Abstracts

Occupational Therapy

MIRROR NEURON SYSTEM: BRAIN ACTIVITY AND CLINICAL APPLICATION

Mari Kuroda
(Ms., Master course student)

Division of Occupational Therapy, Department of Rehabilitation Sciences
Postgraduate School of Health Sciences, Nagoya University

Introduction

Mirror neuron system (MNS) is an important brain network for motor recognition and execution during sequential movement in human. The network connects frontal and parietal neural activities, and it works not only during performance but also during observation of movements of other persons.

The MNS system is not a theoretical system. The latest brain imaging techniques, such as magnetoencephalography (MEG) and magnetic resonance imaging (MRI), has shown responsible brain areas for MNS.

In the present study, I conducted an experiment to show the brain activity related to MNS during a daily performance. I also present a clinical case, whom a theoretical intervention relating to MNS was effective.

1. Experimental study of MNS using a MEG system

In the present experimental study, brain activity in the parietal cortex, which may relate MNS during sequential movement, was detected by MEG system. Nine healthy adults participated in the study (3 men and 6 women, mean age: 26.4 ± 8.10 years). Participants were asked to watch pieces of movie showing four sequential movements without any voluntary movements (Table 1). Three of four movements included am identical target movement, putting spoon into a cup. Brain activity before and after the onset of the target movement were recorded, and an activated area was estimated.

Figure 1 shows a representative brain activity recorded from a subject by MEG. Parietal brain activity was identified in both hemispheres during the target movement. Estimated brain activity in the parietal cortex was obtained in the period between 175 ms before and 600 ms after the onset of the target movement although the timing and duration of the activity was varied among subjects (Fig. 2). On a different movement from putting a spoon into a cup, T4, parietal activity was obtained in a similar area of parietal cortex (Fig. 1).

The experimental results were summarized as: 1) brain activity during watching a video of other's movement included the parietal activity, 2) The parietal activity might cause at each part of movement during sequential movement.

Table. 1: Hand activities in short film (T1-4). These have same movement but different meaning except for T4.

	T1	T2	T3	T4
Preceded movement	Putting sugar into a cup	None	Cleaning the table	None
Target movement	Putting a spoon into a cup	Putting a spoon into a cup	Putting a spoon into a cup	Holding-up a cup
Following movement	Stirring sugar	None	Clearing the table	Drinking coffee

2. Application of MNS theory to intervention

With understanding MNS, some types of intervention for stroke patients have been developed. Previous studies reported that motor exercise by showing video of instructive movements facilitates recovery of patients' motor performance (Franceschini M et al., 2010). Imagination trainings of sequential movements have been used not only in the sports training, but also applied in the rehabilitation (Mulder T, 2007). The theoretical background of such intervention is that the visual information of other's movements activates MNS and motor-related cortices, including cortices relating the spatial and movement recognition in the parietal cortex. By measuring brain activity using functional MRI, improvement in activity of motor related cortices has been demonstrated (Ertelt D et al., 2007). Such interventions by watching video have been mainly applied to patients with motor paresis in the field of rehabilitation. However, there are very a few studies that applied interventions based on the MNS to improve daily activity in patients with dementia.

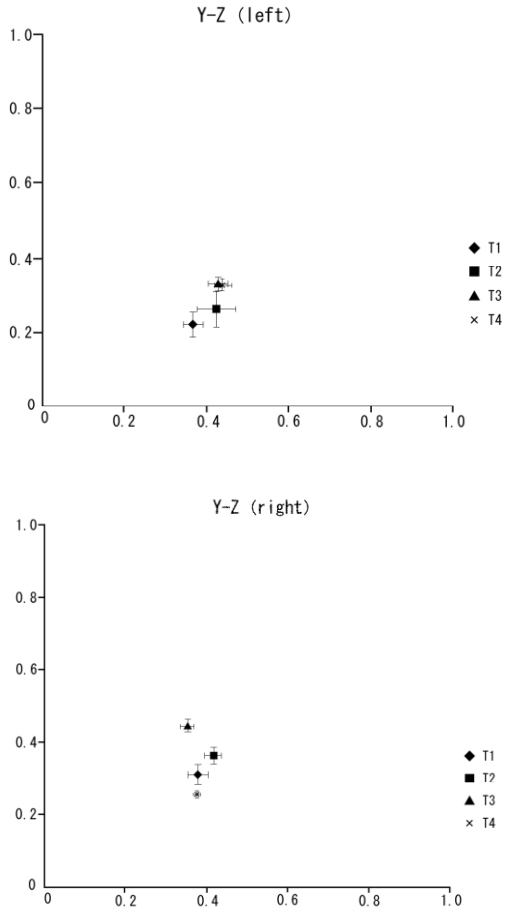

Fig. 1: Dipole localization on the Y-Z axes in the left (top) and right (bottom) hemispheres. Y and Z axis was of antero-posterior and vertical direction, respectively. Values indicate standardized size of brain from the center of the brain (0) to the scalp surface (1.0).

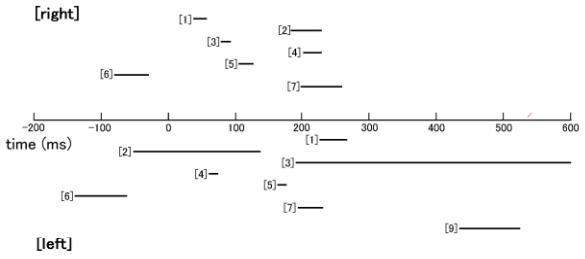

Fig. 2: Temporal course of parietal activity in the left (top) and right (bottom) hemisphere observed during the presentation of the video. At zero point of the time course, a person on the video started putting spoon into a cup.

3. Case study

Since the experimental research showed that watching video evoked the parietal activity, we considered such visual intervention might activate cognitive function relating with motor performance in daily life via activation in the visuo-spatial and mirror neuron systems. This case study was a challenging one based on an experimental theory regarding MNS.

