Table 1. Demographic data, error rate, and error patterns

Classification	CDR	Number	Age years	HDS-R	Error of 'fox' n[1]	Error of 'pigeon' n[1]	Error patterns of 'pigeon'			
							palm-palm n[2]	palm-dorsum, n[2]	dorsum-dorsum, n[2]	intermediate, n[2]
NC	0	53	78.9 ± 5.3	–	0 (0.0)	3 (5.7)	3 (100)	0 (0.0)	0 (0.0)	0 (0.0)
MCI	0.5	19	80.7 ± 7.4	26.5 ± 1.3	0 (0.0)	11 (57.9)	5 (45.5)	1 (9.1)	5 (45.5)	0 (0.0)
Mild dementia	1	39	81.4 ± 6.5	20.2 ± 4.1	1 (2.6)	30 (76.9)	10 (33.3)	6 (20.0)	10 (33.3)	4 (13.3)
Moderate dementia	2	20	82.1 ± 5.4	12.1 ± 3.8	0 (0.0)	15 (75.0)	11 (73.3)	3 (20.0)	1 (6.7)	0 (0.0)
Severe dementia	3	29	81.6 ± 4.0	7.0 ± 5.0	9 (31.0)	26 (89.7)	0 (0.0)	11 (42.3)	12 (46.2)	3 (11.5)
Dementia total	1–3	88	81.6 ± 5.5	14.0 ± 7.3	10 (11.4)	71 (80.7)	21 (23.9)	20 (22.7)	23 (26.1)	7 (8.0)

Figures in parentheses represent percentage. More than half of MCI (CDR 0.5) and 4/5 of demented subjects failed to imitate 'pigeon'. The most frequent error pattern of 'pigeon' was the palm-palm pattern, especially in CDR 0.5–2. HDS-R = Hasegawa's Dementia Scale-Revised (top score is 30, as in the *Mini-Mental State Examination*).

[1] Errors as a percentage of the total number of attempts.

[2] Each error pattern as a percentage of the total number of errors.

etal lobe [8]. Meaningless gesture imitation examines representation of the body state [9], which is affected by parietal lobe deficits [10, 11]. Thus, we tested meaningless imitation and adjusted the difficulty level according to a previous study showing that complex meaningless gesture imitation can detect AD in the early stages, whereas simple ones cannot [12].

Here, we developed an easy and rapid test, the Yamaguchi Fox-Pigeon Imitation Test (YFPIT), which detects dementia/AD within 1 min. This game-like test reduces the psychological burden associated with ordinary cognitive tests, which often hurts the pride and self-confidence of aged people.

Methods

We tested 160 aged people: 97 in out-patient clinics and 63 in residences for seniors; 41 males and 119 females. The inclusion criterion was being aged 65 years or over. Exclusion criteria were psychiatric diseases, delirium, verbal incomprehension including aphasia, inability to walk, and motor deficits such as paralysis. The Ethics Board of Gunma University School of Health Sciences approved all procedures (No. 21–26), and signed informed consent was obtained from participants or their proxies. Subjects were diagnosed based on criteria for dementia diseases such as National Institute of Neurological and Communicative Disorders and Stroke and the Alzheimer's Disease and Related Disorders Association (NINCDS-ADRDA). Normal controls (NC) were judged by interviews and questionnaires on frequent symptoms of dementia and instrumental activities of daily living, taken from their family members/carers. Patients and some NC underwent MRI and a set of cognitive tests: e.g. Hasegawa's Dementia Scale-Revised, which is similar and well-correlated with the Mini-Mental State Examination and common in Japan, the cube copying test, clock drawing test, Stroop test, trail-making test, and memory tests. The demented subjects consisted of 64 with AD, 13 with dementia with Lewy bodies, and 11 with other dementia types. In the present study, subjects were classified according to the Clinical Dementia Rating (CDR; table 1). There were no significant differences in age nor gender among the groups (age: $p = 0.11$, 1-way ANOVA; gender: $p = 0.19$, χ^2 test).

The YFPIT consists of a hand-gesture imitation of a 'fox' (fig. 1a) contiguous with a 'pigeon' (fig. 1b). The protocol is as follows:

(1) The examiner sits face-to-face with a subject.
(2) The examiner gives a simple instruction: 'Watch my hand gesture carefully and imitate it.' The instruction can be repeated if necessary.
(3) Then, the examiner makes the 'fox' sign using his/her left hand: fingers III and IV touching the thumb on flexion of the metacarpophalangeal joints with fingers II and V held up (fig. 1a).
(4) The examiner maintains the gesture for 10 s. The subject imitates the gesture concurrently with the examiner. Say nothing during the 10 s of the test. Be careful not to say the words 'fox', or the instruction.
(5) The examiner judges whether or not the subject produces the same sign within 10 s of demonstration; the subject may use either hand.
(6) For 'pigeon', the examiner gives the same instruction, and then makes a 'pigeon' sign using both hands: crossing the hands, palms facing the body, with fingers II–IV extended upward and the two thumbs crossing each other (fig. 1b).
(7) The examiner maintains the gesture without saying anything, especially the word 'pigeon' nor instructions, during the 10 s of the test.
(8) The examiner judges whether or not the subject concurrently makes the same sign within 10 seconds of demonstration.

Points for judgment are as follows:

(a) The direction of the arm and fingers II–V should be upward: hand positions in horizontal or downward directions are judged as failures (fig. 1f).

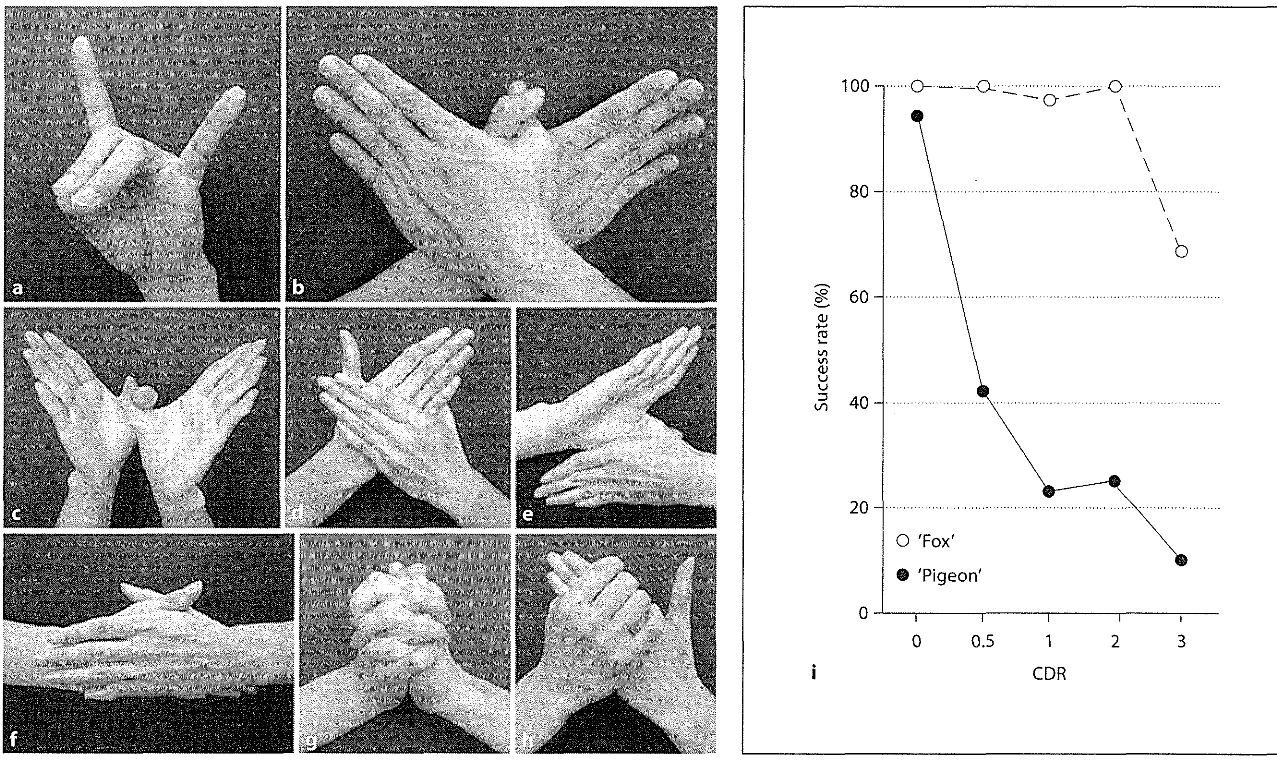

Fig. 1. Hand-gesture demonstration, error responses, and the success rate of the YFPIT according to the CDR. Examiner's demonstration of 'fox' (**a**) and 'pigeon' (**b**). Subjects' typical error patterns of palm-palm (**c**), dorsum-dorsum (**d**), and palm-dorsum (**e**). **f** Error pattern with downward direction of arms. **g, h** Error patterns common in CDR 3. **i** The success rate of 'fox' started to decrease at CDR 3, while that of 'pigeon' decreased at CDR 0.5.

(b) Both cases are acceptable: right hand in an outward position or vice versa.
(c) Both palms should be facing the body.
(d) Thumbs should be crossing each other.

Results

Most CDR 0–2 subjects succeeded in imitating the 'fox', whereas 31.0% of CDR 3 subjects failed. No subjects who failed to imitate the 'fox' succeeded with the 'pigeon' (fig. 1i and table 1).

On the other hand, the success rate of the 'pigeon' was 94.3% in NC (i.e. specificity), whereas more than half of the subjects with MCI (CDR 0.5) and 4/5 of demented subjects failed to imitate 'pigeon' (table 1). The error rate was not significantly influenced by age ($p = 0.17$, two-sample t test) nor gender ($p = 0.10$, χ^2). The specificity of the test was 94.3%. In comparison between NC and MCI, the sensitivity was 57.9%, the positive prediction value (PV+; positive diagnosis/test positive) was 86.2%, and negative prediction value (PV–; negative diagnosis/test negative) was 78.6%. In comparison between NC and mild dementia, the sensitivity was 76.9%, PV+ was 84.7%, and PV– was 90.9%. When subjects were limited to the 64 with AD and compared to NC/MCI, the results were similar to those obtained from all demented subjects (online suppl. table 1, www.karger.com/doi/10.1159/000289819). The number of subjects was too small to analyze the differences among the causes of dementia.

