Association between Psychiatric Symptoms and Difficulty with Computer Operation in Schizophrenia: Analysis Using a Questionnaire and a Computer Operation Skills Test

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Abstract: The objective of the study was to identify the reasons behind difficulties in learning computer operation skills among persons with schizophrenia. Twelve persons with schizophrenia and 14 control subjects without neuropsychiatric diseases took a course in personal computer usage consisting of ten 60-minute weekly lessons. All subjects took a computer operation skills test before and after the course. For the persons with schizophrenia, relationships between the test results and scores on the Brief Psychiatric Rating Scale (BPRS) were analyzed quantitatively. Difficulties with computer operation were identified using a questionnaire and analyzed qualitatively. The mean test scores after the course increased for the control group, but were unchanged for the persons with schizophrenia. There was no correlation between the total BPRS score and the test results, but ‘positive symptoms’ scores were negatively correlated with test scores and the number of input letters. In the qualitative analysis, 24 items in 6 categories were identified as reasons for difficulty with computer operation, with 11 of these items being unique to the persons with schizophrenia. These findings indicate the need to develop a computer learning course that is compatible with the characteristics of persons with schizophrenia.

Key words: computer operation skills, psychiatric symptoms, schizophrenia

Introduction

Schizophrenia is a mental disorder with chronic marked disabilities. Functioning in an ordinary workplace is often difficult for persons with schizophrenia due to psychiatric symptoms that accompany the condition. However, many such persons want to become meaningfully employed. On the other hand, Marwaha and Johnson (2004) reported that work can both improve psychiatric symptoms and produce better QOL outcomes for persons with schizophrenia. Growing evidence has also shown that work and psychiatric symptoms influence each other (Harvey et al., 1996).

In recent years, computers have become widely used in all aspects of work, entertainment and life. Basic computer operation skills are required in many work situations and many persons with schizophrenia want to master these skills. However, this may be difficult due to the psychiatric symptoms that accompany schizophrenia, and difficulties may arise even in jobs that require only simple computer operation skills. For this reason, it is necessary to develop a computer learning program that is suitable for persons with schizophrenia. This would be useful in vocational training programs, in increasing employment opportunities and in improving social life. To our knowledge, the aspects of computer operation with which persons with schizophrenia have difficulty, the association between difficulty with computer operation and psychiatric symptoms and the most efficient method through which these persons can acquire computer operation skills have not previously been investigated.

Our recent study, we determined quantitatively if persons with schizophrenia have learning difficulties.
when taking standard computer learning course (Morimoto, Yotsumoto & Hashimoto, 2009). We evaluated the types of errors made by persons with schizophrenia and a control group in learning computer operation skills and compared the two groups’ scores on a computer operation skills test. Moreover, a qualitative analysis of the learning difficulties of persons with schizophrenia was performed to identify reasons for difficulties with computer operation (Morimoto et al., 2009). The mixed method (Creswell, 2007) was employed, in which quantitative and qualitative data were collected in parallel in the same step, with overlapping of the results in the analytical step. In this study, we examined if the severity of psychiatric symptoms made the learning of computer operation skills more difficult and whether certain kinds of psychiatric symptoms were associated with the learning difficulties. Correlations of these results with the Brief Psychiatric Rating Scale (BPRS) scores were examined for persons with schizophrenia.

**Subjects and Methods**

**Subjects**

The 26 subjects were recruited by a public advertisement from people who were looking for a job. They included 12 persons diagnosed with schizophrenia based on ICD-10 and 14 control subjects without neuropsychiatric diseases or substance-related disorders. The 12 persons with schizophrenia (9 men and 3 women) had a mean BPRS score of 26.1 ± 6.6 and all were stable outpatients. Their mean age was 35.3 ± 6.0 years old and they had a mean school attendance of 13.4 ± 1.9 years. The 14 controls (1 man and 13 women) had a mean age of 40.5 ± 7.0 years old and a mean school attendance of 13.7 ± 1.5 years. Age and school attendance did not differ significantly between the groups, but there were more men in the schizophrenia group and more women in the control group. This study was approved by the Medical Ethics Committee of Kobe University Graduate School of Medicine, and consent for participation in the study and publication of the results was obtained from the subjects.