The case was a 74-year-old female with Alzheimer disease (4 years after onset). It was difficult to communicate verbally with her due to severe symptom of dementia. Her eating in oral movement was preserved, but she did not use chopsticks or spoon, but she ate meal with her hands and fingers. She occasionally did not eat meal at table but played with food.

I planed an intervention, in which a video showed a person eating meal using chopsticks or spoon. I expected that the movie evoked MNS related cortical activities, and her to eat with chopsticks as the movie showed. The short movie was presented on a monitor screen (14 inch, diagonal) in front of the subject on the table at lunch. The intervention was conducted initially for 9 days and after 8-days interval it applied again for 3 days again. Percentage of time period, when she used chopsticks or spoon, during her eating time was measured.

During the intervention, amount of food eaten at lunch was 80-100 % of full-served, and the amount was not changed, compared to that before the intervention. Duration of time taken for lunch was 35 min ±4 min 28 sec and 50 min 25 sec ± 6 min 54 sec, before and during the intervention, respectively. Before the intervention, she used chopsticks or spoon 23.5 ±25.4% of eating period, but the value increased to 69.3 ±29.0 % during the intervention. When a caregiver helped to use chopsticks or spoon she used it only 18.3 ±13.3 % of eating time before the intervention, but it became 75.8 ± 37.3 % during the intervention (Fig. 3).

The present intervention was conducted only for lunch; and there was no change of her manner in other meals, e.g., she used her hands and fingers to eat food during breakfast and supper. The effect of the intervention did not continued after the intervention. She again used her hands and fingers without chopsticks and spoon at lunch during the 8-days interval. However, in the second term of the intervention, she again began to use chopsticks and spoon to eat lunch.

4. Discussion

The case report suggested that the visual intervention, which gave the subject other's movement of eating with chopsticks and spoon, was obviously effective to improve her manner at eating. She might just copy the movement presented in front of her, but even in such case of copying, brain activities relating MNS should worked to lead her movements to similar ones presented on the movie as shown in the experimental study. She did not suffer from motor paresis but dementia. Therefore, this present intervention was effective to improve cognitive function relating motor performance.

Reproducibility of the effect of the intervention was observed, but due to her physical problem, the intervention could not apply after the second period. Since I could applied the intervention only two periods, generalization of the effect on other meals was not recognized, and learning effect was not obtained at lunch during the interval period. However, the effect of video presentation was so dramatic on her eating manner, application of modified intervention by showing video of motor performance could be considered for patients with cognitive disturbance and dementia.

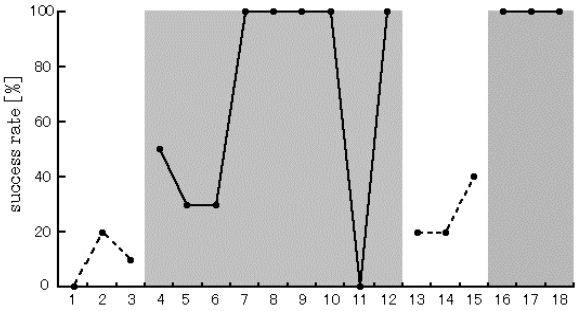

Fig. 3: Percentage of successful behavior with chopsticks or spoon during eating in the subject. During presentation of video (gray periods), the patient used tools to eat than during periods without video (white).

Conclusions

In conclusion, I investigated the brain activity during watching motor performance. Activation of the parietal cortex was consistently observed, which might relate with MNS. In a case study, showing motor performance my video movie was effective to improve eating manners in a patient dementia. The present study suggested that the visual stimulation of other's motor performance could stimulate subject's cognition or motivation, possibly via MNS.

References

[1] Gallese V, Fadiga L, Fogassi L, Rizzolatti G. Action recognition in the premotor cortex. Brain. 119: 593–609, 1996.

[2] Rizzolatti G, Craighero L. The mirror neuron system. Annu RevNeurosci. 27: 169–192, 2004.

[3] Iacoboni M, Mazziotta JC. Mirror neuron system: basic findings and clinical applications. Ann Neurol. 62: 213-218, 2007.

[4] Franceschini M, Agosti M, Cantagallo A, Sale P, Mancuso M, Buccino G. Mirror neurons: action observation treatment as a tool in stroke rehabilitation. Eur J Phys Rehabil Med. 4: 517-523, 2010.

[5] Mulder T. Motor imagery and action observation: cognitive tools for rehabilitation. J Neural Transm. 114(10): 1265-1278, 2007.

[6] Ertelt D, Small S, Solodkin A, Dettmers C, McNamara A, Binkofski F, Buccino G. Action observation has a positive impact on rehabilitation of motor deficits after stroke. Neuroimage. 36: 164–173, 2007.

[7] Rizzolatti G, Foggassi L, Gallese V. Neurophysiological mechanisms underlying the understanding and imitation of action. Nat Rev Neurosci. 2: 661-670, 2001.

[8] Fogassi L, Ferrari PF, Gesierich B, Rozzi S, Cherisi F, Rizzolatti G. Parietal lobe: from action organization to intention understanding. Science. 308: 662-667, 2005.

Author address

E-Mail: kuroda.mari@f.mbox.nagoya-u.ac.jp

Effects of mental sweating and skin blood flow during Trail Making Test

Masahiro Tanaka

(Mr., Master course student)

Division of Occupational Therapy, Department of Rehabilitation Sciences

Postgraduate School of Health Sciences, Nagoya University

1. Introduction

Patients with dementia or psychological disorders often suffer from symptoms caused by attention deficit [1], and the symptoms cause various problems in their daily life. For such patients, one of the objectives in the intervention provided by occupational therapists is to minimize the problems and to support their daily activities.

Situation requiring attention or concentration may lead mental stress and stress-related biological responses [2]. We may experience spontaneous sweating on palm and flushing of face in such situation. Therapists need to observe clients' physical condition as well as emotional expression during intervention to know their mental stress. The present study is a basic research to elucidate relationship between tasks with attention effort and biological autonomic responses.

Trail Making Test (TMT, [3]) is a widely used conventional task to evaluate attention function. TMT comprises two parts, Part-A and –B, which is simple and complex character-searching task, respectively. We measured skin perspiration and vascular responses on hand during TMT to evaluate sympathetic nerve activity during the tests.