As qualitative analysis, we categorized 4 error patterns of 'pigeon' based on the direction of the hands: (1) palm-palm pattern, both palms outward (fig. 1c), (2) dorsum-dorsum pattern, both dorsa outward (fig. 1d), (3) palm-dorsum pattern, one palm and one dorsum outward (fig. 1e), and (4) other patterns. The characteristic error pattern was palm-palm, and subjects showing this error seemed not to notice it, because, from the subjects' perspective, they saw their dorsa as well as the dorsa of the examiner (table 1).

Regardless of the hand direction, severely demented subjects showed a tendency to fold their fingers (n = 12, 41.4% in CDR 3), e.g. bring their hands together (fig. 1g), or grip one hand with the other (fig. 1h). Inability to perform 'fox' is also observed mostly among CDR 3 subjects, and, therefore, the rate of subjects showing a folding finger pattern and/or inability to perform 'fox' was 0% in CDR 0.5, 5.1% in CDR 1 (n = 2), and 5.0% in CDR 2 (n = 1), whereas it was 58.6% in CDR 3 (n = 17).

No subjects refused to undertake the test and all finished the test within 1 min.

Discussion

Our results suggest that the YFPIT is useful to detect dementia/AD. The merits of the YFPIT are:

(1) Easy and simple, requiring 1 min.
(2) Enjoyable, like a game.
(3) Nearly half of the subjects with mild to moderate dementia showed a palm-palm pattern, and did not notice their mistakes, preserving self-confidence.
(4) Low error rate of 'pigeon' in NC (5.7%).
(5) High sensitivity for detecting dementia (80.7%).

Adding to the merits for detecting mild dementia, the YFPIT revealed the characteristics of severe dementia; more than half of CDR 3 subjects failed to imitate 'fox' and/or showed a folding finger pattern (i.e. fig. 1g, h) in 'pigeon'.

Why did the YFPIT sensitively detect dementia? The reason is that we adopted a hand gesture, 'pigeon', containing 2 components as follows. One was the component of perspective taking, which is the cognitive process when perceiving a visual scene from one's own perspective (first-person perspective, 1PP), differing from taking a view of the same scene from another person's viewpoint (third-person perspective, 3PP) [13]; 3PP recruits the bilateral parietal area more intensely than 1PP [14]. The most frequent error pattern was the palm-palm pattern, which is related to deficits of perspective taking. In the palm-palm pattern, the subjects see the dorsum of both the examiner and themselves. Another component is body midline crossing, where the hands invade the contralateral space. Making adequate gestures crossing the midline is more complex than making those limited to ipsilateral sides.

As above, with the YFPIT, we successfully detected dementia/AD in the early stages. However, a detection (error) rate of 58% in MCI (CDR 0.5) is insufficient. We do not propose that dementia should be screened with the YFPIT independently. The YFPIT can be one of the components of a test battery for dementia/AD. Questionnaires on instrumental activities of daily living from carers are also important for detecting dementia in its early stages [15]. Combination with other tests is necessary for an accurate diagnosis.

The main issue of MCI is the prognosis of conversion to AD. Imaging studies have reported that hypometabolism and/or hypoperfusion in parietal association areas have a high predictive value of conversion to AD [3], and hand-gesture imitation recruits the bilateral parietal association area. Thus, we assume that the hand-gesture imitation test is useful to predict the conversion from MCI to AD. To evaluate the prognostic role of the YFPIT in MCI, follow-up observation is needed.

Corticobasal degeneration is a progressive movement disorder with cortical and basal ganglionic dysfunction [16], and the hand-gesture imitation test is applied to evaluate the movement disorder [17]. Therefore, failure in the YFPIT can be seen in limb apraxia of corticobasal degeneration as well as ideomotor apraxia of stroke.

Our priority was to devise a simple test protocol – one easy gesture followed by a complex gesture, the difficulty of which is appropriate to distinguish dementia/AD from NC. As a result, more than half of CDR 0.5 subjects failed 'pigeon'. Gesture order is also important. We tested the simple 'fox' before the complex 'pigeon' gesture to rule out deficits caused by the incomprehension of verbal commands or visual deficits. To perform the test as a nonsymbolic imitation, we did not use the words 'fox' and 'pigeon'. Thus, the test evaluated the visuomotor but not semantic function. Previous studies revealed deficits of imitation in AD in the context of apraxia [4–7]. This hand-gesture imitation test, the YFPIT, is an effective 1-min test of dementia/AD, showing good sensitivity/specificity, even though it is quite easy, rapid, and low in psychological burden.

Acknowledgements

This work was performed with no funding. However, Dr. Yamaguchi is supported by a grant-in-aid from the Ministry of Education, Science, Culture and Sports, Japan. Dr. Maki had salary support from the Good Practice Program of the Ministry of Education, Science, Culture and Sports, Japan. We thank Rumi Shinohara, and Yuko Tsunoda, research assistants at Gunma University School of Health Sciences, for help with the initial data analysis.

References

1 Tippett WJ, Sergio LE: Visuomotor integration is impaired in early stage Alzheimer's disease. Brain Res 2006;1102:92–102.

2 Braak H, Braak E: Frequency of stages of Alzheimer-related lesions in different age categories. Neurobiol Aging 1997;18:351–357.

3 Matsuda H: Role of neuroimaging in Alzheimer's disease, with emphasis on brain perfusion SPECT. J Nucl Med 2007;48:1289–1300.

4 Parakh R, Roy E, Koo E, Black S: Pantomime and imitation of limb gestures in relation to the severity of Alzheimer's disease. Brain Cogn 2004;55:272–274.

5 Blondel A, Desgranges B, de la Sayette V, Schaeffer S, Benali K, Lechevalier B, Viader F, Eustache F: Disorders in intentional gestural organization in Alzheimer's disease: combined or selective impairment of the conceptual and production systems? Eur J Neurol 2001;8:629–641.

6 Chainay H, Louarn C, Humphreys GW: Ideational action impairments in Alzheimer's disease. Brain Cogn 2006;62:198–205.

7 Rumiati RI, Weiss PH, Tessari A, Assmus A, Zilles K, Herzog H, Fink GR: Common and differential neural mechanisms supporting imitation of meaningful and meaningless actions. J Cogn Neurosci 2005;17:1420–1431.

8 Freund HJ: The parietal lobe as a sensorimotor interface: a perspective from clinical and neuroimaging data. Neuroimage 2001;14:S142–S146.

9 Chaminade T, Meltzoff AN, Decety J: An fMRI study of imitation: action representation and body schema. Neuropsychologia 2005;43:115–127.

10 Wolpert DM, Goodbody SJ, Husain M: Maintaining internal representations: the role of the human superior parietal lobe. Nat Neurosci 1998;1:529–533.

11 Goldenberg G: Apraxia and the parietal lobes. Neuropsychologia 2009;47:1449–1459.

12 Derouesné C, Lagha-Pierucci S, Thibault S, Baudouin-Madec V, Lacomblez L: Apraxic disturbances in patients with mild to moderate Alzheimer's disease. Neuropsychologia 2000;38:1760–1769.

13 Vogeley K, Fink GR: Neural correlates of the first-person-perspective. Trends Cogn Sci 2003;7:38–42.

14 David N, Bewernick BH, Cohen MX, Newen A, Lux S, Fink GR, Shah NJ, Vogeley K: Neural representations of self versus other: visual-spatial perspective taking and agency in a virtual ball-tossing game. J Cogn Neurosci 2006;18:898–910.

15 Mariani E, Monastero R, Ercolani S, Rinaldi P, Mangialasche F, Costanzi E, Vitale DF, Senin U, Mecocci P, ReGAl Study Group: Influence of comorbidity and cognitive status on instrumental activities of daily living in amnestic mild cognitive impairment: results from the ReGAl project. Int J Geriatr Psychiatry 2008;23:523–530.

16 Peigneux P, Salmon E, Garraux G, Laureys S, Willems S, Dujardin K, Degueldre C, Lemaire C, Luxen A, Moonen G, Franck G, Destee A, Van der Linden M: Neural and cognitive bases of upper limb apraxia in corticobasal degeneration. Neurology 2001;57:1259–1268.

17 Salter JE, Roy EA, Black SE, Joshi A, Almeida Q: Gestural imitation and limb apraxia in corticobasal degeneration. Brain Cogn 2004;55:400–402.

International Psychogeriatrics 23(4): 674-676, 2011

In-Patient Psychiatric Settings and Emergency Departments. London: National Institute of Clinical Excellence.
Stewart, I., Knight, C. and Johnson, C. (2008). Just how challenging can older people be? Part 2: Making the case for specialist services for risky and aggressive behavior. *PSIGE Newsletter*, 103, 66–74.
Stubbs, B. (2010). Physiotherapist involvement and views on the application of physical intervention to manage aggression: data from a national survey. *Journal of Psychiatric and Mental Health Nursing*, 17, 754–756.
Stubbs, B., Yorston, G. and Knight, C. (2008) Physical intervention to manage aggression in older adults: how often is it employed? *International Psychogeriatrics*, 20, 855–857.
Winstanley, S. and Whittington, R. (2004). Aggressive encounters between patient and healthcare staff: the context and assailants levels of cognitive processing. *Aggressive Behaviour*, 30, 534–543.

BRENDON STUBBS[1] AND LEE HOLLINS[2]
[1]Clinical Specialist Mental Health Research Physiotherapist, Northampton, U.K.
Email: brendonstubbs@hotmail.com
[2]Physiotherapist and Physical Intervention Tutor, London, U.K.

doi:10.1017/S1041610210001912

Rehabilitation for dementia using enjoyable video-sports games

The aging of society inevitably leads to an increase in the numbers of elderly with dementia who reside in nursing homes, and delaying disease progression of residents with dementia has become a big concern. Rehabilitation that focuses directly on training cognitive function (e.g. memory training) reveals what patients are unable to do. Realization of their cognitive deficits can devastate their self-confidence and lead to anxiety, depression and the lowering of self-esteem (Small *et al.*, 1997). We propose rehabilitation that encourages patients' motivation for self-improvement through social interaction based on five principles as follows: (1) the activities should be enjoyable and comfortable for patients, (2) therapists should praise the patients naturally to motivate them, (3) the activities should be associated with empathetic two-way communication to make patients feel valued and safe, (4) therapists should encourage the patients to play "social roles" to restore self-worth, and (5) error-less learning based on brain-activating rehabilitation (BAR; Yamaguchi *et al.*, in press) should be adopted wherever possible. It is suggested that the positive feelings activate those areas of the brain related to reward, which plays a critical role in motivation (Berridge *et al.*, 2003), and it is a typical social reward to be praised and appreciated in public.

