■**WFOT SYMPOSIUM**

The International Challenge for Occupational Therapy

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As occupational therapists we need to develop the capacity and power to construct our own destiny. The future of the profession is ours to make and in 20 years or a hundred years time our success will be the only reliable measure of how effectively we have taken hold of our vision. By joining together we can take the future, fold it back into the present and make that destiny a reality.

An entrepreneurial approach to practice is about thinking outside of the square, and finding increasingly innovative ways to deliver services that positively influence people's lives, health and well being. In order to do this as occupational therapists we need to challenge ourselves to create the future of the profession and direct our own destiny.

Occupational therapy is practiced in many countries around the world. Occupational therapists are part of a large (and growing) international workforce and like every other allied health profession it is impacted upon by the changing world and changing health environment.

Occupational therapists need to understand what is impacting on the health landscape of the future and be ready to meet the changes. So what are the major issues impacting on the healthcare environment now and in the future?

There is a global move towards change and healthcare reform and occupational therapists need to consider what are the trends and drivers affecting the health and social services sector.

Demographic and societal change
Rising expectations and consumerism
Health informatics and telemedicine
New medical technologies
Increasing costs of health and social services provision

There are calls for the traditional paradigm of the health workforce to be changed. Part of the problem is that the system is geared to deal with episodes of acute care rather than ongoing care of chronic conditions.

In Japan the basic principle governing the delivery of health care services is that all citizens should be able, at any time and place, to receive the care they require, with an affordable personal contribution.

The health situation in Japan remains one of the best in the region. The majority of health-related statistics, such as life expectancy and the under-five mortality rate, continue to improve. The health disparities within the country are also relatively small compared with those in other industrialised nations. Due to the increasingly complex social environment created by a high-tech and competitive society, it is said that the stress levels felt by all age groups are rising.

With advancement of the ageing society, disease patterns have shifted to lifestyle-related diseases, such as cancer, heart disease, cerebrovascular disease and diabetes. These diseases account for 60% of mortality and this trend is expected to continue.

So where do occupational therapists fit in?

I practice my profession in the best way that I can and from time to time I feel frustrated that others don't always share my views on the value and contribution of occupational therapy. I tire of explaining what we do in much the same way as I am sure we all do. But as I start to explain I always reignite my belief that as occupational therapists we can have significant impact on the lives of others whether it as is as individuals, families or communities. I love my profession and hold a vision and a dream for the future, which I am sure many of you share.

I believe we need to strive to move beyond the traditional boundaries because that is what they are – boundaries. They fence us in and limit our practice. This doesn't mean walking away from our core skills rather it means applying those core skills in more and more sophisticated and most importantly effective ways.

Our expertise lies in the design of creative solutions to complex problems. It is the integration of multi level variables into workable, effective and sustainable solu-

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tions that is the core of occupational therapy practice. We need to think entrepreneurially. If we are going to imagine the future we must make sure we see ourselves in it. An old Japanese proverb tells us: "Vision without action is a daydream, but action without vision is a nightmare". So we need to implement that vision.

How often have we heard or said:

Nobody knows what we do.

I can't really tell you what we do because it's too complicated.

The trouble with O.T.'s is that there are so few of us.

Is occupational therapy destined to remain the best kept secret? It will if occupational therapists don't face the challenge to take their rightful place in health care.

Occupational therapists are expanding the current dominant focus on curative and preventative practice with individuals toward a focus on the right of all people to occupational engagement and enrichment. Wilcock (2005) told us that occupational therapists have much more to offer than a service solely for those with a medically defined illness or dysfunction.

The expanded focus involves a community and population orientation, which addresses the health promotion needs of groups, communities and populations. It requires understanding the fundamental ways in which health is promoted and ill health is avoided and establishing equitable opportunities and resources to enable engagement in occupation at all levels.

Globalisation has led to enormous and sweeping changes in the world. New technologies such as the Internet have made people much more aware of modern trends. Better preventative medical systems, new drugs and improved medical care have led to an increase in life expectancy in many societies. The changes add up to great opportunities and vast challenges. But in some instances they have also led to socioeconomic inequalities and political instability. Two years after the historic call for action by the United Nations, the World Health Organisation published its annual health report, *Reducing risks, promoting healthy life* (Sinclair 2004).

It stated the obvious. It reiterated the close and self-evident links between poverty and disease. It added that disease often meant people could not work which in turn led to a lack of food on family tables with the inevitable results; malnutrition and other health issues. *More than half of the world's people suffer from malnutrition and substandard healthcare.*

So where should we occupational therapists place our priorities? How should we be addressing the awesome challenges? How best can we use our knowledge, skills and dedication to bring about lasting improvements in the health of our people and our communities?

Well you must be the change you wish to see in the world. Much is to be done. In communities around the world, proactive therapists have been addressing issues at the heart of these global concerns, looking at ways we can effectively tackle the base causes of deprivation caused by occupational and social injustice.

The World Federation of Occupational Therapists (WFOT) is the key international representative of occupational therapist and occupational therapy and it links 66 countries and organisations (WFOT website 2009) world wide. The Federation believes that occupational therapy has a valuable contribution to make to occupational performance as it affects the health and well-being of people. The Federation maintains that it can positively influence health, welfare, education and vocation at an international level combined with the development of excellence within the profession.

In 2006 during the Focus Day prior to the commencement of the World Council Meeting in Australia, WFOT considered the future of the profession.

The Delegates including the Delegate from Japan met to consider the following questions:

What will be the health landscape of the future (2015)

What will be the "Roles" of the future (2015)

What will be the Occupational Therapy landscape in the future (2015)

How WFOT can lead the profession into this future (2015)

WFOT saw that there will be a link between research, education and practice, with increased self confidence to have a broader role for occupational therapy; there will be roles for occupational therapists at policy levels to influence delivery models and political agendas. Occupational therapists will advocate for health promotion and prevention from the results of chronic conditions. Occupational therapists will advocate for participation in "good decent human life".

Occupational therapists will have more to offer than traditional "health" and will distance themselves even more from the medical model. They will work with individuals, groups and society and work with healthy people as well as ill people through preventative and rehabilitative healthcare models. Many services will be delivered via a community based model whilst still acknowledging the need for acute care services. There will be increased use of technology e.g. telecare, virtual home visits via webcams.

Occupational therapists will develop wider and stronger liaison with other professions outside of health e.g. town planners, architects as well as developing emerging areas of practice (Pattison, 2007). Information and communication technologies (ICT) have arrived and therapists need to be innovative in how they participate. These technologies include personal computers, the Internet, email, videoconferencing, telehealth and mobile

technologies.

One of the common occupations we observe is the task of grocery shopping – can the individual put together a shopping list, physically go to the supermarket, choose the items needed, purchase them and return home. In the not too distant future, an individual is going to be referred to an occupational therapist for a similar assessment of their ability to live independently in the community. But instead of the 'standard' grocery store expedition, the occupational therapist is going to have to work with the person to make sure they have the cognitive skills needed to continue to use the Internet fridge in their kitchen. The person will have no need to physically visit the store but will attach meaning and purpose to being able to use the Internet fridge and to communicate with the family and the local doctor via the telecare link in the laser TV. The occupational therapist will need to focus on the skills and occupations of meaning to the individual.

But application of technology does not have to be computer or engineering based. Students in the Ugandan occupational therapy education programme had to learn not only how adaptive equipment could help people with disabilities but also how to make the equipment they prescribed. Students learnt basic carpentry and needlework skills and liaised closely with local craftsmen; however wood and specialised skills were still costly and a low cost alternative was needed.

APT (Appropriate Paper Technology) uses waste paper and cardboard and glue made from local flour and water. In the dry season constructions can dry quickly enabling occupational therapists to make large pieces of equipment over a number of days/weeks. APT involves layering pasted paper strips to make a shape, sometimes cardboard is used to give larger constructions sturdiness; the paste dries clear and adds strength; all equipment can be painted and take on an individual theme finally a layer of varnish makes the product waterproof.

Ugandan occupational therapists also use APT as a therapeutic tool; the activity is a messy one and allows individuals a structure to work with whilst developing problem solving and decision making skills. Clients have been involved in making equipment for others and/or pieces that they themselves can use at home occasionally income generating projects have been developed.

If occupational therapists are really serious about working with all people they need to be where all people are – in the community. There are a multitude of opportunities to put occupational therapy amongst the general population. One area of practice is workplace based programmes. This is not just about putting in place programmes for injured workers and assisting them to return to work but more importantly working within a safety, health and environment context to promote health and well being.

It is well documented that the population is ageing, particularly in the high resource countries and it is up to occupational therapists to make the links between occupation and health clear. Programmes to maintain the elderly and older people in the community involved and active could easily be developed and implemented by occupational therapists rather than waiting until there is illness of disability.

Of course these resources are not available in every country – in fact not in many countries. Thibeault (2006) in her keynote address at the WFOT 2006 World Congress describes what she refers to as the "Majority World". This world is where she has worked with child soldiers, torture survivors, people disabled by landmines and survivors of natural disasters. This is about the rebuilding of sustainable communities and the contribution occupational therapy can make.

Occupational therapists around the world are involved in working with many of these groups of people in community based rehabilitation programmes (CBR).

Traditionally occupational therapists have not been automatically involved in disaster response however through the WFOT Disaster Preparedness and Response (DP&R) the opportunity to have occupational therapists further involved has been explored.

So what roles can the occupational therapist play in DP&R. In Indonesia two days after the earthquake in May 2005 occupational therapists and occupational therapy students were already involved in undertaking needs analyses identifying people with disabilities and the requirements for immediate rehabilitation services.

In Thailand 16 months post tsunami occupational therapists were developing proposals to assist communities with community development projects. Relocated survivors described an aimless, meaningless and incomplete community. They were grateful for the government assistance but they felt the organisations had not completed their work. They had to be careful to live on the money they had and they felt they should be given assistance to go back to their original vocations. They didn't believe the assistance had been given equitably and they were worried and frightened about their future (Pattison, 2006).

The occupational therapists identified what skills they had to deal with this situation and as outcomes they developed a project to assist these villagers as well as a national action plan for occupational therapy involvement in disaster preparedness and response in Thailand. These occupational therapists are there and working within the communities, making a difference to hundreds of people and we can all do it.

Of course there are still many countries where occupational therapy is not a recognised profession and so the

work must continue.

If we seek to understand a people, we have to put ourselves, as far as we can, in that particular and cultural background… One has to recognise that countries and people differ in their approach to life and ways of living and thinking. In order to understand them, we have to understand their way of life and approach. If we wish to convince them, we have to use their language as far as we can – not language in the narrow sense of the word, but the language of the mind (Jawaharlal Nehru).

And our language is the language of occupation or activity – the language of participation, engagement and meaningful living. That language is spoken in every country in every culture.

Before concluding I would like to answer the questions I raised earlier in this paper.

Nobody knows what we do

We are experts in the science of doing and living

I can't really tell you what we do because it's too complicated

We are performance improvers

The trouble with occupational therapists is that there are so few of us

We are a select and highly specialised group with a major contribution to make to the health and well being of all people

The future of the profession is ours to make and our success will be the only reliable measure of how effectively we have taken hold of our vision. I would like to think that we embrace the notion of strategic intent to enable us all to turn our visions into reality. By joining together we can take the future, fold it back into the present and make it happen right now. So the next time someone asks you what occupational therapy is – look at them quizzically and say incredulously - "you mean you don't know?"

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■ORIGINAL ARTICLE

Psychological Distress of Women Newly Diagnosed with Breast Cancer: Relationship with a Self Management Intervention Program

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Abstract: Psychological distress is especially common with any cancer diagnosis. This study examined the psychological distress in a cohort of women newly diagnosed with breast cancer. A longitudinal study of a cohort of women (n=147) diagnosed with breast cancer (within the past 1 year), were conducted at University Malaya Medical Centre, Kuala Lumpur. Data were collected at baseline and at post 4-week intervention. Analysis of variance was conducted to examine for any significant differences in the change-scores between the experimental group (n=69) and the control group (n=78). Using the change scores, analysis of variances shows significant differences between groups for stress, $F(1,140) = 13.68$, $p<0.0001$, anxiety, $F(1,140) = 8.44$, $p<0.004$, and depression, $F(1,140) = 11.57$, $p<0.0001$. Levels of stress, anxiety and depression generally decreased significantly in the experimental groups ($p<0.05$), but either maintained or increased in the control group. This study indicates that the level of psychological distress of women with breast cancer can be ameliorated with a 4 week self management intervention. Lower stress was also found in women who reported engagement in higher physical activity than women with low physical activity. Future studies may examine role of physical activity in ameliorating distress.

