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Implementation intention training for prospective memory in schizophrenia: a 3-month follow-up study

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Abstract

The beneficial effect of implementation intentions (II) on prospective memory (PM) deficits in patients with schizophrenia has been reported. However, these studies were limited to brief interventions such that the transfer and long-term effects of II training remains unclear. This study examined whether a 10-session II programme could improve PM performance, social functioning and functional capacity in patients with schizophrenia immediately after training and at 3-month follow-up. Patients with schizophrenia (*n* = 42) recruited from the community were randomly assigned to II training (*n*=21) or treatment as usual (TAU) (*n*=21). Participants in the II group learned the verbal and imagery component of II and were encouraged to apply these strategies in their daily lives. We found that the II group performed better than the TAU group on computer-based PM tasks and a daily life PM task (telephone call at specified date and time) at post-treatment and at 3-month follow-up. The II group also exhibited better working ability than the TAU group at post-treatment. Our results suggest that the II intervention programme may have lasting beneficial effects in PM performance and significant transfer effects to functional capacity in schizophrenia patients.

Keywords: Implementation intention training, Prospective memory, Schizophrenia, Social functioning, Functional capacity

1. Introduction

Schizophrenia is associated with a wide range of cognitive deficits (Insel, 2010), including prospective memory (PM) impairment (Ordemann, Opper, & Davalos, 2014; Wang, Chan, & Shum, 2017; Wang et al., 2009). PM refers to the ability to remember to carry out intended actions in the future (Einstein & McDaniel, 1990). Based on the nature of cue that is related to the delayed intention, PM can be classified as time-based (perform the intended action at a particular time in the future) or event-based (perform the intended action when external cues appear) (Einstein & McDaniel, 1996). A meta-analysis reported that schizophrenia patients exhibit severe PM deficit for both time- (d = -1.33) and event-based PM (d = -0.87) (Wang et al., 2009). Moreover, the PM impairment in schizophrenia patients has been found to be associated with poor medication management ability (Lam, Lui, Wang, Chan, & Cheung, 2013; Raskin et al., 2014) and poor social functioning and functional capacity (Au et al., 2014; Twamley, Woods, et al., 2008). These deficits may affect independent everyday functioning of these patients.

Compensatory training typically aims to use strategies to circumvent the underlying cognitive deficits and lead to benefits that transfer to daily life (Wykes, Huddy, Cellard, McGurk, & Czobor, 2011). Compensatory training has been shown to be effective in improving PM performance (McDonald et al., 2011; Neroni, Gamboz, & Brandimonte, 2014; Thöne- Otto & Walther, 2003). Some promising findings have also been demonstrated by compensatory training to improve PM in individuals with psychotic disorders (Twamley, Savla, Zurhellen, Heaton, & Jeste, 2008; Twamley, Vella, Burton, Heaton, & Jeste, 2012). For example, Twamley et al. (2012) found that schizophrenia patients who received compensatory training showed better PM than a control group at 3-month follow-up. However, studies conducted to date have some limitations (Twamley, Savla, et al., 2008; Twamley et al., 2017; Twamley et al., 2012). For example, many previous studies did not measure real-world PM performance, which makes it difficult to determine whether compensatory training can improve real-world PM performance in individuals with psychotic disorders. In addition, previous interventions mainly consisted of training participants to use external aids (e.g., calendar). The reliance on external aids may limit the utility of this training approach because such aids may not always be available or practical to use in real life.

In contrast to compensatory training strategies that use an external aid, training in the use of internal strategies encourages people to deepen the encoding of intentions with internal aids. Internal aids do not require external devices and are more applicable to a wider range of situations. In addition, an internal strategy can be applied to both time- and event-based PM (Burkard et al., 2014), while an external strategy is mainly suitable for time-based PM. Implementation intention (II) training uses an internal encoding method in the form of "if I encounter X, then I will do Y" (Gollwitzer, 1999). II has shown robust beneficial effects for PM in various populations (Chen et al., 2015), including individuals with schizophrenia spectrum disorders (Chen et al., 2016; Chen et al., 2014; Khoyratty et al., 2015). In particular, II strategies that combine verbal rehearsal and imagery (e.g., verbal rehearsal of the instruction in the "if… then…" format for three times and imagine performing the PM task for 30 seconds) has shown robust effect in improving PM performance (Chen et al., 2015).

