Table 3
The result of paired t test on BACS-J data with NEAR participants.

	Baseline	Post treatment	t	p	Cohen's d
Verbal memory	−1.09±0.92	−0.13±0.99	8.80	<0.0001	1.01
Working memory	−0.95±0.95	−0.54±1.17	4.11	<0.0005	0.39
Motor speed	−1.60±1.37	−1.04±1.42	3.28	<0.005	0.41
Verbal fluency	−0.47±1.00	−0.14±1.10	3.41	<0.005	0.32
Attention and speed of information processing	−1.24±0.88	−0.99±0.96	3.19	<0.005	0.28
[EX]	−0.79±0.59	−0.55±0.55	3.02	<0.005	0.44
Composite score	−1.65±1.27	−0.79±1.33	8.96	<0.0001	0.67

[EX] = −log[2 − (Executive function BACS-J z score)].

of variance were performed on BACS-J data using 'group' (NEAR group, control group) and 'treatment settings' (inpatient, outpatient) as inter-individual factors, while 'time' (baseline, post-treatment) was used as an intra-individual factor. Moreover, in the analyses of verbal memory, [EX], and composite scores, baseline data were used as covariates.

3. Results (Tables 3, 4, Fig. 1)

3.1. The within-NEAR treatment change of BACS-J data

There were significant improvements in the scores of all subcomponents in the BACS-J (Table 3).

3.2. In comparison with control patients

There were significant interactions between 'group' and 'time' in verbal memory, working memory, verbal fluency, attention and speed of information processing, [EX], and composite scores (Table 4). The improvement of these areas was significantly greater in the NEAR group than in the control group. There was no difference between groups in terms of the change in motor speed.

4. Discussion

In the present study, we found significant improvement for all cognitive domains related to the BACS-J. According to the meta-analysis of the effectiveness of cognitive remediation in schizophrenia, neurocognitive benefit varied from small (Cohen's $d = 0.2$) to very large ($d = 1.2$) effect size (Medalia and Choi, 2009). Medalia et al. (2009) also suggested that heterogeneity of response to cognitive remediation might depend on instructional techniques, intellectual ability, and intrinsic motivation. In NEAR, instructional techniques are devised to enhance intrinsic motivation. It has already been shown that the use of NEAR educational software without an instructional approach did not achieve clinically meaningful change in neurocognitive capacity (Bellack et al., 2005; Dickinson et al., 2010). In our study, we complied with the principle of NEAR by attaching great importance to instructional approach and could find small to very large effect sizes in broad domains ($d = 0.28$–1.01). In comparison with the control group, the positive findings remained significant except for the motor speed. NEAR proved to be a feasible psychosocial therapy, even in Japan with its different cultural background and with the use of software programs that differ from those in Western countries.

In BACS-J, motor speed was assessed by the "Token Motor Task". The task requires the participants to put 100 plastic tokens into a container bimanually as quickly as possible within 60 s, and the outcome measure is the total number of tokens put in the container (Keefe et al., 2004). In the NEAR session, participants were engaged in the computerized learning tasks selected to address specific domains of cognitive function (Medalia et al., 2009); however, we may have failed to include those tasks that required considerable motor speed to perform in the session. This may explain why the NEAR participants were not able to achieve greater improvement in motor speed than the controls.

In this study, the two groups were heterogeneous in many points, and although several subcomponent scores of the BACS-J were significantly lower in the control group than in the NEAR group, correlations between baseline BACS-J data and the improvement in