2. Methods

Fourteen young healthy subjects participated in the study (7 females and 7 males, mean age: 20.7 ±0.5 (SD) years). Perspiration on the left palm and blood flow at the left index finger were continuously recorded during TMT every 60 sec, using a diaphoremeter (SKD-2000, Skinos, Nagoya) and a laser doppler blood flow imaging system (ALF-21, Advance, Tokyo**).** Subjective feeling regarding effort and stress during TMT was asked by questionnaires after the test.

Subjects were seated on a chair in front of a desk in a quiet room with sensors of diaphoremeter and blood flow meter attached on the tip of index and on the central area on the left palm, respectively.

After a five-minutes rest, subjects were asked to perform Part-A of TMT as quick as possible. Then, they were asked to answer questionnaires for Part-A, and took a short rest for 5 minutes. Part-B of TMT was similarly performed after the session for Part-A. The questionnaires included questions for attention, fatigue and stress during each test.

Time periods needed for each Part of TMT were measured in each subject, and they were compared by a paired-t test. Amount of mean and maximum change ratio (per 60 sec) in perspiration and blood flow during the record were assessed to statistical analysis. Those values at rest and during two TMT, Part-A and -B, were compared using one-way (rest or tasks) repeated measures analysis of variance (ANOVA), followed by Turkey Kramer's test for multiple comparisons. Scores in each questionnaire were compared between Part-A and -B of TMT using a Wilcoxon signed-ranks test. A p value less than 0.05 was considered to be significant.

3. Results

Subjects needed longer time to complete Part-B than Part-A of TMT ($p<0.01$, t-test). There was a main effect of TMT on the perspiration ($F [2, 41] = 10.7$, $p<0.01$, Fig. 1) and blood flow ($F [2, 41] = 23.9$, $p<0.01$, Fig. 2). Multiple comparisons revealed the mean palmar perspiration significantly increased ($p<0.01$), and the blood flow decreased ($p<0.01$), during both Parts of TMT, than those at rest. However, there was no difference of the values between Part-A and -B of TMT. The maximum change ratio of palmar perspiration significantly larger during Part-B than -A ($p<0.05$, Fig. 3). Scores in questionnaires showed that the subjects answered Part B more difficult than -A ($p<0.01$, 0000).

4. Discussion

The present study showed that sympathetic activities on skin were facilitated during TMT. Sympathetic response of palmar perspiration and blood flow reciprocally changed as shown in the previous reports [4][5].

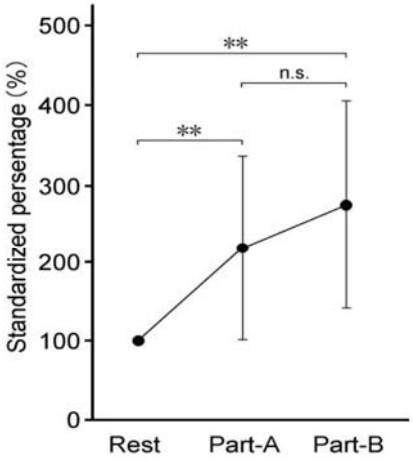

Fig.1: Effect of TMT Tasks on palmar perspiration. The values were standardized and each vertical bar indicates standard deviation (** p<0.01).

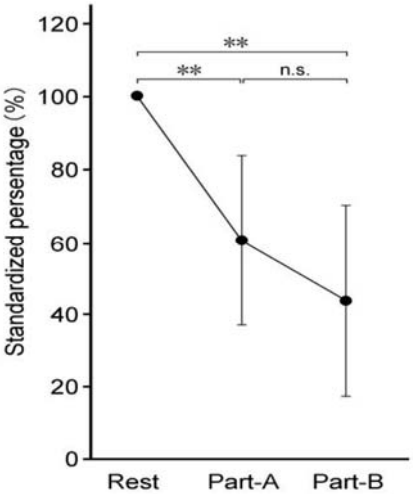

Fig.2: Effect of TMT Tasks on blood flow in the finger. The values were standardized and each vertical bar indicates standard deviation (** p<0.01).

Difference of the maximum change ratio of palmar perspiration may indicate the difference effect on the sympathetic response between the Parts of TMT. Part-B requires more in attention and concentration, as seen in the results of questionnaires in the present subjects. Since the qualitative difference between the Parts was of frontal function required, i.e., attention maintenance, attention shift or working memory, such frontal activities induced more stress and sympathetic responses in the peripheral area.

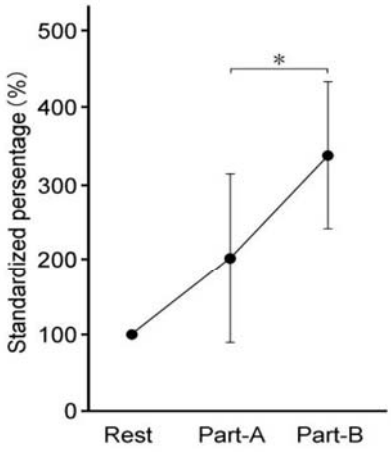

Fig.3: Maximum palmar perspiration during tasks. The values were standardized and each vertical bar indicates standard deviation (* p<0.05, ** p<0.01).

Another factor should be considered. The subjects needed longer time to complete Part-B of TMT and they felt the Part difficult than Part-A. Apart from higher brain functions to solve TMT, a preconception that Part-B seemed to be difficult might cause mental stress and more sympathetic response than for Part-A.

From the present results, we occupational therapists may know that tasks to evaluate clients' higher brain function, including frontal functions, induced considerable sympathetic responses in the subjects.

References

[1]Traykov L, Rigaud AS,Cesaro P,Boller F. Neuropsychological impairment in the early Alzheimer's disease. Encephale 2007 May-Jun;33:310-316.

[2]Lindqvist M, Kahan T, Melcher A, Hjemdahl P. Cardiovascular and sympatho-adrenal responses to mental stress in primary hypertention. Clin Sci (Lond). 1993 Oct;85 (4):401-409.

