CHAPTER 7
SMS Text-messages as a Prosthetic Aid in the Cognitive Rehabilitation of Schizophrenia: a pilot study*

7.1 Abstract

Objective: To evaluate the efficacy of SMS Text-Messages as a compensatory aid to improve independence in individuals diagnosed with schizophrenia and cognitive deficits.

Design: An A-B-A withdrawal single case experimental design was used. Eight men diagnosed with schizophrenia took part in the study, all demonstrated memory and/or planning problems in everyday life.

Results: Five participants completed the entire trial. Four were more successful in carrying out daily activities when receiving prompts, while one did not profit from the intervention. Conclusion: SMS Text-Messages can be effective in compensating for cognitive impairment in some, but not all individuals with schizophrenia.


7.2 Introduction

Cognitive impairment is considered to be one of the core deficits in schizophrenia. Impairments in multiple cognitive domains have been reported over the past decades; functions such as verbal learning, working memory, vigilance, psychomotor speed, executive functioning (Heinrichs & Zakzanis, 1998), and affect recognition (Edwards et al., 2002) are impaired in schizophrenia.

The limited effects of pharmacological treatment on cognition (for example
Woodward et al., 2005) stimulated the development of behavioural interventions to enhance cognitive functioning or cognitive rehabilitation. In a meta-analysis on cognitive rehabilitation in schizophrenia, Krabbendam and Aleman (2003) evaluated the effects of training programs based on restoration, and strategy training, or compensation, and found that both approaches can improve task performance. In restoration the use of a particular cognitive function is practiced repeatedly, while in compensation individuals are provided with alternative strategies to achieve goals. In addition, they tentatively conclude that compensation is more useful to enhance cognitive functioning, than cognitive exercises. However, in most cases, effects of these interventions do not generalize to complex daily living situations, in which the burden on memory or executive skills is at a maximal level (see also Twamley et al., 2003).

Typically, cognitive rehabilitation is aimed at impairments, identified by scores on tests, rather than activity limitations and participation restrictions (ICF, 2001), which are the ways impairments manifest themselves in the form of everyday problems and social limitations. Basic cognitive impairments are treated in the hope that participation restrictions and social or environmental inadequacies will be reduced as well. This is also the case in most behavioural interventions used to treat cognitive impairments in schizophrenia, which are typically aimed at “teaching thinking skills”. These efforts have generally focussed on statistically significant changes in performance on a single neuropsychological task, but effects failed to generalize to improved social functioning in daily life (Wykes & Van der Gaag, 2001). According to Wilson (1997) rehabilitation should therefore be aimed at the level of daily functioning, rather than at impairment level.

In the treatment of individuals with traumatic brain injury, this is most often done by the use of prosthetic aids, which have often proven to be very effective (for example Wilson et al., 2001). In the cognitive rehabilitation of individuals with schizophrenia, the use of environmental supports to compensate for deficits in cognitive functioning in schizophrenia has remained understudied. To our knowledge, only Velligan, et al. (2002) have systematically studied the use of environmental supports like posted lists or instructions to bypass executive problems. They found an improvement of adaptive functioning and quality of life and less psychotic relapses during the intervention.

In the present study we follow this line of research and propose an intervention aimed at the level of real-world outcomes: a cognitive prosthesis will is be used to prompt relevant behaviour in daily living situations. We studied the efficacy of a non-stigmatising compensatory aid: the MEmory and EXecutive functioning project (MEMEX project). In the MEMEX project, Short Message Service (SMS) Text-
Messages were used as prompts to remind participants of their daily activities and appointments. SMS Text-Messages are short text messages (up to 160 characters), send to cell phones by other cell phones or web pages. We hypothesize that prompting individuals with schizophrenia with external cues will lead to an increase of the percentage of goals achieved in daily live. Furthermore, we expect that performance of the participants will decrease again after the removal of the prosthetic aid.