Based on BAR, we tried to improve residents' cognitive function indirectly by enhancing motivation using enjoyable video-sports games in a group setting. We conducted interventions with nine elderly people with mild to moderate dementia (88.9 ± 4.9 years of age, mean ± SD; three males and six females: one with Parkinson's disease dementia, one with vascular dementia, and seven with Alzheimer's disease (AD)) residing in a nursing home. All were in the stable phase of dementia, and had been admitted to the nursing home at least three months previously. None of the participants was medicated with donepezil hydrochloride.

We used video sports-games specifically devised for rehabilitation (Hot-plus, SSD Co. Ltd, Shiga Japan). These utilize psychomotor skills, such as hand-eye coordination, require timing, and necessitate fine three-dimensional control of the limbs in space. There were essentially two types of games: those working the upper limbs, and those the lower limbs. An example of the games for upper limbs required a player to grab coins which appeared to be coming out of the TV screen. The players wore bands on their hands equipped with sensors, and when the timing and direction were accurate, they scored points. Games for the lower limbs included those which required the players to move their legs to music. Two Japanese drums were shown on the TV screen, and two balls fell slowly from the top of the TV screen. A player was required to tap his/her feet on a mat equipped with sensors, synchronizing with the balls bouncing on the drums. He/she scored when the timing was accurate. These interventions were conducted once a week for ten weeks.

General cognitive function was measured using Hasegawa's Dementia Scale-revised (HDS-R), which is similar and well-correlated with the Mini-mental State Examination. The visuospatial and constructive function was measured using Kohs block-design tests (Kohs). Behavioral changes were evaluated using the Multidimensional Observation Scale for Elderly Subjects (MOSES), with the subitems of self-care, disorientation, depression, irritability, and withdrawal. No residents had previously experienced playing the video-sports games and so to help the residents enjoy the games, the caregivers (aged 40.8 ± 12.9 years, 7 males and

Table 1. The HDS-R, Kohs and MOSES scores

SCALE	BASELINE (MEAN ± SD)	POST-INTERVENTION (MEAN ± SD)	PAIRED-T TEST (p)
HDS-R	18.89 ± 4.26	25.33 ± 2.35	0.002
Kohs	20.22 ± 15.62	37.44 ± 12.44	0.02
MOSES			
Self-care	15.18 ± 4.09	15.00 ± 3.74	0.92
Disorientation	12.01 ± 2.47	10.64 ± 2.06	0.15
Depression	12.36 ± 3.08	10.46 ± 2.58	0.13
Irritability	9.46 ± 0.82	9.00 ± 0.63	0.16
Withdrawal	15.09 ± 5.13	13.55 ± 4.53	0.46
Total	64.18 ± 7.29	58.64 ± 5.16	0.054

12 females) participated in the sessions. They were taught in advance how to maintain empathetic two-way communication with the elderly participants. They were given a communication checklist of 34 items before commencement, and they kept an observation record to reinforce empathetic communication with residents.

The HDS-R scores improved from 18.98 ± 4.26 (mean ± SD) to 25.33 ± 2.35 (p = 0.002, paired t-test), the Kohs test scores improved from 20.22 ± 15.62 to 37.44 ± 12.44 (p = 0.02), and the total MOSES scores improved from 64.18 ± 7.29 to 58.64 ± 5.16 (p = 0.054; Table 1). Regarding communication, the sociability of residents also showed an improvement as seen in the MOSES subitems relating to communication and social interaction – i.e. depression, irritability, and withdrawal. According to the caregivers' observation records, the residents' faces became expressive, especially with smiles. Caregivers' communication skills were also improved by self-assessment (12.92 ± 2.07 items in the checklists with 34 items listed before commencement of the sessions). Communication was not limited to verbal communication; the main purpose of communication was to enjoy exchanges of affection and empathy rather than to obtain information; thus, nonverbal communication was very important. With the aid of the games, a situation promoting communication could be easily created by playing doubles, watching others play, cheering each other on, etc.

Although it is not possible to prove a causal relationship between cognitive improvement and increased communication, a community-based study has shown that communication, i.e. social interaction in the broad sense, has a protective effect in preserving mental function in the elderly (Wang *et al.*, 2002). Furthermore, communication might at least help ameliorate the residents' disuse syndrome. Disuse syndrome keeps the residents below the mental level expected based on the degree of brain pathology or brain damage. Nursing home residents tend to be passive, apathetic and dependent on caregivers. According to a survey conducted in Japan to explore the characteristics of depressive mood in different care settings, the residents in nursing homes felt more dissatisfied, apathetic and worthless, and unwilling to stay there, compared with community-dwelling residents and the hospitalized elderly (Onishi *et al.*, 2006). A depressive and apathetic tendency leads to cognitive and functional decline in AD; the results of MOSES showed some sign of improvement with regard to depressive tendencies. The cognitive decline resulting from disuse may be a reversible change, and so residents may regain their capacities.

Inter-subjectivity is a major factor in the rehabilitation for dementia; playing video-sports games in a group setting can be effective in improving the cognitive function of elderly people with dementia, especially when performed with trained caregivers who understand the principles of BAR: namely, the importance of creating enjoyment, empathetic two-way communication, using praise, and developing social roles.

Conflict of interest

None.

Description of authors' roles

Y. Maki and H. Yamaguchi formulated the research question, designed the study, carried it out, analyzed the data and wrote the letter. K. Takahashi was the doctor in charge of the patients.

Acknowledgments

This research was supported by a Grant-in-Aid for Scientific Research from the Ministry of Education, Science, Sports, Culture and Technology, Japan (18650196) and a Research Grant for Longevity Sciences (21A–12) from the Ministry of Health, Labor and Welfare. The authors thank the residents and care staff of Seseragi-en nursing home, R. Shinohara and Y. Tsunoda.

References

Berridge, K. C. (2002). Pleasures of the brain. *Brain and Cognition*, 52, 106–128.

Onishi, J., Suzuki, Y., Umegaki, H., Endo, H., Kawamura, T. and Iguchi, A. (2006). A comparison of depressive mood of older adults in a community, nursing homes, and a geriatric hospital: factor analysis of Geriatric Depression Scale. *Journal of Geriatric Psychiatry and Neurology*, 19, 26–31.

Small, G. W. ***et al.*** (1997). Diagnosis and treatment of Alzheimer disease and related disorders: Consensus Statement of the American Association for Geriatric Psychiatry, the Alzheimer's Association and the American Geriatrics Society. *JAMA*, 278, 1363–1371.

Wang, H. X., Karp, A., Winblad, B. and Fratiglioni, L. (2002). Late-life engagement in social and leisure activities is associated with a decreased risk of dementia: a longitudinal study from the Kungsholmen Project. *American Journal of Epidemiology*, 155, 1081–1087.

Yamaguchi, H., Maki, Y. and Yamagami, T. (in press). Overview of nonpharmacological intervention for dementia and principles of brain-activating rehabilitation. *Psychogeriatrics: Official Journal of the Japanese Psychogeriatric Society.*

H. YAMAGUCHI,[1] Y. MAKI[1,2] AND K. TAKAHASHI[3]

[1] Gunma University School of Health Sciences, Maebashi, Japan

[2] Department of Neurology, Geriatrics Research Institute and Hospital, Maebashi, Japan

[3] Matsuida Hospital, Annaka, Japan

Email: yamaguti@health.gunma-u.ac.jp.

PSYCHOGERIATRICS
The Official Journal of the Japanese Psychogeriatric Society

doi:10.1111/j.1479-8301.2011.00370.x PSYCHOGERIATRICS 2011; **11**: 205–211

ORIGINAL ARTICLE

A figurative proverb test for dementia: rapid detection of disinhibition, excuse and confabulation, causing discommunication

Haruyasu YAMAGUCHI,[1] Yohko MAKI[1,2] and Tomoharu YAMAGUCHI[1,3]

[1]Gunma University Graduate School of Health Sciences, [2]Department of Neurology, Geriatrics Research Institute and Hospital, and [3]Rehabilitation Academy affiliated with Gunma University of Health and Welfare, Maebashi, Japan

Correspondence: Dr Haruyasu Yamaguchi MD, PhD, 3-39-15 Showa-machi, Maebashi 371-8514, Japan. Email: yamaguti@health.gunma-u.ac.jp

Received 18 January 2011; accepted 9 May 2011.

Abstract

Background: Communicative disability is regarded as a prominent symptom of demented patients, and many studies have been devoted to analyze deficits of lexical-semantic operations in demented patients. However, it is often observed that even patients with preserved lexical-semantic skills might fail in interactive social communication. Whereas social interaction requires pragmatic language skills, pragmatic language competencies in demented subjects have not been well understood. We propose here a brief stress-free test to detect pragmatic language deficits, focusing on non-literal understanding of figurative expression. We hypothesized that suppression of the literal interpretation was required for figurative language interpretation.

Methods: We examined 69 demented subjects, 13 subjects with mild cognitive impairment and 61 healthy controls aged 65 years or more. The subjects were asked the meaning of a familiar proverb categorized as a figurative expression. The answers were analyzed based on five factors, and scored from 0 to 5. To consider the influence of cognitive inhibition on proverb comprehension, the scores of the Stroop Colour–Word Test were compared concerning correct and incorrect answers for each factor, respectively. Furthermore, the characteristics of answers were considered in the light of excuse and confabulation qualitatively.

Results: The proverb comprehension scores gradually decreased significantly as dementia progressed. The literal interpretation of the proverb, which showed difficulties in figurative language comprehension, was related to disinhibition. The qualitative analysis showed that excuse and confabulation increased as the dementia stage progressed.

Conclusions: Deficits in cognitive inhibition partly explains the difficulties in interactive social communication in dementia. With qualitative analysis, asking the meaning of a proverb can be a brief test applied in a clinical setting to evaluate the stage of dementia, and to illustrate disinhibition, confabulation and excuse, which might cause discommunication and psychosocial maladjustment in demented patients.