Previous studies that have examined the effects of II on PM in schizophrenia patients (Chen et al., 2016) and individuals at high risk for schizophrenia (Chen et al., 2014; Khoyratty et al., 2015) have employed brief training protocols. In these studies, participants were instructed to rehearse the "if… then…" instructions and imagine performing PM task in less than 1 minute before the experimental trials. The whole training protocol took less than 5 minutes. However, a brief training protocol does not guarantee that the beneficial effect on PM will persist over time or that individuals will apply the technique learned in their daily lives. As such, the transfer and longer-term effects of II training in patients with schizophrenia remain unknown. Furthermore, the effect of II training on PM may not necessarily lead to improved social functioning. Recently, Burkard et al. (2014) developed an II training programme conducted over 10 sessions for older adults. In this programme, participants are encouraged to use the learned verbal and imagery encoding strategies in simulated and real-life situations. Participants also discuss the difficulties they experience in practice during the training sessions. After the 10-session training programme, participants showed a significant immediate training effect on PM (Burkard et al., 2014).

The present study aimed to examine whether II training can improve PM performance and whether this improvement can be maintained over time in patients with schizophrenia. Based on findings that showed compensatory training can improve PM performance in individuals with psychotic disorders at 3-month follow-up (Twamley, Savla, et al., 2008; Twamley et al., 2012), we hypothesized that II training would improve PM performance when tested immediately following training and at 3-month follow-up. In addition, PM plays an important role in social functioning (Au et al., 2014). For example, PM failures such as forgetting to turn up at an appointment or forgetting to bring an important document to a meeting are social manifestations of PM dysfunction. PM has been shown to be positively associated with social functioning (Au et al., 2014; Twamley, Woods, et al., 2008), and it has been suggested that PM training may lead to improvements in social functioning and functional capacity (Twamley, Woods, et al., 2008). We, therefore, further hypothesized that II training would enhance social functioning and functional capacity both immediately following training and at 3-month follow-up. Finally, we also explored what variables measured at baseline would predict improvements in PM performance at post-training and 3-month follow-up.

2. Methods

2.1. Participants

Schizophrenia patients were recruited from the general community in Beijing. All fulfilled the following inclusion criteria: DSM-IV diagnosis of schizophrenia, aged between 18 to 60 years, estimated IQ≥70, and clinical stability (those who came to the community hospital to pick up their medications regularly without dosage changes). Participants were excluded if they had a history of neurological disorder, alcohol or drug dependence/abuse, or had received ECT in the previous three months. All schizophrenia patients were on second generation antipsychotic medications. This study was approved by the Ethics Committee of the Institute of Psychology, the Chinese Academy of Sciences. Written informed consent was obtained from all participants.

Figure 1 illustrates the flow of participants through the study. A total of 42 patients were recruited and randomly assigned to the II group (n = 21) or the treatment as usual (TAU) group (n =21). Two patients in the TAU group did not complete the 3-month follow up, leaving 19 patients in this group.

INSERT FIGURE 1 HERE

2.2. II intervention

The training protocol was adapted from the programme developed by Burkard et al. (2014) for use in the Chinese setting. Similar to the original programme (Burkard et al., 2014), the training programme consisted of five modules:

1. Psycho-education. We first defined PM and illustrated PM failures. Participants were then required to report PM difficulties in their daily lives and discuss the advantages and disadvantages of their adopted strategies to overcome PM failures. Next, II was introduced to the participants as a complementary strategy.

2. Training the verbal component. We trained the verbal component with a series of scenarios where the protagonist in the scenario had to finish a PM task. Participants were required to formulate a proper "if…, then…" sentence for each scenario for the protagonist. In addition, participants were trained to identify the situations where II was suitable and learn how to inhibit unsuitable behaviours with II strategies.

3. Training the imagery component. We first introduced an imagery component and then illustrated this component with short video clips. The video clips showed

what the protagonist in the scenario needed to imagine when forming an II. Participants were then asked to imagine the scenario in as much detail as possible. They were also asked to practice imagining several different scenarios.