Key words: patient self management, women, breast cancer, psychological distress

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Introduction

Emotional distress, a common sequela of a cancer diagnosis, is a core indicator of a patient's wellbeing and has been promoted as the sixth vital sign in cancer care (Bultz & Carlson, 2005). Emotional distress varies in level of intensity, depending on severity of disease and phase of treatment (Simonton & Sherman, 1998). Earlier research have documented that up to 50% of women with breast cancer experience psychiatric morbidity (Hall, Fallowfield & A'Hern, 1996), coupled with anxiety and depression commonly faced right from the moment they are diagnosed with breast cancer (Dow, 2000). It has also been reported that the onset of reactive anxiety and depression also often coincides with the fatigue experienced with daily radiation treatments (Rowland & Holland, 1990). Thus, management of emotion is crucial as one quarter to one third of women undergoing chemotherapy experienced distress (Campora, Naso & Vitullo, 1992; Newell, Sanson-Fisher, Girgis & Ackland, 1999). Breast cancer, among all cancers, is the leading cause of cancer mortality in women worldwide. Out of the 35 million people who died from chronic disease in 2005, half were under 70 years and half were women (WHO, 2005). Breast cancer is primarily a woman's disease, although among males there is a minimal risk of developing breast cancer as well, with a ratio of 1:100 as reported by the American Cancer Society (American Cancer Society, 2005). This paper examines the Depression, Anxiety and Stress of women newly diagnosed with breast cancer who participated in a 4 week self management clinical controlled trial in University Malaya Medical Centre, a large teaching hospital situated in the central part of Kuala Lumpur, Malaysia.

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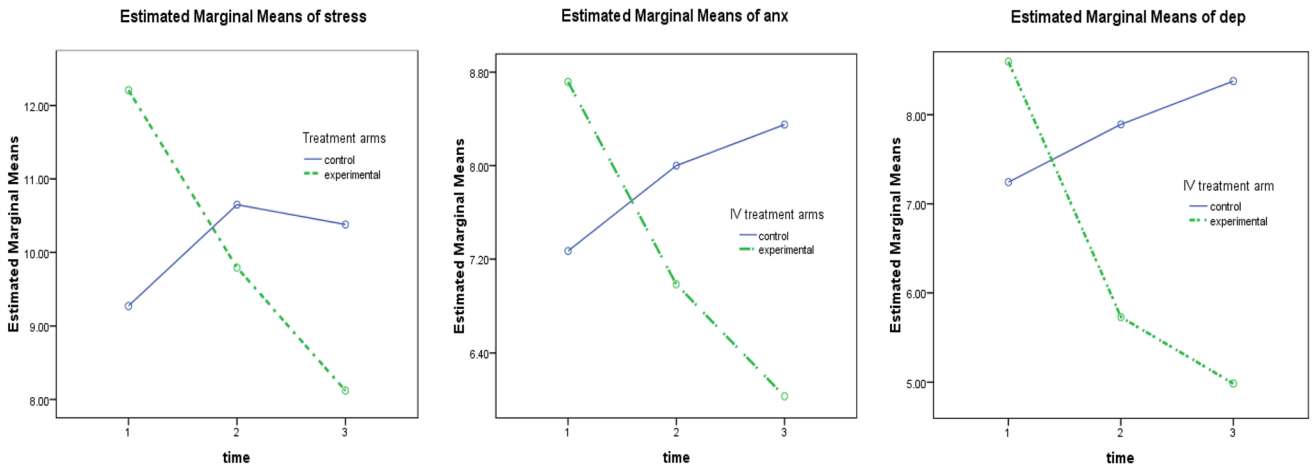

anx = Anxiety, dep = depression
T1 = Time 1 (baseline), T2 = Posttest at 4 weeks, T3 = Posttest at 8 weeks
- - - = Experimental — = Control

Fig. 1. Line graph of repeated measures between the experimental and control group.

Methods

Design & subjects

A longitudinal study with repeated measures was conducted on an experimental group and followed by a control group (Fig. 1). There were 147 women newly diagnosed (within one year) with breast cancer from December 2006 to February 2008 who were recruited. The experimental group undertook the 4-week self management sessions and the control group were those from the usual-care group. Both groups completed the questionnaire as the baseline, and at 4 weeks as well as 8 weeks from baseline. The participants were selected based on the following eligibility criteria: (i) more than 18 years of age, (ii) confirmed by physician, a diagnosis of Stage 1-III (within one year since diagnosis), (iii) completed surgery, may or may not be undergoing chemotherapy and/or radiotherapy, (iv) may or may not be undergoing Tamoxifen (or other endocrine therapy), (v) can read and understand English, and (vi) give informed-consent. The exclusion criteria are (i) marked cognitive impairment or learning disabilities (through observation/ interview), and (ii) has other form of medical problem interfering with participation and attendance (from self report).

Tools

The Depression, Anxiety and stress (DASS) tool was used to measure psychological distress in Malaysian women diagnosed with breast cancer. The DASS tool has been established as having excellent psychometric properties (Crawford & Henry 2003). It measures 3 distinct items - the depression, anxiety and stress. DASS-21 is a self report questionnaire (Lovibond & Lovibond, 1995) which allows simultaneous assessment of three emotional states - depression, anxiety (hyper arousal) and stress. A Likert-type scale is used to rate items according to symptoms experienced in the past week, ranging from 0 (not at all) to 3 (most of the time). Alpha value for the 7-item scales ranged from 0.73 (anxiety), 0.81 (depression) and 0.81 (stress) and has adequate convergent and discriminate validity (Crawford & Henry, 2003; Lovibond & Lovibond, 1995). It is a valid, reliable routine clinical outcome measure of these constructs in clinical and non-clinical groups (Antony, Bieling, Cox, Enns & Swinson, 1998; Brown, Chorpita, Korotitsch & Barlow, 1997) and for inpatient setting (Ng et al., 2006).

The intervention program

The intervention group went through usual care and the 4 week self management program is a group format for 8 to 15 women who meet weekly (about 2 ½ hours) for four consecutive weeks. The sessions with its respective self-management themes for each sequential week, on medical management tasks, emotional management tasks, healthmanagement and role management tasks (see Fig. 2). The facilitation style was based on Tuckman's theory (Tuckman, 1965). Use of didactic and experiential exercises, were drawn from the social cognitive theory and cognitive behavioral principles. The first session was scheduled one hour earlier while the final session was scheduled one hour later than the middle two sessions, to cater for the pen-paper testing. Group work, mini lectures and homework were incorporated in each of the four sessions. The last session also finished off with a tea and

Session	Group work strategy (Example of exercises from SAMA*)	Facilitator's style (Tuckman's theory on group and facilitation style)
Session 1 Managing my Breast cancer	Focus on Relationship building: Facilitator highlight common problems and goals. 'Buddy system'* to promote closeness - first tier buddies are assigned to encourage each other; Second tier buddies are self-selected to support each other with transportation, problem-solving etc.	Moving from a '**Directing**' style,
Session 2 Managing my Emotions	**Exploratory stage:** Paying attention to feelings and acknowledging them. Also, increasing the group work, from simple tasks like 'understanding the adjustment process', 'finding what relaxes me', to 'challenging myths and self-defeating thoughts in groupwork'. Homework is used to shape the team transitions from "as is (the present)" to "to be (the future)".	moving through a '**Coaching**' style,
Session 3 Managing my Health	**Decision-making stage:** Requires more team-work with task-oriented actions e.g. finding yourself an exercise group or visiting a wig shop. (This encourages participants to look for common themes and common work). Action planning focus on health plan. (The team reaches consensus on the "to be" process).	then into '**Participating**'- to finishing- **Delegating**
Session 4 Managing my Roles and relationships	**Working Stage:** Encourage the participants to take an active role. Group representative and members coordinate meeting dates, ensure attendance, plan food, outing, and visits to breast welfare association, breast resource centers. (The team has settled its relationship dynamics, and the overall group as well as personal expectations). **Termination Stage:** The group may be exposed to another group to expand its networking. The optional 3rd line buddies can be initiated by any group member. (They share their improvements and personal growth).	and ending with an almost- **Detached style**

Fig. 2. Overview of the sessions, exercises and facilitation style. SAMA* = Staying Abreast, Moving Ahead, a 4-week program. 'Buddy system'* - a SAMA strategy to improve groupwork and cohesiveness of members

exchange of gifts to show mutual support to their new partner (or known as the SAMA buddy). The 2-tier buddy system was added to the program as an inbuilt support-mechanism for the participants to encourage each other as well as to discuss their homework. The usual-care group went through the typical treatment which comprises of surgery and combination of chemotherapy, radiotherapy and targeted therapy. Details of the trial have been published elsewhere (SY Loh, 2009).

Data analysis

The data was entered into the SPSS (Version 15). All missing data from dropouts at post test and follow up were input using the last observation of carried forward

Table 1. Demographic of participants

Variables	ALL n=147		Experiment n=69		Control n=78		Test p-value
	n	%	n	%	n	%	χ^2
Age Rang							
20–49	72	49.0%	31	44.8%	41	52.5%	0.022*
50–79	75	51.1%	38	55.1%	37	47.4%	
Ethnicity							
Chinese	95	64.6%	54	78.3%	41	52.6%	0.040*
Indian	21	14.3%	7	10.1%	14	17.9%	
Malay(22) &Others(9)	31	21.1%	8	11.6%	13	29.5%	
Marital Status							
Single	26	17.7%	9	13%	17	21.8%	0.312
Married	111	75.5%	56	81.2%	55	70.5%	
Widowed/Divorced	10	6.8%	4	5.7%	6	7.7%	
Living Companion							
Alone	11	7.5%	5	7.2%	6	7.7%	0.989
Spouse, kids and parent	108	73.5%	51	73.9%	57	73.1%	
Parents & siblings	12	8.2%	6	8.7%	6	7.7%	
Friends/Others	16	10.9%	7	10.1%	9	11.3%	
Additional Roles							
Yes	40	27.2%	16	23.2%	24	30.8%	0.303
No	107	72.8%	53	76.8%	54	69.2%	
No. of Children							
None	33	22.4%	14	20.3%	19	24.4%	0.840
< 2 kids	62	42.2%	30	43.5%	32	41.0%	
> 3 kids	52	35.4%	25	36.2%	27	34.6%	
Education Level							
Nil -Primary	7	4.8%	2	2.9%	5	6.4%	0.999
Secondary	65	44.2%	30	43.5%	35	44.9%	
College	39	26.5%	21	30.4%	18	23.1%	
University	36	24.5%	16	23.2%	20	25.6%	
Insurance							
Yes	78	53.1%	45	65.2%	33	42.3%	0 .005*
No	69	46.9%	24	34.8%	45	57.7%	
Physical activity level							
Sedentary-low	92	62.6%	30	43.5%	62	79.5%	0.02
Moderate -high	55	37.4%	39	56.5%	16	20.5%	

method (for those missing at later time). Mean substitution was used for those missing at an earlier time. Data from participants on the experimental group who attend at least three sessions were input and data accepted for analysis. Descriptive analysis and analysis of variance were conducted.

Results

Demographic data were obtained from the Patient Information Questionnaire (PIQ) and tabulated in Table 1 below. A total of 147 women participated in the study. The majority of the participants were Chinese (65%), with a mean age of 50 years (± 9 SD) and within a range of 25–75 years. Most were married (76%), living with spouse and children (68%), had fewer than 2 children (42%), and had at least a secondary education (44%). Most had no extra role looking after aged parents (73%). Only about 6.8 percent were living alone, the rest were living with someone, indicating the traditional Asian trend of living within an extended family system which is still highly prevalent, although the family today have fewer children. More than half the women had some form of insurance policy (53%) and had a household income of 1000-5000 ringgit per month (55%). The independent Chi-square tests (Tables 1, 2) showed only two personal demographic variables were significant at baseline. These were ethnicity (p=0.04) and insurance status (p= 0.005).