Key words: *Alzheimer's disease, behavioural and psychological symptoms of dementia, confabulation, excuse, pragmatic language deficits, proverb comprehension.*

INTRODUCTION

As patients with dementia gradually lose their identity, the care burden placed on their family members increases with the patients' dependence and unpredictability. One of the major problems in the care of patients with dementia is discommunication; even patients with preserved verbal intelligence might fail to engage in interactive social communication. In human speech, we often make use of non-literal expressions. For example, in Japan, 'apple-cheeked' is an expression for cute children, and 'a fat-bellied man' means a generous-minded man. In these cases, direct literal interpretation leads to misunderstanding. However, it was reported that patients with dementia have difficulties with non-literal language comprehension,[1,2] and that this might contribute to their deficits in social communication.

To our knowledge, there is no quick test available in a clinical setting to check for deficits of figurative interpretation in patients with dementia. In the present study, we assessed the interpretation of a figurative proverb as a clinical test; proverb comprehension is often used to assess the tendency of patients with schizophrenia to provide literal explanations for figurative expressions.[3–5] The aim of the present study was to show the characteristics of proverb comprehension in dementia, and test the hypothesis that suppression of the literal interpretation was required for figurative language interpretation.[2,6–8] Adding to this kind of disinhibition, we checked excuses and confabulation from the context. Clinical observation suggested that patients with dementia tended to make excuses to protect themselves, and they were prone to confabulation to compensate for their memory distortion.[9]

To obtain effective information in a busy outpatient setting, brevity and simplicity are critical components. Asking the meaning of a single proverb is simple yet informative; it takes less than 1 min and no tools are needed, but it shows the typical symptoms of disinhibition, excuse and confabulation. Furthermore, asking the meaning of a well-known proverb does not cause the patients' distress, which is often associated with ordinary cognitive tests. It is also beneficial for family members (caregivers) to obtain information on patients' deficits in figurative comprehension, which can result in communication gaps with patients.

METHODS

Among the participants, the outpatients were classified according to the Clinical Dementia Rating scale (CDR): 13 with mild cognitive impairment (MCI; CDR 0.5), 30 with mild dementia (CDR 1), 28 with moderate dementia (CDR 2) and 11 with severe dementia (CDR 3). The ages of the patients were as follows: 81.4 ± 8.8 years (mean ± SD) in CDR 0.5, 81.8 ± 7.5 years in CDR 1, 82.3 ± 6.2 years in CDR 2 and 83.6 ± 4.3 years in CDR 3. The male-to-female ratio was 3:10 in CDR 0.5, 9:21 in CDR 1, 5:23 in CDR 2 and 3:8 in CDR 3. Among patient groups, there was no significant difference in age ($P = 0.87$; one-way ANOVA) or sex ($P = 0.65$; χ^2-test). A total of 61 normal controls (NC; 28 in their late 60s, 23 in their early 70s and 10 in their late 70s) were healthy community dwellers. The exclusion criteria were: age less than 65 years, psychiatric diseases, delirium and verbal incomprehension including aphasia.

The Ethics Board of Gunma University School of Health Sciences approved all procedures (No. 21–26), and informed consent was obtained from all participants. Subjects were diagnosed based on the criteria for dementia diseases: Alzheimer's disease (AD) by NINCDS-ADRDA,[10] dementia with Lewy bodies (DLB) by the third report of the DLB Consortium[11] and MCI by the report of the International Working Group on Mild Cognitive Impairment.[12] CDR 0.5 was regarded as mild cognitive impairment (MCI), although a different classification was proposed whereby CDR 0.5 encompasses both mild and earlier dementia[13] or it corresponds to very mild dementia.[14] Normal controls (NC) were judged based on an interview and a questionnaire on the symptoms of dementia. The diagnoses were: 53 AD including AD with cerebral vascular changes, 13 DLB and three vascular dementia.

We assessed the participants' non-literal language comprehension using a figurative proverb. The examiner asked only the meaning of a Japanese proverb, '*Saru mo ki kara ochiru*'. The proverb is one of the most familiar ones, which is taught in the early elementary school years in Japan. Literally, the sentence means that even a monkey falls from trees, and the corresponding proverb in English is, 'Even Homer sometimes nods', or 'Even a good swimmer can drown'. The figurative meaning is that even a skilled person sometimes makes a mistake in what he/she is good at. Proverbs often contain lessons regarding the context-appropriate proverb meaning;[15] in this case, the lesson is that one has to stay alert. The answers were scored from 0 to 5: one score for each component of 'skilled', 'person', 'sometimes' and 'making a mistake', and one score for extraction of the lesson of 'to stay alert.' The components of 'person' and 'making a mistake' are hypothesized as the ability to suppress the literal interpretation of 'monkey' and 'falling from trees'; thus, participants were not given a score unless they answered explicitly. Concerning the other two components of 'skilled' and 'sometimes', scores were given regardless of explicit or implicit explanations.

The answers were also considered qualitatively. We reviewed the responses and counted the number of answers including each feature: not knowing, answer out of context, literal interpretation, making excuses, and confabulation. A 'literal answer' was defined as that including the explicit expression of 'a monkey falls from a tree' instead of 'a person makes mistakes'. Multiple selections were allowed in the qualitative analysis.

To avoid scoring bias, the evaluation was carried out by two authors and a co-medical staff member who was not involved in the study. Analysis was carried out by another author who took no part in scoring.

To verify the hypothesis that suppression of the literal interpretation was required for figurative language interpretation, we used the Stroop Colour–Word Test (Stroop) with patients in stages from CDR 0.5 to CDR 2; patients in CDR 3 were excluded because the requirement of Stroop is above the level of CDR 3. The test comprises words describing a colour, but written in a different colour; for example, the word 'red' is written in green, and the test requires the subject to state the colour (green) not the word (red). The number of correct answers was regarded as the Stroop score; to answer correctly, it is necessary to inhibit the literal interpretation, which can be more automatic.[16] Individuals with AD show a stronger tendency to respond with the word rather than the colour compared with the normal aged subjects,[17] which can be regarded as one of the manifestations of disinhibition. The patients were also tested using Hasegawa's Dementia Scale-revised (HDS-R), which is similar to and well-correlated with the Mini-Mental State Examination, and common in Japan; to assess the contribution of inhibition and general cognitive function to the five components of the proverb, the scores of Stroop and HDS-R were compared between correct and incorrect answer groups, respectively. Analysis of data was carried out using the Japanese version of SPSS 18.0 (SPSS Japan, Tokyo, Japan).

RESULTS

Demographic data are shown in Table 1. The figurative proverb test scores according to CDR were 4.03 ± 1.09 in CDR 0 (NC), 2.62 ± 1.04 in CDR 0.5 (MCI), 2.53 ± 1.46 in CDR 1, 1.39 ± 1.31 in CDR 2 and 0.73 ± 0.90 in CDR 3 (Fig. 1). There was a significant difference among the groups regarding the gradual decrease ($P < 0.001$; one-way ANOVA). According to post-hoc analysis with Bonferonni correction, the scores of CDR 0.5 and CDR 1 were significantly lower than those of NC ($P = 0.002$, $P < 0.001$, respectively), and those of CDR 2 were significantly lower than those of CDR 1 ($P = 0.005$; Fig. 1). Stroop and HDS-R scores according to CDR are shown in Table 1.

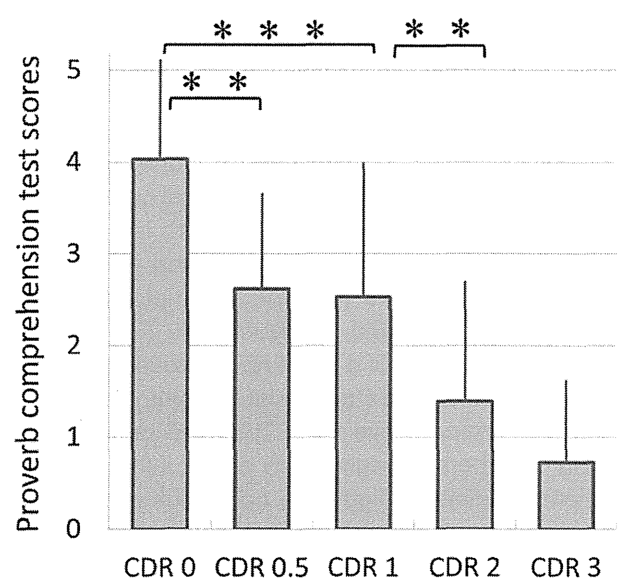

Figure 1 The figurative proverb test scores, showing a gradual decrease according to the clinical dementia rating scale (CDR). Level of statistical significance: **$P < 0.01$; ***$P < 0.001$.

Table 1 The Stroop and Hasegawa's Dementia Scale-revised scores according to clinical dementia rating

	n	Age (mean ± SD)	Sex (male/female)	Stroop (mean ± SD)	HDS-R (mean ± SD)
CDR 0.5 (MCI)	13	81.4 ± 8.8	3/10	21.38 ± 2.40	26.77 ± 2.17
CDR 1	30	81.8 ± 7.5	9/21	17.07 ± 6.57	20.10 ± 4.85
CDR 2	28	82.3 ± 6.2	5/23	10.00 ± 8.43	14.89 ± 5.36
CDR 3	11	83.6 ± 4.3	3/8	ND	7.00 ± 7.46

Among patients' group, there was not a significant difference of ages ($P = 0.87$; 1 way ANOVA) or sex ($P = 0.65$; χ^2-test). The normal control group consisted of 28 late 60s, 23 early 70s and 10 late 70s, and all woman. CDR, clinical dementia rating; MCI, mild cognitive impairment; ND, not done.

