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Communicative Competence in Alzheimer's Disease: Metaphor and Sarcasm Comprehension

Yohko Maki, PhD[1,2], Tomoharu Yamaguchi, MA[1,3], Tatsuya Koeda, MD, PhD[4], and Haruyasu Yamaguchi, MD, PhD[1]

Abstract

The purpose of this study was to evaluate the deficits of metaphor and sarcasm comprehension in Alzheimer's disease (AD), as pragmatic interpretation such as metaphor and sarcasm comprehension is required in social communication. A total of 31 young normal controls, 104 aged normal controls (ANC), 42 patients with amnesic mild cognitive impairment (aMCI), and 30 patients with mild AD were evaluated by Metaphoric and Sarcastic Scenario Test, which consists of 5 metaphoric and 5 sarcastic questions with 5 answer choices. Scores were analyzed using the repeated measures analysis of variance (metaphor/sarcasm vs 4 participant groups). Sarcasm comprehension, which requires second-order Theory of Mind (ToM), started to deteriorate in ANC, and metaphor comprehension, which requires first-order ToM, started to deteriorate in aMCI, and both deteriorated as disease progressed. Literal interpretation of pragmatic language is characteristic in patients with mild AD. Such misinterpretation would result in social miscommunication, even if they still retained semantic-lexical competence.

Keywords

Alzheimer's disease, theory of mind, empathy, communication difficulties, pragmatic competence

Introduction

Communicative competence occupies a central place in participation in social activities and it can be impaired in patients with Alzheimer's disease (AD). In AD, lexical-semantic competence is deteriorated as a result of cognitive decline.[1] However, patients could also have communicative difficulties even from the stage where lexical-semantic competence is still preserved. In social communication, literal lexical-semantic comprehension is not sufficient.[2] Comprehension of nonliteral implication is often required to infer a speaker's intended meaning (Theory of Mind [ToM]),[3] which is not always expressed explicitly.

Theory of Mind is considered to consist of 2 stages, first-order ToM is the ability to grasp the intentions of the speaker and second-order ToM is the ability to infer the speakers' evaluation for an attributed thought.[4-7] Metaphor and sarcasm comprehension are considered to be appropriate materials of ToM.[8] First-order ToM is sufficient for metaphor comprehension.[9] Metaphor suggests meanings through mental linkage and comparison of similarities between different expressions normally not related to each other.[10,11] Second-order ToM is required for sarcasm comprehension.[5] Sarcasm expresses something other than explicitly stated and especially the opposite of the literal meaning of the utterance.[12] Thus comprehension of sarcasm requires the ability to reflect on the speakers' evaluation about the attributed thought, adding to utterance intention.[4]

Metaphoric and sarcastic competence has been mainly studied to evaluate the social communicative competence in the phases of development and its disorders,[13] as interaction with other people is critical for normal neurocognitive development.[14] In the phase of aging and degeneration, it is also meaningful to evaluate the decline of social communicative competence. However, a recent review on nonliteral language in AD noted a severe lack of evidence.[15] Furthermore, previous reports on metaphor and sarcasm comprehension are inconsistent; for example, deficits in metaphor comprehension were reported from early stages of AD,[16-18] whereas concerning irony and sarcasm, previous studies did not find a significant impairment relative to an aged control group,[19,20] which is surprising because irony involves more cognitive processes than metaphor.[21]

[1] Gunma University Graduate School of Health Sciences
[2] Geriatrics Research Institute and Hospital, Gunma, Japan
[3] Department of Rehabilitation, Gunma University of Health and Welfare, Gunma, Japan
[4] Department of Humanity Education, Faculty of Education and Regional Sciences, Tottori University, Tottori, Japan

Corresponding Author:
Haruyasu Yamaguchi, MD, PhD, Gunma University School of Health Sciences, 3-39-15 Showa-machi, Maebashi, 371-8514 Gunma, Japan
Email: yamaguti@health.gunma-u.ac.jp

The controversy could be partly due to the material in the test; it is a prerequisite that difficulty level of lexical-semantic aspects is even among sentences used in the tests. Thus, we conducted the present study to evaluate the deficits of metaphor and sarcasm in AD using a questionnaire that consists of the same type of sentences with similar difficulty levels and whose efficacy was validated for differential diagnosis of developmental disorders in children.[22] For a better understanding of characteristics of AD, error patterns were analyzed. We hypothesized that comprehension might be deteriorated at the early stages of disease and sarcasm comprehension might be deteriorated earlier than metaphor comprehension.

