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Cognitive impairments in schizophrenia

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CHAPTER 8

SMS text messages as a prosthetic aid in the cognitive rehabilitation of schizophrenia and related disorders*

8.1 ABSTRACT

Objective To evaluate a cognitive prosthesis in the form of SMS-text messages to compensate for the effects of cognitive impairments in schizophrenia.

Method A waiting list controlled trial was conducted in sixty-two people with schizophrenia or related psychotic disorders. All patients showed impaired goal-directed behaviour in daily life situations.

Results The overall percentage of goals achieved increased with prompting, while performance dropped to baseline level after withdrawing the prompts. Keeping appointments with mental health workers and carrying out leisure activities increased with prompting, while medication adherence and attendance at training sessions remained unchanged. Prompting was especially helpful in patients who achieved relatively few goals at baseline, and in those with poorer planning abilities and poorer recognition of facial affect. A clear majority of the patients enjoyed receiving the SMS-text messages.

Conclusion SMS-text messages as a cognitive prosthesis significantly reduced impairments in goal-directed behaviour for some, but not all, daily activities. A majority of patients was satisfied with the cognitive prosthesis and almost half wanted to continue its use afterwards.

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8.2 INTRODUCTION

Although the use of cognitive prostheses to compensate for cognitive impairments is common practice in the rehabilitation of patients with traumatic brain injury (e.g. Evans et al., 1998), this approach has remained understudied in schizophrenia. Given the limited effect of anti-psychotic agents on these impairments (Purdon, 2000) and the lack of spontaneous generalisation of cognitive rehabilitation to relevant outcome in daily life (Twamley et al., 2003; Krabbendam & Aleman, 2003), this may be a regrettable omission.

Cognitive impairment is a prominent and disabling aspect of the schizophrenia; performance on neuropsychological assessment is within the normal range in only 20-30% of patients (Holthausen et al., 2002, Harvey & Keefe, 1997). In many schizophrenia patients it hampers the regulation of goal directed behaviour and limits participation in everyday activities (Mueser, 2000; Pijnenborg et al., submitted).

Traditionally, three approaches to cognitive rehabilitation in schizophrenia are distinguished: restoration, substitution and compensation (Wilson, 1997). Restoration refers to interventions that aim to improve underlying cognitive functions. Substitution is the use of intact functions instead of the impaired function to reach the same goal. Compensatory approaches include those methods that aim to improve daily functioning without necessarily changing the level of underlying cognitive impairment. Such approaches include methods of maximising residual learning skills, the use of mental strategies or external aids, or modifications to the environment that reduce the cognitive load on individuals.

Two meta-analyses show that cognitive rehabilitation in schizophrenia has a positive effect on neuropsychological test performance, although effect sizes were modest (Twamley et al., 2003; Krabbendam & Aleman, 2003). Studies that included measures of daily activities, such as community functioning or job performance demonstrate that improved task performance often does not generalise spontaneously to relevant situations in daily life. Even after successful training of performance on neuropsychological tests severe limitations on the ability to participate in activities of daily life may persist.

Compensation in the form of external aids or cognitive prostheses directly aims at improving daily activities, and therefore bypasses the lack of generalisation that is seen in other forms of cognitive rehabilitation. However, systematic reports on cognitive prostheses in schizophrenia are very few. Three studies have examined whether prompting would lead to a decrease of failure to attend appointments in schizophrenia (Reda and Makhoul, 2001). In two studies patients received a reminder telephone call 24 (Kluger and Karras, 1983) or 48 (Burgoyne et al., 1983)

hours before clinic appointments. Attendance increased by phoning patients a day before an appointments, although this effect did not reach statistical significance. Short written reminders a few days before the appointment day, also increased clinic attendance (Kluger and Karras, 1983; Swenson and Pekarik, 1988). In another study of environmental adaptations, Velligan et al. (2006) used a combination of external aids, such as alarms, and labels to bypass executive problems (Velligan et al., 2001). The intervention led to an improvement of everyday functioning.

The use of cognitive prostheses in schizophrenia can be theoretically underpinned by theories that hypothesise that patients have problems in performing goal-directed behaviour as a result of both ineffective schema selection (Hemsley, 2005) and impaired 'willed action', or self-initiated action (Frith, 1992). We argue that a cognitive prosthesis that prompts goal-directed behaviour will compensate for these impairments. Indeed, it has recently been demonstrated that schizophrenia patients with impaired willed action are capable of adequate response to external prompts (e.g. Langdon et al., 2007).