Prior to the analysis the baseline differences between the two groups were assessed using t-test. There were no statistically significant differences in the mean scores of the two groups for stress (p=0.08), anxiety (p=0.299) and depression (p=0.44) suggesting that the two groups are from the same population. Thus any changes in the find-

Table 2. Descriptive (mean +SD) at repeated measures with percentages of change scores

DASS subscales		Repeated Measures						Change Score (T2-T1)		% change scores (at T2)	Change Score (T3-T1)		% change scores (at T3)
		Baseline (T1)		Post-test (T2)		Follow Up (T3)							
		Mean	SD	Mean	SD	Mean	SD	Mean	SD		Mean	SD	
Stress	Exp	12.67	8.22	9.86	7.21	8.29	6.98	–2.81	6.9	–22.2*	–4.38	8.15	–34.6*
	Ctrl	10.31	8.05	11.92	9.82	11.33	9.89	1.62	6.6	15.7	1.02	8.27	9.9
Anxiety	Exp	9.13	7.57	7.16	6.45	6.64	6.90	–1.97	5.37	–21.6*	–2.49	5.46	–27.3*
	Ctrl	7.92	6.47	9.05	7.95	8.97	7.84	1.13	5.45	14.3	1.05	5.75	13.3
Depression	Exp	9.28	8.7	6.09	6.59	5.54	6.33	–3.19	7.21	–34.4*	–3.74	7.04	–40.3*
	Ctrl	8.21	8.04	9.26	9.53	9.41	9.92	1.05	6.46	18.3	1.21	8.16	14.7

DASS= Depression, Anxiety and Stress scale. Exp= experimental arm [n=69], ctrl=control arm [n=77]. * significant at $p<0.05$

ings can be interpreted with confident as changes were likely due to the intervention. Descriptive statistic (Table 2) shows that with the experimental group, a favorable decrease on all three scales ranging from –19.8 percent (stress) to 33.3 percent (depression) at T1 to T2 and a further decrease of 13.7 percent anxiety to 17.1 percent stress at T2 to T3. In the control group, all three scales had unfavorable increase with higher measures on stress, anxiety and depression with a percentage ranging from 8.9 percent to 14.9 percent on T1 to T2 period and 4.5 percent to 4.4 percent stress improves slightly with a decrease mean score of 2.5 percent for T2 to T3. Overall, the trend of change from baseline T1 to Post test T2 was favorable for the experimental group, but unfavorable in the control group.

Changes over time between the two groups for depression, anxiety and stress

Using the change scores (T2-T1), analysis of variances shows significant differences between groups for stress, $F(1,140) = 13.68$, $p<0.0001$, anxiety, $F(1,140) = 8.44$, $p<0.004$, and depression, $F(1,140) = 11.57$, $p<0.0001$. Figure 1 showed the changes over time in the experimental and control groups. There were no significant difference between the age group (young and old), mental status and ethnic groups. With level of physical activity, significant differences were found between the low (sedentary to light physical activity) and high (moderate to active) group for stress ($p=0.031$) but not for depression and anxiety. The within subject repeated measure (on just the experimental group, n=69) showed that the changes were statistically significant ($p<0.001$) for all three variables on stress, anxiety and depression.

Discussion

At baseline the level of distress of women with breast cancer who were allocated to a 4 weeks self management program were higher although the differences were not statistically significant at the level of $p<0.05$. This also shows that the two groups did not differ at baseline and thus are comparable. It is postulated that a reason for the higher scores in the experimental group could be due to the added psychological arousal from the knowledge that they needed to come into the medical centre for an additional five sessions on top of all the other multiple appointments that they need to adhere to like chemotherapy or radiology.

The pattern of reduced distress appears significant over the repeated measures for the experimental group ($p<0.05$). However, a pattern of unfavourable increase in distress (stress, anxiety and depression) was observed in the control group. Cancer diagnosis can lead to enduring feelings of vulnerability (Bower et al., 2005) resulting in cognition errors and faulty beliefs which can lead to distress and interfere with physiologically ready states for self-management. Thus, the 4 weeks self management intervention was purposefully designed to provide components of cognitive behavioural exercises such as identifying negative self deprecating thoughts and challenging them with positive statement and practice of relaxation skills. Cognitive behavioural therapy (CBT) utilize a multimodal approach and is particularly effective in decreasing symptom severity for patients with cancer (Antoni et al., 2001; Dodd & Miaskowski, 2000; Sherwood et al., 2007). The favourable findings in this study is supported by a study which shows that CBT was effective for depression (ES = 1.2; 95% CI = 0.22–2.19), anxiety (ES = 1.99; 95% CI = 0.69–3.31), and QOL (Osborn, Demoncada & Feuerstein, 2006).

This provision of knowledge, skills and support in a group of about 6-10 people, increase the women self efficacy to self manage the medical, emotion and role tasks. Thus, although there were extra demands for them to attend the sessions, the women reported feeling supported by the health team. The unavailability of information (Loh et al., 2007) – a barrier to self management, may have been addressed in the program. In a group for-

mat, stressors may be mediated by the embedded buddy mechanism where each person was assigned a buddy, and can select a second buddy based on needs. Thus the program provided a built-in support system from their peers' (buddies) and from the health team. This perhaps led to a favourable outcome for the experimental group. The positive results have been supported by several studies that promotes that groups produce greater benefits than individual therapy, e.g. in weight loss programs (Renjilian et al., 2001), gastrointestinal symptom reduction (Vollmer & Blanchard, 1998) and in the level of QOL of breast cancer patients (Sakiko et al., 2000). Evidence suggest that structured support group intervention can significantly improve depression (p=0.0001), anxiety (p=0.0001) and QOL (p=0.0009) (Lindemalm, Strang & Lekander, 2005). Also, the health of disadvantaged women is compromised due to a lack of education, lack of information and lack of awareness of factors that contribute to the disease (Luddy, 2007). Thus facilitating them with information, skill and inbuilt support system may have improved their confidence in self management and consequently reduces their stress level. Indeed, self-management education 'complements traditional patient education in supporting patients to live the best possible quality of life with their chronic condition' (Bodenheimer, Davis & Holman, 2007).

On the aspect of depression, the profile in the control group shows a sharper rise even at the third repeated measure. One study has shown that in a large cohort of breast cancer patients (n=2943), the post-hoc multivariate analysis revealed that chemotherapy (HR: 1.2; 95% CI: 1.0 –1.5), and hormonal receptor positive status (HR: 1.2; 95% CI: 1.0–1.5) were significantly and independently associated with an increased risk for developing depression (Lee, Ray, Thomas & Finley, 2007). A cut off score of 5 for anxiety and 12 for depression is recommended. This study found significant improvement in the experimental group in terms of cut off score. Nevertheless, any clinical significance (as a means of assessing outcome as appropriate), should be interpreted with caution. This is because improvement can also be expected upon completion of treatment. Another significant finding is that women who reported higher physical activity level showed significant difference in terms of stress. Larger study is needed to confirm the role of physical activity in buffering stress during treatment. These findings suggest that women with breast cancer need support in managing the multiple tasks even after breast surgery, as chemotherapy and radiation can be equally distressing and it alters participation in life because of its duration of treatment. One limitations of the study is that data were obtained by self report. Future studies can include larger cohorts and examine the role of physical activities on the psychological distress of these women.

Conclusion

Having a diagnosis of breast cancer is distressing to most women but women who were offered the self management support as they go through the multiple appointments for treatment, showed statistically significant reduction in their psychological distress. Women with breast cancer who went through a 4 week patient self management programme led by health professionals showed significant reduction in stress, anxiety and depression over time. In contrast, women who were in the usual care group showed unfavourable increases in distress over time. Having a higher physical activity level is also significantly associated to a lowered stress, and as such exercise as a lifestyle strategy should be offered to women newly diagnosed with breast cancer. The psychosocial rehabilitation of women with breast cancer needs to be emphasised as increasingly more women are living with this condition. The 4 week self management intervention is a timely blueprint to improve education, information and awareness amongst women with breast cancer. The program can be embedded as an essential part of clinical practice guidelines to be delivered by occupational therapists, as an early intervention therapy for women with breast cancer.

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■ORIGINAL ARTICLE

Study of Visual Function Evaluation for People with Severe Motor and Intellectual Disabilities Utilizing Near-Infrared Spectroscopy

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Abstract: The purpose of this study was (1) assess the effectiveness of near-infrared spectroscopy (NIRS) for evaluating visual function of people with severe motor and intellectual disabilities (SMID), and (2) investigate the inference of characteristics of visual stimuli to response from them and to dynamics of cerebral blood flow. Twenty-one SMID were presented Visual Task 1 which uses a photograph, and classified into four groups based on subjects' eye movement. Additionally, oxy-Hb which was most increased was measured. Results, the averages of oxy-Hb for "gaze" and "habituation" group were 0.45 and 0.83 mM*mm, "non-gaze" was almost 0 mM*mm, and "non-judgment" were resembled "gaze". In Visual Task 2 which uses a moving image, most subjects were classified in "gaze", and an oxy-Hb had increased. This study indicated that NIRS is an effective instrument for visual function evaluation, and that difference in the characteristics of stimuli could affect the responses and oxy-Hb of SMID.

Key words: people with severe motor and intellectual disabilities, near-infrared spectroscopy, visual function

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Introduction

In Japan, people with severe motor and intellectual disabilities, termed people with SMID hereafter, live in institutions and get long-term living support and rehabilitation. This is an administrative program of Japanese government, and there are more than one hundred such institutions in Japan. It is often the case that people with SMID have difficulties in rolling over or walking by themselves and they cannot talk with others. Furthermore they cannot express themselves and have disorder in their upper limb function. These disabilities make it very hard for them to take action or respond to their ambient environment. The rehabilitation staffs realize that setting up suitable living environment and making personal rehabilitation program according to their disabilities are indispensable for them. However, the severity of their disabilities makes it difficult for the staff even to assess their developmental stage, especially mental development, properly.

Regarding mental development of people with SMID, Nakamura, Taniguchi, and Adachi (1990) reported that the abilities of sensory-motor intelligence, the orienting responses and the gazes have related to their intellectual development. The authors found that the people with SMID who could orientate to and habituate to visual stimuli were age of higher developmental stage and had higher activities of daily livings (ADL) performance (Nakamura, Sengoku, Nakajima, Yanagiya & Tachi, 2006). The habituation is a reaction of the subject who was sated with the stimulus after having recognized the characteristics of it. Hotz et al. (2006) reported that an environment of intelligibly arranged physical sensory stimuli has im-

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proved their active behavior. Especially under so-called Snoezelen and Multi-sensory environment that gave moving visual stimuli with high contrast to people with SMID, they have continued exploring and paying attentions to the stimuli for longer duration of time (Hotz et al., 2006). These findings indicate that it is necessary to properly measure their fixation to and gaze at stimuli for evaluating their mental development. And also setting up an environment, which promotes the fixation and the gaze of people with SMID, is important. However, even identifying the fixation is not easy in case the people with SMID have nystagmus or difficulty in controlling their head, since the identification is mainly done by just observation of rehabilitation staff.