Methods

Participant

The participants were 31 young normal controls (YNC), 104 aged normal controls (ANC), 42 patients with amnesic mild cognitive impairment (aMCI), and 30 patients with mild AD in Clinical Dementia Rating scale (CDR) 1. The YNC were university students and ANC were recruited from community dwellers, who underwent clinical interviews by a clinician who specialized in evaluation of dementia. Patients were recruited from the outpatient clinics. The exclusion criteria were psychiatric diseases and delirium. Verbal incomprehension was also an exclusion criterion. The participants were required to read out the questions and those who lacked fluency were excluded. Concerning language ability, the participants received the Mini-Mental State Examination (MMSE) and were confirmed to have the capacity to name simple objects, repeat phrases, follow written commands, and write a sentence with a noun and a verb. The participants were diagnosed based on the criteria for AD by National Institute of Neurological and Communicative Disorders and Stroke-Alzheimer's Disease and Related Disorders Association[23] and on the criteria for aMCI by the report of the International Working Group on Mild Cognitive Impairment.[24] Patients with aMCI were limited to those free from objective symptoms of other types of dementia such as dementia with Lewy bodies or frontotemporal dementia. The Ethics Board of the Gunma University School of Health Sciences approved all procedures (No. 21-26), and written informed consent was obtained from all the participants.

Task

Metaphor and sarcasm comprehension was evaluated by the Metaphoric and Sarcastic Scenario Test (MSST), which was developed for discrimination of high functioning pervasive developmental disorders from attention deficit/hyperactivity disorders in young children.[22] This test consists of 5 metaphoric and 5 sarcastic sentences; metaphoric sentences are odd numbered and sarcastic sentences even. The words and sentences in MSST were selected from standard textbooks of Japanese language (Mitsumura Press) for 1st, 2nd, and 3rd grades in elementary school. Therefore, the lexical-semantic components were not above the levels for those who completed 6 years of elementary school education. The test employed a multiple-choice style, that is, 1 choice was correct and 4 were incorrect. The wrong choices included a literal interpretation, an answer associated with part of the sentence, misunderstanding of the sentence, and not knowing. The number of correct answers represented the metaphor score and sarcasm score, respectively. Each pattern of incorrect answers was totaled. Cognitive performance was assessed using MMSE.

Analysis

Group comparison of scores and the 4 error scores were conducted using the repeated measures analysis of variance (metaphor/sarcasm vs 4 participant groups).

Among aged groups, we conducted the repeated measures analysis of covariance (metaphor/sarcasm vs 3 participant groups) with covariates of age, sex, education, and MMSE scores. A post hoc test was conducted with multiple comparisons with Bonferroni correction. All analyses were conducted using the Japanese version of SPSS for Windows version 19.0 (IBM Corporation, New York). Significance was set as $P < .05$.

Results

Demographic scores are shown in Table 1. The results of the MSST are shown in Table 2 and Figure 1. The main effect indicated that sarcasm was more difficult to comprehend than metaphor ($F_{1,203} = 54.634$, $P < .001$), and interaction with participant groups was also significant ($F_{3,203} = 3.354$, $P = .020$). According to within-subject post hoc analysis, no significant difference was observed between metaphor and sarcasm scores in YNC ($P = .442$), whereas in ANC, aMCI, and mild AD, scores of sarcasm was significantly lower than that of metaphor ($P < .001$ in all the groups). According to between-subject post hoc analysis, metaphor scores were not different between YNC and ANC, whereas metaphor scores were significantly better in ANC than in aMCI ($P = .011$) and in aMCI than mild AD ($P < .001$). Sarcasm scores were significantly better in YNC than in ANC ($P = .040$), in ANC than in aMCI ($P = .005$), and in aMCI than in mild AD ($P = .002$).

Concerning the error patterns, group differences were observed only in literal interpretation and there were no group differences in the other 3 error patterns (an answer associated with a part of the sentence, misunderstanding of the sentence, and not knowing; Table 3, Figure 2). The main effect was significant ($F_{1,203} = 34.283$, $P < .001$) and interaction was also significant ($F_{3,203} = 6.887$, $P < .001$). According to the between-subject post hoc analysis, errors of literal interpretation of metaphor and sarcasm comprehension were not different between YNC and ANC ($P = 1.000$ in both), and ANC and aMCI ($P = .115$, $P = .349$, respectively), whereas a significant difference was observed between aMCI and mild AD ($P < .001$ in both). According to within-subject post hoc analysis, the errors of literal interpretation were more in sarcasm than in metaphor in aMCI ($P = .038$) and in mild AD ($P < .001$), whereas there was no significant difference in YNC ($P = .187$) and in ANC ($P = .072$).