Based on this assumption, we studied the efficacy of a cognitive prosthesis in the form of Short Message Service (SMS) Text-Messages. SMS Text-Messages are short text messages (up to 160 characters), sent to mobile phones. The extensive use of mobile telephones in the general population makes the use of this kind of cognitive prosthesis non-stigmatising and most schizophrenia patients are likely to be familiar with them. A pilot study (Pijnenborg et al., 2007) showed promising results in a small case-series.

In the present study the efficacy of SMS Text-messages in prompting behaviours was evaluated. In the same way that spectacles can be said to compensate for visual impairment but do not lead to enduring improvement in vision when they are removed, we predicted that provision of SMS Text-messages would lead to an increase in the percentage of goals achieved in daily life, followed by a decrease in performance after their withdrawal. In addition to this primary hypothesis we were interested in whether patients who benefit from the SMS-text messages would also improve on indirect outcome measures of self-esteem, community functioning and psychiatric symptoms. Moreover, we examined the predictive validity for success of a number of variables. Finally, we were interested in whether patients felt positive about the intervention and whether or not they would want to continue to use the SMS Text-message prompting after completion of the study.

8.3 METHODS

8.3.1 Patients

Inclusion criteria for the study were a diagnosis of schizophrenia or a related disorder and observed impairments in goal-directed behaviour (see procedure for more details).

Sixty-two people (49 men, 13 women) participated. They were diagnosed with schizophrenia (n=53), schizoaffective disorder (n=4), schizotypal personality disorder (n=2) psychotic disorder NOS (n=3) according to DSM IV criteria. Diagnoses were determined using chart information and confirmed by independent psychiatrists.

Patients mean age was 28.8 years (sd 8.8). A scale ranging from 1= primary school to 7=university (Verhage, 1983) was used to classify the level of education; the mean level of education was 4.5 (sd .9). The mean number of psychotic episodes was 1.6 (sd .97). Four patients did not use anti-psychotic medication; two patients used a combination of classic anti-psychotic medication (Penfluridol, Chlorprothixene) and atypical anti-psychotic medication (Olanzapine, Risperdone). The remaining patients used atypical anti-psychotic medication (Aripripazole; n= 2, Clozapine; n = 16, Olanzapine; n =17 , Quetiapine; n=3 and Risperdone; n=18). In addition, a number of patients used anti-depressive medication (n=23), Lithium (n=3) and /or benzodiazepines (n=24).

Eight patients were living independently, seven of them received outpatient care and one participated in a rehabilitation program. Six patients were living in sheltered housing. The remaining 48 patients were inpatients, 41 of them were following an inpatient rehabilitation program.

8.3.2 Materials

SMS text-messages

Thirty patients were provided with a Nokia 8310 or 8210 during the intervention, while 24 patients used their own mobile telephone. SMS text-messages for each patient were entered and sent via a web application built for the purpose of the study.

Tests and Questionnaires

Cognitive Functioning:

To measure cognitive abilities we used: the short version of the Groninger Intelligence Test (GIT); Luteijn & Van der Ploeg, 1983); a verbal memory test (15-Words Test;

Saan & Deelman, 1986); a test of behavioural memory (Rivermead Behavioral Memory Test, RBMT; Wilson et al., 1989); a vigilance test (Continuous Performance Test, CPT; Cornblatt & Keilp, 1994); a test of planning (Six Elements Test, SET; Burgess et al., 1996); a test of perceptual-motor speed and mental flexibility (Trail Making Test; Reitan, 1979); a Theory of Mind test (Faux Pas Test; Stone et al., 1998); a test of perception of emotional prosody (Prosody Test, Pijnenborg et al., 2007); and a test of facial affect perception (FEEST; Young et al., 2002).

Motivation: a shortened version of the Client Motivation for Therapy Scale (CMFTS; Deci & Ryan, 1985) was used to assess motivation. Nine items that measure motivation for a specific intervention on a five-points scale were selected from the original questionnaire.