4. Application of II in simulated situations. Each participant received tasks (e.g. “when the trainer says the session is over, you should give him a red pen”) to be carried out with II in the training sessions. They were asked to use both the verbal and imagery components in the practice.

5. Generalized application of II in daily life. Participants were required to record their own PM difficulties and identify situations suitable for the use of II in their daily lives from the first session. They were asked to use a chart to record their experiences in applying the II strategies and share these experiences during the training sessions. Finally, participants and the trainer discussed why II was successful or why it was not and also discussed ways to improve.

The five-week intervention programme was conducted twice a week with a total of 10 sessions. The participants attended the 1.5-hour sessions in small groups of 6-8 participants. The difficulty level gradually increased as the training progressed. Participants were encouraged to apply the learned verbal and imagery encoding strategies in simulated and daily life situations. During the training sessions, they were also required to discuss difficulties experienced when applying these strategies.

Participants allocated to the TAU group received no information or training in II. All patients continued to receive their regular medication treatment throughout the study.

2.3. Measures

2.3.1. PM

1) PM computer task. The task was programmed with Matlab (version R2012a) and was developed in a previous study (L.-l. Liu et al., 2018). It included a baseline block followed by two event-based and two time-based PM task blocks. Each trial included a word stimulus presented on the screen for 1400 ms, followed by a 900-1100 ms

blank. For the baseline task, participants were required to judge whether two-character Chinese words presented on the screen were living things or not. Participants pressed the “J” key for yes and “F” key for no. After finishing the baseline task, participants were asked to undertake the event-based and time-based PM task in a random order.

The two PM blocks consisted of an ongoing task and a PM task. The ongoing task was the same as the baseline task. For the event-based PM, participants were required to press the “spacebar” when either of the two characters included a radical “□ ” (e.g. “dolphin” [□ □], “bacon” [□ □], “rubber” [□ □]) when performing the ongoing task. There were three PM cue words and 157 non-target words in each block. The PM cue words appeared once in each block. The PM words appeared at the 50th, 103th and 149th trial in block 1, and were presented at the 52th, 99th and 150th trial in block 2. The event-based PM task lasted for about 13 minutes.

For the time-based PM task, there were two blocks and 160 trials in each block. During the ongoing task, participants were required to press the “spacebar” every two minutes (PM task) when performing the ongoing task. Participants were able to monitor the time by pressing the “E” key at any point during the block. When the “E” key was pressed, the time elapsed from the beginning of the block (e.g., 03:10) appeared at the upper right corner of the screen for 2s. The responses were counted as correct if the participants pressed the spacebar within 5s of the target time. The time-based PM task lasted for approximately 13 minutes. The accuracy of the PM tasks was recorded.

2) Telephone PM task. The daily PM task was adapted from a telephone task (Fish et al., 2007). Participants were required to make calls at four appointed time points during the day. The duration between two adjacent calls must not be less than two hours. The target time for the calls for each participant was different. Participants were explicitly forbidden to use active external aids (e.g. “alarm clock”) but were allowed to read the appointed time points on a written note. Each call within five

minutes of the target time was given five points, and scores decreased by one point for each successive five minutes away from the target time. Participants scored zero if they did not make a call or they made a call that was more than 25 minutes from the target time. The task was assigned on the day of each assessment (baseline, post-treatment, follow-up) and participants were required to carry out the task on the next day. No cues were provided.

3) The Prospective and Retrospective Memory Questionnaire (PRMQ) (Chan et al., 2008; G. Smith, Del Sala, Logie, & Maylor, 2000). A Chinese version of the PRMQ was used to assess PM problems the participants experienced in their daily life. Only the PM subscale of the PRMQ was used in the present study. Higher scores indicate more PM problems. The PRMQ has been reported to have good validity and reliability in Chinese samples (Chan et al., 2008).

2.3.2. Social functioning and functional capacity

1) Beijing Performance-based Functional Ecological Test 2.0 version (BJ-PERFECT) (Shi, He, Cheung, Yu, & Chan, 2013). The BJ-PERFECT was used to assess functional capacity in the laboratory. Participants were asked to finish a role-play task in three subdomains of functioning: A) transportation: participants were required to utilize maps to plan routes; B) financial management: participants were required to manage changes and fees; C) working ability: participants were required to prepare tableware and play the role as a cashier. Correct transportation (range 0-10), financial management (0-8) and working ability (0-12) subdomain scores were summated to produce a total score (range 0-30).