Table 1. Demographic Data[a]

	n	Age Mean ± SD	Gender Male, Female	Education Mean ± SD	MMSE Mean ± SD
YNC	31	19.3 ± 1.4	M10, F21	13.3 ± 0.6	
ANC	104	72.1 ± 4.2	M25, F79	12.0 ± 2.3	28.4 ± 1.4
aMCI	42	74.0 ± 5.4	M18, F24	11.1 ± 3.0	25.8 ± 1.7
AD	30	78.0 ± 7.2	M6, F24	9.3 ± 2.3	21.4 ±4.0

Abbreviations: YNC, young normal controls; ANC, aged normal controls; aMCI, amnestic mild cognitive impairment; AD, patients with mild Alzheimer's disease in clinical dementia rating 1; MMSE, Mini-Mental State Examination; SD, standard deviation.

[a] The rate of gender difference was not different among the groups ($P = .088$, chi-squared statistic). Concerning age, there was no difference between ANC and aMCI, but patients with mild AD were significantly older than ANC and aMCI ($P < .001$, $P = .004$, respectively). Concerning years of education, there was not difference between ANC and aMCI, but patients with mild AD received significantly shorter education than the patients with ANC and aMCI did ($P < .001$, $P = .006$, respectively). Scores of MMSE was significantly different among groups ($P < .001$, among all the groups).

Table 2. Correct Answers

	Metaphor Mean ± SD	Metaphor P Value[a]	Sarcasm Mean ± SD	Sarcasm P Value[a]	P Value[b]
YNC	5.0 ± 0.2		4.8 ± 0.4		.442
YNC vs ANC		1.000		.040*	
ANC	4.8 ± 0.7		4.1 ± 1.2		<.001**
ANC vs aMCI		.011*		.005*	
aMCI	4.3 ± 1.2		3.4 ± 1.3		<.001**
aMCI vs AD		<.001**		.002*	
AD	3.3 ± 1.2		2.3 ± 1.6		<.001**

Abbreviations: YNC, young normal controls; ANC, aged normal controls; aMCI, amnestic mild cognitive impairment; AD, patients with mild Alzheimer's disease in clinical dementia rating 1; SD, standard deviation.

[a] The difference among groups analyzed by between-subject post hoc analysis of 2 × 4 analysis of variance (metaphor and sarcasm; 4 groups).

[b] The difference between metaphor and sarcasm analyzed by within-subject post hoc analysis of 2 × 4 analysis of variance (metaphor and sarcasm; 4 groups).

* $P < .05$.

** $P < .001$.

There was weak correlation between MMSE scores and metaphor ($r = .362$ $P < .001$) and sarcasm scores ($r = .337$, $P < .001$).

The difference among the aged groups of ANC, aMCI, and mild AD remained by the repeated measures analysis of covariance with covariates of age, sex, education, and MMSE scores. According to within-subject post hoc analysis, in ANC, aMCI, and mild AD, scores of sarcasm was significantly lower than that of metaphor ($P < .001$, $P < .001$, $P = .004$, respectively). According to between-subject post hoc analysis, metaphor scores were significantly better in ANC than in aMCI ($P = .040$) and in aMCI than mild AD ($P = .002$). Sarcasm comprehension was significantly better in ANC than in aMCI ($P = .021$) and in aMCI than in mild AD ($P = .023$).