Recently, the near-infrared spectroscopy (NIRS) has been introduced to evaluate human's response to visual stimuli. Although NIRS has low spatial resolution and provides only two-dimensional surface mapping, it was shown that NIRS was robust to subject's body movement (Takahashi et al., 2000). Kato, Kamei, Takashima, and Ozaki (1993) employed NIRS to evaluate activity of optic area in the brain of normal adults for the first time. They have revealed that the changes in oxygenation hemoglobin concentration (oxy-Hb changes) in optic area had increased right after the onset of flashlight as visual stimuli, and decreased right after disappearing of the stimuli. The similar changes had been observed in infants (Taga, Asakawa, Maki, Konishi & Koizumi, 2003; Wilcox, Bortfeld, Woods, Wruck & Boas, 2005). NIRS is simple equipment for measuring the brain activity but has a characteristic that the identification of visual stimuli can be measured objectively as the oxy-Hb changes in optic area. As NIRS has been used for infants, the authors considered that it is effective to evaluate the visual function of people with SMID who have difficulty in understanding the tests themselves. A multi-channel NIRS, which can monitor different sites in the brain simultaneously, is more suitable equipment to identify the activated sites of people with SMID within a short time period after the onset of a visual stimulus than other means to test the brain function, since such means make the subjects tightly restricted and then cannot be applied to people with SMID. In order to clarify the suitable living environment for people with SMID, dynamics of their cerebral blood flow and their responses along with changes of visual stimuli should be investigated with NIRS.

The purpose of this study was twofold: (1) assess the effectiveness of NIRS for evaluating visual function of people with SMID, and (2) investigate the inference of characteristics of visual stimuli to response from people with SMID and to dynamics of their cerebral blood flow.

Methods

Subjects

Twenty-one people with SMID (11 males and 10 females; age, 19 to 57 yr; mean age, 38.5 yr) participated in this study. All of them lived in institutions, and they needed to get full assistance in all of their ADL. Thirteen among of them were cerebral palsy, three were abnormal chromosome, two were aftereffect of hypoxic encephalopathy, two were intractable epilepsy, and one was aftereffect of cerebral meningitis. The results of Japanese Denver Developmental Screening Test (JDDST) (Ueda, 1980) showed that their developmental ages of gross motor activity were from zero to six months, and those of language development were from one to twenty three months. They did not have clear visual deficit, and they had blinking reflex. In addition, they could gaze at human faces or reach their hands to toys in their daily livings. These criteria for selecting subjects were chosen from the evaluation items that we have developed to apply for people with SMID by modifying the Visual Acuity Scores originally made by Katsumi et al. (Katsumi, Chedid & Kronheim, 1998). Table 1-1 and 1-2 show the profiles and visual activities of twenty-one subjects.

Seven normal adults (4 males and 3 females; age, 22 to 32 yr, mean age, 27.3 yr) who did not have anamnesis of visual function were recruited as controls for NIRS evaluation. The subjects with low visual acuity wore glasses or contact lens.

Visual tasks

The first task, termed Visual Task 1, was composed of four slides, numbered from 1 to 4. An illustration was drawn in the slide 1 to get subjects' attention paid to this task. Both the slides 2 and 4 were just black screen. These slides were added in order to make subjects resting. The slide 3 was a photo of Japanese infant face for subjects of people with SMID, while a photo of landscape for those of normal adults. We considered that the people with SMID and the normal adults were much interested in the photo of infant face and landscape, respectively.

The second task, termed Visual Task 2, was also composed of four slides, numbered from 1 to 4. The slides 1, 2 and 4 were identical to those of Visual Task 1. A moving image of the bubble unit of Snoezelen apparatus that was captured by a digital camera for 30 seconds was used for the slide 3 of Visual Task 2. The bubble unit is a clear tube filled with water in it and in which bubbles flow upward with gently changing colors as visual stimuli.

Figure 1 shows a protocol to conduct Visual Task 1 and Visual Task 2. The slide 1 was presented to each subject until it was confirmed that the subject paid an attention to the slide. After that, the slide 2, 3 and 4 were

Table 1-1. Profiles of the subjects with SMID

Case No.	Sex	Age (Yr.)	Diagnosis	JDDST (Mon.)		Blink Reflex
				Gross motor	Language	
1	Male	44	Cerebral Palsy	5	1	+
2	Female	53	Cerebral Palsy	5	18	+
3	Female	42	Cerebral Palsy	5	1	+
4	Male	43	Cerebral Palsy	0	1	+
5	Male	46	Hypoxic Encephalopathy	6	23	+
6	Female	44	Cerebral Palsy	1	1	+
7	Female	28	Abnormal Chromosome	5	1	+
8	Female	44	Cerebral Palsy	0	9	+
9	Male	57	Cerebral Palsy	1	1	+
10	Male	33	Abnormal Chromosome	6	18	+
11	Male	26	Intractable Epilepsy	5	3	+
12	Male	24	Intractable Epilepsy	1	5	+
13	Male	23	Hypoxic Encephalopathy	5	5	+
14	Male	49	Cerebral Palsy	5	5	+
15	Female	57	Cerebral Palsy	1	5	+
16	Male	19	Cerebral Palsy	0	3	+
17	Female	27	Cerebral Palsy	1	5	+
18	Male	42	Cerebral Palsy	5	5	+
19	Female	42	Cerebral Palsy	6	23	+
20	Female	38	Cerebral Palsy	0	1	+
21	Female	28	Cerebral Meningitis	1	1	+

"Yr." indicates the age in years, and "Mon." indicates the age in months. "SMID" indicates severe motor and intellectual disabilities, "JDDST" indicates Japanese Edition Denver Development Screening Test.

Table 1-2. Visual activities of subjects with SMID

Investigation item	Case No.																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Squints in bright sunlight?	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Detects a small thing like a glass marble?	–	+	–	–	+	–	–	+	–	+	+	+	+	+	+	–	+	+	+	–	–
Follows a small thing like a glass marble?	–	+	–	–	+	–	–	+	–	+	+	+	+	+	+	–	+	+	+	–	–
Gazes at a face of human?	–	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Follows a face of human?	–	+	+	–	+	+	–	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Detects a toy?	–	+	+	–	+	–	–	+	+	+	+	+	+	–	+	+	+	+	+	+	+
Follows a toy?	–	+	–	–	+	–	–	+	+	+	+	+	+	–	+	–	+	+	+	–	+
Gazes at a television screen?	–	+	–	–	+	–	–	+	+	+	–	+	+	+	+	+	+	+	+	–	–
Gazes at a tool of Snoezelen?	–	+	+	+	+	+	+	+	+	+	+	+	+	–	+	+	+	+	+	+	+
Tries to reach a toy?	+	+	–	+	+	–	–	+	–	+	+	+	+	+	+	–	–	+	+	+	–

Investigation item were employed from Visual Acuity Scores developed by Katsumi et al., which was modified by us to apply for people with SMID. "+" shows that an answer of an investigation item is "yes", "–" shows "no".

presented for 30 seconds each in this order. Firstly, all subjects were tested with Visual Task 1. Secondly, Visual Task 2 was used only for people with SMID who were selected based on the result of Visual Task 1. The normal adults were required to gaze at the slides during all the time of Visual Task 1.

Equipments and their setting

Figure 2 illustrates the equipments and their settings for this study. A multi channel NIRS instrument (ETG-4000, Hitachi Medical) was used for this study. According as the International 10–20 System of Electrode Placement, the set of 22 optical fibers (gross area, 6 cm × 12 cm) was placed at subject's occipital area to measure oxy-Hb changes at 10 Hz of sampling rate. The lowest fibers were placed symmetrically at 0.5 cm directly above from inion. The slides of visual tasks were presented on a 19-inch LCD display (LCD92V-V, NEC) by using Microsoft® Office PowerPoint 2003 software running on a mobile PC (CF-W5, Panasonic). A digital video camera (DCR-TRV30, SONY) was set up over the LCD display to capture the subject's eye movement. NIRS and the camera were synchronously controlled. People with SMID sat in front of the LCD display at a distance of 80–100 cm by

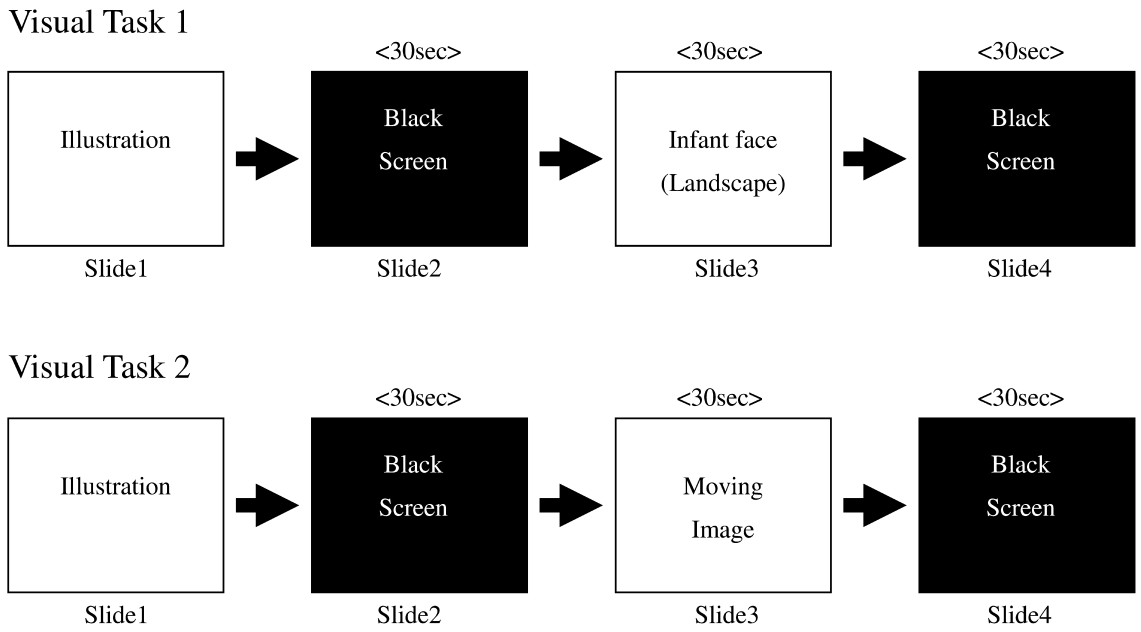

Fig. 1. Protocol of Visual Task 1 and Visual Task 2. Contents in each square show presented slides, and the upper time shows presentation time.

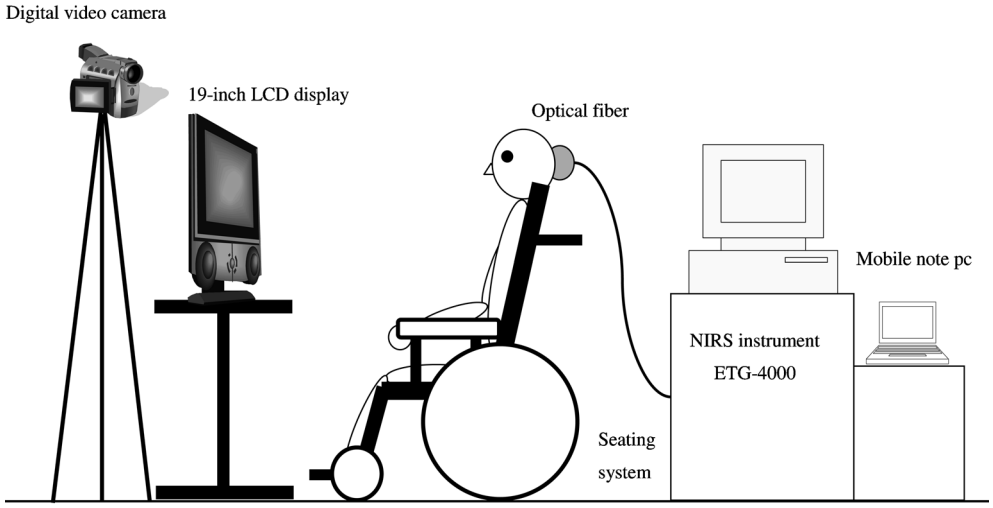

Fig. 2. Equipments and their settings for this study. This study was carried out in the darkroom where visual stimulation and auditory stimulation were controlled. The circumference of a 19-inch LCD display which showed visual stimulation was covered with a black screen.

using a seating system. For those who could not control their heads, we assisted their heads manually.