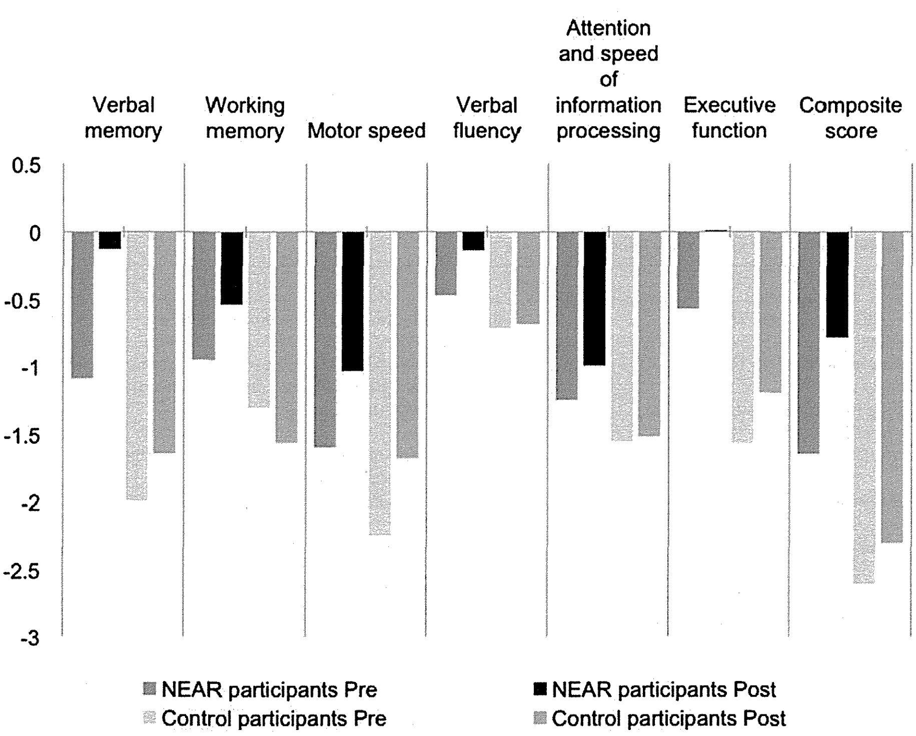

Fig. 1. Changes in cognitive function over a 6-month period.

Table 4
"Time × group" interaction effect on ANOVA with BACS-J data in comparison with control group.

	d.f.	F	p
Verbal memory#	1,69	16.1	<0.0005
Working memory	1,70	16.9	<0.0005
Motor speed	1,70	1.53	n.s.
Verbal fluency	1,70	4.39	<0.05
Attention and speed of information processing	1,70	5.79	<0.05
[EX]#	1,69	4.69	<0.05
Composite score#	1,69	19.1	<0.0001

# baseline data were used as covariates.
[EX] = −log[2 − (Executive function BACS-J z score)].

BACS-J data were negative ($r = -0.57$ to -0.06) in the NEAR group. This implies that the NEAR program is more effective when baseline neurocognitive ability is weaker. Although it is possible that there was recruitment bias to include higher functioning subjects in the NEAR group at baseline, it may be assumed that taking into account the difference in neurocognition would not negate the effect of NEAR.

There are several limitations of the present study. First, although only the difference in treatment settings between the NEAR participants and the controls appeared significant, clinical and demographic variables were not well matched between the two groups. Second, subjects were not randomly assigned to either of the groups. Third, some clinicians who managed the NEAR session also had to take a role as a tester in the BACS-J. To resolve these issues, randomized control studies of the NEAR program with testers being blinded to the treatment assignment are warranted. Moreover, while we focused on the neurocognitive effect of NEAR in Japan in the present report, we should also take into consideration its effectiveness on social function and/or quality of life in patients with schizophrenia.

Acknowledgements

The authors would like to thank Masato Kato, Kuniya Tamashiro, Izumi Nagata, Junya Sasaki, Yuichiro Hata, Seiji Katayama, Akira Iwasaki, Yu Hiroe, Miki Nakada, Maki Umebayashi, Kouko Yamada, Chiaki Komatsu, Mayumi Kurimura, Kanako Nakatani, Yukina Senda, Takafumi Shinkawa, Hironori Ohmiya, Kenji Matsumura, Junko Oka, and Maroko Yoshizawa for their support and assistance with this research.

Funding for this study was provided by a Scientific Research Grant-in-Aid for Development of Characteristic Education from the Japanese Ministry of Education, Culture, Sports, Science, and Technology (MEXT). MEXT had no further role in study design; in the collection, analysis, and interpretation of data; in the writing of the report; or in the decision to submit the paper for publication.

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