Psychiatric symptoms: the PANSS-interview (Kay et al., 1987) was used to measure psychopathology. Symptom clusters were based upon the model of Lindenmayer (1994), which encompasses a five-factor structure of psychiatric symptoms consisting of positive symptoms, negative symptoms, desorganisation, depression and excitement.

Social Functioning: the Social Functioning Scale (Birchwood et al., 1990) was used to assess social community functioning. The participant and a nurse or family member who regularly interacted with him/her were asked to complete the scale: basic skills and other aspects of community functioning are rated as present or absent.

Self esteem: the Rosenberg Self-Esteem Questionnaire (Rosenberg, 1965), a ten item self report questionnaire.

8.3.3 Procedure

Impaired performance on neuropsychological assessment does not have a one-to-one relationship with actual limitations in naturalistic settings. Therefore, selection of patients for the study was based on observed limitations in daily life, rather than on performance on neuropsychological tests. Patients were referred to the study by nursing staff, psychologists or psychiatrists when impaired goal directed behaviour (e.g. frequent failures to attend appointments or poor medication adherence) was observed. After being informed of the procedures, all patients gave written informed consent. Subsequently, cognitive functioning, psychiatric symptoms, social community functioning and self-esteem were assessed by independent raters. After assessment patients attended six weekly sessions in groups of five to seven patients. The first session contained information about the project, the following three sessions included psycho-education on cognitive impairments in schizophrenia and then in the final two sessions patients were trained in receiving and reading SMS

text-messages.

Following the group sessions, goals for the intervention were set. The intervention was tailored to individual needs by encouraging patients to choose their own goals. Some patients had difficulties reporting on their daily behaviour or in setting realistic goals, so a nurse or family member who interacted with the participant on a regular basis was present to assist the participant whenever necessary. These persons made suggestions of goals for the intervention whenever the patients were not able to identify goals themselves. For each patient a schedule of SMS text-messages was developed and entered into a website. For each goal, two prompts were sent. The first was sent an hour before the goal behaviour should take place, to enable patients to fit the target action into their current schedule. In a previous pilot study patients sometimes arrived late at prompted sessions when a ten minute prompt was used because they were engaged in other activities and needed more time to end current activities and reach the correct location. A second prompt for action was provided ten minutes before goal behaviour was due, so patients could then initiate relevant actions (e.g. walking to the consulting-room of their psychiatrist or collecting medication).

The most common goals were “taking medication”, “appointments with mental health workers” and “attending the training programme”. Other goals were activities such as “doing grocery shopping” or “attending a band rehearsal”. Two patients asked for prompts to inhibit behaviour rather than activations; their goals were “not eating more than one portion of dinner” and “relaxing two hours during the afternoon”.

The design was based on a previous study examining the efficacy of a cognitive prosthesis in the cognitive rehabilitation of traumatic brain injury (Wilson et al., 1997b). The first 33 patients that were referred to the study followed an A1-B-A2 design, with A1 being the baseline (and withdrawal) phase, B being the intervention phase and A2 follow up. For the rest of the patients an extra baseline condition was added to control for the effects of time passing; 29 patients were assigned to a waiting list control condition (A0-A1-B-A2). The assignment of patients to conditions can be considered as random, because the assignment was purely based on the availability of places in the experimental treatment condition and not in any sense on patient characteristics. Because psycho-education was offered in groups, patients commenced the trial in groups of five. It was of course not possible for patients to be blind to condition.

After goals were set, a two-week baseline (A1) for goal behaviours was set for all patients. Several mental health workers and family members observed patient's behaviour during the trial and scored whether goals were achieved. Behaviour was scored as successful when the goal was achieved within a specified time frame (for

example medication taken within one hour of the planned time or arriving for a consult within ten minutes of the planned time) or as non-successful if the goal was achieved too late or was not achieved at all. Subsequently, patients in the A1-B-A2 group were prompted with SMS text-messages during an intervention period of seven weeks. In the last three weeks of the intervention period target behaviour was scored again (B). At the end of this period, assessment of social community functioning, psychiatric symptoms and self-esteem was repeated. After SMS text-messages stopped and after a period of three weeks, behaviour was scored again over a period of two weeks (A2). Finally, the intervention was evaluated in a meeting with the participant and the contact person. Patients in the A0-A1-B-A2 condition were on a seven-week waiting list after the first baseline measurement (A0). During the last two weeks of the waiting list (A1) behaviour was scored while the rest of the trial was the same as in the A1-B-A2 condition.