Analysis

1) Classify people with SMID

Visual task 1: The first author and an occupational therapist who has 15 years of experience in the field of developmental disease classified people with SMID into four groups based on their eye movement during presenting the slide 3 of Visual Task 1: (a) subjects who gazed at the slide obviously but were not habituated to it were classified into “gaze group”; (b) subjects who gazed at the slide obviously and were habituated to it were classified into “habituation group”; (c) subjects who did not gaze at the slide obviously were classified into “non-gaze group”; (d) the other subjects were classified into “non-judgment group”. For each subject, the two occupational therapists did the classification separately, and discussed on their classifications. After they agreed on the classifications, all the subjects were classified into one of the four groups.

Visual task 2: Subjects classified into groups of “non-gaze group” and “non-judgment group” were furthermore

tested with Visual Task 2. The first author and the occupational therapist classified them into three groups based on their eye movement during presenting the slide 3 of Visual Task 2: (a) subjects who gazed at the slide obviously were classified into "gaze group"; (b) subjects who did not gaze at the slide obviously were classified into "non-gaze group"; (c) the other subjects were classified into "non-judgment group". The procedure of the classification was same as that of Visual Task 1.

2) NIRS evaluation

It is known that oxy-Hb changes show the same direction as the changes of blood flow but deoxy-Hb changes and the total Hb changes do not (Hoshi, 2005). This is the reason why oxy-Hb changes have been widely used for an index of brain activities. We used the data of oxy-Hb changes obtained by the NIRS for the evaluation of brain activities of the subjects.

Visual task 1: Data measured by the NIRS were 5-seconds moving averages at 10 Hz of sampling rates. We used the data measured at two points of each 22 channels. One point was at the beginning time of presenting slide 3, termed B1, and the other one was at the time oxy-Hb changes be most increased, termed M1. Since the value of oxy-Hb changes is a relative value from the beginning of the measurement, the value of oxy-Hb changes at M1, termed M1 data, was recalculated by assuming the value at B1 be 0 mM*mm. Among of M1 data at 22 channels for a subject, we used the largest one as the subject's data.

We calculated the average of subjects' M1 data for each four groups and seven normal adults.

Visual task 2: Just like analysis of data from Visual Task 1, we used the data measured at two points of each 22 channels. One point was at the beginning time of presenting slide 3, termed B2, and the other one was at the time oxy-Hb changes be most increased, termed M2. The value of oxy-Hb changes at M2, termed M2 data, was recalculated by assuming the value at B2 be 0 mM*mm. Among of M2 data at 22 channels for a subject, we used the largest one as the subject's data. In order to discuss an inference of the difference of visual stimuli, we compared M1 data and M2 data.

In accordance with the regulations set forth by the Ethics Committee of Sapporo Medical University, this study has passed an examination of the Committee, and informed consent was obtained from all people with SMID or their parents and from all normal subjects.

Results

Visual task 1

1) Normal adults

By observing eye movements of seven normal adults, we confirmed that they gazed at the slides during all the time of Visual Task 1 as required. The average of M1 data for them was 0.36 ± 0.08 mM*mm.

2) People with SMID

Nine people with SMID were classified into "gaze group", seven of them were into "habituation group", two of them were into "non-gaze group", and three of them were into "non-judgment group". Table 2 shows M1 data. The averages of M1 data for "gaze group" and "habituation group" were 0.45 and 0.83 mM*mm, respectively. M1 data of two subjects in "non-gaze group" were 0.019 and 0.005 mM*mm, while those of three subjects in "non-judgment group" were 0.263, 0.251 and 0.207 mM*mm. From these results, the M1 data of subjects in "gaze group" and "habituation group" is greater than those in "non-gaze group".

Visual task 2

Table 3 shows the results of classifications and NIRS data obtained from both Visual Task 1 and Visual Task 2. All subjects in "non-gaze group" and two of three subjects in "non-judgment group" classified after Visual Task 1 were classified into "gaze-group" as a result of Visual Task 2, and the M2 data had increased.

Discussion

The M1 data of normal adults

Some previous studies on evaluating visual function of infants and normal adults by using NIRS have employed flashing stimuli or checkerboard as visual stimuli (Takahashi et al., 2000; Kato et al., 1993, Taga et al., 2003; Obrig et al., 2002). These stimuli were originally used to measure visual evoked potential to diagnose organic disorders in visual pathway. Since our study was aimed to evaluate visual function of subjects in the environment like their daily livings, we used a photo of landscape. As a result, we could confirm that the M1 data of all normal adults increased after seeing the photo of landscape just like the previous studies using flashing stimuli or checkerboard. Csibra et al. (2004) has also reported that oxy-Hb changes have increased at occipital lobe of normal adults during presenting a photo of human face as a visual stimulus. From these results, it is suggested that NIRS can be used to evaluate oxy-Hb changes by using even not specific stimuli such as a landscape picture and a photo of human face.

The M1 data of people with SMID

The M1 data of subjects in "gaze group" and "habituation group" were larger than those of subjects in "non-gaze group". In some previous studies it has been reported that the increase and decrease of oxy-Hb changes of infants and normal adults corresponds to the On-Off of vi-

Table 2. The M1 data for each group

Classification	Case No.	M1 data (mM*mm)	Mean M1 data (mM*mm)
Gaze group	3	0.29	0.45
	4	0.48	
	8	0.50	
	9	0.11	
	13	0.80	
	14	0.64	
	15	0.36	
	18	0.59	
	19	0.31	
Habituation group	2	1.24	0.83
	5	0.72	
	6	0.98	
	10	0.65	
	11	0.80	
	16	0.60	
	17	0.84	
Non-gaze group	12	0.02	–
	20	0.005	
Non-judgment group	1	0.26	–
	7	0.25	
	21	0.21	

The number of people classified into "non-gaze group" and "non-judgment group" was few; mean M1 data were not calculated.

Table 3. Classification and NIRS evaluation between Visual task 1 and Visual task 2

Case No.	Visual Task 1		Visual Task 2	
	Classification	M1 data (mM*mm)	Classification	M2 data (mM*mm)
12	non-gaze	0.019	gaze	1.349
20	non-gaze	0.005	gaze	0.787
1	non-judgment	0.263	non-judgment	-0.001
7	non-judgment	0.251	gaze	0.731
21	non-judgment	0.207	gaze	0.734

Case No.7, 12, 20, and 21 were classified into "gaze group" and the M2 data increased.
Case No.1 has no change in result of classification and the M2 data.

sual stimuli (Kato et al., 1993; Taga et al., 2003). From these results, it is suggested that the oxy-Hb changes in SMID people from "gaze group" and "habituation group" derived from active gaze at the stimulus. The M1 data of subjects in "non-gaze group" were almost zero. We considered that the behavior of "non-gaze" could be detected by the value of M1 data being almost zero. The M1 data of subjects in "non-judgment group" were similar to those of normal adults. In addition, we confirmed that they watched TV and reached out for toys in their daily livings. A study using a checkerboard with infants and normal adults has reported that oxy-changes at occipital lobe were about 0.1mM*mm (Takahashi et al., 2000; Taga et al., 2003). As the M1 data of subjects in "non-judgment group" were larger than 0.2mM*mm, we considered that they at least watched the visual stimuli, and they may show clear gaze at some other stimuli in which they are more interested.

An inference of the different characteristics of visual stimuli toward people with SMID

Four subjects out of five classified into "non-gaze group" or "non-judgment group" after Visual Task 1 were classified into "gaze group" as a result of Visual Task 2, and their M2 data increased. It suggests that a visual stimulus with high contrast and changing colors or figures, such as a bubble unit, can lead an active gaze of people with SMID. In previous papers, it was reported that people with SMID have continued exploring and paying attentions to the stimuli for longer duration of time under Snoezelen and Multi-sensory environment (Hotz et al., 2006; Kaplan, Clopton, Kaplan, Messbauer & McPherson, 2006). Yashiro, Ozawa, and Fujimura (1998) have reported that people with SMID of from zero to six months developmental age were more interested in various kinds of sensory stimuli of Snoezelen among people with SMID of from zero to eighteen months developmental age. The

language developmental ages of people with SMID who were classified into "non-gaze group" or "non-judgment group" after Visual Task 1 in this study were from one to seven months by JDDST. From this result and NIRS data from subjects classified into "non-gaze group" or "non-judgment group", it was suggested that a visual stimulus like the third slide of Visual Task 2 could not only get interests but also promote visual orientation and gaze of people with SMID whose developmental age were low.

In this study, we presented that the increase or decrease of oxy-Hb changes of people with SMID depended on gazing or non-gazing at visual stimuli by using NIRS to evaluate their visual function. We also showed that NIRS could be used to infer visual function of a subject whose gaze could not be evaluated by visual observation. The data of oxy-Hb changes alone are not capable for neither assessing subjects' understanding of the presented stimuli nor judging just watching or gazing at the stimuli. By gathering information on their daily livings and evaluating the information together with oxy-Hb changes, the subjects' visual function might be assessed in properly and objectively. Since it is impossible for people with SMID to use MRI with NIRS, it is difficult to identify the primary visual area of them by using NIRS alone. However, by using a multi channel NIRS and employing the International 10–20 system of Electrode Placement, we could capture responses from people with SMID to visual stimuli by analyzing data from the channel that showed the largest oxy-Hb changes. This result suggests that a multi channel NIRS is more applicable for evaluating people with SMID than other NIRS evaluations. The difference in the characteristics of visual stimuli could affect the responses and the dynamics of blood flow in brain of people with SMID. A continuous support from infant to adulthood is required in occupational therapy for people with SMID. A program of occupational therapy that is aimed to promote their visual attention is necessary and important. We presented that there was a visual stimuli that tended to attract visual interests of people with SMID. An activity of employing such visual stimuli should be conducted in the daily living of people with SMID as well as in their rehabilitation program.

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■ORIGINAL ARTICLE

A Preliminary Study on the Usability of Head Mount Display (HMD) for Evaluating Attentional Behavioral Disturbance

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Abstract: To investigate the clinical applicability of head-mount display (HMD) in evaluating attentional behavioral disorders, we developed a new desk-task environment with HMD. 18 patients with right hemisphere damage were recruited. We compared the results of traditional neuropsychological tests and tasks carried out under the HMD setting using attention behavioral disturbances observed in daily life. The findings show that performance under HMD settings predicts the presence or absence of attention behavioral disturbance with higher accuracy than traditional tasks. Our newly developed HMD system shows promise as an appropriate method for assessing attentional behavioral disturbances. Although necessarily speculative at this stage, we believe that the more dynamic cognitive demands required to successfully accomplish the HMD task might be linked to attentional behavior in ADL.

Key words: stroke, attention, head-mount display (HMD)

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Introduction

The purpose of Occupational Therapy (OT) is to help people increase their functional independence in daily life while preventing or minimizing disability. Physical, psychological, and cognitive factors, as well as personal history, are linked causally to disabilities. In the clinical setting, some patients show behavioral disorders mainly due to cognitive deficits, and occupational therapists often apply several neuropsychological tests to verify the factors causing their behavioral disorders. However, it has been recognized that some patients don't show any abnormalities in neuropsychological tests, but do display behavioral deficits in activities of daily living (ADL) (Sasaki, Sengoku, Nakajima, Sugama & Kitajima, 2005). The authors investigated the relation between results of a revised bisection task and attentional performance in ADL in stroke patients. The results showed that some patients exhibited no behavioral abnormalities in spite of their lower score in the task.

This clinical discrepancy has a negative impact on our clinical practice because it restricts our understanding of the impairments causing patients' behavioral disorders. This in turn can lead to anomalies in communication with other medical staff and even patients' families, resulting in disagreements regarding treatment options. Accordingly, evaluations with higher accuracy in detecting behavioral abnormalities should be developed.