[3]Takeda C, Notoya M, Sunahara N. Identification of three factors influencing trail making test performance using multichannel near-infrared spectroscopy. Tohoku J Exp Med. 2011;223(2):103-12.

[4]Kobayashi M. Arithmetic calculation, deep inspiration or handgrip exercise-mediated pre-operational active palmar sweating responses in humans. Auton Neurosci Basic＆Clin.2003;104:58-65.

[5]Margaret J Christie. Electodermal activity in the 1980's:areview. Journal of the Royal Society of Medicine Volume.1981;74:616-622.

Author address

E-Mail:tanaka.masahiro@a.mbox.nagoya-u.ac.jp

Mismatch response modified by synchronous visual stimuli.

Yoshiro Nakagawa
Division of Occupational Therapy, Department of Rehabilitation Sciences
Postgraduate School of Health Sciences, Nagoya University

Introduction

We detect changing stimuli in our surrounding events without paying attention. Clinical studies revealed that this process of automatic detection system was abnormal in patients with schizophrenia, dementia, or developmental disorders. The automatic discrimination processes have been measured as an event-related component called mismatch negativity (MMN) using electroencephalography (EEG) [1], or mismatch magnetic field (MMNm) recorded by magneto-encephalography (MEG) [2]. Conventional MMN has been investigated using single modality of auditory stimulation, but in our daily life, surrounding stimulation is usually multi-modal, i.e., audio-visual and visuo-tactile, etc. Therefore, I investigated mismatch response evoked by multi-modal stimulation, which could be applicable to our stimulus situation in daily life.

Method

Ten healthy righted-handed volunteers (6 males and 4 females: mean age, 29.5±7.2 years) participated. Auditory MMNm was recorded during synchronous visual stimulation with auditory stimulation by MEG (PQ1160C, YOKOGAWA, Japan). Three experimental conditions were conducted; 1) Auditory stimulation consisted with standard and deviant stimuli (A-0) condition, 2) Consistent visual stimulation synchronized with auditory and standard stimulation (AV-S) condition, 3) Consistent visual stimulation at random timing to auditory and deviant stimulation (AV-R)

Auditory stimuli included two tones (standard and deviant tones), and were presented by ear tips. Deviant stimuli were 2000 kHz pure tone (20%), and standard was 1000 kHz (80%). The duration of each tone was 500 ms and an inter-stimulus interval (ISI) was 500 ms, and intensity was 80 dB for both stimuli at the ear tips. Visual stimulus was pattern-reversal black and white checkerboard stimulation in the peripheral eye field, and was projected using a crystal digital light projector. Auditory evoked MMNm were analyzed. Thirty channels gradiometers were selected from the temporal lobe in each hemisphere to calculate MMNm responses. The amplitude of MMNm was calculated in 30 channels. For the MMNm, the amplitude ware compared among conditions using a one-way (stimulus conditions) repeated measures analysis of variance (ANOVA) followed with a Fisher's protected least significant difference (Fisher's PLSD) test for multiple comparisons. The significance of statistical threshold was set as $p < 0.05$.

Result

Figuer.1 shows the grand average of MMNm waveform in each condition. The MMNm amplitude in root mean square (RMS) value during AV-S condition was enhanced compared to other conditions in the right hemisphere ($p=0.0087$, ANOVA)(fig.2).

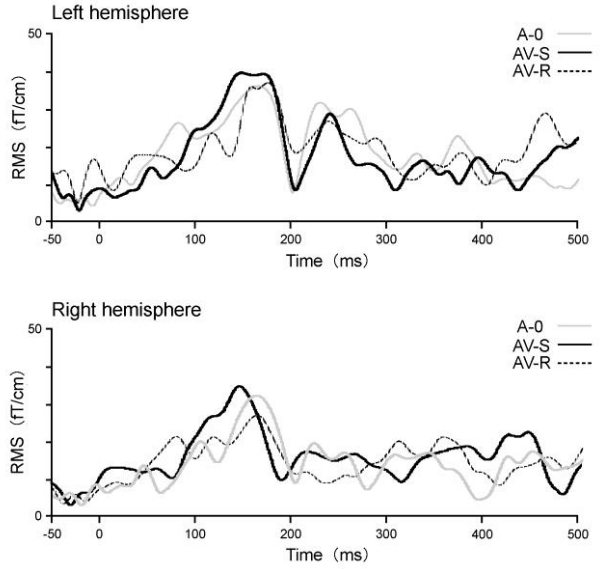

Fig. 1: Grand-average RMS waveforms of MMNm in each condition.

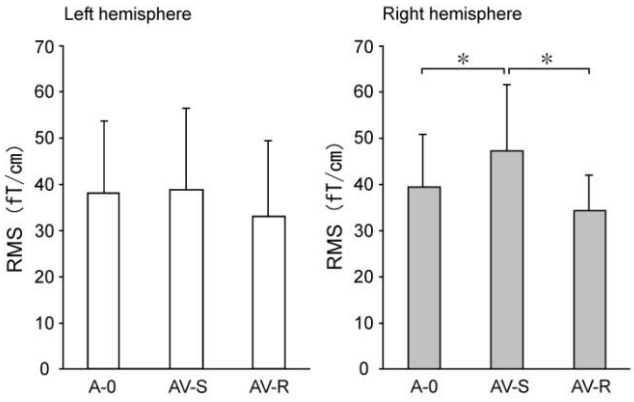

Fig. 2: Root mean square values of the MMNm response in each condition. (*$p < 0.05$, ANOVA).

Discussion

The results indicated that simultaneous visual stimulus enhanced auditory MMNm, although the additional visual stimulus was similarly given with both standard and deviant stimuli. The result could be interpreted in two ways. Firstly, MMN depended on the amount of physical changing and on the feature changing [3]. In this present study, MMN was produced not only by difference in physical amount of stimuli but also in stimulus feature, which was in line. Secondly, there were two types of MMN elicited in this study. One is conventional MMN elicited by the mismatch between standard and deviant tones. Another is elicited by the difference between audio-visual sets (Fig.3).