**Evaluation of psychiatric symptoms**

The severity of the persons with schizophrenia was evaluated by their attending physicians using the Japanese Version of the BPRS, which consists of 4 symptom categories (Mueser, Curran & McHugo, 1997) and 16 items (Miyata, Fuji, Inagaki, Inada & Yagi, 1995; McEvoy, 2002). In addition to the total score, scores for Positive symptoms: Grandiosity, Suspiciousness, Hallucinatory behavior, and Unusual thought content, Negative symptoms: Emotional withdrawal, Motor retardation, Uncooperativeness, and Blunted affect, Emotional symp-

toms: Somatic concern, Anxiety, Guilt feeling, Depressive mood, and Hostility, and Disorganized symptoms: Conceptual disorganization, Tension, Mannerisms, and posturing were calculated.

**Content of the computer learning course**

The subjects took the standard Microsoft Word 2003 computer learning program consisting of ten 60-minute lessons between January and April, 2008. The subjects took the class about once a week on days and at times of their choice. A self-study system was used in which a maximum of 8 students participated in one class, with one instructor present per 1–3 students. The persons with schizophrenia and the control group took the same class. The instructors did not actively intervene, and responded only when a participant asked a question.

**Evaluation of learning using a computer operation skills test**

To measure the effect of the computer learning program, a computer operation skills test was performed before and after the course. In this test, word processing skills in Microsoft Office Word 2003 were evaluated. The subjects created a document, as shown in Appendix 1. The evaluation method utilized a points system, in which points were added for accurate entries and deducted for errors. A total of 196 points were possible for accurate entries, and if the errors exceeded 196 a score of zero was assigned (therefore, a negative total score was not possible). The test time was set at 10 minutes. The same test was administered before and after the course. The speed of computer operation was evaluated by the number of keyboard key strokes, and the accuracy of operation was evaluated by the number of errors. The results between the groups were compared, and correlations between the results and symptom categories and items were analyzed for the persons with schizophrenia.

**Statistical analysis**

The learning effect measured using the computer operation skills test was evaluated using the total scores on the test before and after the course. These scores were compared between the persons with schizophrenia and the control group by the Mann-Whitney test and within the groups by the Wilcoxon signed-rank test. The numbers of input letters and errors were similarly compared. The association between BPRS scores and test results was investigated using Spearman rank correlation. The significance level was set at less than 0.05. SPSS ver. 11.5J for Windows was used for data analysis.
Qualitative evaluation of the computer learning course

As previously stated (Morimoto et al., 2009), to evaluate the reasons for difficulty with computer operation, a qualitative descriptive analysis of the computer learning course was performed, based on the content analysis technique described by Krippendorff (1989). A free descriptive questionnaire (Kayama, 2007) concerning difficulties with computer operation was given to the persons with schizophrenia and the control group at the end of each lesson. The instructors also completed a questionnaire concerning the questions they were asked, and the Microsoft Word 2003 documents that were saved in the course by subjects were collected. These documents were arranged and analyzed to extract the reasons for difficulty using the following process.

Phase 1: Inferring the reasons for difficulty for each study task and each subject
a) Creation of a database of difficulties with computer operation

The database was created from subjective information provided by the persons with schizophrenia and the control group based on their answers to the subjects’ questionnaires and objective information in the instructors’ questionnaires.

b) Verification of the database

The authors and instructors verified that the questionnaire answers reflected difficulty in the course, using the documents that the subjects saved. Each difficulty was matched with a computer operation that the subject performed. To discern the difficulties that the subjects showed with actual computer operation, these situations were reproduced and the difficulties of following the operation process were carefully examined. A difficulty that could not be clearly reproduced was excluded.

c) Simplification of the database

Sentences were extracted from the database and simplified with care as not to change their significance. The simplified sentences were added to the database as a third category of difficulty.

d) Inferring the reasons for difficulty of each study task

The reasons for difficulty of each study task were inferred from the difficulties. These reasons for difficulty were added to the database as a fourth category for each study task.