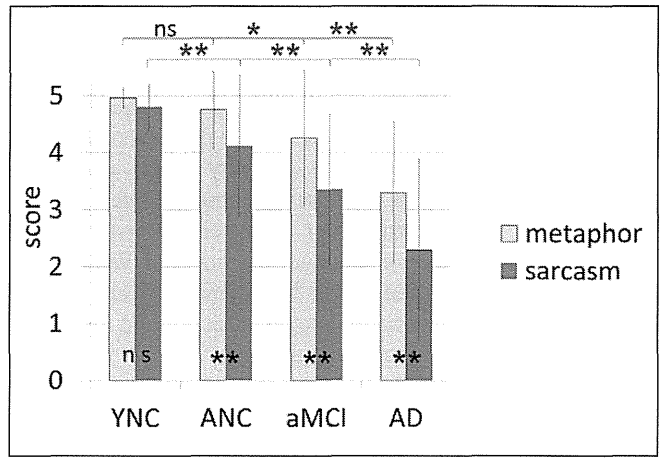

Figure 1. Scores of correct answers. Sarcasm scores were significantly lower in ANC than YNC, whereas metaphor scores were not different between the 2 groups. Metaphor scores were deteriorated from MCI. Post hoc analysis of 2 × 4 analysis of variance (metaphor and sarcasm; 4 groups) was conducted; * in upper row indicates statistical significance of between subject analysis of metaphor, * in middle row indicates that of sarcasm, and * in the bottom row indicates statistical significance calculated by intrasubject analysis. *$P < .05$, $P < .001$. YNC indicates young normal controls; ANC, aged normal controls; aMCI, amnestic mild cognitive impairment; AD, patients with mild Alzheimer's disease in clinical dementia rating 1.

Table 3. Errors of Literal Answers

	Metaphor Mean ± SD	Metaphor P Value[a]	Sarcasm Mean ± SD	Sarcasm P Value[a]	P Value[b]
YNC	0.00 ± 0.00		0.19 ± 0.40		.187
YNC vs ANC		1.000		1.000	
ANC	0.05 ± 0.21		0.19 ± 0.44		.072
ANC vs aMCI		.115		.349	
aMCI	0.21 ± 0.47		0.48 ± 0.77		.038*
aMCI vs AD		<.001**		<.001**	
AD	0.87 ± 0.82		1.77 ± 1.72		<.001**

Abbreviations: YNC, young normal controls; ANC, aged normal controls; aMCI, amnestic mild cognitive impairment; AD, patients with mild Alzheimer's disease in clinical dementia rating 1; SD, standard deviation.

[a] The difference among groups analyzed by between-subject post hoc analysis of 2 × 4 analysis of variance (metaphor and sarcasm; 4 groups).

[b] The difference between metaphor and sarcasm analyzed by within-subject post hoc analysis of 2 × 4 analysis of variance (metaphor and sarcasm; 4 groups).

* $P < .05$.

** $P < .001$.

Discussion

Scores for both metaphor and sarcasm were not significantly different from each other in YNC, which confirmed that the difficulty level of metaphor and sarcasm comprehension tested by MSST was not different, at least among young participants.

The result suggested that deterioration of sarcasm comprehension was an age-related change. Sarcasm scores were