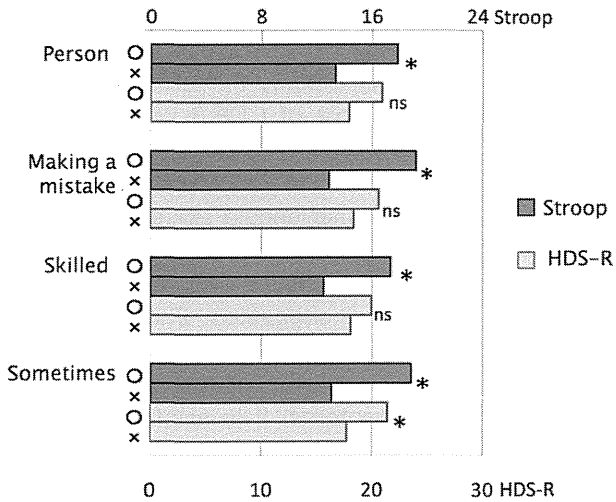

Figure 2 Comparison of the Stroop Colour–Word test and Hasegawa's Dementia Scale-revised (HDS-R) scores between the correct (○) and incorrect (×) answer groups for each component of the proverb: *$P < 0.05$.

The percentage of correct answers of CDR 0 (NC) was as follows: the component of 'skilled', 95.1%; 'person', 88.5%; 'making a mistake', 86.9%; 'sometimes', 85.3%; and 'to stay alert', 47.5%.

Total scores of the proverb test were significantly correlated with Stroop ($r = 0.45$, $P < 0.001$) and HDS-R ($r = 0.33$, $P = 0.005$) in CDR 0.5 to 2 subjects ($n = 71$). We, however, examined the relationship between each component of the proverb and the Stroop/HDS-R scores by dividing subjects into the correct and incorrect answer groups. The results are shown in Figure 2 and Table S1. Regarding the components of 'person', 'making a mistake' and 'skilled', the scores of Stroop in the correct answer group were significant higher than those in the incorrect answer group (P = 0.023, P = 0.001, P = 0.011, respectively), but not HDS-R scores (P = 0.056, P = 0.146, P = 0.230, respectively). Concerning the component of 'sometimes', the scores of both Stroop and HDS-R were significantly higher in the correct answer group than those in the incorrect answer group (P = 0.004, P = 0.019, respectively).

The characteristics according to stages are shown in Figure 3 and Table S2 (multiple selections allowed). There were three patterns: (i) responses characterized as 'not knowing' and 'excuse' comprised 0% in NC and then gradually increased, but remained at less than 20 and 30%, respectively, in CDR 3; (ii) The

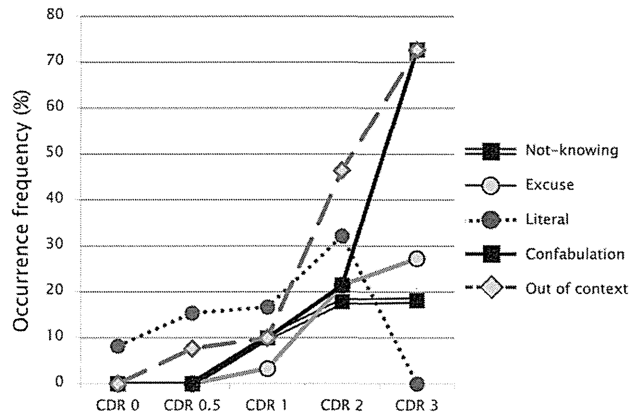

Figure 3 Occurrence frequency of five features according to the clinical dementia rating scale (CDR).

'literal answers' increased gradually from NC to CDR 2, approximately 30%, but remained at 0% in CDR 3; and (iii) answers 'out of context' and confabulation increased more than 70% in CDR 3. The results of qualitative analyses are described in the Discussion with examples of responses.

There was a significant difference in years of education among the groups of CDR 0.5 to CDR 3 (P = 0.010, one-way ANOVA), and post-hoc analysis showed that participants with CDR 0.5 had received a longer education than the CDR 2 group.

The same analysis of patients with AD alone showed similar results (Tables S3, S4).

DISCUSSION

The present study showed the deficits of figurative language comprehension in dementia according to disease progression. As shown in Figure 1, the figurative proverb test scores in the CDR 0.5 (MCI) and CDR 1 (mild dementia) groups were significantly lower than those in CDR 0 (NC). It has been controversial whether the capacity for figurative language comprehension deteriorates from the early stages, or is preserved until advanced stages;[7,18] our data showed that the capacity declines from CDR 0.5 (MCI).

In the present study, we proposed a new way to analyze the answer. We divided the proverb into four components and evaluated appropriateness of the answer for each component (1 point for each). The ability to extract a lesson from the proverb was also evaluated (1 point). Extraction of the lesson is difficult, even for the individual in CDR 0, but more than 80%

of them could explain the meaning of the four components appropriately. Thus, an inappropriate answer of any component, but not extraction of the lesson, can be taken as an indication of decline of non-literal proverb comprehension in MCI and dementia.

Relationship between answers and cognitive test of Stroop and HDS-R

Regarding the components of 'person', 'making a mistake' and 'sometimes', significantly low scores were shown in Stroop, but not shown significantly in HDS-R in incorrect answer groups. The results concerning the components of 'person' and 'making a mistake' suggested that a subject might answer incorrectly when they failed to inhibit the literal interpretation, consistent with previous studies; it was reported that individuals with AD had difficulties in suppressing the literal interpretation, which is concurrently activated, even if they still retained knowledge of the figurative meaning.[2,7] No literal answers were observed in CDR 3, although they were expected to be the most frequent in this group where disinhibition was the most prominent. Literal answers could be replaced by confabulation and out of context in CDR 3.

'Skilled' is the connotation of 'a monkey' from the context. Once the semantic network is constructed, presentation of a word automatically activates related words through the semantic network of association, but patients with AD undergo deterioration of the associations,[19] which can be related to the reduced inhibitory control over concurrently activated words.[20]

The component of 'sometimes' checked the 'attention to detail'; the particle '*mo*' means 'even or sometimes'. The Stroop task is concerned with divided attention directed toward literal meaning and colour;[21] thus, the ability checked by the test could be related to such attention to the components (or syllables) of the proverb, and such attention can be related to HDS-R scores.

As aforementioned, all four components were associated with difficulties in suppressing concurrently active words, tending to comprehend figurative expressions literally in daily conversation, too.

Answers of excuse and 'not knowing'

There were qualitative differences in excuse according to the stages. Examples of CDR 1 were, 'I've heard the proverb but I don't know the meaning, because I'm foolish and I haven't studied well'. They used excuses defensively. An example of CDR 2 was, 'I haven't heard this before, the elderly say such things', and an example of CDR 3 was, 'What are you telling me for? I don't know because I don't keep monkeys'. The answer for CDR 2 contained the nuance that the examiner should ask someone else, and the answer in CDR 3 was with an accusatory nuance toward the examiner. The aforementioned qualitative differences suggested a declining tendency of self-monitoring. Such deterioration of self-monitoring can lead to anosognosia;[22] that is, unawareness of symptoms. It is assumed to result from deficits in metamemory to distinguish what they know from what they don't.[23,24] In dementia, self-awareness ranges from being somewhat aware to completely unaware of their deficits, reflecting the stage of the disease.[25] In CDR 3, approximately 20% of participants answered that they did not know the meaning. However, those who answered that they did not know were not necessarily aware of their deficits. They replied immediately before taking time to think; thus, they seemed to reply without accessing their own knowledge. The immediate answer of 'not knowing' would suppress accusation; we assumed that the patients took the intuitive precautions against accusation, after a number of experiences with failure.[26]

Confabulation and out of context

The confabulation in CDR 1 and 2 was just to add some information to the answers. Examples are: 'falling down because monkeys were not paying attention', 'falling down because it dropped food' or 'falling down because of being overweight'. In CDR 3, confabulation reached over 70% and it tended to be out of context. For example, 'I know the meaning. Monkeys fell from a mountain, I saw the scene and I felt sorry for the monkeys. I saw baby monkeys and they were cute . . .'. For clinical suggestion, the confabulation began with pretention to know the proverb; pretention is one of the characteristics of AD. Failing to explain the meaning, the story immediately shifted to their own stories; confabulation might be a manifestation of episodic memory distortion[9] and deterioration of self-monitoring.[22] They continued to fluently tell the illogical stories until being interrupted. Telling such stories showed the patients' lack of self-monitoring of the answer. However, some patients sought the examiner's approval, which is a typical characteristic of AD to rely on others, probably because of uncertainty. This suggested that even those who lacked explicit consciousness of their deficits might have a vague perception of their illness.

Implication for family education

Social language impairment, such as deficits in the interpretation of figurative language, markedly hinders communication with those around the patient. Communication gaps, especially with families, might arouse feelings of anxiety, and trigger behavioural and psychological symptoms of dementia (BPSD) in patients.[27] Bridging such communication gaps is left to the family, and so family education to enhance communication skills can be effective to reduce BPSD.[27] It is useful for this purpose to understand the characteristics of the patient's deficits of figurative language comprehension.

As aforementioned, the difficulties in interactive social communication in dementia can be partly attributed to deficits in cognitive inhibition. With qualitative analysis, asking the meaning of a proverb is a brief test that can be applied in a clinical setting to detect disinhibition, confabulation and excuse, which are characteristics of dementia and somewhat useful for evaluating its stages. We gave an example of a Japanese proverb; even if customs and language are different, this study might be applicable in other linguistic areas using proverbs with figurative expressions, such as animal analogies.

ACKNOWLEDGEMENTS

This research was supported by a Grant-in-Aid for Scientific Research from the Ministry of Education, Science, Sports, Culture and Technology, Japan (18650196), a Research Grant for Longevity Sciences (21A-12) and a Grant-in-Aid for Scientific Research (H22-Ninchisho-Ippan-004) both from the Ministry of Health, Labor and Welfare of Japan. The authors thank Dr Masamitsu Takatama, Geriatrics Research Institute and Hospital, Maebashi, and Rumi Shinohara and Yuko Tsunoda, at the Gunma University, Maebashi, for their support.