8.4 RESULTS

8.4.1 Main Effects

Figure 8.1 is a flow chart of the number of participants and drop-outs in each phase of the trial. In sum, 62 patients were included, while 47 patients completed the intervention, of whom 44 patients completed the follow up three weeks after the intervention. Reasons for dropout are presented in Table 8.1.

Post hoc inspection of patients' goals revealed that they could be divided into five categories: "medication adherence", "appointments", "activities", "attending training sessions" and "inhibition of undesired behaviour". The number of goal categories varied from one to four. The number of times a specific goal behaviour should occur varied considerably between goals and also between patients. The dependent variable therefore was the percentage of goals achieved.

Performance on each goal was rated as a "success" (goal achieved within a specified timeframe) or as a "failure" (goal achieved too late or goal not achieved at all). As a first step in the data analysis, we examined the effect of time by comparing the overall percentage success per person during A1 (baseline) of the A1-B-A2 condition to the overall success percentage during A1 (the waiting list) of the A0-A1-B-A2 condition. Twenty-one patients completed the first two phases of the waiting list condition. There was no significant difference between patients in the A-B-A and A-A-B-A condition on any of the demographic or cognitive variables or motivation for the intervention. Mean percentage success was 56% (SD 27.2) during baseline (A0) and 52% (SD 29.3) during the waiting list (A1). As a Kolmogorov-Smirnov test for normality was not significant for any of the variables, parametric

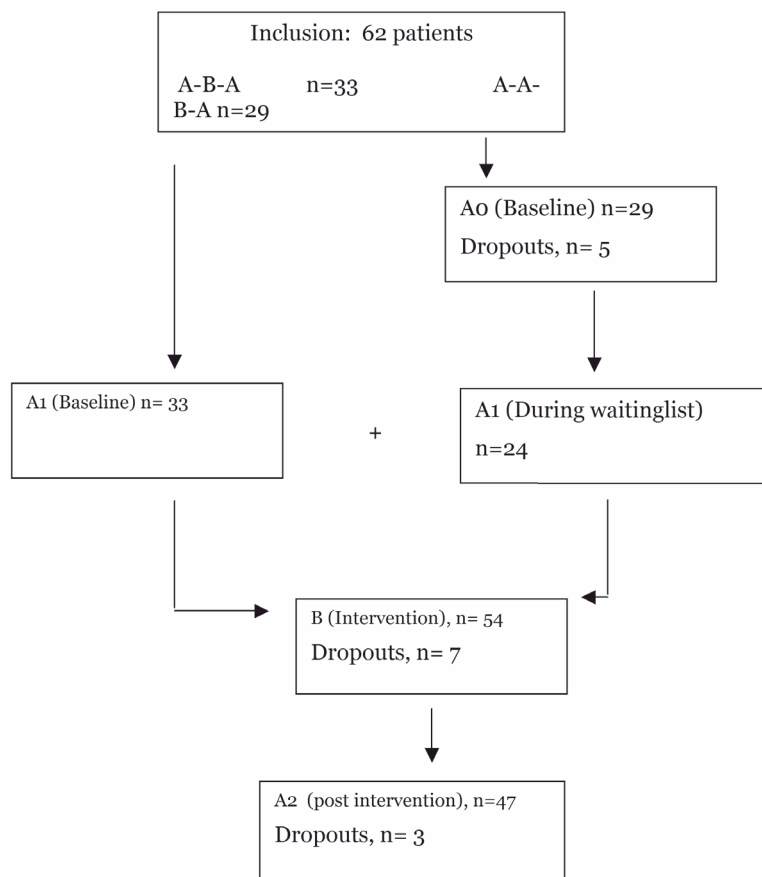


Figure 8.1 Flowchart : number of patients and drop outs during each phase of the trial