2) The Personal and Social Performance (PSP) scale (Morosini, Magliano, Brambilla, Ugolini, & Pioli, 2000; Si et al., 2011). A Chinese version of the PSP scale was adopted to assess personal and social functioning by trained psychiatrists through face-to-face interviews. The PSP assesses four domains: a) socially useful activities; b) personal

and social relationships; c) self-care; and d) disturbing and aggressive behaviours. The total score was calculated based on the subdomain scores. Higher total scores represent better function (range 0-100). The Cronbach's alpha of the scale was 0.84 in a Chinese sample (Si et al., 2011).

3) The Schizophrenia Quality of Life Scale (SQLS) (Luo, Luo, Wang, Chen, & Mao, 2003; Wilkinson et al., 2000). The SQLS is a self-report questionnaire that assesses the quality of life in schizophrenia patients. A Chinese version of the SQLS was adopted in this study. Higher scores indicate poorer quality of life. The Cronbach's alphas of the its subscales were all above 0.70 in a Chinese sample (Luo et al., 2003).

2.3.3. Clinical measures

The Positive and Negative Syndrome Scale (PANSS) was adopted to assess schizophrenia symptoms (Kay, Fiszbein, & Opler, 1987; Si et al., 2004). The Abnormal Involuntary Movement Scale (AIMS) (J. M. Smith, Kucharski, Oswald, & Waterman, 1979; Zhang, 1993) and the Barnes Akathisia Rating Scale (BARS) (Barnes, 1989)were used to assess medication side effects. These measures were completed by a trained psychiatrist.

2.3.4. Other measures

Estimated IQ was measured using four-subscales (information, arithmetic, similarity, and digit span) of the Chinese version of the Wechsler Adult Intelligence Scale-Revised (WAIS-R) (Gong, Jiang, Deng, Dai, & Zhou, 1989). The Annett Handedness Scale was used to assess handedness (Spreen & Strauss, 1991).

Emotional status was also measured to examine whether II training would improve emotion as well. The Beck Depression Inventory (BDI) was used to assess the severity of depressive symptoms (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961; D. T. Shek, 1990). The State-Trait Anxiety Inventory (STAI) was used to measure anxiety (D. T. L. Shek, 1988; Spielberger, Vagg, Barker, Donham, & Westberry, 1980).

2.4. Procedure

Patients in this study were identified by their psychiatrists or nurses. After a brief introduction to the project, participants provided written informed consent, and received baseline assessment. Participants were then randomly assigned to the II group or the TAU group. Post-training assessment and 3-month follow-up assessment were conducted after the intervention and three months after the intervention. All participants were paid RMB 100 yuan for each assessment.

2.5. Data analyses

To test for differences in demographic, clinical, and all measures between the II and TAU groups at baseline, independent *t*-tests and Chi-square tests were used. We conducted analysis of covariance (ANCOVA) to examine the treatment effect after the intervention programme. Post-treatment performances were compared between groups after controlling for baseline performances. Similarly, to examine the longer-term effect of the intervention programme, analysis of covariance (ANCOVA) were conducted to compare the group difference on 3-month follow up performances while controlling for baseline performances. η_p^2 was used as the measure of effect size for the ANCOVAs, with medium (> 0.06) and large (> 0.14) effects considered as clinically meaningful (Cohen, 1988). Pearson correlation analyses were conducted to examine the baseline predictors associated with changes in PM performance at post-treatment and 3-month follow-up in the II group. Changes in PM scores were obtained by subtracting baseline performance from the post-test or 3-month follow up performance. Demographic information (gender, age, education years, IQ), and emotional status (anxiety, depression), illness duration, medication dosage, PANSS score, and baseline PM performance were the baseline variables.

3. Results

3.1. Demographics, clinical information and baseline performances

As shown in Table 1, the two groups did not differ in demographics, clinical variables and baseline performance (all *p*s > 0.05).