Phase 2: Systematization of all reasons for difficulty
e) Summarizing the reasons for difficulty

Since different representations were included in the inferred reasons for difficulty, those with the same significance were reduced to one representation. Summarizing the database was performed separately for persons with schizophrenia and the control group, and was carried out until new reasons for difficulty did not arise in either group.

f) Categorization of the reasons for difficulty

We formed a conglomerate of the data and categorized the data based on significant identity and similarity. The reliability and validity of the approach described in a) through f) were reviewed by OTs with extensive experience in qualitative research in mental disorders to increase the reliability of data interpretation. In carrying out step f), the categorization and category naming of the reasons for difficulty were performed by five researchers to increase the reliability. These persons included one psychiatrist and four OTs with ten years or more of clinical experience with mental disorders. These five persons were requested to individually check the semantic contents of the reasons for difficulty, to categorize all the reasons and to give a name to each category. After the categorization was completed, the category table was sent to all five persons and their consent was obtained for each category and name.

Results

Computer operation skills test

The total scores for the computer operation skills test did not differ significantly between the persons with schizophrenia and the control group before or after the course (Table 1). In within-group comparisons, the mean test score improved significantly after the course for the control group (38.0 ± 36.9 vs. 71.9 ± 32.9 points, p < 0.005), but did not change significantly for the persons with schizophrenia (42.4 ± 35.9 vs. 52.6 ± 29.1 points), indicating no significant learning effect.

<table>
<thead>
<tr>
<th>Table 1. Total scores for the computer operation skills test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Persons with schizophrenia (N = 12) Control subjects (N = 14)</td>
</tr>
<tr>
<td>Before the course</td>
</tr>
<tr>
<td>Total score</td>
</tr>
<tr>
<td>number of input letters</td>
</tr>
<tr>
<td>number of errors</td>
</tr>
<tr>
<td>After the course</td>
</tr>
<tr>
<td>Total score</td>
</tr>
<tr>
<td>number of input letters</td>
</tr>
<tr>
<td>number of errors</td>
</tr>
</tbody>
</table>

The notation of value is mean ± standard deviation. Total score = (number of input letters - number of errors) × 100 / 196 (maximum number of input letters). * p < 0.05, ** p < 0.01. (Morimoto, Yotsu-moto & Hashimoto, 2009).
The numbers of input letters in the computer operation skills test performed before and after the course were 93.7 ± 65.9 and 120.7 ± 64.0, respectively, for the persons with schizophrenia, and 86.0 ± 71.1 and 148.6 ± 62.3, respectively, for the control group (Table 1). These results did not show a significant difference between the two groups before or after the course. In within-group comparisons, the number of input letters increased significantly after the course for both the persons with schizophrenia (p < 0.05) and for the control group (p < 0.005).

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### Number of errors on the computer operation skills test

In within-group comparisons, the number of input letters increased significantly after the course for both the persons with schizophrenia (p < 0.05) and for the control group (p < 0.005).

### Correlation between BPRS score and the computer operation skills test

The total BPRS score was not associated with the total score on the computer operation skills test or with the number of input letters and errors (Table 2). However, significant negative correlations were found in the scores for the BPRS category ‘Positive symptoms’ and the item ‘Unusual thought content’ with total test scores and the number of input letters. A significant positive correlation was found between the scores for the item ‘Tension’ and the number of errors.

### Reasons for difficulty in computer operation skills

The persons with schizophrenia identified 24 reasons for difficulty with computer operation (Table 3), of which 13 were also given by the control group, and 11 were unique to the persons with schizophrenia. The 24 difficulties were divided into the following 6 categories: ‘Ability to understand’, ‘Attention functions’, ‘Memory’, ‘Motor functions’, ‘Problem-solving skills when difficulties arise’, and ‘Other disease characteristics’. The last two of these categories were found only for persons with schizophrenia.
Discussion

Quantitative analysis

The total scores on the computer operation skills test increased from before to after the course for the control group, but did not change significantly for persons with schizophrenia. The number of input letters increased for the persons with schizophrenia, but the number of errors also increased, which may have resulted in the absence of an increase in the total score. Thus, acquiring the ability to input letters does not indicate an improvement in accuracy of computer operation as the course progressed. Therefore, the standard computer learning course may not improve the computer operation skills of persons with schizophrenia.