REFERENCES

1 Papagno C. Comprehension of metaphors and idioms in patients with Alzheimer's disease: a longitudinal study. *Brain* 2001; **124**: 1450–1460.
2 Papagno C, Lucchelli F, Muggia S, Rizzo S. Idiom comprehension in Alzheimer's disease: the role of the central executive. *Brain* 2003; **126**: 2419–2430.
3 Goldstein RH, Salzman LF. Proverb word counts as a measure of verinclusiveness in delusional schizophrenics. *J Abnorm Psychol* 1965; **70**: 244–245.
4 Sponheim SR, Surerus-Johnson C, Leskela J, Dieperink ME. Proverb interpretation in schizophrenia: the significance of symptomatology and cognitive processes. *Schizophr Res* 2003; **65**: 117–123.
5 Thoma P, Hennecke M, Mandok T *et al.* Proverb comprehension impairments in schizophrenia are related to executive dysfunction. *Psychiatry Res* 2009; **170**: 132–139.
6 Uekermann J, Thoma P, Daum I. Proverb interpretation changes in aging. *Brain Cogn* 2008; **67**: 51–57.
7 Rassiga C, Lucchelli F, Crippa F, Papagno C. Ambiguous idiom comprehension in Alzheimer's disease. *J Clin Exp Neuropsychol* 2009; **31**: 402–411.
8 Kempler D, Van Lancker D, Read S. Proverb and idiom comprehension in Alzheimer disease. *Alzheimer Dis Assoc Disord* 1988; **2**: 38–49.
9 Attali E, De Anna F, Dubois B, Della Barba G. Confabulation in Alzheimer's disease: poor encoding and retrieval of over-learned information. *Brain* 2009; **132**: 204–212.
10 Dubois B, Feldman HH, Jacova C *et al.* Research criteria for the diagnosis of Alzheimer's disease: revising the NINCDS-ADRDA criteria. *Lancet Neurol* 2007; **6**: 734–746.
11 McKeith IG, Dickson DW, Lowe J *et al.* Diagnosis and management of dementia with Lewy bodies: third report of the DLB Consortium. *Neurology* 2005; **65**: 1863–1872.
12 Winblad B, Palmer K, Kivipelto M *et al.* Mild cognitive impairment-beyond controversies, towards a consensus: report of the International Working Group on Mild Cognitive Impairment. *J Intern Med* 2004; **256**: 240–246.
13 Reisberg B, Ferris SH, Kluger A, Franssen E, Wegiel J, de Leon MJ. Mild cognitive impairment (MCI): a historical perspective. *Int Psychogeriatr* 2008; **20**: 18–31.
14 Grundman M, Petersen RC, Ferris SH *et al.* Alzheimer's Disease Cooperative Study: mild cognitive impairment can be distinguished from Alzheimer disease and normal aging for clinical trials. *Arch Neurol* 2004; **61**: 59–66.
15 Della Sala S, MacPherson SE, Phillips LH, Sacco L, Spinnler H. The role of semantic knowledge on the cognitive estimation task-evidence from Alzheimer's disease and healthy adult aging. *J Neurol* 2004; **251**: 156–164.
16 MacLeod CM. Half a century of research on the Stroop effect: an integrative review. *Psychol Bull* 1991; **109**: 163–203.
17 Bondi MW, Serody AB, Chan ASE *et al.* Cognitive and neuropathologic correlates of Stroop Color-Word Test performance in Alzheimer's disease. *Neuropsychology* 2002; **16**: 335–343.
18 Amanzio M, Geminiani G, Leotta D, Cappa S. Metaphor comprehension in Alzheimer's disease: novelty matters. *Brain Lang* 2008; **107**: 1–10.
19 Gollan TH, Salmon DP, Paxton JL. Word association in early Alzheimer's disease. *Brain Lang* 2006; **99**: 289–303.
20 Faust ME, Balota DA, Multhaup KS. Phonological blocking during picture naming in dementia of the Alzheimer type. *Neuropsychology* 2004; **18**: 526–536.
21 Peterson BS, Skudlarski P, Gatenby JC *et al.* An fMRI study of Stroop word-color interference: evidence for cingulated subregions subserving multiple distributed attentional systems. *Biol Psychiatry* 1999; **45**: 1237–1258.

22 Kashiwa Y, Kitabayashi Y, Narumoto J Nakamura K, Ueda H, Fukui K. Anosognosia in Alzheimer's disease: association with patient characteristics, psychiatric symptoms and cognitive deficits. *Psychiatry Clin Neurosci* 2005; **59**: 697–704.
23 Mograbi DC, Brown RG, Morris RG. Anosognosia in Alzheimer's disease-the petrified self. *Conscious Cogn* 2009; **18**: 989–1003.
24 Souchay C. Metamemory in Alzheimer's disease. *Cortex* 2007; **43**: 987–1003.
25 Starkstein SE, Jorge R, Mizrahi R, Robinson RG. A diagnostic formulation for anosognosia in Alzheimer's disease. *J Neurol Neurosurg Psychiatry* 2006; **77**: 719–725.
26 Yamaguchi H, Maki Y, Yamagami T. Overview of non-pharmacological intervention for dementia and principles of Brain-activating rehabilitation. *Psychogeriatrics* 2010; **10**: 206–213.
27 Gitlin LN, Winter L, Dennis MP, Hauck WW. A non-pharmacological intervention to manage behavioral and psychological symptoms of dementia and reduce caregiver distress: design and methods of project ACT3. *Clin Interv Aging* 2007; **2**: 695–703.

PSYCHOGERIATRICS
The Official Journal of the Japanese Psychogeriatric Society

doi:10.1111/j.1479-8301.2011.00373.x

PSYCHOGERIATRICS 2011; **11:** 221–226

ORIGINAL ARTICLE

Yamaguchi fox–pigeon imitation test (YFPIT) for dementia in clinical practice

Haruyasu YAMAGUCHI,[1] Satoshi TAKAHASHI,[6] Kenji KOSAKA,[7] Koichi OKAMOTO,[2] Tsuneo YAMAZAKI,[2] Masaki IKEDA,[2] Makoto OSAWA,[3] Masakuni AMARI,[4] Yasuo HARIGAYA,[5] Shuichi AWATA[8] and Yohko MAKI[1]

[1]Gunma University Graduate School of Health Sciences, [2]Department of Neurology, Gunma University Graduate School of Medicine, [3]Oido Clinic, [4]Geriatrics Research Institute and Hospital and [5]Maebashi Red Cross Hospital, Gunma, [6]Division of Neurology and Gerontology, Iwate Medical University, Iwate, [7]Yokohama Houyuu Hospital, Kanagawa and [8]Tokyo Metropolitan Institute of Gerontology, Tokyo, Japan

Correspondence: Prof Haruyasu Yamaguchi MD PhD, 3-39-15 Showa-machi, Maebashi, 371-8514, Japan. Email: yamaguti@health.gunma-u.ac.jp

Received 22 March 2011; accepted 22 May 2011.

Abstract

Background: In out-patient clinics, having simple procedures to check for signs of dementia is invaluable. In the present study, we evaluated the imitation of hand gestures to detect visuomotor deficits in dementia in clinical practice.

Methods: In all, 1219 subjects were enrolled in the present study, including 497 with Alzheimer's disease (AD), 98 with dementia with Lewy bodies (DLB), 71 with other types of dementia diseases, 175 with a Clinical Dementia Rating (CDR) of 0.5, and 378 normal controls. All subjects were aged 65 years or older. Subjects were recruited from 10 clinics and two communities. Visuomotor function was evaluated by the Yamaguchi fox–pigeon imitation test (YFPIT), which consists of a simple one-handed sign for 'fox' and a complex two-handed sign for 'pigeon', a rapid, game-like test with low psychological burden.

Results: The success rate (successful/total) for imitating the 'pigeon' hand gesture was reduced as the severity of the dementia increased: 85.7% in normal controls, 60.6% in CDR 0.5 (mild cognitive impairment), 39.2% in CDR 1 (mild dementia), 21.2% in CDR 2 (moderate dementia), and 5.7% in CDR 3 (severe dementia). The success rate for imitating the 'pigeon' hand gesture was higher in patients with DLB than AD within the CDR 1 group (51.2% *vs* 35.4%, respectively), but lower for patients with DLB than AD within the CDR 2 group (12.5% *vs* 24.4%, respectively). The success of imitating the hand gesture for 'fox' was similar for patients with AD and DLB. Of those subjects who failed to imitate the hand gesture for 'pigeon', 49.5% of those with AD showed the palm–palm pattern (both palms facing outward), suggesting deficits of perspective conversion from the first-person to the third-person. Conversely, 52.8% of patients with DLB showed a dorsum–dorsum pattern (both dorsa facing outwards), suggesting deterioration of visual attention and recognition.

Conclusion: In conclusion, the YFPIT is a useful test to detect visuomotor deficits in dementia that can differentiate between AD and DLB.

Key words: *Alzheimer's disease, dementia, dementia with Lewy bodies, hand gesture imitation, perspective taking, visuomotor deficit.*

INTRODUCTION

We have proposed a hand gesture imitation test, the Yamaguchi fox–pigeon imitation test (YFPIT), which consists of a simple one-handed sign for 'fox' and a complex two-handed sign for 'pigeon', as a rapid, game-like test for dementia/Alzheimer's disease (AD) that has a low psychological burden.[1] The aim of the YFPIT is to examine the representation of the body state and visuomotor function, which deteriorate from the early stages of AD. Before the onset of clinical symptoms, the bilateral parietal lobes are affected with AD-related pathology, showing hypoperfusion as a characteristic finding on single photon emission computed tomography (SPECT).[2] Therefore, clarification of deficits in gesture imitation, which requires parietal function, is useful for understanding disease presentation. Gestures can be categorized into meaningless non-symbolic and semantic/symbolic gestures. It has been reported that the recognition and execution of meaningless gestures, such as body posture, are affected by parietal lobe deficits, whereas semantic recognition and execution are related to temporal function.[3] Thus, to eliminate semantic components, we adopted meaningless non-symbolic gestures in the YFPIT; it is important that the examiner should conduct the YFPIT without saying anything that would stimulate semantic ideas regarding the gestures. The YFPIT is very easy, requiring only 1 min to perform, and is an enjoyable game-like test with a low psychological burden on patients.[1] Moreover, the outcomes of the YFPIT provide information as to the difficulties patients may face in everyday life, because the visuomotor function concerning representation of the body state is important in daily living.

Because our previous report involved only one clinical site,[1] we conducted the YFPIT in a larger-scale study involving 1219 patients at 10 clinical sites to confirm its validity and found that it could differentiate between AD and dementia with Lewy bodies (DLB).