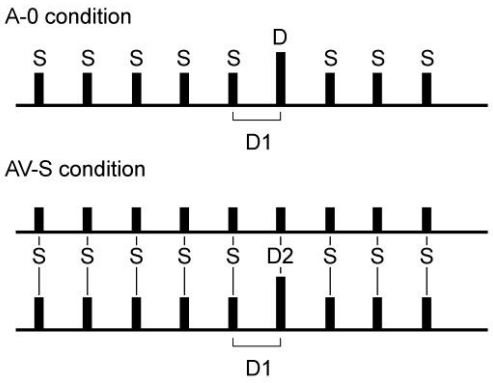

Fig. 3: Conventional auditory MMN production by standard (S) and deviant (D) stimuli with no visual stimulation (A-0) in a temporal sequence. In the A-0 condition conventional MMNm (D1). In the AV-S condition, deviation of combined feature of stimuli (D2) was added to D1 to produce MMNm.

The mismatch response could be evoked not only by temporal dimension of stimulus deviation but also by a deviated feature produced by two modalities of stimulation at a time. This study indicated that bimodal stimulation might effect on pre-attentive automatic detection.

Reference

[1] Näätänen R, Gaillard AW, Mäntysalo S. Early selective-attention effect on evoked potential reinterpreted. Acta Psychol (Amst). 1978 Jul;42(4):313-29.

[2] Alho K. Cerebral generators of mismatch negativity (MMN) and its magnetic counterpart (MMNm) elicited by sound changes. Ear Hear. 1995 Feb;16(1):38-51.

[3] Shiga T, Yabe H, Yu L, Nozaki M, Itagaki S, Lan TH, Niwa S. Temporal integration of deviant sound in automatic detection reflected by mismatch negativity. Neuroreport. 2011 May 11;22(7):337-41.

Author's address
E-Mail: nakagawa.yoshiro@mbox.d.nagoya-u.ac.jp

Internet communication of outpatients with schizophrenia or pervasive developmental disorders

Takashi Watabe

Division of Occupational Therapy, Department of Rehabilitation Sciences
Postgraduate School of Health Sciences, Nagoya University

Introduction

In Japan, the number of Internet users reached 94.08 million people as of the end of 2009 with an Internet penetration rate of 78.0% [1], and the population diffusion rate of the Internet is 95% or more among people aged 20 to 39. Most psychiatry hospitals have not allowed the inpatients of this age group use of the Internet. As a result, these young patients have to choose shortly after discharge whether to avoid use of the Internet or to attempt to use it without preparation.

Although many studies have been carried out concerning Internet usage, participants of most studies have been normal teenagers. To our knowledge, there are few studies concerned with how patients with schizophrenia or pervasive developmental disorders (PDD) use the Internet to communicate with other people. The objective of the present study was to investigate Internet communication used by young patients with schizophrenia or PDD, which impair social cognition and communication.

Materials and Methods

We conducted a cross-sectional study over seven months from January 1, 2011 to July 31. The present study, approved by the ethics review committee of Nagoya University School of Health Sciences (No. 10-608), had three groups of participants. The S-group consisted of thirty-six outpatients who met DSM-IV-TR criteria for schizophrenia (S-patients). The PDD-group consisted of forty-four outpatients (PDD-patients) who met DSM-IV-TR criteria for PDD [i.e., Asperger's disorder, autistic disorder, and PDD not otherwise specified (PDDNOS)]. The Control-group consisted of 101 adults (Controls).

S- and PDD- patients were recruited through public hospitals (n = 3), private hospitals (n = 3), and psychiatry clinics (n = 5) in Nagoya, and diagnosed by their attending psychiatrists. Controls were selected randomly from eighteen facilities (theaters, sport facilities, factories, welfare facilities, etc.) in Nagoya.

The inclusion criteria for S- and PDD- groups were (1) male, (2) 20-39 years of age, (3) patient lives in Nagoya, (4) has been not hospitalized for more than 6 months continuously, (5) has accessed the Internet once or more in the last week, (6) has adequate communication skills to answer our questionnaire about Internet usage, (7) has agreed to participate in this study, (8) is an outpatient of a hospital or clinic in Nagoya, and (9) has been judged to have no severe intellectual disability by his attending psychiatrist. The inclusion criteria for the Control-group were (1)-(7) noted above.

We constructed an original self-administered questionnaire for assessing Internet usage. The questionnaire consists of 21 questions: (1) age, (2) family structure, (3) educational background, (4) average number of people (including family) with the participant communicated face-to-face (off-line) in the last week, (5) year when participant used the Internet for the first time, (6) devices used to access the Internet [PC (including notebook PC and tablet PC) and/or mobile phone (including PHS and smart phone)], (7) the number of persons the participant e-mailed in the last month: [a) family and relatives (Related-persons), b) known off-line friends and acquaintances (Off-persons), c) strangers contacted only on-line and has not met directly (On-persons)], (8) the amount of time spent on-line per day through PC, (9) through mobile phone, (10)-(19) attitudes and opinions about Internet (Table. 1), (20) the frequency of Internet communication through PC, (21) and through mobile phone. In (20) and (21), the use of Internet communication was divided into 5 services: e-mail, bulletin board system (BBS), blogs, micro blogs, and social networking service (SNS).Each service was then subdivided into expressing (sending, writing, etc.) and receiving (getting, reading, etc.). Point scales (i.e., a four-point scale, a six-point scale, or an eight-point scale) were used for responding to (4) and (7)-(21).

Positive symptoms were assessed using the positive items of the Positive and Negative Symptom Scale [PANSS(P)] for the S- and PDD- groups. The attending psychiatrists scored the PANSS(P). In the S- and PDD- groups, autistic traits were also assessed using the Autism-Spectrum Quotient Japanese version (AQ-J, Wakabayashi et al., 2004) [2], which is a self-administered questionnaire consisting of 50 items rated on a 4-point scale.