Evaluation of the association between BPRS scores and computer operation skills in persons with schizophrenia suggested that the total computer operation skills test score and the number of input letters decreased as the severity of ‘Positive symptoms’, and particularly ‘Unusual thought content’ increased, and that the number of errors increased as the severity of ‘Tension’ increased.

‘Unusual thought content’, which was observed in the computer learning course, include delusions, thought insertion, thought withdrawal, thought broadcast, etc. The number of input letters may be due to the characteristic of ‘Unusual thought content’. Examples of ‘Tension’ include nervousness, agitation, finger tremors, etc. As persons with schizophrenia experience tense posture, restlessness, and anxiety, it is conceivable that the number of errors increase.

These findings suggest that persons with schizophrenia are more likely to operate a computer effectively when their positive symptoms are controlled, and that reduction of ‘Tension’ will decrease the number of errors.

Qualitative analysis

More reasons for difficulty with computer operation were reported by the persons with schizophrenia than by the control group. The persons with schizophrenia had difficulty with all items with which the control group also had difficulty; thus, no reported difficulty was unique to the control group.

An impaired ability to understand is a characteristic of persons with schizophrenia (Weickert et al., 2000; Harvey & Sharma, 2002). Such persons are too concerned with details and cannot grasp the overall view. The persons with schizophrenia made comments such as ‘Cannot

Table 3. Reasons for difficulties with computer operation reported by persons with schizophrenia

<table>
<thead>
<tr>
<th>Reason for difficulty</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cannot understand words (oral).</td>
<td>Ability to understand</td>
</tr>
<tr>
<td>Cannot understand sentences.</td>
<td></td>
</tr>
<tr>
<td>Cannot understand a concept (such as a folder or file).</td>
<td></td>
</tr>
<tr>
<td>*Cannot understand when the text display is different from that on the Computer.</td>
<td></td>
</tr>
<tr>
<td>*Cannot understand what they need to know.</td>
<td></td>
</tr>
<tr>
<td>Unable to find differences in the detailed display.</td>
<td></td>
</tr>
<tr>
<td>Cannot appreciate small differences.</td>
<td></td>
</tr>
<tr>
<td>Cannot grasp a lot of information at once.</td>
<td></td>
</tr>
<tr>
<td>Monitoring failure (misrecognition).</td>
<td>Attention functions</td>
</tr>
<tr>
<td>Monitoring failure (oversight).</td>
<td></td>
</tr>
<tr>
<td>*Anxiety disturbs work (cannot keep a clear mind).</td>
<td></td>
</tr>
<tr>
<td>*Mind wanders from one thing (cannot focus).</td>
<td></td>
</tr>
<tr>
<td>Cannot remember the Roman alphabet.</td>
<td></td>
</tr>
<tr>
<td>Cannot learn new terms (input functions).</td>
<td>Memory</td>
</tr>
<tr>
<td>Cannot memorize (holding functions).</td>
<td></td>
</tr>
<tr>
<td>Cannot drag.</td>
<td></td>
</tr>
<tr>
<td>Unable to set the pointer in the correct area.</td>
<td>Motor functions</td>
</tr>
<tr>
<td>*Cannot click properly (such as a double click).</td>
<td></td>
</tr>
<tr>
<td>*Relay on their own resources rather than seek out other solutions when they encounter something they do not understand.</td>
<td>Problem-solving skills when difficulties arise</td>
</tr>
<tr>
<td>*Physical symptoms emerge if something goes wrong.</td>
<td></td>
</tr>
<tr>
<td>*Irritation disturbs work if something goes wrong.</td>
<td></td>
</tr>
<tr>
<td>*Easily become tired.</td>
<td>Other disease characteristics</td>
</tr>
<tr>
<td>*Auditory hallucination disturbs work.</td>
<td></td>
</tr>
<tr>
<td>*Anxiety due to technical terms.</td>
<td></td>
</tr>
<tr>
<td>* Difficulty found in persons with schizophrenia, but not in control subjects. (Modified from Morimoto, Yotsumoto &amp; Hashimoto, 2009).</td>
<td></td>
</tr>
</tbody>
</table>
understand when the text display is different from that on
the PC’ and ‘Cannot understand what they need to know’,
reflecting their reduced ability in computer operation.