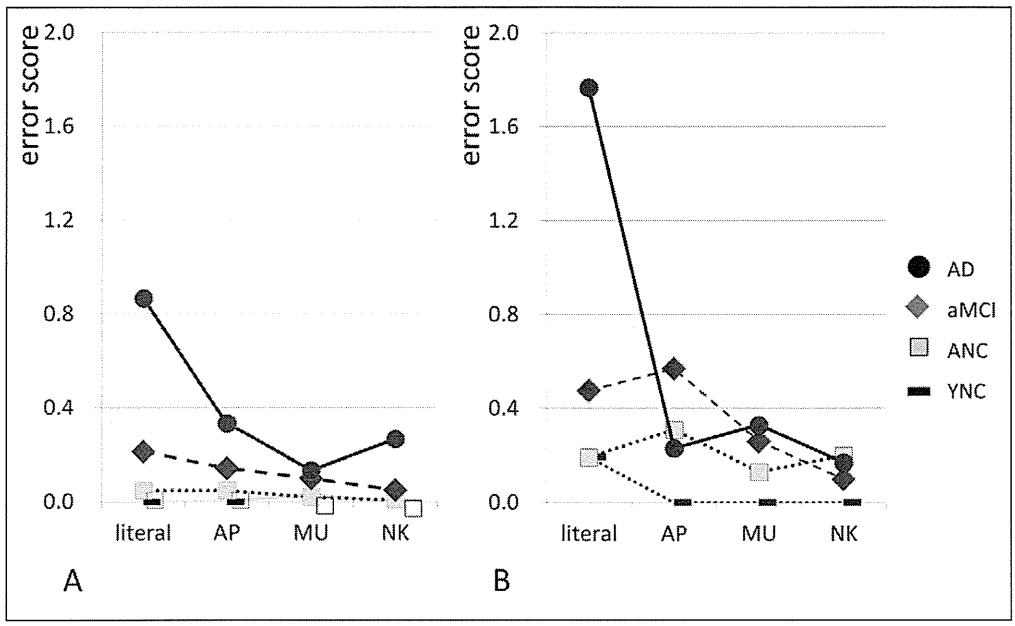

Figure 2. Error patterns. Error patterns of metaphor (A) and sarcasm (B). Significant differences among groups were observed in literal errors in both metaphor and sarcasm and the other 4 patterns of error were not significantly different among groups. AD indicates patients with mild Alzheimer's disease in clinical dementia rating 1; aMCI, amnestic mild cognitive impairment; ANC, aged normal controls; YNC, young normal controls; literal, literal interpretation; AP, answers associated with part of the sentence; MU, misunderstanding of the sentence; NK, not knowing.

significantly lower in ANC than in YNC, whereas no difference was observed in metaphor comprehension. Empirical developmental studies of normal children have found that metaphors are comprehended at an earlier age than ironies.[4] One factor critical for understanding verbal irony (sarcasm) is an individual's ability to attribute appropriate second-order ToM.[4] The success of the second-order ToM task emerges at around age 5 or 6[25] and it has been revealed that age-related decline occurred directly in the second-order ToM and indirectly in the first-order ToM.[26] The influence of difference in difficulty level could not be ruled out. Colston and Gibbs have shown that it takes healthy adults longer to read ironic than metaphoric statements, which suggests that irony (sarcasm) processing requires more cognitive load than metaphor processing.[5]

Age-related decline in metaphor comprehension was not shown in the present study. The deterioration was reported in the early stage of AD by a study that did not include the participants with MCI,[16-18] and the present study showed that comprehension begins to decline even during aMCI, the prodromal stage of AD.

Another issue was with the comprehension of conventional metaphor. In the present study, conventional metaphor comprehension was deteriorated as well as nonconventional novel expressions, as shown in previous studies.[16,17] However, Amanzio et al reported the deficits in nonconventional novel metaphors, while no impairment was observed in conventional metaphors.[18] The study assumed that conventional metaphors might be interpreted automatically through frequent usage, whereas novel metaphors recruited ToM processes. However, the patients might tend to avoid complicated pragmatic wording and without usage in everyday speech, conventional metaphors could recruit ToM processes as novel metaphors.

Deficits of AD were characterized by literal interpretation; concerning error patterns, group differences were observed only in the pattern of literal interpretation. Decline of inhibition could be related to choosing literal interpretation. Metaphor and sarcasm comprehension requires contextual coherence judgment, as literal interpretation can be taken out of context. It has been proposed that both the literal and the nonliteral meaning are activated concurrently and the inappropriate meaning is inhibited by the context.[27-31] However, patients with AD had difficulty suppressing inappropriate literal interpretation, which is concurrently activated.[32,33] Literal interpretation of metaphor causes misunderstanding and that of sarcasm could be more problematic. In sarcastic expression, the speakers say the opposite of what they mean[15] and thus the patients with AD may interpret the utterance as admiration, which would be opposite to the speakers' intention. Such misinterpretation would result in social miscommunication.

Miscommunication between patients and caregivers could lead to behavioral and psychological symptoms of dementia (BPSD) in patients and distress in caregivers.[34-37] Therefore, caregivers' understanding of decreased communication abilities in patients may reduce BPSD and caregiver distress.[38,39]

As a limitation, the groups of the present study were not matched for age and education. Based on the results of the present study, further study is required with a larger group of participants for consideration of clinical relevance.

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Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Original Research Article

A Randomized Controlled Trial of Brain-Activating Rehabilitation for Elderly Participants with Dementia in Residential Care Homes

Tetsuya Yamagami[a] Yoshifumi Takayama[b] Yohko Maki[c]
Haruyasu Yamaguchi[c]

[a]School of Health Care, Takasaki University of Health and Welfare, Takasaki,
[b]Wisnet Co., Ltd., Saitama, and [c]Gunma University Graduate School of Health Sciences,
Maebasi, Japan

Key Words
Alzheimer's disease · Brain activity · Dementia care · Non-pharmacological therapies · Randomized clinical trials · Rehabilitation · Reminiscence therapy