We showed comparisons of scores among the S-, PDD-, and Control-groups. The scores of point scales were compared among the three groups using Kruskal-Wallis test and between two groups using Mann-Whitney test (Bonferroni multiple comparison). P-values less than 0.05 were considered to be significant.

Table 1: Ten questions regarding attitudes and opinions about the Internet from the original self-administered questionnaire consisted of twenty-one questions for assessing Internet usage. A four-point scale (1 = definitely agree, 2 = slightly agree, 3 = slightly disagree, and 4 = definitely disagree) was used for responding to each question.

	Question (Recognition to the Internet)
(10)	I regard the worldwide spread of the Internet as desirable.
(11)	I regard the worldwide spread of the Internet as dangerous.
(12)	I think it is difficult to protect privacy in the present Internet.
(13)	For me, it is beneficial to use the Internet under anonymous or fictitious names.
(14)	When I communicate with people whom I have not met directly on the Internet, I regard almost all of them as trustworthy.
(15)	When I communicate with people whom I have not met directly on the Internet, I can discriminate trustworthy people and untrustworthy ones.
(16)	Emotional troubles arise more frequently from the Internet communication than from face-to-face-communication.
(17)	I can say more clearly what I want to say with the Internet communication than with face-to-face communication.
(18)	I frequently hurt other people's feelings without intending to through Internet communication.
(19)	I am frequently hurt when communicating on the Internet.

Results

The number of valid responses were thirty-two in S-, forty-three in PDD-, and ninety-seven in the Control-group. PDD-patients who had a score of 3 or more on at least one of the PANSS(P) items assessing "delusions" or "hallucinatory behavior" were excluded (n = 8), and those who had a score of 25 or less on AQ-J were also excluded (n = 6) [3], in order to

diagnose pervasive developmental disorders more correctly. Twenty-nine PDD-patients remained.

There were no significant differences among the three groups in (1) age [one-way analysis of variance (ANOVA), $F = 1.34$, $p = 0.266$], (3) educational background (chi-square test, $x^2 = 2.71$, $p = 0.258$) or (5) the first year of having used Internet ($F = 0.79$, $p = 0.924$).

Twenty-seven (84.4%) S-patients, nineteen (65.5%) PDD-patients, and forty-three (44.3%) Controls were living with their parents, and a significant difference was found between S- and Control- groups ($x^2 = 15.55$, $p = 0.000$). Thirty-six (37.1%) Controls were living with their wives and/or children, but S- and PDD- patients were not. Four (12.5%) S-patients, nine (31.0%) PDD-patients, and twenty-one (21.6%) Controls were living alone, but there was no significant difference ($x^2 = 3.40$, $p = 0.183$)

The average number of people (including family) communicating face-to-face (off-line) in the last week was highest in the Control-group. There were significant differences between the S- and Control- groups ($U = 1{,}087.0$, $p = 0.009$), and between the PDD- and Control- groups ($U = 835.5$, $p = 0.001$).

Twenty-nine (90.6%) S-patients, twenty-seven (93.1%) PDD-patients, and ninety (92.8%) Controls accessed the Internet through a PC ($x^2 = 0.18$, $p = 0.912$). However twenty-eight (87.5%) S-patients, twenty-three (79.3%) PDD-patients, and ninety-five (97.9%) Controls accessed the Internet through a mobile phone, and there was a significant difference between the PDD- and Control- groups ($x^2 = 13.03$, $p = 0.000$).

The number of Related-persons and Off-persons e-mailed to in the last month were significantly lower in S- than in the Control-group ($U = 1{,}040$, $p = 0.002$, $U = 867.0$, $p = 0.000$). Those numbers were also significantly lower in PDD- than in Control-group ($U = 968.0$, $p = 0.002$, $U = 936.5$, $p = 0.005$). There was no significant difference among the three groups in the number of On-persons e-mailed to in the last month ($H = 0.75$, $p = 0.689$).

The amount of time spent online a day through a PC was highest in the PDD-group, which was significant by different from the Control-group ($U = 652.0$, $p = 0.002$). Also, the amount of time spent online a day through a mobile phone was lowest in the PDD-group, and there was a significant difference between the PDD- and Control-groups ($U = 531.0$, $p = 0.002$).

In questions (10) to (19), there were significant differences in (14), (17), and (19). The answer rates of (14), (17), and (19) in each group are shown in Fig. 1.

There were five significant differences between the PDD- and Control- groups regarding frequency of Internet communication. PDD-patients expressed themselves in BBS ($U = 87.0$, $p = 0.16$), and received from BBS ($U = 361.5$, $p = 0.007$) and blogs ($U = 381.5$, $p = 0.015$) significantly more frequently than Controls using PCs. On the other hand, PDD-patients significantly less frequently sent ($U = 422.0$, $p = 0.000$) and received e-mail than Controls ($U = 474.5$, $p = 0.000$) using mobile phones. There was no significant difference between S- and Control- groups, or between S- and PDD- groups in the frequency of Internet communication.

Discussion and Conclusion

The present study investigated attitudes and opinions, and the frequency of Internet communication among patients with schizophrenia or pervasive developmental disorders.