Persons with schizophrenia also have difficulty main-
taining attention (Heinrichs & Zakzanis, 1998; Medalia,
Revheim, & Herlands, 2008), and this was also apparent
in the learning of computer operation skills.

Persons with schizophrenia exhibit impairment of
motor and tactile dexterity (Heinrichs & Zakzanis, 1998),
with slow and unskilled motions (Hiruta, 2007) and slow
learning of movement and a high frequency of movement
errors (Walker, Lewis, Gold, Loewy & Palyo, 1999). In
our study, only persons with schizophrenia had difficulty
with ‘Cannot click properly (such as a double click)’, sup-
porting the presence of motor dysfunction.

Persons with schizophrenia have also been reported
to have disturbance of memory (Saykin et al., 1991; Gold,
Randolph, Carpenter, Goldberg & Weinberger, 1992;
Heinrichs & Zakzanis, 1998; Harvey & Sharma, 2002;
Medalia et al., 2008), but the controls also had difficulty
with all items in the category of ‘Memory’. Therefore, the
results do not indicate a particular difficulty with memory
associated with learning computer operation skills in
persons with schizophrenia. This may be because all people
go through the same process to memorize unfamiliar
terms and techniques, and this may account for the diffi-
culties in this area being common to the two groups. This
finding is also consistent with a report showing no sig-
nificantly greater loss of acquired information by persons
with schizophrenia compared to the control group (Cirillo
& Seidman, 2003).

Difficulties with problem-solving in persons with
schizophrenia when encountering a difficulty in task per-
formance have also been found in previous reports (Hein-
richs & Zakzanis, 1998; Weickert et al., 2000; Green et
al., 2004; Medalia et al., 2008). Our subjects reported the
reasons for difficulty in learning computer operation skills
using statements such as ‘Rely on their own resources
rather than seek out other solutions when they encounter
something they do not understand’, ‘Physical symptoms
emerge if something goes wrong’, and ‘Irritation disturbs
work if something goes wrong’. These statements were
unique to persons with schizophrenia and were catego-
rized into ‘Problem-solving skills when difficulties arise’,
which reflects the disease characteristics.

The categories of ‘Other disease characteristics’,
‘Easily become tired’, ‘Auditory hallucination disturbs
work’ and ‘Anxiety due to technical terms’ were also
identified as unique to persons with schizophrenia and
may have a direct association with the disease character-
istics.

Overlap of the results of quantitative and qualitative
analysis

In quantitative analysis, ‘Positive symptoms’ influ-
enced the difficulty in learning computer operation skills,
which indicates the need for medical improvement of the
psychiatric symptoms. The number of input letters in-
creased for the persons with schizophrenia, but the num-
ber of errors also increased after the standard computer
learning course. It seems that difficulty maintaining atten-
tion to errors or omissions through self-monitoring
greatly influenced the increase in the number of errors.

Therefore, the qualitative results clarify the difficulty
maintaining attention in schizophrenia, as indicated by
comments such as ‘Cannot appreciate small differences’,
‘Monitoring failure (misrecognition)’ and ‘Monitoring
failure (oversight)’. Furthermore, persons with schizo-
phrenia reduce problem-solving skills when difficulties
arise, based on comments such as ‘Rely on their own re-
sources rather than seek out other solutions when they en-
counter something they do not understand’, and this may
also have led to poor self-monitoring and a consequent
increase in the number of errors.

The information obtained from the quantitative and
qualitative studies suggests that measures focusing on the
two categories of ‘Attention functions’ and ‘Problem-solv-
ing skills when difficulties arise’ are important for promot-
ing computer learning in persons with schizophrenia.