METHODS

As part of the present study, the YFPIT was applied to 1219 subjects. In all, 1041 subjects were recruited from nine clinics in the Kanto area (Gunma, Tokyo, and Kanagawa Prefectures) and from one clinic in the Tohoku area (Iwate Prefecture). In addition, 178 normal controls (NC) were recruited from community dwellers in two cities in Gunma Prefecture. The Ethics Board of each of the participating sites approved all study procedures (e.g. Gunma University, no. 21–26), and written informed consent was obtained from the participants or their proxies. Subjects were diagnosed by specialists of dementia medicine based on current criteria for dementia diseases, such as the National Institute of Neurological and Communicative Disorders and Stroke and the Alzheimer's Disease and Related Disorders Association (NINCDS-ADRDA) diagnostic criteria for AD[4] and the third report of the DLB Consortium.[5] Normal controls were confirmed to be free of dementia by interviews conducted by doctors specializing in dementia. The inclusion criterion was age ≥65 years. Exclusion criteria included the presence of psychiatric diseases, delirium, verbal incomprehension including aphasia, an inability to walk, and motor deficits, such as paralysis. We recruited 378 NC, 175 patients with mild cognitive impairments (MCI), and 666 subjects with dementia (497 AD, 98 DLB, 30 with frontotemporal dementia, 22 with vascular dementia, and 19 with other types of dementia) to the present study.

In the present study, subjects were classified according to the Clinical Dementia Rating (CDR). Patients with a CDR of 0.5 were defined as having MCI, although different classifications have been proposed whereby CDR 0.5 encompasses both mild and earlier dementia[6] or it corresponds to very mild dementia.[7]

The mean (± SD) age of subjects in the present study was 77.7 ± 7.4 years, and there were no significant differences in age or gender among the patient groups. The level of education (11.1 ± 3.6 years in education) did not differ significantly between patient groups.

The YFPIT requires subjects to imitate the hand gesture for 'fox' (Fig. 1a) contiguous with the hand gesture for 'pigeon' (Fig. 1b). The precise protocol for the YFPIT is as follows:[1]

1. The examiner sits face-to-face with the subject.
2. The examiner gives the simple instruction. 'Watch my hand gesture carefully and imitate it'. The instruction can be repeated if necessary.
3. Then, the examiner makes the sign for 'fox' using his/her left hand: fingers III and IV touching the thumb on flexion of the metacarpophalangeal joints with fingers II and V held up (Fig. 1a).
4. The examiner maintains the gesture for 10 s. The subject imitates the gesture concurrently with the examiner. The examiner says nothing during the 10 s of the test. The examiner must be careful not to say the word 'fox' or to give any further instructions.
5. The examiner judges whether the subject has produced the same sign within 10 s of demonstration; the subject may use either hand.
6. The examiner then gives the same instruction, 'Watch my hand gesture carefully and imitate it', but this time makes the sign for 'pigeon' using both hands: crossing the hands, palms facing the body, with fingers II–IV extended upward and the two thumbs crossing each other (Fig. 1b).
7. The examiner maintains the gesture without saying anything, especially the word 'pigeon' and/or

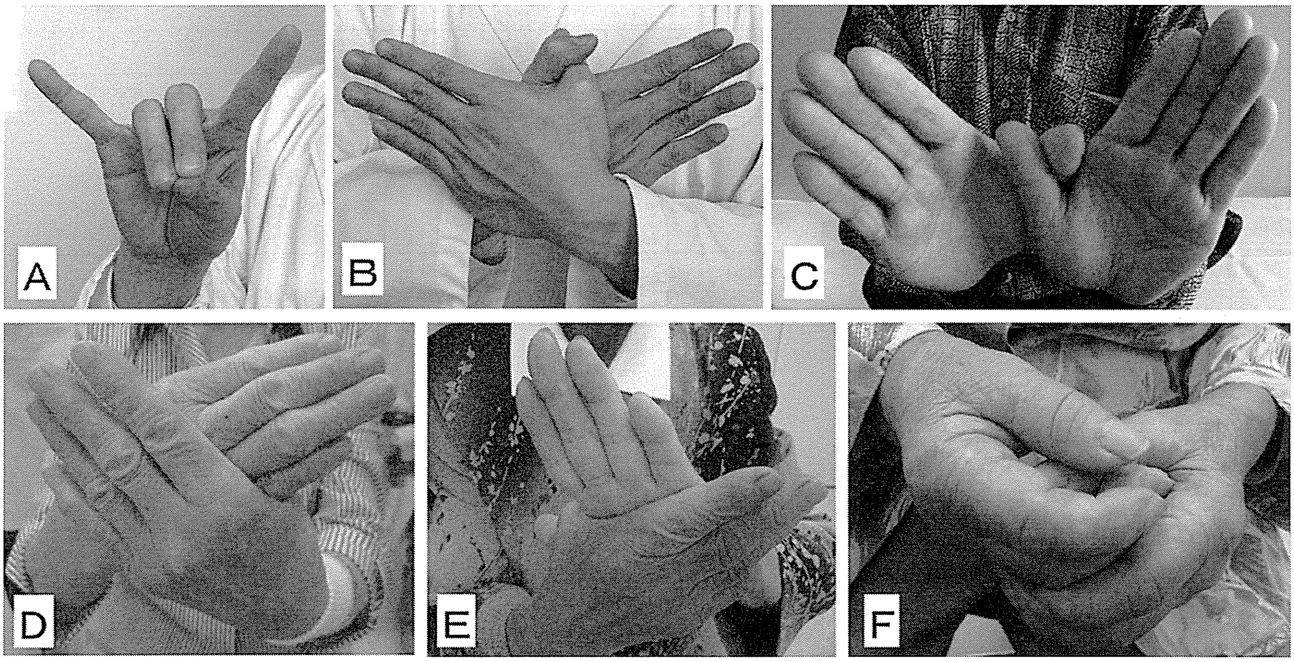

Figure 1 Demonstration by the examiner of the (a) 'fox' and (b) 'pigeon hand gestures. (c–f) Typical error patterns: palm–palm (c), dorsum–dorsum (d), palm–dorsum (e) and 'others' (f).

repeating the instructions, during the 10 s of the test.

8. The examiner then judges whether the subject has made the same sign within 10 s of demonstration

The following aspects of the 'pigeon' hand gesture need to be evaluated: (i) the direction of the arm and fingers II–V should be upward: hand positions in horizontal or downward directions are judged as failures; (ii) gestures made with the right hand in the inward position and the left hand in the outward position or vice versa are both correct; (iii) both palms should be facing the body; and (iv) the thumbs should be crossing each other.

For qualitative analysis, we categorized four error patterns of the 'pigeon' hand gesture based on the direction of the hands: (i) a palm–palm pattern, with both palms facing outward (Fig. 1c); (ii) a dorsum–dorsum pattern, in which both dorsa face outward (Fig. 1d); (iii) a palm–dorsum pattern, in which one palm and one dorsum face outward (Fig. 1e); and (iv) other patterns (Fig. 1f). Error pattern analysis of the 'pigeon' hand gesture was conducted on patients classified as CDR 1 and CDR 2, because most of patients classified as CDR 3 completely failed to imitate the gestures (e.g. Fig. 1f). The rate of each error pattern (no. each error/total errors) was compared between AD and DLB patients.

RESULTS

The success rate (no. subjects who successfully imitated the hand gestures/total no. subjects) of the YFPIT for all participants is given in Table 1 and Fig. 2. Imitating the 'pigeon' hand gesture was much more difficult than imitating the hand gesture for 'fox', and the success rate for imitating the 'pigeon' hand gesture decreased according with increasing CDR stage from 85.7% in NC, 60.6% in CDR 0.5, 39.2% in CDR 1, and 21.2% in CDR 2 to 5.7% in CDR 3. Participants from one site in the Tohoku area classified as CDR 1 and CDR 2 exhibited greater success in imitating the hand gestures; thus, the success rate for participants from the Tohoku area is shown separately from that in other sites in the Kanto area in Fig. S1, available as an accessory publication to this paper.

Comparing results for AD and DLB patients, the success rate for imitating the sign for 'pigeon' was higher for patients with DLB than AD rated as CDR 1 (51.2% *vs* 35.4%, respectively), but lower for patients

Table 1 Success rate of hand gesture imitation

	CDR	*n*	'Fox' (all)	'Pigeon' All	'Pigeon' AD	'Pigeon' DLB	'Pigeon' Other type of dementia
NC	0	378	99.2 (375)	85.7 (324)			
MCI	0.5	175	93.7 (164)	60.6 (106)			
Mild dementia	1	334	86.2 (288)	39.2 (131)	35.4 (90/254)	51.2 (22/43)	51.4 (19/37)
Moderate dementia	2	227	76.7 (174)	21.2 (48)	24.4 (40/167)	12.5 (5/40)	13.0 (3/23)
Severe dementia	3	105	55.2 (58)	5.7 (6)	7.6 (6/79)	0.0 (0/15)	0.0 (011)

Data show the percentage in each group, with the actual number of subjects given in parentheses.
NC, normal controls; MCI, mild cognitive impairment; CDR, Clinical Dementia Rating; AD, Alzheimer's disease; DLB, Dementia with Lewy bodies.

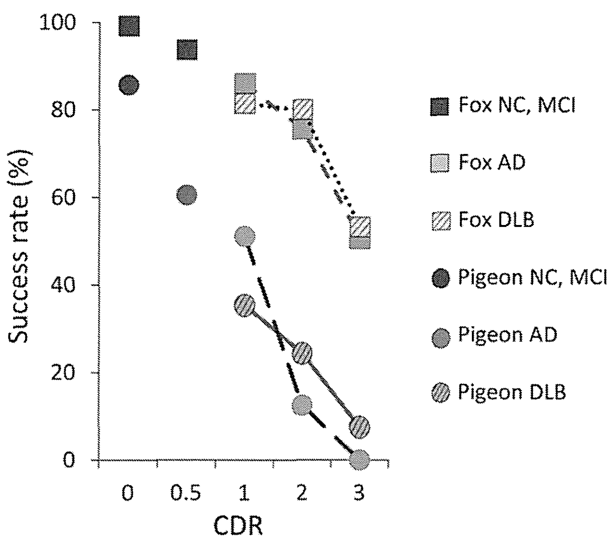

Figure 2 Success rate for the imitation of the 'fox' and 'pigeon' hand gestures in different patient groups and with different Clinical Dementia Rating (CDR) scores. NC, normal control; AD, Alzheimer's disease; DLB, dementia with Lewy bodies; MCI, mild cognitive impairment.

