make a floral arrangement based on them, while placing order for each block is not determined in Block-design training. Participants need not memorise order information in Block-design training. Working memory dysfunction is often treated in cognitive rehabilitation for traumatic or degenerative brain damaged patients, as well as psychiatric patients. The SFA programme may be useful for demented patients with organic brain damage, as well as schizophrenic patients. Lesions in the right dorsolateral prefrontal cortex induce dysfunction of the visuospatial working memory (Bor, Duncan, Lee, Parr, & Owen, 2006). Moreover, right brain damaged patients with visuospatial cognition disability or unilateral spatial neglect could also be treated using the SFA programme due to the requirement for manipulation of more complex (three-dimensional) visuospatial information. It is reported that cognitive improvement would induce an increase of brain activation in schizophrenic patients (Wykes et al., 2002), so we will examine the change of brain activation during the SFA programme in the future.

There was a discrepancy between the present copy results and that of previous studies. The non-treated control group showed a significant decrease in mean copy score from pre- to post-test phase, while decline of copy ability has been little reported in schizophrenic patients (Bowie et al., 2008; Dickinson, Ragland, Gold, & Gur, 2008). It was inconclusive whether or not SFA treatment contributed to the maintenance of copy ability in treated participants. Further studies are required to confirm the positive effects of SFA treatment in visuospatial copy ability.

The attendance rate for the SFA programme was 62.5%. Although this rate was not particularly high, it seems to be higher than that of a previous study involving a horticultural therapy programme conducted at the same facility (Yamakawa et al., 2008). The present attendance rate was nearly double that of an ordinary daily non-horticultural programme (Yamakawa et al., 2008). These findings agree with previous studies involving horticultural therapy (Pereira & Pereira, 2009; Sullivan, 1979). It is important to reduce anxiety levels and improve motivation during the cognitive approach with schizophrenic patients. Medalia and Richardson (2005) reported that high motivation (high attendance rate) among schizophrenic patients may lead to a better outcome for cognitive rehabilitation based on computational studies. It is probable that, irrespective of the training tool, psychological care for participants in cognitive remediation training will probably facilitate cognitive improvements. In this study, we only compared the present attendance rate and that of a previous study using horticultural therapy executed in the same facility. As a next step, we could compare the effectiveness of facilitating attendance between the SFA programme and other therapies. Additionally, in the SFA procedure, the floral arrangement process was divided into four to five stages. Such a step-by-step procedure might support participants' planning ability in a similar way to that of Problem-solving Therapy (von Cramon, Matthes-von Cramon, & Mai, 1991). We plan to investigate the effects of the SFA treatment on other cognitive abilities such as planning, organisational ability and skill learning.

There are some limitations to the present pilot study. First, the sample size was small. It is necessary to investigate the cognitive and psychological outcomes of the SFA programme in larger and more randomly sampled groups. Second, cost-effectiveness and social outcomes of this programme remain to be examined.

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Manuscript received August 2009
Revised manuscript received February 2010
First published online May 2010