We assume that one of the reasons for these discrepancies could be environmental differences: static in desk-task settings vs. dynamic in ADL settings. In general, it

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Table 1. Demographic and clinical characteristics

case	age	sex	etiology	duration from onset (month)	FIM	MMSE	motor deficit	sensory deficit	USN	visual field deficit
1	62	female	infraction	11	95	23	moderate	+++	+	+
2	72	male	infraction	1	87	24	mild	+	+	+
3	76	male	infraction	1	70	28	mild	+	+	+
4	77	male	infraction	2	103	28	mild	–	+	+
5	58	male	infraction	1	101	20	mild	+	+	+
6	54	male	hemorrhage	3	71	18	severe	+++	+	+
7	55	male	hemorrhage	5	77	26	severe	++	+	+
8	57	female	infraction	1.5	74	27	severe	++	+	–
9	62	male	hemorrhage	1	91	28	severe	+++	+	–
10	57	male	infraction	4	101	29	severe	+++	+	–
11	61	female	hemorrhage	1	119	26	mild	++	–	–
12	69	male	hemorrhage	3	114	29	moderate	+	–	–
13	75	female	infraction	1	110	25	mild	+	–	–
14	78	male	infraction	0.5	126	30	mild	–	–	+
15	58	male	infraction	1	63	25	severe	+++	–	–
16	57	male	infraction	2.5	115	29	moderate	+++	–	–
17	74	male	infraction	0.5	99	30	mild	+	–	–
18	50	male	infraction	1	122	30	mild	+	–	–
ave.	64.0			2.3	96.6	26.4				
SD	8.9			2.4	18.9	3.3				

a. sensory deficit; +++, severe; ++, moderate; +, mild; –, absent. b. USN; +, present; –, absent. c. visual field deficit; +, present; –, absent.

has been thought that the desk-task setting is so static that less sensory integration was needed to successfully accomplish a given task (Thompson & Sanderson, 2008). Another reason, postulated by Deouell, Sacher, and Soroker (2005), was that desk tasks do not reflect the dynamic character of the natural daily environment, in which relevant stimuli (e.g. background of objects and changing shadow) occur. That is, in most cases, patients sit and carry out relatively one-dimensional tasks, e.g. vision for a search task. Patients no longer need to process stimuli irrelevant to desk tasks and only less sensory information has to be integrated to successively accomplish tasks. On the other hand, ADL settings involve dynamic situations that require patients to integrate external and internal incoming sensory information properly while performing concurrent activities. Few studies have been reported in which the subjects were required to concentrate on environmental differences while performing desk-tasks, and in which the relationship between the results of desk tasks and ADL performance was analyzed.

Hence, we developed a desk-task setting using a head mount display (HMD) and a tablet, in which more sensory integration is needed than in the traditional desk-task setting. The present work is intended to evaluate the clinical applicability of the test settings.

Materials and Methods

Subjects

18 patients (14 men and 4 women) with right hemisphere damage were the subjects of this study. Participants gave written informed consent, and the experiments were approved by the local ethics committee of Sapporo Medical University. All subjects had undergone a usual rehabilitation program. The mean age was 64.0 with a standard deviation of 8.9. The score of the Mini-Mental States of Examination (MMSE) ranged from 18 to 30 and its average ± *SD* was 26.4 ± 3.3. The mean months from onset were 2.3 ± 2.4 (ranging from 0.5 to 11). 8 out of 18 subjects had visual field deficit on confrontation. 10 patients exhibited spatial neglect in at least one task including cancellation, copying, bisection, and behavior in daily life. We excluded subjects who had severe dementia, aphagia, or apraxia as well as those who couldn't concentrate on successive tasks for about 45 minutes. The clinical and demographic data are summarized in Table 1. Patients who were mild to moderate in their severity were selected because the discrepancy between results of desk tasks and performance in ADL settings (proposed in the introduction) occurs in mild patients.

Tasks in traditional settings

Subjects were seated in front of a table, on which a task sheet was placed in front of their trunk midline.

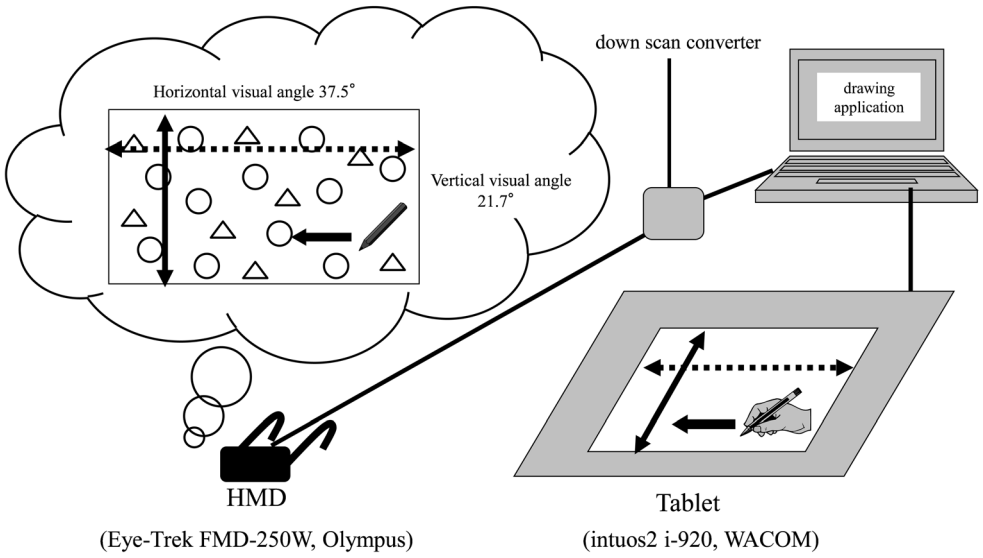

Fig. 1. Schematic representation of experimental setting in HMD environment. In HMD setting, the tablet is placed in front of subjects. Subjects wear HMD during the tasks. Subjects see only a task stimulus, pen icon and the marks they make on the HMD display by manipulating the pen on the tablet. There is no apparent time lag between pen manipulation on the tablet and movement of pen icon on HMD display.

The following three visuo-spatial tasks were administered in the traditional setting: a line bisection task, a figure copying task, and a figure cancellation task consisting of 20 triangles and 20 circles scattered on A4 paper (target "circle"). In the line bisection task, subjects were asked to mark the midpoint on each line. We analyzed the averaged percent deviation with respect to the true midpoint, defined as rightward and as a positive value in all trials. Following Levine's criteria (Levine, Warach, Benowitz & Calvanio, 1986), we also graded the deviation: less than 9.9% as 0, 10.0% to 39.9% as 1, 40.0% to 69.9% as 2, and more than 70.0% as 3. In the figure copying task, subjects copied a daisy. We analyzed the area of parts omitted and scored it 0 if there were no omissions, 1 if less than the left-most 1/3 was omitted, 2 if more than 1/3 but less than 2/3 was omitted, and 3 for more than 2/3 omission. In the figure cancellation task, subjects were asked to cancel out all circles. We analyzed the number of targets canceled out and time taken. The same criteria were used for cancellation. We also calculated the performance score as a function of the number of canceled targets and time taken using the following formula: the number of canceled targets × the number of canceled targets / time taken. A higher score was considered to indicate a better performance.

Tasks in HMD setting

1) Apparatus and experimental setting

A head mount display (Eye-Trek FMD-250W, Olympus) (HMD) was used. HMD is a type of eye-ware, and only the task is displayed on it. Its screen resolution was 653×368 pixels: the viewing area was 37.5° (horizontal) × 21.7° (vertical) of visual angle. Subjects operated a pen icon displayed on the HMD with a stylus on a tablet. We also used a tablet (intuos2 i-920 WACOM) with an A4-size work space on which subjects conducted tasks with the stylus. These two apparatuses were connected to a lap top computer (Winbook WA2200C5, SOTEC) whose refresh rate and screen resolution was 60 Hz and 1024×768 pixels, respectively. Task stimulus for the HMD settings was made using a drawing application.

A schematic representation of the experimental settings is shown in Fig.1. The computerized stimulus was projected on the HMD through a down scan converter, allowing the experimenter to switch the projection on and off. The subjects wore the HMD and carried out the tasks with the stylus on the work area of the tablet. The top left corner and the bottom right corner of the work area of the tablet corresponded approximately to those of the HMD display.

2) Task

The HMD setting includes two sessions. Firstly, to familiarize themselves with the use of the HMD and the stylus, subjects carried out a series of trial line drawing and pointing tasks. In the line drawing task, subjects were instructed to draw a horizontal line while wearing the HMD. In the pointing task, they were asked to mark two black dots presented on the HMD display. Their familiarization was evident if they correctly drew a horizontal line and marked two dots. After familiarization, subjects

Table 2. Directional attention behavioral questionnaire

item	score		
1 to experience difficulty in finding people or objects on contralesional side	0. none	1. sometime	2. frequently
2 to experience difficulty in looking towards contralesional side	0. none	1. sometime	2. frequently
3 to forget to eat food on contralesional side of plate	0. none	1. sometime	2. frequently
4 to forget to eat food on contralesional side of dish	0. none	1. sometime	2. frequently
5 to forget to groom or shave on contralesional side of face	0. none	1. sometime	2. frequently
6 to experience difficulty in adjusting contralesional side of sleeve	0. none	1. sometime	2. frequently
7 to forget to use wheelchair brake on contralesional side	0. none	1. sometime	2. frequently
8 to forget to use wheelchair foot-rest on contralesional side	0. none	1. sometime	2. frequently
9 to start to transfer without taking foot off contralesional side of foot-rest	0. none	1. sometime	2. frequently
10 to bump into something on contralesional side	0. none	1. sometime	2. frequently
11 to experience difficulty in finding way towards contralesional side	0. none	1. sometime	2. frequently
12 to be unaware of noise or people addressing him/her from contralesional side	0. none	1. sometime	2. frequently
13 to orient ipsilesional side when one is called	0. none	1. sometime	2. frequently
	sum (0 / 26) =		

(adapted and revised from Ishiai, S. (1999) and Azouvi, P. et al. (2003))

carried out a figure cancellation task. The number of the targets (circles) and the distracters (triangles) was the same as that in the traditional setting. We used the cancellation task in the HMD setting because this cancellation task has several analytic components (Manly et al., 2009) and a higher sensitivity to attentional deficit (Azouvi et al., 2002). We applied the same analysis used in the traditional setting.

Overall procedure

Subjects were seated in front of the table. Firstly, they were asked to conduct tasks in the traditional setting: a line bisection task 5 times for each length, a figure cancellation task and a figure copying task. Then the tablet was placed and they carried out the familiarization task in the HMD setting. Finally, the figure cancellation task in the HMD setting was carried out.

Behavior in ADL

To assess the subjects' behavioral condition in ADL, we used two questionnaires. One was designed to assess the association of behavioral disorders with directional attentional deficit (Ishiai, 1999; Azouvi et al., 2003), for example "to bump into something on the contralesional side," and "to orient oneself to the ipsilesional side when one is called." 13 items were included and each item was scaled from 0 (never) to 2 (frequently) (Table 2). Therefore, the total score ranged from 0 to 26. Another questionnaire was associated with general attentional deficit (Ponsford & Kinsella, 1991), including "to be slow in movement," and "to miss important details in what he / she is doing." This questionnaire has 14 items scored from 0 (not at all) to 4 (always) for each item, and 0 to 56 as a total score (Table 3). Therapists who were in charge of the patients answered these questionnaires.

Data analysis

In the first analysis, we classified subjects into positive groups and negative groups on the basis of the cut-off score for each task: subjects who scored higher than 1 were positive and a 0 score was negative. Subjects showing attentional deficit on the tasks were identified as positive and those who didn't as negative. For the performance score in the figure cancellation task in both test settings, the cut-off score was the median of the performance score. We compared the scores of each behavioral questionnaire of the positive group with those of the negative group. Mann-Whitney's U test was applied for the comparison.

The second analysis was conducted to identify how much influence the HMD setting had on attention behavioral disorders. The traditional setting to HMD setting ratio was calculated for their performance score and compared with the total score of each attention behavioral questionnaire. Spearman's rank correlation coefficient was performed.

To learn whether HMD tasks could be an index of attention behavioral disorders, a third analysis examined variations in the results of tasks and attention behavioral problems at an individual level.