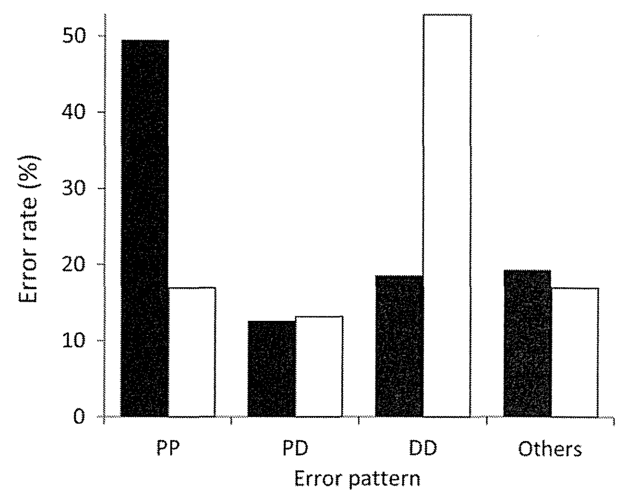

Figure 3 Comparison of the rate of different error patterns for the imitation of the 'pigeon' hand gesture among 285 errors made by patients with Alzheimer's disease (■) and 53 errors made by patients with dementia with Lewy bodies (□). PP, palm–palm pattern; PD, palm–dorsum pattern; DD, dorsum–dorsum pattern. The figure shows the ratio of each error pattern (errors/total errors) for patients with AD or DLB rated as Clinical Dementia Rating (CDR) 1 and 2.

with DLB than AD rated as CDR 2 (12.5% *vs* 24.4%, respectively). However, the success rate for imitating the sign for 'fox' was almost the same between the AD and DLB patient groups.

In patients who failed to imitate the sign for 'pigeon', the rate of each type of error pattern was compared between 285 AD and 53 DLB patients (from a total of 418 AD and 83 DLB patients in the CDR 1 and CDR 2 groups; Fig. 3). Approximately half the errors (141/285; 49.5%) made by AD patients were of the palm–palm pattern (both palms outward), suggesting deficits of perspective conversion from the first-person to the third-person. In contrast, only 17.0% of errors (9/53) made by DLB were of this pattern. Approximately half the errors (28/53; 52.8%) made by DLB patients were of the dorsum–dorsum pattern (both dorsa outward), compared with only 18.6% (53/285) of this type of error in the AD group. The palm–dorsum pattern accounted for 12.6% (36/285) of errors made by the AD patients and for 13.2% (7/53) of errors made by DLB patients.

DISCUSSION

The rate of successfully imitating the 'pigeon' hand gesture decreased with increasing CDR stage. This shows that the YFPIT is useful for the detection of deficits in hand gesture imitation in patients with dementia, confirming previous findings.[1] Furthermore, we were able to identify differences between AD and DLB on the basis of YFPIT results.

Gesture imitation starts with a recognition of another's actions and then requires perspective conversion to match one's own actions with those of the other. We perceive a visual scene from our own perspective (first-person perspective), but successful imitation of the 'pigeon' hand gesture requires viewing the same scene from another person's perspective (the third-person perspective).[8] Patients with AD may have difficulties in converting perspective, which is a function related to the parietal lobes.[9] Previous imaging studies have reported that the third-person perspective recruits the bilateral parietal area more intensely than the first-person perspective;[10] a significant reduction in regional cerebral blood flow has been reported in the bilateral parietal area in the early stages of AD.[2] In the present study, almost half the errors made by AD patients consisted of the palm–palm pattern, whereas this pattern accounted for <20% of the errors made by patients with DLB. As mentioned above, the palm–palm pattern may be related to deficits in conversion of perspective, because the subjects see the dorsum of both the examiner and themselves. Most patients showing a palm–palm pattern did not notice their errors because they may have lost the concept of conversion of perspective.

Patients with DLB may have difficulties in action recognition,[11] which is related to the visual association cortex. Previous imaging studies have shown significant reductions in glucose metabolism in the visual association cortex of patients with DLB compared with patients with AD.[12] More than half the patients with DLB made the dorsum–dorsum error pattern, whereas this type of error accounted for <20% of the errors made by AD patients. With the dorsum–dorsum pattern, the conversion of perspective is retained but visual recognition deteriorates. Disturbed attention may be at the core of the defects in visual recognition in DLB patients, to divide and shift attention among relevant factors, ignoring irrelevant distractors.[13] In the present study, the DLB patients had a tendency to focus their visual attention on certain specific parts of the gesture, failing to perceive the overall gesture (e.g. crossing the hand or only clinging to the thumb). Then, they tried to shift their attention to another part of the gesture in vain. As such, disturbed attention in DLB patients led to difficulties using visual information to coordinate hand movements.

Simple one-handed gesture imitation was preserved until the late stages of dementia. Successful imitation of the 'fox' hand gesture means that most demented patients understand verbal commands and that failure imitating the 'pigeon' hand gesture is not due to disturbed verbal comprehension. Imitation of the gesture requiring bimanual coordination deteriorated from the mild stages of dementia, especially in AD. In DLB, the visuomotor function was relatively preserved until the mild stage of CDR 1, but function was clearly deteriorated at the moderate stage of CDR 2.

Regarding the success rate of imitating the 'pigeon' gesture, regional differences were observed, which went against our hypothesis. Subjects from one site in the Tohoku area were more successful in imitating the 'pigeon' hand gesture than subjects from other sites, as well as compared with subjects evaluated in a previous study.[1] The Tohoku area is located in the northern part of Japan, where population mobility is low especially in agrarian communities. According to their doctors' observations, the patients who succeeded in imitating the 'pigeon' hand gesture were more likely to have engaged in 'shadow play' as children using hand gestures for 'fox' and 'pigeon'. Thus, these subjects may be using procedural memories, which are preserved long after the deterioration of episodic memories. Thus, we should carefully analyze patients with these sorts of childhood experiences of hand play.

On the first visit to an outpatient clinic, a brief assessment is required for the approximate examination of patients. Easy and simple visuomotor assessment using the YFPIT may assist in detecting visuomotor deficits in dementia, as well as distinguishing between AD and DLB.[14] In this respect, the YFPIT is useful as a pretest before further detailed investigation of a patient's cognitive function.

ACKNOWLEDGMENTS

This work was conducted without funding. However, H.Y. is supported by a Grant-in-Aid for Scientific Research from the Ministry of Education, Science, Sports, Culture and Technology, Japan (22650123), a Research Grant for Longevity Sciences (21A-12) and a Grant-in-Aid for Scientific Research (H22-Ninchisho-Ippan-004), both from the Ministry of Health, Labor and Welfare of Japan.

REFERENCES

1 Yamaguchi H, Maki Y, Yamagami T. Yamaguchi fox–pigeon imitation test: A rapid test for dementia. *Dement Geriatr Cogn Disord* 2010; **29**: 254–258.

2 Matsuda H. Role of neuroimaging in Alzheimer's disease, with emphasis on brain perfusion SPECT. *J Nucl Med* 2007; **48**: 1289–1300.

3 Freund HJ. Somatosensory and motor disturbances in patients with parietal lobe lesions. *Adv Neurol* 2003; **93**: 179–193.

4 Dubois B, Feldman HH, Jacova C *et al*. Research criteria for the diagnosis of Alzheimer's disease: Revising the NINCDS-ADRDA criteria. *Lancet Neurol* 2007; **6**: 734–746.

5 McKeith IG, Dickson DW, Lowe J *et al*. Consortium on DLB: Diagnosis and management of dementia with Lewy bodies. Third report of the DLB Consortium. *Neurology* 2005; **65**: 1863–1872.

6 Reisberg B, Ferris SH, Kluger A *et al*. Mild cognitive impairment (MCI): A historical perspective. *Int Psychogeriatr* 2008; **20**: 18–31.

7 Grundman M, Petersen RC, Ferris SH *et al*. Alzheimer's Disease Cooperative Study: Mild cognitive impairment can be distinguished from Alzheimer disease and normal aging for clinical trials. *Arch Neurol* 2004; **61**: 59–66.

8 Vogeley K, Fink GR. Neural correlates of the first-person-perspective. *Trends Cogn Sci* 2003; **7**: 38–42.

9 Freund HJ. The parietal lobe as a sensorimotor interface: A perspective from clinical and neuroimaging data. *NeuroImage* 2001; **14**: S142–S146.

10 David N, Bewernick BH, Cohen MX. Neural representations of self versus other: Visual-spatial perspective taking and agency in a virtual ball-tossing game. *J Cogn Neurosci* 2006; **18**: 898–910.

11 Gnanalingham KK, Byrne EJ, Thornton A. Clock-face drawing to differentiate Lewy body and Alzheimer type dementia syndromes. *Lancet* 1996; **347**: 696–697.

12 Ishii K, Imamura T, Sasaki M *et al*. Regional cerebral glucose metabolism in dementia with Lewy bodies and Alzheimer's disease. *Neurology* 1998; **51**: 125–130.

13 Bradshaw JM, Saling M, Anderson V *et al*. Higher cortical deficits influence attentional processing in dementia with Lewy bodies, relative to patients with dementia of the Alzheimer's type and controls. *J Neurol Neurosurg Psychiatry* 2006; **77**: 1129–1135.

14 Tiraboschi P, Salmon DP, Hansen LA *et al*. What best differentiates Lewy body from Alzheimer's disease in early-stage dementia? *Brain* 2006; **129**: 729–735.

SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article:

Figure S1 Comparison of success rates for imitation of the 'pigeon' hand gesture between are Kanto areas (nine sites) and the Tohoku area (one site). The success rate for imitating the 'pigeon' hand gesture in the Kanto and Tohoku areas was 59.2% *vs* 64.0%, respectively, for patients classified as Clinical Dementia Rating (CDR) 0.5; 34.4% *vs* 53.6%, respectively, for patients classified as CDR 1; 16.8% *vs* 35.2%, respectively, for patients classified as CDR; and 7.1% *vs* 0%, respectively, for patients classified as CDR 3.

Please note: Wiley-Blackwell are not responsible for the content or functionality of any supporting materials supplied by the authors. Any queries (other than missing material) should be directed to the corresponding author for the article.