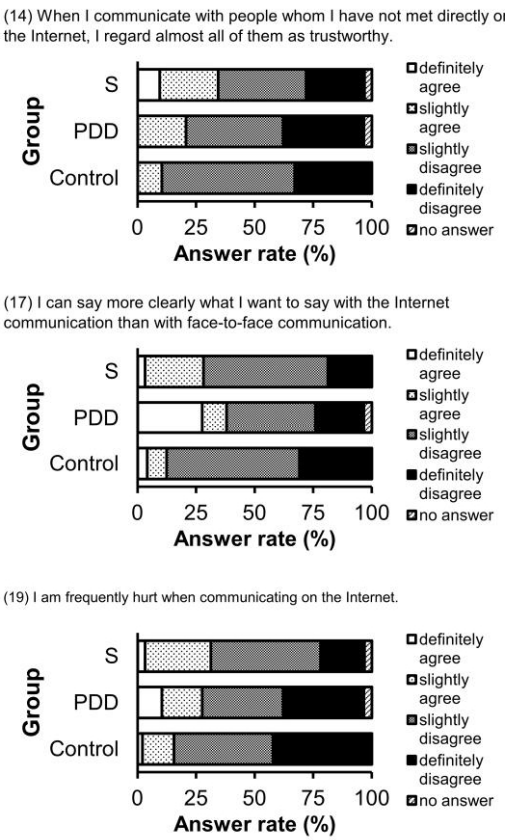

Figure 1: Answer (1 = definitely agree, 2 = slightly agree, 3 = slightly disagree, and 4 = definitely disagree) rates of (14), (17), and (19) in patients with schizophrenia (n = 32, S), individuals with pervasive developmental disorders (n = 29, PDD), and normal controls (n = 97, Control). In (14), there was no significant difference in the average ranks of the groups, but the rate of "total agree" answers ('definitely agree' and 'slightly agree') was significantly higher in S- than in the Control-group ($p = 0.001$). In (17), the average rank was significantly lower in PDD- than in the Control-group ($p = 0.012$). In (19), the average rank was significantly lower in S- than in the Control-group ($p = 0.011$).

Although the social ties of S- and PDD-patients were limited in size, the present study showed that: 1) S-patients had feelings of persecution when engaging in Internet communication, 2) their general trust in Internet communication was higher, and 3) the frequency of Internet communication was close to that of Controls; 4) PDD-patients regard the Internet as more useful for communicating with other people than face-to-face communication, 5) they spent more time online in a day through PCs, 6) they avoid mobile phones, 7) they more frequently use BBS and blogs to communicate, and 8) they less frequently use e-mail to communicate.

References

[1] Ministry of Internal Affairs and Communications. WHITE PAPER Information and communications in Japan. *Ministry of Internal Affairs and Communications.* Tokyo, 2010.

[2] Baron-Cohen S, Wheelwright S, Skinner R, Martin J, Clubley E. The autism-spectrum quotient (AQ): evidence from Asperger syndrome/high-functioning autism, males and females, scientists and mathematicians. *J Autism Dev Disord.* 2001; 31: 5-17.

[3] Kurita H, Koyama T, Osada H. Autism-Spectrum Quotient-Japanese version and its short forms for screening normally intelligent persons with pervasive developmental disorders. *Psychiatry Clin Neurosci.* 2005; 59: 490-496.

Author's address
E-Mail: watabe.takashi@h.mbox.nagoya-u.ac.jp

Effects of virtual reality training on upper extremity function and activities of daily living performance in acute stroke: A double-blind randomized clinical trial

Jae-Sung Kwon and Soo Hyun Park
Department of Occupational Therapy, College of Health Sciences,
Yonsei University, Gangwon-do, Republic of Korea

INTRODUCTION: The aim of this investigation was to examine the effects of conventional therapy (CT) combined with intensive and repetitive virtual reality (VR) program on upper extremity function and activities of daily living (ADL) performance in individuals in the acute stage of stoke.

METHODS: Twenty-six individuals in the acute stage of stroke were recruited. All subjects were randomly assigned to either the control or experimental group. In this double-blind randomized clinical trial, the control group received CT alone for 70 minutes per day, 5 days per week for 4 weeks, while the experimental group received 30 minutes of VR training in addition to CT on the same day. CT consisted of routine physical and occupational therapy such as gait training, balance training, table-top activities, strengthening exercise of upper limb, and ADL training. VR intervention was conducted using the IREX VR system. This VR system consisted of a television monitor, a video camera, cyber gloves and virtual objects, and scenes displayed on a large back screen. In this study, five VR games that were deemed to induce reaching and lifting motor skills of the upper limb at various angles were selected. Fugl-Meyer Assessment and Manual Function Test were used to measure improvement of functioning in the affected limb and the Korean version of the Modified Barthel Index was conducted to evaluate ADL performance for each group at pre- and post-intervention periods.

RESULTS: In tests of upper extremity functioning, VR group showed significant improvement on the Fugl-Meyer Assessment and the Manual Function Test ($p < 0.05$). In the CT group, a significant change was observed only on the Fugl-Meyer Assessment ($p < 0.05$). ADL performance showed a significant improvement pre- and post-intervention in both groups ($p < 0.05$). There were no significant differences between the two groups in upper extremity function and ADL performance ($p > 0.05$).

CONCLUSION: This study observed that while both CT and VR training improves upper extremity function and ADL performance, VR may hold the additional advantage of providing an individualized intensive and repetitive training while maintaining a high degree of motivation for individuals in the acute stage of stroke.

Neck and shoulder muscle activation in farm workers performing simulated orchard work with and without neck support

In-Gyu Yoo, Jin Lee , Min-Ye Jung , and No-Yul Yang .
Department of Occupational Therapy, College of Health Sciences,
Yonsei University, Gangwon-do, Republic of Korea

INTRODUCTION: Work-related musculoskeletal disorders (WMSDs) have become an increasing problem in agricultural society. Activities related to harvest work include climbing ladders, picking fruit, and carrying fruit-laden bags. Such activities lead the worker to assume several awkward postures. Those who perform orchard work frequently report symptoms of musculoskeletal strain. In particular, repeated and sustained work with elevated arms is known to lead to neck and shoulder pain. However, there have been only a few studies focusing on protective ergonomic devices for such activities. The purpose of this study was to hence detect differences in electromyographic (EMG) activity in the neck and shoulder muscles while performing simulated orchard work movements with and without neck support.

METHODS: Fourteen healthy orchard harvesters (eight men and six women) who had no functional disorder of the neck or upper limbs and who had never received orthopedic surgery were recruited. A repeated-measures design was used. The participants were asked to perform simulated orchard work movements with and without neck support. The order of condition under which the participants performed the trials was randomly assigned for each participant. The simulated orchard work selected in our study involved reaching up with the arms while holding a 1kg dumbbell in each hand, and to maintain this posture for 1 minute. It is similar to a simple task that is often performed in harvesting apples and pears during orchard work. In the neck support condition, the UPGUARD 3000 (IMPACTO^{TM} Protective Products Inc.) was worn by each participant. This device includes a strap attachment while it rests on the upper thorax, and approaches the neck when the head is extended or tilted backwards. With the support resting on the upper back, the extension range of motion can be limited. The EMG activities of the anterior deltoid, middle deltoid, upper trapezius, and triceps brachii (lateral head) muscles during the two conditions were analyzed using paired *t*-tests.