Table 8.1 Reasons for dropout

Baseline	<i>Loss of motivation to participate (n=3) Never showed up again after giving informed consent (n=2)</i>
Waitinglist	<i>Continued treatment elsewhere (n=1) Loss of motivation for the intervention (n=2)</i>
Intervention	<i>Was not able to open SMS-text messages due to disorganisation (n=1) Sold the mobile telephone (n=1) Change of work situation in combination with exclusively work related goals (n=1) Was annoyed by SMS text messages (n=1) Was unable to achieve goals due to back pain (n=1) Continued treatment elsewhere (n=1) Was not able to participate due to increased psychotic symptoms (n=1)</i>
Follow up	<i>Continued treatment elsewhere (n=3)</i>

tests were used. A paired sample t-test showed that the difference between baseline and waiting list was not significant ($t = .75$, 95% c.i. of the difference [-7, 16], n.s.). An independent samples t-test on B (intervention) of the A-B-A condition versus A2 (waiting list) of the A-A-B-A condition found that the percentage success during the intervention in the A-B-A condition was significantly higher than during the waiting list (respectively 52% (SD 29.3) and 66% (SD 19.4); $t = 2.01$, 95% c.i. of the difference [.01, .27], $p < .05$). Thus, performance in the baseline condition was comparable to the waiting list condition in the A-B-A-A design, while the percentage success significantly increased during the intervention when the waiting list was compared to the intervention of the A-B-A condition.

These results justify combining the percentage success in each phase over conditions (see flowchart) to enhance statistical power of further analyses. The overall mean success percentage over all goal categories was 47% (SD 27.9) during baseline, increased to 62% (SD 20.1) during the intervention and dropped to 40% (SD 31.7) at follow-up. The standard deviations illustrate that the percentage of achieved goals over patients covered the entire range of 0% to 100% during baseline and after the intervention. This wide range represents large inter-individual variance. Also, the mean and SD for each phase of the trial show that intra-individual variance was also large; only a very small number of patients achieved non or all of their goals, while most patients achieved a number and missed others. With prompting the variance diminished with a maximum of 100% maintained and a minimum of 13% instead of 0%.

For the percentages of achieved goals during each phase of the trial Kolmogorov-Smirnov tests showed the assumption of normality of the variables was not violated. Subsequently a MANOVA repeated measures was performed to examine whether the difference between percentage success during baseline, intervention and follow up were significant. Since our main interest was in the difference between baseline and intervention, the mean percentage success during follow up was imputed for the three patients with missing follow up data, to prevent them from list wise exclusion. Thus the 47 patients who completed the baseline and intervention were included. The number of goals that were achieved differed significantly between conditions ($F_{2,86} = 12.27$, $p < .001$).

Post hoc tests (pair wise comparisons) were used to examine this finding in more detail. During the intervention, patients' mean percentage success was 15 % higher than during baseline, this difference was significant (95% c.i. intervention-baseline [7, 24], $p < .001$). Cohen's d' for this effect was .65, this is a little above a medium effect size according to Cohen's (1988) nomenclature.

Furthermore, the effect of the intervention was not maintained after withdrawing

the SMS-text messages (95% c.i. intervention-follow up [13, 30], $p < .001$), and dropped to the level of baseline performance (95% c.i. baseline-follow up [-3,17], n.s.).

We were interested in whether the effect of the intervention would be the same over goal categories. Mean percentage success for each of the categories was calculated (see Table 8.2). As three patients were lost to follow up and moreover, for a number of patients specific goal behaviour did not take place after the intervention, mean percentage success during follow up was imputed for patient with missing follow up data.

Table 8.2 Mean success percentage and standard deviation for medication adherence, attending training program, individual appointments, activities and inhibition

	Medication M	Medication SD	Program M	Program SD	Appointments M	Appointments SD	Activities M	Activities M	Inhibition M	Inhibition SD
Baseline	57%	28.8	49%	39.6	39%	32.1	33	29.5	89	15.7
	N=24		N=14		N=38		N=6		N=2	
Inter- vention	65%	25.3	51%	35.1	65%	26.2	76	23.8	90	14.1
	N=24		N=14		N=38		N=6		N=2	
Follow-up	48%	33.4	37%	38.7	56%	37.5	25	39.5	67	25.2
	N=19		N=13		N=25		N=6		N=2	

MANOVA repeated measures analyses were performed for mean percentage success in the categories “Appointments”, “Medication” and “Training Program” separately. The number of patients in the categories “Activities” and “Inhibition” were too small to perform further significance testing.