Results

Positive group vs. negative group

In all tasks performed, the directional attention behavioral score of the subjects who were diagnosed as positive was significantly higher: total score of the three visuo-spatial tests ($p = 0.0009$), line bisection ($p = 0.0435$), copying ($p = 0.0341$), traditional cancellation (number of omits) ($p = 0.0016$), traditional cancellation (performance score) ($p = 0.0051$), and HMD cancellation (performance score)

Table 3. General attention behavioral questionnaire

item	score				
1 seemed lethargic (i.e. lacking energy)	0. Not at all	1. Occasionally	2. Sometimes	3. Almost always	4. Always
2 tired easily	0. Not at all	1. Occasionally	2. Sometimes	3. Almost always	4. Always
3 been slow in movement	0. Not at all	1. Occasionally	2. Sometimes	3. Almost always	4. Always
4 been slow to respond verbally	0. Not at all	1. Occasionally	2. Sometimes	3. Almost always	4. Always
5 performed slowly on mental tasks	0. Not at all	1. Occasionally	2. Sometimes	3. Almost always	4. Always
6 needed prompting to get on with things	0. Not at all	1. Occasionally	2. Sometimes	3. Almost always	4. Always
7 stared into space for long periods	0. Not at all	1. Occasionally	2. Sometimes	3. Almost always	4. Always
8 had difficulty concentrating	0. Not at all	1. Occasionally	2. Sometimes	3. Almost always	4. Always
9 been easily distracted	0. Not at all	1. Occasionally	2. Sometimes	3. Almost always	4. Always
10 been unable to pay attention to more than one thing at once	0. Not at all	1. Occasionally	2. Sometimes	3. Almost always	4. Always
11 made mistakes because he/she wasn't paying attention properly	0. Not at all	1. Occasionally	2. Sometimes	3. Almost always	4. Always
12 missed important details in what he/she is doing	0. Not at all	1. Occasionally	2. Sometimes	3. Almost always	4. Always
13 been restless	0. Not at all	1. Occasionally	2. Sometimes	3. Almost always	4. Always
14 been unable to stick at an activity for very long	0. Not at all	1. Occasionally	2. Sometimes	3. Almost always	4. Always
	sum (0 / 56) =				

(adapted from Ponsford & Kinsella. (1991))

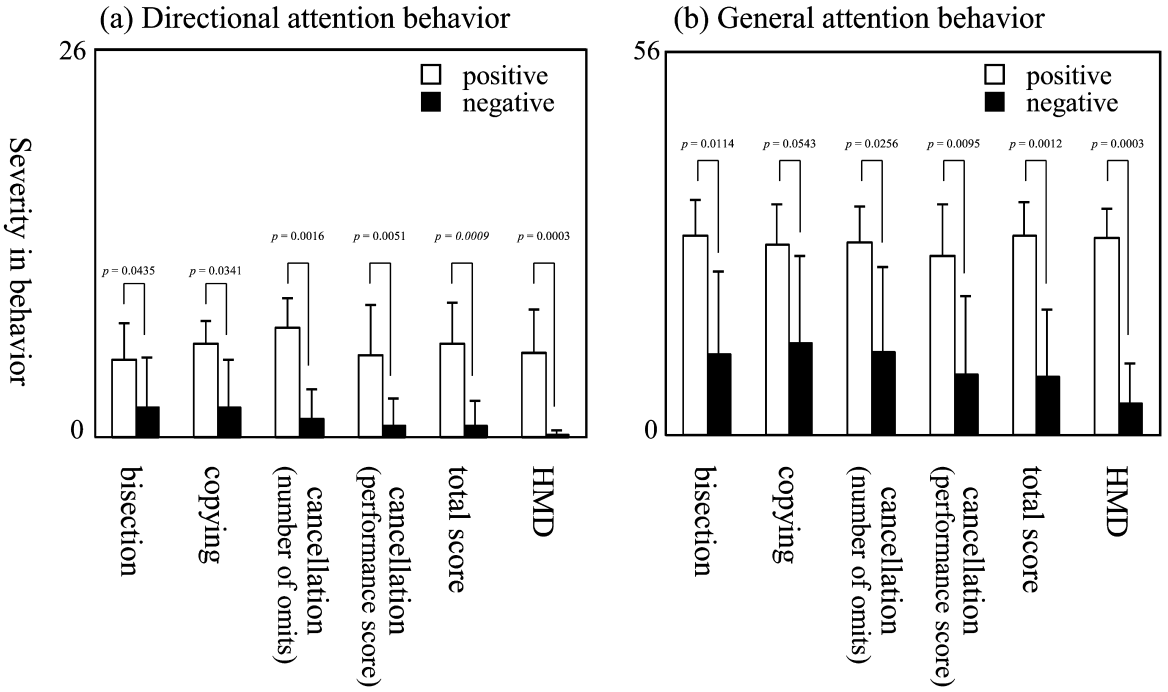

Fig. 2. Behavioral score of positive group and negative group for each task in (a) and (b). For both directional and general attention behavior, the positive group exhibits a much higher score than the negative group.

(p = 0.0003) (see Fig. 2a). The same was true for the general attention behavioral score, except in the figure copying task, in which no difference between the two groups was found. In the other 5 tasks and indexes, the positive group achieved a significantly higher score than the negative group: total score of the three visuo-spatial tests (p = 0.0012), line bisection (p = 0.0114), traditional cancellation (number of omits) (p = 0.0256), traditional cancellation (performance score) (p = 0.0095), and HMD cancellation (performance score) (p = 0.0003) (see Fig. 2b).

Traditional / HMD ratio and behavior

Although all subjects showed lower performance scores in HMD tasks, the mean of the traditional / HMD ratio was 5.6, ranging from 2.0 to 15.5. As shown in Fig. 3a, subjects with a significantly higher ratio achieved a higher score in the directional attention questionnaires (r = 0.78, < 0.0005). A similar tendency was found in general attention behavior (r = 0.68, < 0.005; Fig. 3b). A separate correlation of the HMD task vs. each attentional behavior score and of traditional cancellation (perfor-

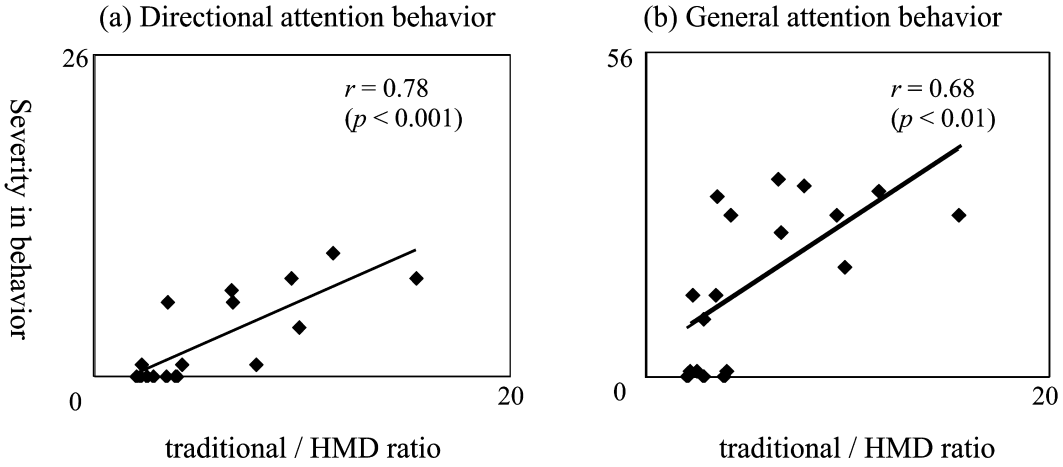

Fig. 3. Correlation between severity in behavior and traditional / HMD ratio in their performance score in the cancellation task in (a) and (b). In both behavioral scores, subjects who present higher ratio showed more severe behavioral problems. Each diamond represents one subject.

Table 4. Correlation between tasks and attentional behavior

	Attentional Behavior Score	
	Directional Attention	General Attention
HMD	r = 0.75 (p<0.01)	r = 0.78 (p<0.01)
Cancellation (performance score)	r = 0.65 (p<0.05)	r = 0.56 (p<0.05)
Cancellation (number of omit)	r = 0.84 (p<0.01)	r = 0.58 (p<0.1)
Bisection	r = 0.47 (p<0.1)	r = 0.52 (p<0.1)
Copying	r = 0.54 (p<0.05)	r = 0.5 (p<0.1)

(** $p < 0.01$, * $p < 0.05$. *n.s.* : not significant)

mance score) vs. attentional behavior score are summarized in Table 4. The correlation between other traditional tasks, including cancellation as a function of the number of omits, bisection task and copying task and attentional behavioral questionnaires are also shown in Table 4. No significant correlation was found except in cancellation (number of omits) vs. directional attentional behavior ($r = 0.84, < 0.01$) and in the copying task vs. directional attentional behavior ($r = 0.54, < 0.05$).

Variations at the individual level

We used the total score of the three visual-spatial tests and the performance score in the traditional cancellation task and in the HMD task as indexes for behavior deficit. For directional attention behavior, three subjects diagnosed as negative in the total score showed more than one behavioral problem. In the other three subjects, more than one directional attention behavior problem was evident, whereas they were diagnosed as negative through the performance score in the traditional cancellation task. On the other hand, only one subject who was diagnosed as negative in the HMD task showed directional attention behavior, but his score in the behavioral questionnaire was extremely low (1/26) (Fig. 4a).

8 subjects diagnosed as negative in the total score of the desk-tasks displayed general attention behavior problems. In 7 subjects, general attention behavioral problem were evident despite their performance score on the traditional cancellation task being below the cut-off score. For the HMD task, three subjects who scored higher in the general attention questionnaires were diagnosed as positive. The remaining 6 subjects diagnosed as negative in the HMD task showed general attention behavioral problems, however their score was not higher than the other subjects (Fig. 4b).

Discussion

Theoretical framework of the HMD setting

As described in the introduction, we assumed that environmental differences, static in desk-task settings and dynamic in ADL settings, could lead to the discrepancy whereby patients show abnormalities in ADL but not in desk-task settings. To evaluate this assumption, we newly devised a more dynamic task environment than the traditional task environment using a HMD and a tablet, based on the theory of frame of reference proposed by Karnath (1994).

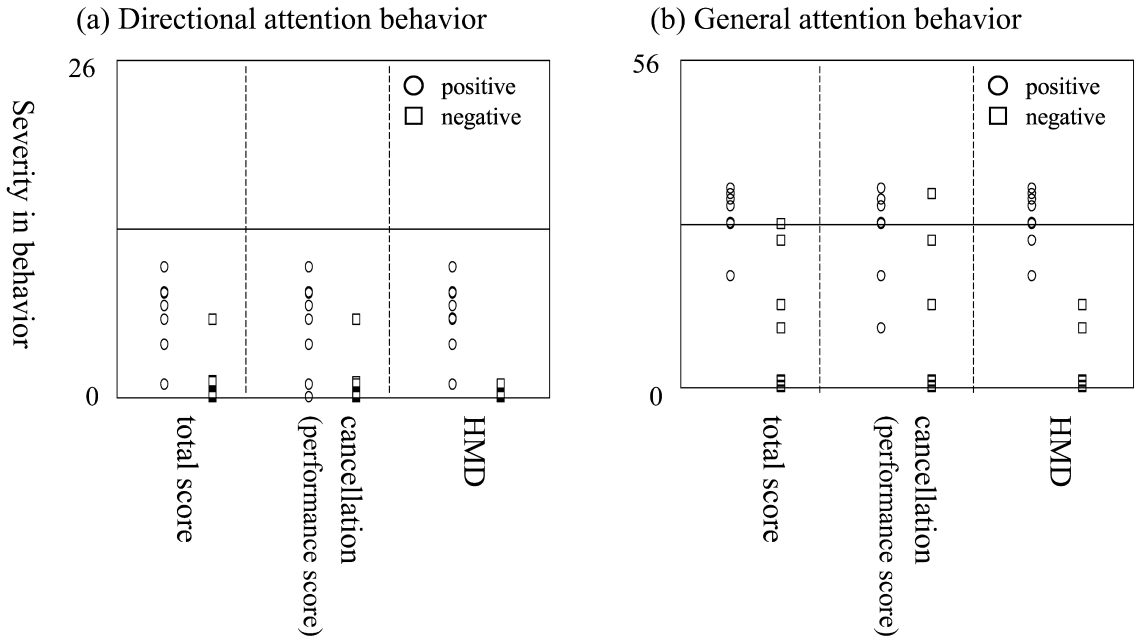

Fig. 4. Severity in behavior at the individual level. Left row of each column represents subjects(○) diagnosed as positive, marks in the right row(□) corresponds to negative. (a) For directional attention behavior, all but one subject diagnosed as negative by HMD task did not show behavioral problems. (b) For general attention behavior, subjects diagnosed as negative by the HMD task exhibited lower behavioral score.