7.3 Methods

7.3.1 Participants
Eight men diagnosed with schizophrenia according to DSM IV criteria participated in the MEMEX project. Diagnoses were based on chart review and confirmed by judgement of an independent clinician. All participants were clinically stable at the start of the study and were participating as inpatients in a rehabilitation program at the Department of Psychotic Disorders in Assen, the Netherlands. At the time of the study, no women were participating in the rehabilitation program, therefore all participants were men. Inclusion in the study was based on observations in daily life situations. This was decided because, in our opinion, inclusion criteria should be congruent with the level of intervention. An independent clinician and the nursing staff, who interacted with the participants on a daily basis, observed the participants’ daily functioning. Participants who self-reported or demonstrated memory and executive problems were invited to participate in the study. The mean number of psychotic episodes experienced by the participant sample was 1.4 (SD = .74), ranging from 1 to 3. Other relevant participant’s characteristics are summarized in Table 7.1.

7.3.2 Materials
An application using Microsoft Access was used to set up a schedule of reminders for each individual participant. A conventional computer, a plugin, and a cell phone were used to transmit the SMS Text-Messages. Each individual participant used a cell phone, type Nokia 8310.

7.3.4 Procedure
After institutional board approval was obtained, participants were informed in detail about the MEMEX project, and after the experimental procedures had been explained, all participants gave written informed consent. Thereafter, they were assessed with a short neuropsychological battery, covering domains frequently reported to be impaired in schizophrenia (Heinrichs & Zakzanis, 1998) and a PANSS-interview. This is the most widely used semi-structured interview on symptoms of schizophrenia,
and has excellent psychometric properties (Kay et al., 1987). Memory, attention, psychomotor speed, mental flexibility, and planning abilities were assessed with respectively the 15 Words Test (Saan, & Deelman, 1986), the Stroop Color Word Test (Golden, 1978), Trailmaking A and B (Reitan, 1979), and the Modified Six Elements Test of the Behavioural Assessment of the Dysexecutive Syndrome (Wilson et al., 1997). During two subsequent group sessions, participants were trained in the use of a cell telephone. Directly after the telephone training, participants were asked to fill out a questionnaire each day during a two-week period, to assess the exact nature of their cognitive problems. An example item of this questionnaire was ‘I completely forgot about something important I had planned for today’. After this assessment of daily problems, goals for the intervention were set and a schedule of reminders was developed. An A-B-A withdrawal single case experimental design was used to evaluate the MEMEX intervention. After goals for the intervention were set, the nursing staff and other rehabilitation workers were asked to record daily whether or

<table>
<thead>
<tr>
<th>Participant</th>
<th>Age</th>
<th>Level of Education</th>
<th>Medication and dose</th>
<th>Main Symptoms (PANSS)*</th>
<th>Main Cognitive Deficits*</th>
</tr>
</thead>
<tbody>
<tr>
<td>DE</td>
<td>23</td>
<td>5</td>
<td>Risperidone 5mg</td>
<td>Blunted affect (4) Anxiety (4)</td>
<td>Memory (15 words test) attention (Stroop)</td>
</tr>
<tr>
<td>PT</td>
<td>24</td>
<td>5</td>
<td>Olanzapine 20mg</td>
<td>Lack of Judgement and Insight (5)</td>
<td>No impairments</td>
</tr>
<tr>
<td>GW</td>
<td>19</td>
<td>6</td>
<td>Olanzapine 20mg</td>
<td>Symptoms in remission</td>
<td>Memory (15 words test)</td>
</tr>
<tr>
<td>CX</td>
<td>38</td>
<td>6</td>
<td>Olanzapine 10mg</td>
<td>Delusion (4) Depression (4) Lack of Judgement and Insight (4)</td>
<td>No impairments</td>
</tr>
<tr>
<td>BW</td>
<td>23</td>
<td>5</td>
<td>Clozapine 100mg</td>
<td>Lack of Judgement and Insight (5)</td>
<td>Memory (15 words test)</td>
</tr>
<tr>
<td>HL</td>
<td>27</td>
<td>5</td>
<td>Risperidone 5mg</td>
<td>Blunted affect (5) Passive/Apathetic social withdrawal (4) Depression (5) Lack of Judgement and Insight (4)</td>
<td>Memory (15 words test) executive functioning (Six Elements Test)</td>
</tr>
<tr>
<td>JL</td>
<td>32</td>
<td>4</td>
<td>Clozapine 200mg</td>
<td>Emotional withdrawal (4) Passive/apathetic social withdrawal (4) Depression (5)</td>
<td>Memory (15 words test) attention (Stroop)</td>
</tr>
<tr>
<td>RH</td>
<td>21</td>
<td>3</td>
<td>Clozapine 100mg</td>
<td>Difficulty in abstract thinking (4) Passive/apathetic social withdrawal (4) Lack of Judgement and Insight (5)</td>
<td>Memory (15 words test) Psychomotor speed (Trailmaking A) attention (Stroop) executive functioning (Six Elements Test)</td>
</tr>
</tbody>
</table>