INSERT TABLE 1 HERE

3.2. Group differences at post-treatment

For PM performance, as presented in Table 2 and Figure 2, compared with the TAU group, the II group exhibited significantly higher accuracy on both event- ($F(1,39) = 7.75$, $p = 0.008$, $\eta_p^2 = 0.166$) and time-based ($F(1,39) = 4.50$, $p = 0.031$, $\eta_p^2 = 0.114$) computer PM tasks. Similarly, the II group also performed significantly better on the telephone call task than the TAU group ($F(1,39) = 4.54$, $p = 0.040$, $\eta_p^2 = 0.104$).

INSERT TABLE 2 AND FIGURE 2 HERE

For social functioning and functional capacity, as presented in Table 2 and Figure 2, the II group scored higher in total score ($F(1,39) = 4.74$, $p = 0.036$, $\eta_p^2 = 0.108$) and the working subdomain score ($F(1,39) = 5.34$, $p = 0.026$, $\eta_p^2 = 0.121$) of the BJ-PERFECT than the TAU group.

For emotional status, as presented in Table S1 (supplementary material), there was no significant difference between the II group and the TAU group at post-treatment.

3.3. Group differences at 3-month follow-up

For PM performance, as shown in Table 3 and Figure 2, the II group exhibited a significantly higher accuracy in the event-based computer PM task ($F(1,37) = 4.53$, $p = 0.040$, $\eta_p^2 = 0.109$), but a non-significant but medium sized effect in time-based computer PM task ($F(1,37) = 2.49$, $p = 0.123$, $\eta_p^2 = 0.063$) compared with the TAU group.

For the daily PM task, the II group performed significantly better on the telephone call task (F(1,37) = 4.44, p = 0.042, η_p^2 = 0.107) than the TAU group.

INSERT TABLE 3 HERE

For social functioning and functional capacity, as presented in Table 3, a non-significant but medium sized effect on the total score of the SQLS (F(1,37) = 1.70, p = 0.105, η_p^2 = 0.069) was found between the II group and the TAU group.

For emotional status, as shown in Table S2 (supplementary material), there was no significant difference between the two groups, although there was a medium sized effect favouring the II group in STAI score (F(1,37) = 2.66, p = 0.111, η_p^2 = 0.067).

3.4. Correlation of baseline variables with PM performance improvement in the II group

At post-treatment assessment, participants scoring lower in baseline event-based PM accuracy (r = - 0.792, p < 0.001) showed greater improvement in event-based PM accuracy. Participants with lower estimated IQ (r = - 0.470, p = 0.031), baseline event-based PM accuracy (r = - 0.508, p < 0.019) and baseline time-based PM accuracy (r = - 0.864, p < 0.001) showed greater improvement in time-based PM accuracy. Those who were receiving lower doses of antipsychotic medications (r = - 0.540, p = 0.011) and those with worse baseline telephone call task performance (r = - 0.610, p = 0.003) showed greater improvement in telephone call task.

At 3-month follow-up, participants scoring lower at baseline on the PSP (r = - 0.559, p = 0.008) and those with lower baseline event-based PM accuracy (r = - 0.600, p = 0.004) improved more on event-based PM accuracy. In contrast, those scoring higher on the STAI (r = 0.490, p = 0.024) and the BDI (r = 0.505, p = 0.020) showed more improvement in event-based PM accuracy. Participants with a shorter length of education (r = - 0.486, p = 0.025) and lower baseline time-based PM accuracy (r = - 0.755, p < 0.001) showed greater improvement in time-based PM performance, whereas those scoring higher on general psychopathology symptoms on the PANSS (r = 0.454, p = 0.039) and the STAI (r = 0.547, p = 0.010) at baseline showed more improvement in time-based PM performance. Participants with poorer baseline telephone call task performance (r = - 0.553, p = 0.009) also improved more on telephone call task at 3-month follow-up.

4. Discussion

In this study, II training-associated beneficial effects were observed on computer-based PM tasks and a real-life PM task (telephone call at specific date and time) at post-treatment and 3-month follow-up. In addition, the II group showed significantly higher working ability than the TAU group at post-treatment. We also found that poorer baseline PM performance, lower education level, lower estimated IQ and poorer baseline psychosocial functioning were correlated with a larger magnitude of improvement in PM performance.