According to Karnath (1994), Karnath, Fetter, and Niemeier (1998), and Karnath and Dieterich (2006), humans behave accurately in space by integrating incoming sensory information such as vision, proprioception, and vestibular sensation, and these should be integrated into an egocentric reference frame. This successive and concurrent process is the key concept of the HMD setting. We postulated that a more dynamic task environment could be accomplished by taxing such a process during testing.

Subjects wear HMD and handle a stylus in the HMD setting. As shown in Fig.1, the only things subjects can directly see on the HMD display are task stimulus and the pen icon, which represents the real pen they manipulate on the tablet. Subjects cannot see the movement of their hand or upper extremity while operating the pen. Indirect vision of the hand trajectory induces conflicting visual and proprioceptive signals (Clower & Boussaoud, 2000). This experimental environment must strongly encourage subjects to integrate proprioceptive sensation from their arm and finger movements with vision on the HMD display while testing. In other words, subjects need to reorganize their work space by integrating the proprioceptive space and visual space while performing the HMD task (Vakalopoulos, 2007).

Relation between the results of the HMD task and attention behavior

The most interesting result of this study was that in both directional and general attentional behavior, almost all the subjects who were classified into the negative group in the HMD task did not display attentional disturbance in ADL or vice versa. This implies that the HMD setting has a similar cognitive feature to that of the ADL environment. As mentioned earlier, the ADL environment is so dynamic that sensory information relevant to concurrent activity must be integrated (Deouell, Sacher & Soroker, 2005; Thompson & Sanderson, 2008). According to this idea, the present results support our postulation that the HMD setting induces a dynamic situation and requires subjects to perform much more sensory integration more than in the traditional setting. In the HMD setting, subjects have to rely more on proprioception to adapt to sensory-motor conflict. In fact, Thompson and Sanderson (2008) have pointed out that one of the reasons why results of the traditional desk-task were not fully congruent with conditions in ADL was that the desk-task was less dynamic. Tilikete, Rode, Rossetti, Pichon, Li, and Boisson (2001) reported that reorganization of the spatial framework led to amelioration in ADL performance. Several studies concur with those reports (Karnath, Fetter & Niemeier, 1998; Karnath & Dieterich, 2006; Rorden, Karnath & Driver, 2001; Niemeier & Karnath, 2003). As in the HMD environment, in ADL, humans have to adapt

to a constantly changing dynamic experience by correctly selecting internal and external cues relevant to the subsequent action. This environmental similarity between HMD and ADL may have led to the apparent correlation between performance in the HMD setting and behavioral disorders in ADL.

Another possible interpretation is provided by Burgess (2000). He insisted that daily activity consists of multi-tasking situations. In the HMD setting, subjects were encouraged to conduct the cancellation task as well as adapt to the HMD environment. However, the concept of multi-tasking doesn't fully explain the present results because the same results should have been obtained from the traditional task setting, as this setting involves multi-tasking aspects to some degree.

In the present study, only the cancellation task was used in the HMD setting. Considering that there are several neuropsychological tests available, further studies incorporating different desk-tasks should be carried out.

Applicability in clinical settings

The present results reveal that although all subjects marked lower performance scores in HMD tasks compared to traditional cancellation tasks, subjects who scored above the cut-off in the HMD tasks seldom exhibited both directional and general attention behavioral problems. This implies that HMD tasks are a more sensitive tool than traditional neuropsychological tests for the evaluation of presence / absence of attentional deficit in ADL if evaluated by means of the cut-off score used in the present study.

In recent years, the number of studies using an HMD or a virtual environment is increasing. Knight and Baber (2007) reported the influence of HMD on posture. Cho, Ku, Jang, Kim, et al. (2002) and Cho, Ku, Jang, Lee, et al. (2002) developed an attention training system using an HMD and an HMD device for people with impaired vision (Culham, Chabra & Rubin, 2004). In addition, HMD could be used to train patients with visuo-spatial problems (Castiello, Lusher, Burton, Glover & Disler, 2004; Kim et al., 2004; Baheux, Yoshizawa, Tanaka, Seki & Handa, 2005; Baheux, Yoshizawa, Seki & Handa, 2006; Glover & Castiello, 2006). In clinical practice in occupational therapy, Weiss, Naveh, & Katz (2003) and Katz et al. (2005) introduced a training system for patients with spatial neglect to navigate road traffic safely. Almost all of these studies were addressing the issues of therapy or intervention as well as simple evaluation (the presence / absence of a certain symptom). To the best of our knowledge, few studies have addressed the issue of clinical applicability through establishment of an index for attentional behavioral problems in everyday life.

As seen in Fig. 4, subjects who were classified as negative according to their total score and performance score in traditional cancellation showed attentional behavioral problems. By these criteria, the total score of the three visuo-spatial tasks and performance score in traditional cancellation can't be an index of behavioral problems: no data exists to the contrary. On the other hand, HMD differentiated those subjects. As mentioned by Sasaki et al. (2005), changing the environment under which tasks are conducted rather than changing the task stimulus itself could account for the present results.

In conclusion, the present preliminary study would appear to demonstrate that tasks carried out in the HMD setting can function as a useful index of attentional behavioral problems.

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■ORIGINAL ARTICLE

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

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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).

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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, Fujii, 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 symptoms: 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.

Table 1. Total scores for the computer operation skills test

	Persons with schizophrenia (N = 12)	Control subjects (N = 14)
Before the course		
Total score	42.4 ± 35.9	38.0 ± 36.9
number of input letters	93.7 ± 65.9	86.0 ± 71.1
number of errors	10.5 ± 7.7	11.5 ± 7.5
After the course		
Total score	52.6 ± 29.1	71.9 ± 32.9**
number of input letters	120.7 ± 64.0*	148.6 ± 62.3**
number of errors	17.5 ± 19.3	7.7 ± 6.0*

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, Yotsumoto & Hashimoto, 2009).

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 2. Spearman's rank correlation coefficient between BPRS and the computer operation skills test after the course results of the persons with schizophrenia

BPRS item	BPRS statistics		Computer operation skill test after the course results		
	Mean	Standard Deviation	Total score	The number of input letters	The number of errors
BPRS total score	26.1	6.921	–0.193	–0.239	–0.190
(1) Positive symptoms	5.9	1.929	–0.602*	–0.684*	–0.425
Grandiosity	1.4	0.669	–0.118	–0.095	–0.169
Suspiciousness	1.3	0.866	–0.219	–0.263	–0.351
Hallucinatory behavior	1.3	0.492	–0.436	–0.565	–0.283
Unusual thought content	1.9	1.165	–0.600*	–0.692*	–0.352
(2)Negative symptoms	6.4	2.678	0.045	0.158	0.424
Emotional withdrawal	1.6	0.515	–0.098	–0.025	0.394
Motor retardation	1.8	1.357	–0.027	0.073	0.335
Uncooperativeness	1.3	0.492	0.103	0.283	0.463
Blunted affect	1.8	1.215	–0.008	0.028	0.047
(3)Emotional symptoms	9	0.539	0.051	–0.085	–0.420
Somatic concern	2	0.953	0.017	–0.102	–0.281
Anxiety	2.6	1.165	–0.053	–0.107	–0.166
Guilt feeling	1.8	0.866	–0.197	–0.275	–0.174
Depressive mood	1.3	0.492	0.359	0.308	–0.180
Hostility	1.3	0.651	–0.069	–0.177	0.125
(4)Disorganized symptoms	4.8	0.638	–0.177	–0.069	0.125
Conceptual disorganization	1.8	1.138	–0.181	–0.150	–0.098
Tension	1.7	0.651	–0.027	0.223	0.585*
Mannerisms and posturing	1.3	0.651	–0.374	–0.483	–0.338

The number of samples of the persons with schizophrenia is N = 12. (1)~(4) are total scores for symptom categories. * $p < 0.05$, ** $p < 0.01$.

Number of input letters on the computer operation skills test

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 ($p < 0.005$).

Number of errors on the computer operation skills test

There was no significant difference between the two groups in the number of errors made on the computer operation skills test before or after the course (Table 1). In within-group comparisons, the number of errors made by the persons with schizophrenia showed a tendency to increase from 10.5 ± 7.7 before the course to 17.5 ± 19.3 at the completion of the course, although the difference was not significant. For the control group, the number of errors significantly decreased from 11.5 ± 7.5 before the course to 7.7 ± 6.0 after the course ($p < 0.05$).

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.

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

Reason for difficulty	Category
Cannot understand words (oral). Cannot understand sentences. Cannot understand a concept (such as a folder or file). *Cannot understand when the text display is different from that on the Computer. *Cannot understand what they need to know.	Ability to understand
Unable to find differences in the detailed display. Cannot appreciate small differences. Cannot grasp a lot of information at once. Monitoring failure (misrecognition). Monitoring failure (oversight). *Anxiety disturbs work (cannot keep a clear mind). *Mind wanders from one thing (cannot focus).	Attention functions
Cannot remember the Roman alphabet. Cannot learn new terms (input functions). Cannot memorize (holding functions).	Memory
Cannot drag. Unable to set the pointer in the correct area. *Cannot click properly (such as a double click).	Motor functions
*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. *Irritation disturbs work if something goes wrong.	Problem-solving skills when difficulties arise
*Easily become tired. *Auditory hallucination disturbs work. *Anxiety due to technical terms.	Other disease characteristics

* Difficulty found in persons with schizophrenia, but not in control subjects. (Modified from Morimoto, Yotsumoto & Hashimoto, 2009).

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

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 maintaining 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)', supporting 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 difficulties in this area being common to the two groups. This finding is also consistent with a report showing no significantly 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 performance have also been found in previous reports (Heinrichs & 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 categorized 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 characteristics.

Overlap of the results of quantitative and qualitative analysis

In quantitative analysis, 'Positive symptoms' influenced the difficulty in learning computer operation skills, which indicates the need for medical improvement of the psychiatric symptoms. The number of input letters increased for the persons with schizophrenia, but the number of errors also increased after the standard computer learning course. It seems that difficulty maintaining attention 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 schizophrenia reduce problem-solving skills when difficulties arise, based on comments such as 'Rely on their own resources rather than seek out other solutions when they encounter 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-solving skills when difficulties arise' are important for promoting computer learning in persons with schizophrenia.

Many approaches are currently used to improve cognitive deficits in schizophrenia (Dixon et al., 2009). Development of a computer learning program which incorporates specific measures that permit self-monitoring of errors and provides concrete approaches to effective problem-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 difficulties 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 persons 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

Type of error*	Definition	Example**
Character input	Mistake in input (incorrect entry).	青木電子 → 青木でんき (1 character input error) (Error in character conversion)
Conversion	Mistake in conversion (the input is OK).	お礼 → おれい (1 conversion error) 鈴木 → すずき (ibid) 平成 → 凩 (ibid) (Error between upper-case and lower-case character input)
Posting	Mistake in fullwidth / halfwidth. Mistake in punctuation marks.	５００ → 500 (3 posting errors) (Error in character size) …のことと、 → …のことと (1 posting error)
Font size	Mistake in font size. Mistake in bold type/ normal type.	送付状 → 送付状 (1 font size error) 記/以上 → **記/以上** (3 font size errors)
Shortage of characters, clauses, sentences, spaces, line feeds, etc.	Shortage of characters. Shortage of sentences. Shortage of spaces and line feeds.	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)
Surplus of characters, clauses, sentences, spaces, line feeds, etc.	Surplus of characters. Surplus of sentences. Surplus of spaces and line feeds.	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)
Numeric input	Input the wrong numeric value.	15年 → 16年 (1 numeric input error) 15年 → 20年 (2 numeric input errors) (Error in numeric input)

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.