*aLevel of education: range 1-7 (1 = primary school, 7 = university)

*bMain psychiatric symptoms are defined as items of the PANSS with a rating of four or higher: range 1-7 (1 = absent, 7 = extreme)

*cImpairment is defined as test scores in the first decile or more than two standard deviations below average.
not targets had been achieved, for two weeks, to establish a baseline (A). The baseline period was followed by an intervention phase of seven weeks. Target behaviour was measured again during the last three weeks of this period (B). The intervention was followed by a post-treatment phase during which SMS Text-Messages were stopped. A two-week follow-up measure of target behaviour (A) followed two weeks after the intervention.

7.4 Results

Of the eight participants initially recruited to the study, five participants completed the entire trial. One participant was withdrawn from the study before baseline measurement, because of an exacerbation of psychotic symptoms (JS). Two additional participants stopped using the cell phone during the trial due to of increased negative symptomatology (RH and HL). Mean success percentages for consults with mental health workers (n=5) were 57% at baseline, 81% during the MEMEX-intervention and 75% during follow up. As to attendance at the training program (n=3), mean success percentages were 53% at baseline, 59% during the MEMEX-intervention and 38% during follow up. Finally, medication compliance (n=2) at baseline was 75%, 90% during the MEMEX-intervention, and 71% during follow up. With regard to medication and appointmentss with mental health workers, mean success rates show an increase in targets achieved during the intervention, as compared to the baseline. Furthermore, a decline in performance after the intervention can be observed. With regard to attendance at the training program, no overall effect of the intervention was observed. Our study concerns a small sample with large inter-individual variance, therefore no further significance testing was performed, as the under-powered statistical analyzes would disguise the clinical value of our study. Because we observed clear clinical significant effects of the intervention in some of the participants, the authors feel that presenting the data as single cases is more informative than conventional significance testing. Therefore, the five participants who completed the entire trial are described in greater detail in the following case studies.

7.4.1 Case studies

**DE.**

DE was a 23-year-old man, diagnosed with paranoid schizophrenia according to DSM IV criteria. DE was referred to the MEMEX project because he demonstrated severe memory and attentional problems in daily life, which was confirmed during neuropsychological assessment. In addition, DE’s functioning was hampered by
Figure 1: Percentage of targets achieved during Baseline, Memex Intervention and Follow Up.
negative symptomatology. DE used the SMS Text-Messages to remind him of medication, compliance with appointments appointments with mental health workers and attendance at the training sessions of the rehabilitation program. DE improved on all targeted behaviours during the intervention phase (See Figure 1). With regards to consults with mental health workers and attendance at the training program, his success rate during the intervention was stable at the maximum level. After the intervention, attendance at the training program became less stable; DE’s performance decreased to the baseline level during the first week of the follow up, while it was back at a maximal level during the second week. With regards to consults, the success percentage remained high after the intervention. Because his medication compliance had improved during the intervention, he was no longer required to collect his medication from the nursing staff every day. Therefore, the authors were not able to provide a reliable follow up measurement of medication compliance. However, unstructured observation from the nursing staff learned that DE was not able to establish a medication-routine after the intervention.

PT.

PT was a 24-year-old man, diagnosed with paranoid schizophrenia and substance dependence according to DSM IV criteria. He was referred to the MEMEX project because he demonstrated marked problems in remembering therapy sessions and other consults with mental health workers. During neuropsychological assessment, he showed no impairments. PT was reminded of his appointments with mental health professionals. Although success rates during baseline and intervention were not stable, Figure 1 shows that PT’s performance improved during the intervention. In the post-treatment phase, success rate decreased again; he was not able to establish a routine.

GW.