Abstract
Background/Aims: We aimed to prove the effectiveness of brain-activating rehabilitation for dementia, which consisted of 5 principles: pleasant atmosphere, communication, praising, social role, and supportive care. ***Methods:*** The design was a randomized controlled trial that was not blinded. Fifty-four elderly participants with dementia (mean age: 85.2 years) were selected. Intervention based on the 5 principles of brain-activating rehabilitation was conducted for 1 h, twice a week, for 12 weeks (24 sessions). The control group had no treatment. Outcome measures consisted of two observation scales, namely sum of boxes in clinical dementia rating (CDR-SB) and the multidimensional observation scale for elderly subjects (MOSES), and two cognitive tests: the Hasegawa dementia scale revised (HDS-R) and trail making test A. ***Results:*** Repeated measure ANCOVA showed a significant interaction for total score of CDR-SB ($F = 7.190$, $p = 0.015$) and MOSES ($F = 4.525$, $p = 0.038$). There were no significant changes in the two cognitive test scores. ***Conclusion:*** Intervention based on the principles of brain-activating rehabilitation was effective in maintaining and improving daily life functions in elderly participants with dementia in residential care homes.

Tetsuya Yamagami
501 Nakaorui-machi
Takasaki, Gunma 370-0033 (Japan)
E-Mail yamagami@takasaki-u.ac.jp

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Introduction

Rehabilitation for dementia, such as reminiscence therapy, reality orientation, cognitive rehabilitation, and physical activity, has an important role in delaying disease progression and functional decline. Studies on rehabilitation for dementia have focused on the differentiation of each technique (e.g. reminiscence therapy, reality orientation) and a comparison of their effects. However, Cochrane reviews on non-pharmacological interventions have highlighted the insufficiency of the available evidence [1–3]. We thought that the principles of intervention are much more important than each technique of intervention because intersubjectivity between participants and therapists/care staff has a much greater influence than each technique used. When the effects of three kinds of interventions, namely group reminiscence therapy, individual reminiscence therapy, and a group games, were compared in residential care homes, group reminiscence therapy improved memory performance and group games improved well-being, whereas individual reminiscence therapy was less effective. These findings suggested that group membership plays an important role in maintaining and promoting health and well-being [4]. We proposed a new principle of rehabilitation for dementia, brain-activating rehabilitation (BAR) [5], which consists of 5 principles: (1) enjoyable and comfortable activities in an accepting atmosphere; (2) activities associated with empathetic two-way communication between staff and participant, as well as between participants; (3) praising participants to enhance motivation; (4) offering social roles to participants that enhance their remaining abilities, and (5) supportive care to prevent failure, which causes confusion of participants. In fact, BAR was conducted as a combination of several techniques (e.g. reminiscence therapy, reality orientation, games, physical activity, crafts, cooking, and singing) to suit the participants based on these 5 principles. BAR was expected to enhance participants' motivation and maximize the use of their remaining functions and prevent the disuse of functions [5]. BAR was expected to enable participants to recover both a desire for life and their self-respect. Enhanced motivation induced by BAR can lead to amelioration of the behavioral and psychological symptoms of dementia and improvements in activities of daily living [6]. Improvements in cognitive function would also be expected through BAR [7].

In this study, we conducted intervention based on the principles of BAR for elderly participants with dementia as a randomized controlled trial to prove the effectiveness of BAR.

Methods

Participants

Fifty-four elderly participants in four residential care homes (group living homes) were selected on the basis of the following criteria: (1) being diagnosed with dementia; (2) without severe auditory and visual impairments, and (3) being able to engage in a simple activity or a brief conversation.

Randomization

At the end of the initial baseline assessment, we randomly divided participants into intervention and control groups in each residential care home, so that each intervention or control group was composed of four small groups. We used stratified randomization according to the Hasegawa dementia scale revised (HDS-R) [8], which is similar to mini-mental state examination (MMSE) and has a total score of 30, to equalize the severity of dementia between the two groups. Finally, 54 participants were randomly allocated to the intervention group (n = 28) or control group (n = 26) (fig. 1).