The percentage of appointments attended on time differed significantly between conditions ($F_{2,74} = 12.94$, $p < .01$). Post hoc test (paired comparisons) were used to follow up this finding. During the intervention percentage success was 26% higher than during baseline, this difference was significant (95% c.i. intervention-baseline [16.37], $p < .001$). The effect size for this increase was large (Cohen’s $d' .90$; Cohen, 1988). The percentage of appointments attended on time remained relatively high after the intervention (95% c.i. intervention-follow up [-2, 19], n.s.) and was well above baseline level (95% c.i. baseline-follow up [-27, -1], $p < .01$).

As to medication adherence we found a significant difference between conditions ($F_{2,46} = 5.37$, $p < .01$). Again, post hoc tests (pair wise comparisons) were used to specify results. Although percentage success was 8% higher during the intervention than during baseline, this difference was not significant (95% c.i. intervention-

baseline [-2, 19], n.s.). After the intervention medication adherence dropped significantly (95% c.i. intervention-follow up [7, 24], $p < .001$) and was even lower than the level of baseline performance (95% c.i. baseline-follow up [-2,19], n.s.).

The difference in the number of training sessions that were attended during each phase was not significant ($F_{1,13} = 1,57$, n.s.). The increase in goal-directed behaviour with prompting was only 2%. Thus, prompting did not lead to an increase in attended training sessions.

Given the small number of patients in the categories activities and inhibition we did not perform significance testing. For activities percentage success increased during the intervention and decreased again afterwards. For inhibition the success percentage was already high during baseline and did not increase further with prompting.

8.4.2 *Predictors of success*

To identify predictors of success, it was necessary to define success. To avoid an arbitrary cut-off, a median split based on the difference between success percentage during the intervention and during the baseline (a measure of success of the intervention) was used to divide patients into a two groups. In the group below the median ($n=23$) the mean percentage success during baseline was 63% (SD 22.7) and was 56% (SD 19.1) during the intervention. This means that the mean success percentage actually decreased somewhat with prompting in this group. A paired sample t-test showed that this decrease was not significant ($t = -1.8$, 95% c.i. of the difference [-.01, .15], n.s.). In the group above the median ($n=24$), the mean percentage success during baseline was 32% (SD 23.8) and was 68% (SD 19.3) during the intervention. This increase in success percentage was significant ($t = 10.6$, 95% c.i. of the difference [.29, .43], $p < .001$). Also, an independent sample t-test showed that the between group difference of this change in success percentages was significant ($t = 8.4$, 95% c.i. of the difference [.32, .53], $p < .001$). Thus, percentage success increased significantly with prompting in the group above the median, whereas mean performance in the group below the median remained unchanged. The below median group are referred to as non-responders and the above median group as responders.

Next, differences between responders and non-responders were examined. An Independent Sample t-test showed that the between group difference in baseline performance was significant ($t=4.5$, 95% c.i. of the difference [17, 45], $p < .01$): responders achieved significantly less goals during baseline than non-responders .

A set of variables that were expected to be associated with success of the intervention were selected: baseline assessment of cognitive functioning, Panss

subscales (psychiatric symptoms) and PANNS item G12 (insight), Rosenberg (self-esteem), SFS (social community functioning), and CMFTS (motivation).

Independent Sample t-tests were used to compare responders to non-responders. Non-responders performed significantly better than responders on the FEEST and Six Elements Test (respectively $t=2.7$, 95% c.i. of the difference [1.2, 8.3], $p<.01$ and $t=2.6$, 95% c.i. of the difference [.1, 1.3], $p<.01$). No significant difference on any of the other variables was found.

8.4.3 *Effects on psychiatric symptoms, social community functioning and self-esteem*

To examine the effect of the intervention on functional outcome we performed Paired Sample t-tests on the difference between psychiatric symptoms (PANSS subscales), social community functioning (SFS self and other) and self-esteem (Rosenberg). The t-tests were performed in the responders and non-responders separately, since we reasoned that possible indirect effects would be associated with an increased percentage success. Results are shown in Table 8.3. For responders the intervention led to a decrease of negative symptoms, whereas non-responders remained stable over time.