RESULTS: The EMG activity of the anterior deltoid and middle deltoid muscles increased significantly ($p < .05$) and that of the upper trapezius muscles decreased significantly when engaging in work movements with neck support compared to conditions without neck support ($p < 0.05$).

CONCLUSION: Wearing a neck support may prevent overuse of the upper trapezius muscles by encouraging shoulder elevation and activating the deltoid muscles. The activation of these muscles may in turn decrease scapular movement, resulting in greater stabilization of scapulohumeral rhythm. The results of the present study thus indicate that the appropriate application of neck support may ultimately be helpful in preventing disorders of the neck and shoulder muscles resulting from long-term intensive orchard work.

Computer-based cognitive training improves cognitive function and instrumental activities of daily living in individuals with schizophrenia

Duk-Youn Cho and Ji-Hyuk Park
Department of Occupational Therapy, College of Health Sciences,
Yonsei University, Gangwon-do, Republic of Korea

INTRODUCTION: Schizophrenia is a complex brain disorder, characterized by positive and negative symptoms. Negative symptoms such as anhedonia are thought to impair cognitive functioning. Such cognitive impairment in turn negatively affect instrumental activities of daily living (IADL) and result in difficulty returning to home and the community. Cognitive rehabilitation training is commonly provided to improve such cognitive skills deficits. Recently, effects of computer-based cognitive training has shown positive effects in improving memory, attention, and executive functioning in individuals with schizophrenia. However, extant research has only shown the benefits of such training on cognitive functioning although improvement in cognitive function may also affect individuals' capacity for engaging in IADL. As such, the present study examined the effects of computer-based cognitive training on both cognitive functions and IADL.

METHODS: Twelve clinically stable outpatients diagnosed with schizophrenia based on the DSM- IV who also demonstrated predominance of negative symptoms were recruited. Exclusion criteria were individuals with a comorbid medical and/or psychiatric disorder based on the DSM-IV. Word list memory and word list recall tests were used to measure memory. Word list memory test requires participants to recall from a list of 10 nouns. Word list recall test asks participants to recall the 10 nouns after a given lapse of time. Attentional capacity was measured by the 8 attention tasks on the attention subtest of the Korean-Dementia Rating Scale (K-DRS). Time to completion on the Trail Making Test Forms A and B were used as the measure of executive function. To assess individuals' IADL, the Seoul-Instrument Activities of Daily Living (S-IDAL) was used. This test consists of 15 items evaluated on a 3-point scale with, 0 indicating complete independence and 3 indicating complete dependence. With a total possible score of 45, lower scores indicate greater capacity for independence in conducting IADL. REHACOM computer-based cognitive training (HAZOMED Co.) was provided as the cognitive training component. In this program, memory of words program, divided attention and vigiliance programs, and shopping and planning programs were selected to target memory, attention, and executive function, respectively.

RESULTS: Overall, participants' memory, attention, and executive function improved post-cognitive training. While there was no significant improvement in word list memory score (t=-.816, p> .05), improvement in word list recall was significant (t=-2.524, p< .05). A significant improvement in attention was also observed (t=-2.930, p< .05). In regards to executive function, time to completion on the Trail Making Test B significantly decreased following computer-based cognitive training (t=2.634, p < .05). IADL score significantly decreased (t=2.792, p< .05), indicating greater independence. A significant correlation between tests of memory and IADL were also found (p< .05).

CONCLUSION: The results of the present study demonstrated the effectiveness of computer- based cognitive training on improving not only cognitive functions but also instrumental activities of daily living in individuals with schizophrenia.

The effects of home environment modification on occupational performance and fall efficacy in rural community dwelling elderly

Han-Sol Kim and Soo Hyun Park
Department of Occupational Therapy, College of Health Sciences,
Yonsei University, Gangwon-do, Republic of Korea

INTRODUCTION: The concept of "aging in place" highlights the significance of identifying the constellation of factors that place older people with physical ailments and/or impairments at risk or factors that may threaten their ability to manage day-to-day living at home. Home modification intervention is provided by occupational therapists to enhance the fit between the older adult with functional limitations and their home environment by reducing the influence of environmental barriers, thereby increasing (1) occupational performance within the home environment and (2) potential for safety by minimizing fall hazards. This study was designed to investigate the effects of home environment modification on occupational performance and fall efficacy in a sample of rural community dwelling elderly.

METHODS : The sample consisted of 15 elderly participants 65 years and older who are residing in a rural community, who also reported a minimum 5-year farming experience and who had been diagnosed with back pain or musculoskeletal disorders such as arthritis. Researcher used a home environment checklist before deciding on the specifics of the required home modification. Home environment checklist consisted of items from the Home Modification Guideline of the Korea Housing Institution. The researcher met with each participant to discuss environmental hazards and assessed potential target of home modification procedures beginning with the home entrance, then the living area, bedroom(s), kitchen, and the bathroom. Following the assessment, home modification ensued for each household. The degree of satisfaction with the home modification procedure and participants' pre- and post-intervention occupational performance was assessed using the Canadian Occupational Performance Measure (COPM). The participants' degree of fall efficacy was assessed using the Korean Version of the Fall Efficacy Scale (K-FES).

RESULTS: A total of 92 environmental barriers were identified in the homes of the participants. The most common place with reported and observed problems were the bathroom (38 problems), home entrance and toilet arrangement (22 problems each), followed by the living room and bedroom (5 problems each). After home modification, a significant change in the participants' capacity for occupational performance, satisfaction with home modification, and fall efficacy was found following the intervention ($p<.001$).

CONCLUSION: The results of the present study demonstrated the effectiveness of client-centered and occupational therapy-based home modification on improving occupational performance, satisfaction, and fall efficacy in a community of rural-dwelling elderly participants.