Compared with the TAU group, the II group exhibited better computer event-based PM performance at post-treatment and this effect was sustained at 3-month follow-up. These results suggest that our II training programme (adapted from Burkard et al. (2014)) enabled participants to flexibly apply the learned strategies in the future. The psychological process underlying the beneficial training effects could be that II strengthens the encoding of PM cues and the formation of a strong link between the PM cues and intentions, leading to improved PM performance. Similarly, we found that the II group performed better than the TAU group in computer time-based PM tasks at post-treatment, and a non-significant but medium effect sized difference at 3-month follow-up. These results are consistent with previous studies which showed that II improved time-based PM performance in older adults and schizophrenia patients (L.-l. Liu et al., 2018; L. L. Liu & Park, 2004;

Schnitzspahn & Kliegel, 2009). The above results demonstrate that our II training programme can improve both event-based and time-based PM in schizophrenia patients. Moreover, we also found the II group performed better than the TAU group in the telephone call task at both post-treatment and 3-month follow-up, which extends the beneficial effects of training to tasks more closely resembling those found in daily life. Previous compensatory training studies did not explore whether training can improve daily-life PM performance in individuals with psychotic disorders (Twamley, Savla, et al., 2008; Twamley et al., 2017; Twamley et al., 2012) and the present study is the first to provide such evidence. Furthermore, our results extend the robust II training effect on PM to schizophrenia patients.

However, no significant difference between the II group and the TAU group on the PRMQ score was found at post-treatment or at 3-month follow-up. In one PM intervention programme (Rose et al., 2015), researchers trained older adults with a virtual week game and found that training resulted in PM improvements in both a virtual week and naturalistic PM task (the call-back task), but not on the PRMQ. Thus, we speculate that the negative result may be caused by the relative insensitivity of the PRMQ to training effects.

For functional capacity, as measured by the BJ-PERFECT, it was found that II group scored higher than the TAU group in total score and the working ability subdomain at post-treatment. However, no significant difference was found at 3-month follow-up. PM has been found to be positively correlated with social functioning and living skills in schizophrenia patients (Au et al., 2014; Twamley, Woods, et al., 2008), and researchers have suggested that we may improve social functioning and functional capacity through PM training. Our results support this assertion. However, the long-term effect of our PM intervention programme for functional capacity in schizophrenia patients was limited. To gain lasting improvement in working ability, a combination of cognitive training and other interventions such as vocational intervention may be necessary (Vauth et al., 2005).

For social functioning, as measured by the SQLS, patients in the II group did not show significant difference with the TAU group at post-treatment or 3-month follow-up. However, the difference reached a medium effect size at 3-month follow-up. Thus, our intervention might have produced some improvement in subjective quality of life. In fact, such time-lagged improvements in subjective quality of life in patients with psychosis has also been reported in a previous compensatory intervention programme (Twamley et al., 2012).

Generally, lower estimated intellectual functioning, poorer baseline PM performance, lower psychosocial functioning, and more severe baseline symptoms were correlated with greater improvement in PM performance at post-treatment or 3-month follow-up. These results are consistent with a previous compensatory training study which suggested that more room may be left for patients with psychosis with lower baseline functioning to improve (Twamley, Burton, & Vella, 2011).

Our training programme demonstrated lasting effects in PM performance and significant transfer effects to functional capacity. The training effects may be attributed to the emphasis on giving the participants explicit instructions, encouraging them to practice the learned techniques at home and discussing the experience in using these strategies regularly (McDaniel et al., 2014; Waldum, Dufault, & McDaniel, 2016). It is noteworthy that in the II group, no participant dropped out and all finished the 10 sessions in our programme, suggesting high acceptance of the training protocol by the patients. However, not all PM performance or functional capacity improvements were maintained at 3-month follow-up. To achieve more sustained beneficial effects, we can consider integrating the participants' personal goals with the training protocol in the future. This may improve the participants' motivation and produce a stronger and longer-lasting training effect (Choi, Mogami, & Medalia, 2010). Moreover, regular reminders (e.g., phone calls or emails) to encourage participants to adopt the learned strategy in daily life after they finished the training sessions may also enhance the impact of training.