GW was a 19-year-old man, diagnosed with paranoid schizophrenia, according to DSM IV criteria. GW was referred to the MEMEX project because of subjective memory problems. This problem was confirmed during neuropsychological assessment. In daily life, however, he did not demonstrate impaired memory functioning. During the interview at the start of the intervention, it became clear that GW was successful in remembering appointments by continually updating his working memory: rehearsing their times and dates over and over. This strategy was very time-consuming and wearing. Before the start of the MEMEX intervention, times of training sessions and of medication intake were consolidated in his memory by rehearsing, and had become a routine. Since most of his individual appointments were not scheduled at a fixed time, they were selected as targets for the MEMEX intervention. GW’s performance was already at a maximum level during the baseline
period (Figure 1). This optimal and stable success percentage was maintained during the intervention and the post-treatment phase. Although no objective improvement was possible in the case of GW, his subjective evaluation of the MEMEX project was very positive. Because he was no longer dependent of the constant rehearsal of his appointments to achieve his daily targets, his subjective memory complaints decreased.

**CX.**

CX was a 38-year-old man diagnosed with paranoid schizophrenia and co-morbid depressive episodes according to DSM IV criteria. CX was referred to the MEMEX project because of memory and executive problems. Although performance on neuropsychological assessment was not impaired, CW demonstrated marked cognitive problems in more complex daily life situations. Taking medication on time and attending training and therapy sessions were targeted during the trial. With regard to attendance at the training program, prompting had a minimal effect. After the intervention, performance dropped to below baseline level (Figure 1). As to medication compliance, performance increased to its maximum level during the intervention phase. The success rate of consults with mental health workers was somewhat unstable, and varied during both the baseline- and the intervention phase (Figure 1). Overall, however, success rates during the intervention were higher than success rates at baseline. After the intervention, performance on each of the target measures dropped again.

**BW.**

BW was a 23-year-old man, diagnosed with paranoid schizophrenia and ADHD, according to DSM IV criteria. BW was referred to the MEMEX project because he demonstrated memory and executive problems -in particular disorganization- in daily life. During the more structured neuropsychological assessment, only memory functioning was impaired.

During the trial, attendance at the training program and therapy sessions was targeted. Prompting was not effective in helping BW to achieve more target measures in his daily life. As shown in Figure 7.1, success rates of consults with mental health workers varied very much over time, independent of the intervention. Furthermore, his attendance at the training program remained low over the entire trial. The absence of an effect of prompting and the variance in the number of targets achieved with regards to consult could probably be explained by extreme fatigue, a side-effect of Clozapine. This fatigue prevented him from carrying out activities in the morning and early afternoon, when most of his activities were planned.
7.5 Discussion

Our results provide partial support for our hypothesis that prompting individuals with schizophrenia with external cues (SMS Text-Messages) will lead to an increase of the percentage of goals achieved in daily life. Although no significance testing was performed, the authors consider the benefits of the intervention to be clinical significant for a number of participants. The efficacy of SMS Text-Messages in compensating for cognitive impairments was evaluated in eight men with a diagnosis of schizophrenia. Four participants were able to overcome some of the daily consequences of schizophrenia by using a prosthetic aid: three of them achieved more every day tasks during the intervention and the subjective memory complaints of one participant decreased. Three participants dropped out due to an exacerbation of symptoms. Finally, one participant did not benefit from the intervention, probably because of fatigue, a well-known side effect of Clozapine.

Our hypothesis that performance of the participants will decrease again after the removal of the prosthetic aid, was largely confirmed by our results. In most cases, performance returned to baseline levels after the intervention. This suggests that the SMS Text-Messages were the effective component in improving performance, and improvement was not simply a reflection of time, medication, or participation in a cognitive rehabilitation program in general. Furthermore, it can be derived from our results that participants were not able to establish activities as routines during the intervention phase.

The study has several limitations: in most cases the baseline was somewhat unstable, the number of participants was small and inter-individual variability was large. Of course, these limitations limit inferences from our data. However, although the results of our study are somewhat inconclusive, the authors feel that evaluation of the intervention on a larger scale is worthwhile. In our opinion, given that many individuals with schizophrenia suffer from cognitive impairments that are very invalidating and exist even after a long period of pharmacological treatment, every effort to help these individuals cope with their limitations should be made. Therefore, the efficacy of the MEMEX project is being evaluated in a controlled trial (n=60) at the Department of Psychotic Disorders of GGZ Drenthe in Assen, the Netherlands.