8.4.4 *Subjective Evaluation*

Forty-six patients filled out a brief evaluation form after the intervention. Thirty-two patients (70%) were positive about the intervention, nine patients (20%) were neutral, while five patients (10%) were negative. Moreover, 19 patients (41%) thought the SMS text-messages to be effective, 15 patients (33%) were neutral towards the efficacy of the SMS text-messages and 12 patients (26%) evaluated the SMS- text-messages as ineffective.

Finally, twenty-two (47%) patients were willing to continue the SMS text-messages after the trial had stopped, 10 patients (22%) were not sure about continuation and the remaining 14 patients (31%) did not want to continue the SMS text-messages. When data were split into responders and non-responders percentages did not differ across groups.

Table 8.3 Effects of prompting on indirect outcome measures for responders and non-responders

Measure	N responders 1)	N non-responders	Difference in mean and SD responders	Difference in mean and SD non-responders	t ²⁾ responders	t non-responders	95% c.i. of the Difference responders	95% c.i. of the Difference Non-responders
Social Functioning Scale (self)	21	21	-2.04 (36.2)	10.21 (43.5)	-3	1.1	[-18.5, 14.4]	[-9.5, 30.1]
Social Functioning Scale (other)	15	17	-2.6 (39.8)	-16.7 (61.6)	-3	1.1	[-24.6, 19.4]	[-48.4, 14.8]
PANSS negative	23	20	2.5 (3.7)	.6 (3.8)	3.2**	.6	[-.9, 4.6]	[-1.3, 2.4]
PANSS Excitement	23	20	.6 (2.7)	-.9 (2.5)	1.1	1.5	[-6, 1.7]	[-2.0, .3]
PANSS Desorganisation	23	20	.3 (3.5)	-.7 (2.9)	.4	1.1	[-1.2, 1.8]	[-2.0, .6]
PANSS Positive	23	20	.1 (2.7)	-.2 (3.0)	.2	.3	[-1.1, 1.2]	[-1.6, 1.2]
PANSS Depression	23	20	.2 (3.2)	.3 (3.7)	.3	.4	[-1.2, 1.6]	[-1.4, 2.0]
Rosenberg	23	20	0 ³⁾	3(1.5)		1		[-3, 1.0]

1) Because a number of patients did not show up for (parts) of the follow up assessment or were not able to fill out the questionnaires and a number of family members/ nurses did not return the SFS the number of Patients is specified for each measure

2) ** p<.01

3) t-tests could not be computed, since the difference is 0

8.5 DISCUSSION

To our knowledge this paper is the first to report on the efficacy of SMS text-messages in the cognitive rehabilitation of schizophrenia. When prompted with SMS text-messages, patients achieved significantly more of their goals in daily life. The overall effect size of prompting was medium and much higher than that of restorative and other compensation approaches in the cognitive rehabilitation of schizophrenia reviewed in the meta-analyses of Krabbendam & Aleman (2003) and Twamley et al. (2003), although it should be noted that the effect sizes in this meta-analysis concerned performance at a test level rather than measuring everyday functioning. When the effect of prompting on specific categories of goal behaviour was examined, results showed that prompting was clearly effective in increasing the percentage of appointments with mental health workers that patients attended, and there was also a favourable effect on leisure activities. Prompting did not lead to a significant increase in medication adherence, attendance at the training program or the inhibition of undesired behaviour. Intra-individual variance in goal-achievement was large during each phase of the trial and even with prompting patients missed a considerable amount of their goals. The effect of prompting in schizophrenia was smaller (about 10%) than in patients with traumatic brain injury (Wilson et al., 2001).

Apparently prompting alone was not sufficient to overcome all of the effects of negative symptoms or cognitive impairments, or, alternatively, factors that are not addressed by the cognitive prosthesis in our study, such as positive symptoms, may play a role here. Patients set the goals for the interventions and were facilitated to choose their own goals. The majority of patients spontaneously asked for prompts for appointments, while activities and inhibition were also spontaneously mentioned by a number of patients. Medication and training sessions were less often chosen by patients themselves and more often proposed by a nurse or family member. We speculate that some patients may have been compliant, but accepted goals for which they were not intrinsically motivated. Alternatively, it is possible that the length of time (10 minutes) between the SMS prompt and the time for action was too long, such that patients may have been distracted by irrelevant environmental cues. In addition, patients sometimes forgot to bring their phone or to load its battery, which will have inevitably limited the effect of the intervention.