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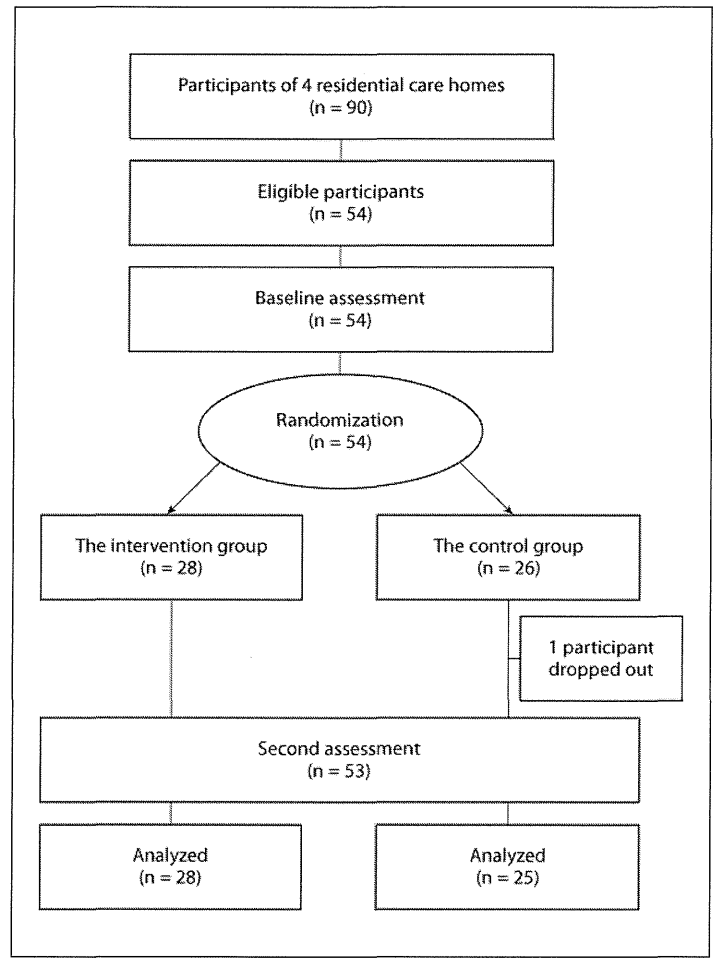

Fig. 1. Participant flow diagram.

Intervention

A total of 24 sessions were conducted in each group for 1 h, twice a week, for a 12-week period. In this study, intervention based on principles of BAR combined reality orientation and various activities (e.g. cooking, singing, and sewing) along with reminiscence therapy. In the baseline assessment, we collected information on life histories and specialties from the participants to select enjoyable topics in the sessions (table 1). The intervention staff consisted of one leader and two vice-leaders for each group. The staff of each residential care home had studied the principles of BAR and specifically learned the guidelines about attitude and communication for 4 h, and they played the roles of leader and vice-leaders by rotation. The researcher contributed to serve the same contents of the sessions for four groups. Throughout the session, staff had to accept and share the world of the participants, regardless of whether it was true or not (the first principle: pleasant atmosphere). At the same time, they organized the participants so that each participant could socially interact with other participants (the second principle: communication). When a participant seemed to make a mistake, or not to understand, staff acted to prevent the mistake (the fifth principle: supportive care). After each session, an evaluation meeting was held to improve the skills of the staff. In total, 41 members of staff were involved in the intervention (mean age: 30 years; duration of work experience: 4.9 years; mean number of sessions: 4.5).

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Table 1. Topics of BAR sessions

Topics	Tools
Cooking rice	rice kettle, furnace, measure, charcoal
Traditional games	beanbag for juggling, cup-and-ball toy, propeller
Pickled vegetables	rice bran, earthenware pot, salt, water
Washing	tub, washing board, washing powder
Sewing duster	cloth, stitch, thread, pincushion
Making rice cakes	mortar, mallet, steam pot, glutinous rice
Rice bran	rice bran, rice bran bag, washbowl
Mortar and pestle	mortar and pestle, taro potato, sesame
Handmade snack	barley flour, rice bowl, spoon
Weaving	silkworm, reel, shuttle
Elementary school	old textbook, pencil, school bag
Making noodles	knead pot, rolling pin, board

In the beginning, the reality orientation method was executed, which provided hints and signs to reconfirm the subjects' orientation in terms of time and date. Then, the reminiscence therapy method was executed. In reminiscence therapy, old-style tools such as a rice kettle, beanbags for juggling, and old textbooks were used, and staff asked the participants about the names of the tools and how to use them. Tools that are familiar to participants provide visual support for enhancing reminiscence. In addition, these tools encompass many activities, from housework to recreation, such as handiwork. These activities using old-style tools recruit procedural memories, which remain after the loss of episodic memory. Therefore, participants gain peace of mind, as they can easily relate to and describe these tools (the fifth principle: supportive care). The participants teach staff how to use these old-style tools. This is role reversal: the participants are teaching the staff who help them in daily living. Through this process, participants were expected to recover their self-confidence and the social function of passing on knowledge to younger generations (the fourth principle: social role). Because of this role reversal, the staff took care to praise the participants naturally (the third principle: praising). Thus, it is expected that participants enjoy the conversations. The control group had no treatment.