Notwithstanding the positive outcomes from the present study, several limitations need to be acknowledged. First, our sample size was relatively small, and the results need to be replicated in a larger sample. In addition, no active control group was included, making it difficult to rule out that the significant effects could be due to exposure to and attention by the trainers during the programme. Moreover, multiple comparisons due to the many statistical tests conducted may lead to alpha inflation.

In summary, our II intervention programme appeared to produce beneficial and sustained effects in improving PM performance and short-term beneficial effects for functional capacity. In addition, the programme appeared to benefit more for schizophrenia patients with lower psychosocial functioning, lower estimated intellectual functioning, poorer baseline PM performance, and more severe general psychopathology symptoms. II training may be an effective intervention to improve PM performance and functional capacity in patients with schizophrenia.

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Table 1. Demographic and clinical information of participants

	II group (N = 21)	TAU group (N = 21)		
	Mean (SD)	Mean (SD)	t/x^2	*p*
Male: female	10:11	6:15	1.62	0.204
Age (years)	44.57 (8.30)	43.86 (9.77)	0.26	0.800
Education (years)	11.67(2.76)	12.24 (3.00)	-0.64	0.524
IQ	103.29 (16.36)	102.95 (14.07)	0.07	0.944
Handiness□ right vs left□	20:1	19:2	0.36	0.549
Illness duration (years)	20.95 (11.18)	17.24 (7.24)	1.28	0.209
PANSS_T	47.24 (9.19)	49.24 (10.22)	-0.67	0.509
PANSS_P	9.67 (2.48)	10.67 (3.14)	-1.12	0.258
PANSS_N	13.52 (3.70)	12.57 (4.61)	0.74	0.462
PANSS_G	24.05 (4.71)	26.0 (5.07)	-1.29	0.203
AIMS	0.57 (1.21)	0.38 (0.67)	0.63	0.531
BARS	0.48 (1.03)	0.76 (1.55)	-0.71	0.485
Medication*	443.45 (376.36)	345.24 (306.35)	0.93	0.359

II= Implementation Intention; TAU= Treatment As Usual; PANSS_T = Positive and Negative Symptom Scale, total score; PANSS_P = Positive and Negative Symptom Scale, positive symptom score; PANSS_N = Positive and Negative Symptom, negative symptom score; PANSS_G = Positive and Negative Symptom, general symptom score; AIMS = Abnormal Involuntary Movement Scale; BARS = Barnes Akathisia Rating Scale.

*Chlorpromazine equivalence mg/day;

Table 2. Descriptive statistics and analysis of covariance results comparing prospective memory, social functioning and functional capacity at post-treatment controlling for baseline performances

	II group (N=21)		TAU group (N=21)				
	Baseline	Post-treatment	Baseline	Post-treatment			
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	*F*	*p*	η_p^2
Computer PM task							
EBPM_acc	0.34 (0.31)	0.81 (0.22)	0.33 (0.24)	0.57 (0.34)	7.75	**0.008**	**0.166**
TBPM_acc	0.56 (0.40)	0.83 (0.21)	0.68 (0.37)	0.75 (0.31)	5.00	**0.031**	**0.114**
Daily PM measures							
PRMQ_PM	20.19 (7.05)	19.29 (6.99)	19.63 (8.00)	19.45 (7.35)	0.04	0.842	0.001
Phone call	10.90 (6.99)	14.67 (6.85)	13.67 (6.75)	11.29 (7.38)	4.54	**0.040**	**0.104**
Social functioning and functional capacity							
BJ-PERFECT_T	22.62 (4.07)	24.57 (4.34)	24.14 (2.97)	24.29 (3.42)	4.74	**0.036**	**0.108**
BJ-PERFECT_a	8.33 (2.06)	8.57 (2.40)	8.67 (1.59)	9.05 (1.40)	0.26	0.610	0.007
BJ-PERFECT_b	5.00 (1.34)	5.24 (1.95)	5.43 (1.57)	5.00 (1.58)	2.54	0.119	**0.061**
BJ-PERFECT_c	9.29 (1.71)	10.76 (1.14)	10.05 (1.47)	10.24 (1.38)	5.34	**0.026**	**0.121**
PSP	77.52 (7.94)	79.62 (7.79)	76.71 (8.62)	78.90 (7.42)	0.06	0.804	0.002
SQLS	38.95 (19.49)	34.05 (14.74)	43.70 (13.83)	41.10 (13.22)	1.89	0.178	0.047