The overall effect of prompting disappeared after the intervention. Most probably, the cognitive prosthesis is helpful in compensating for deficits but its efficacy is dependent on actual use. Alternatively, it may be that seven weeks was too short to establish a routine and prompting over a longer period of time would lead to

a lasting change in behaviour.

At baseline, responders achieved significantly less goals (about one third) than non-responders (about two third). Thus, prompting was more successful in patients with quite poor initial performance, as compared to patients who already achieved larger percentage of their goals. In the latter case, prompting did not lead to improved performance. Responders were more impaired than non-responders and performed more poorly during baseline and so had greater scope to improve during the intervention. But although the non-responders performed better at baseline it was clearly not the case that there was no room for improvement- all had been recruited on the basis of having difficulties remembering to do things in everyday life, and indeed during baseline were only achieving just over half of their intended goals.

Non-responders also outperformed responders on a planning task and on a measure of facial affect perception, while the success of prompting was not associated with other cognitive measures, psychiatric symptoms and motivation. Poorer planning abilities in responders (with performance on memory tests and negative symptoms being comparable) suggest that the effectiveness of prompting lies in its potential to compensate for executive impairments. Another findings of our study point in the same direction. Wilson et al. (2001) argue that in patients with traumatic brain injury who return to baseline after the use of a cognitive prosthesis are more likely to have executive impairments, which was also observed in our sample. The explanation for poorer affect recognition in responders is less straightforward. We speculate here that non-responders are more sensitive to non-verbal feedback from others and therefore are more motivated to be compliant with treatment, while for responders the prompts compensate for the lack of reinforcement in interpersonal interactions. This explanation remains however speculative and the exact nature of the relationship between these cognitive measures and success of prompting needs to be examined in greater detail in future studies.

The effect of the prompts on indirect outcome measures (self-esteem, psychiatric symptoms and social community functioning) was also examined. Patients who profited from the intervention showed less negative symptoms after the intervention than during baseline. Apparently, that fact that these patients were activated by the prompts was also noticed during the PANSS interview. Contrary to our expectations, other psychiatric symptoms, self-esteem and community functioning were not changed by the intervention. It may be that the intervention was too short to bring about real changes in these outcome measures. Furthermore, many patients in our sample were participating in a rehabilitation program. This may have limited the possible range of improvement in social functioning. For example, most patients in

the rehabilitation program did not have a job nor were they looking for one, because they were attending daily training sessions and did not have enough time to work.

A subjective evaluation of the interventions by the patients showed that the majority of the patients was positive about the prompts and almost half of them wanted to continue to receive prompts after the trial had stopped. Furthermore, about half of the patients felt that prompting was effective to help them overcome their limitations. The subjective evaluation of the prompts was not associated with its efficacy for individual patients.

This study has a number of methodological limitations that may be addressed in future studies. Although overall effects were calculated on a substantial number of patients, patients in some categories were too few to do significance testing, result warrant replication in a larger sample. Assessors in the study were not blind to the research hypothesis, though subjective judgement during the scoring of the goal behaviour was not required and the likelihood of bias in scoring behaviour as present or absent is minimal.

The results of our study have a number of implications for clinical practice. First, in schizophrenia prolonged prompting over a longer period of time appears necessary, as the majority of patients did not develop a routine during the trial. Second, results suggest that poor planning abilities at a test level are probably a good indication for offering a cognitive prosthesis in individual patients. Furthermore, as responders performed significantly worse than non-responders at baseline, it is expected that patients with the poorest performance in daily life will probably benefit the most. Third, a lack of intrinsic motivation for specific behaviours may have been responsible for limited effects of prompting. If SMS-text messages are to be used to enhance treatment adherence, they may need to be combined with interventions that enhance motivation for treatment, for example motivational interviewing (Kemp et al, 1996). Many people with schizophrenia find it very hard to associate long term goals with behaviour in the short term. For example, taking medication today may not be associated with a decrease of symptoms in a couple of weeks. The effectiveness of prompting may be larger when short-term goals are explicitly associated with relevant outcome in daily life. Finally, clinicians may ask themselves why patients are apparently more motivated for individual appointments with clinicians than for taking their medication and attending group sessions.