Many approaches are currently used to improve cog-
nitive deficits in schizophrenia (Dixon et al., 2009). De-
velopment of a computer learning program which incor-
porates specific measures that permit self-monitoring of
errors and provides concrete approaches to effective prob-
lem-solving is important for persons with schizophrenia
to learn computer operation skills efficiently. Inclusion
of these elements in the program may allow the person
to overcome difficulty maintaining attention and solving
problems when difficulties arise.

The difficulties faced by the control group may be
solved by improvement of the course, which is currently
in progress, and this may also solve some learning difficul-
ties of the persons with schizophrenia. However, this will
not resolve all the problems, and it is important to address
difficulties that are unique to persons with schizophrenia.

In this study, comparisons were made between per-
sons with schizophrenia and a control group regarding
their reported difficulties in learning computer operation
skills. However, the number of subjects was small and the
female: male sex ratio in the control group was higher than
that for the persons with schizophrenia. In addition, all the
persons with schizophrenia were stable cases. Given these
limitations, it will be important to continue this study with
additional persons with schizophrenia including those
with a greater severity of symptoms and impairments.
Conclusion

Quantitative and qualitative comparisons of learning of computer operation skills by persons with schizophrenia and a control group suggested that the symptoms of schizophrenia have an influence on this process. Persons with schizophrenia had more difficulties in learning computer operation skills, and the reasons for these difficulties were characteristic of the disease. These findings indicate the need to develop a computer learning course that is compatible with the characteristics of persons with schizophrenia.

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### Appendix 1

**Error Definitions and Standard Rating Table**

<table>
<thead>
<tr>
<th>Type of error*</th>
<th>Definition</th>
<th>Example**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Character input</td>
<td>Mistake in input (incorrect entry).</td>
<td>青木電子 → 青木でんき (1 character input error) (Error in character conversion)</td>
</tr>
<tr>
<td>Conversion</td>
<td>Mistake in conversion (the input is OK).</td>
<td>お礼 → おれい (1 conversion error) 鉛木 → すずき (ibid) 平成 → 稲 (ibid) (Error between upper-case and lower-case character input)</td>
</tr>
<tr>
<td>Posting</td>
<td>Mistake in fullwidth / halfwidth. Mistake in punctuation marks.</td>
<td>5 0 0 → 500 (3 posting errors) (Error in character size) …のことと、 → …のことと (1 posting error)</td>
</tr>
<tr>
<td>Font size</td>
<td>Mistake in font size. Mistake in bold type/ normal type.</td>
<td>送付状 → 送付状 (1 font size error) 記/以上 → 記/以上 (3 font size errors)</td>
</tr>
<tr>
<td>Shortage of characters, clauses, sentences, spaces, line feeds, etc.</td>
<td>Shortage of characters. Shortage of sentences. Shortage of spaces and line feeds.</td>
<td>晩秋の候 → 晩の候 (1 character shortage error) (The text has a shortage of characters) 拝啓 晩秋の → 拝啓 晩秋の (1 space shortage error)</td>
</tr>
<tr>
<td>Surplus of characters, clauses, sentences, spaces, line feeds, etc.</td>
<td>Surplus of characters. Surplus of sentences. Surplus of spaces and line feeds.</td>
<td>貴社ますます → 貴社者ますます (1 character surplus error) (The text has a surplus of characters) …ご高配 → …ごこうはい (2 character surplus errors)</td>
</tr>
<tr>
<td>Numeric input</td>
<td>Input the wrong numeric value.</td>
<td>15年 → 16年 (1 numeric input error) 15年 → 20年 (2 numeric input errors) (Error in numeric input)</td>
</tr>
</tbody>
</table>

*Note. *Right justification, centering, etc. are scored based on content, and are not included in the errors listed here.

**Japanese language is written in hiragana and katakana (Japanese syllabary), kanji (Chinese characters), and Latin alphabet. Many Japanese words must be converted from the simpler text, hiragana, into the more complex kanji.*