II= Implementation Intention; TAU= Treatment As Usual; EBPM_acc = Event-based PM accuracy; TBPM_acc = Time-based PM accuracy; PRMQ_PM = Prospective and Retrospective Memory Questionnaire, prospective memory score; BJ-PERFECT_T = Beijing Performance-based Functional Ecological Test, total score; BJ-PERFECT_a = Beijing Performance-based Functional Ecological Test, transportation score;
BJ-PERFECT_b = Beijing Performance-based Functional Ecological Test, financial management score; BJ-PERFECT_c = Beijing Performance-based Functional Ecological Test, work ability score; PSP = Personal and Social Performance scale, total score; SQLS = Schizophrenia Quality of Life Scale, total score; in *p* column, those less than 0.05 were bolded; in η_p^2 column, those larger than 0.06 were bolded.

Table 3. Descriptive statistics and analysis of covariance results comparing prospective memory, social function and functional capacity at 3-month follow-up controlling for baseline performances

	II group (N=21)		TAU group (N=19)				
	Baseline	Follow-up	Baseline	Follow-up			
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	*F*	*p*	η_p^2
Computer PM task							
EBPM_acc	0.34 (0.31)	0.83 (0.28)	0.33 (0.24)	0.61 (0.39)	4.53	**0.040**	**0.109**
TBPM_acc	0.56 (0.40)	0.77 (0.27)	0.68 (0.37)	0.68 (0.34)	2.49	0.123	**0.063**
Daily PM measures							
PRMQ_PM	20.19 (7.05)	21.67 (7.84)	19.63 (8.00)	19.74 (6.38)	1.41	0.242	0.037
Phone call	10.90 (6.99)	12.81 (7.38)	13.67 (6.75)	9.21 (7.74)	4.44	**0.042**	**0.107**
Social functioning and functional capacity							
BJ-PERFECT_T	22.62 (4.07)	23.95 (3.54)	24.14 (2.97)	24.05 (3.24)	1.06	0.310	0.028
BJ-PERFECT_a	8.33 (2.06)	8.52 (1.97)	8.67 (1.59)	8.95 (1.22)	0.40	0.533	0.011
BJ-PERFECT_b	5.00 (1.34)	5.14 (1.74)	5.43 (1.57)	4.89 (1.66)	0.99	0.327	0.026
BJ-PERFECT_c	9.29 (1.71)	10.29 (1.35)	10.05 (1.47)	10.21 (1.62)	0.27	0.608	0.007
PSP	77.52 (7.94)	79.52 (16.98)	76.71 (8.62)	81.26 (9.39)	0.31	0.580	0.008
SQLS	38.95 (19.49)	33.38 (16.15)	43.70 (13.83)	43.47 (19.91)	2.28	0.105	**0.069**

II= Implementation Intention; TAU= Treatment As Usual; EBPM_acc = Event-based PM accuracy; TBPM_acc = Time-based PM accuracy; PRMQ_PM = Prospective and Retrospective Memory Questionnaire, prospective memory score; BJ-PERFECT_T = Beijing Performance-based Functional Ecological Test, total score; BJ-PERFECT_a = Beijing Performance-based Functional Ecological Test, transportation score; BJ-PERFECT_b = Beijing Performance-based Functional Ecological Test, financial management score; BJ-PERFECT_c = Beijing Performance-based Functional Ecological Test, work ability score; PSP = Personal and Social Performance scale, total score; SQLS = Schizophrenia Quality of Life Scale, total score; in *p* column, those less than 0.05 were bolded; in η_p^2 column, those larger than 0.06 were bolded.

Figure legends:

Figure.1. Flow chart of participant group allocation and assessments

Figure.2. Computer event-based, time-based PM and working ability scores of two groups at baseline, post-treatment and 3-month follow-up