Outcome Measures

Care staff who did not participate in the intervention primarily evaluated participants using two observation scales which were primary outcomes: clinical dementia rating (CDR) [9] and multidimensional observation scale for elderly subjects (MOSES) [10]. CDR is reported to have high reliability (internal consistency: 0.68–0.88). Global severity of dementia was evaluated by the sum of boxes in CDR (CDR-SB) [11]. The CDR-SB sums the ratings in each of six domains ('boxes') of CDR to provide a consensus-based global clinical measure. MOSES is reported to have high reliability (internal consistency: 0.78–0.87). The scale is comprised of 40 parameters in 5 categories of daily life functions: (1) self-care; (2) disorientation; (3) depression; (4) irritability, and (5) withdrawal. Each category's score distribution ranges from 8 to 32 points (1 = not at all; 2 = seldom; 3 = at times; 4 = often) with higher scores indicating more severe disorders [10].

The participants underwent two cognitive tests, which are secondary outcomes: HDS-R and trail making test A [12]. HDS-R was performed to assess global cognitive function. HDS-R correlates well with MMSE, and it is more accurate than MMSE in diagnosing Alzheimer's disease [13]. In addition, HDS-R was shown to be more robust to demographic influences

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(age, education level, and gender) than MMSE [14]. Trail making test A was used to evaluate psychomotor speed. Participants were asked to draw a continuous line connecting 25 numbered circles.

After the intervention period, we prepared two questions for staff members: did the participants change after intervention and, if so, how? Did your daily care with the participants change in terms of both physical care and social contact?

Procedure

This study was approved by the Institutional Research Board of Takasaki University of Health and Welfare (No. 2201). Written consent was obtained from each participant and their families after providing full information regarding the purpose of this study, the risks and benefits, confidentiality, anonymity, and freedom of participation. Participants in the control group were assured that they would receive the same intervention after the intervention period.

Statistical Analysis

Data of outcome measures before and after intervention were analyzed using the Japanese version of SPSS Statistics for Windows version 18.0 (IBM Corporation, New York, N.Y., USA). Mann-Whitney U test and Fisher's exact test were used for comparison of the two groups at baseline. The primary and secondary statistical hypothesis was that the two observation scales and two cognitive tests would be improved in the intervention group compared with the control group after the intervention period. Repeated measures analysis of covariance (ANCOVA) with the covariates of age and sex was used to analyze the participants at the end of the study. Post hoc analysis for 'between participants' and 'within participants' was conducted with Bonferroni correction.

'Yes' and 'no' answers from the staff were analyzed. Free descriptions were separated into clauses to extract relevant words. We categorized similar words as the same opinion. We counted the number of words in each category.

Results

Baseline Characteristics of the Participants

The study participants were 54 elderly people with dementia (28 in the intervention group and 26 in the control group). No significant difference was found at baseline in any of the demographic variables (table 2).

In the intervention group, no participants dropped out and all took part in $\geq$20 of the total of 24 sessions. They looked cheerful and the average attendance rate was high (95.5%). In the control group, 1 participant dropped out due to sickness during the intervention period. Finally, outcome measures were analyzed in 53 participants: 28 participants in the intervention group and 25 in the control group, who completed the second evaluation.

Change in the Outcome Measures (table 3)

Repeated measure ANCOVA showed a significant interaction for total score of CDR-SB ($F(1, 49) = 7.190$, $p = 0.015$). The control group showed significant deterioration of CDR-SB ($p = 0.016$). On the other hand, the intervention group showed maintenance of this score.

Repeated measure ANCOVA showed a significant interaction for the total score of MOSES ($F(1, 49) = 4.525$, $p = 0.038$), subscale of disorientation ($F(1, 49) = 6.453$, $p = 0.014$) and withdrawal ($F(1, 49) = 4.955$, $p = 0.031$) in daily life functions. In the post hoc analysis, the

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Table 2. Demographics of the study participants (n = 54)

	Intervention group (n = 28)	Control group (n = 26)	p
Age, years	85.5 ± 4.0	84.9 ± 6.5	0.652
Gender			
Male	1 (3.6)	4 (15.4)	0.153
Female	27 (96.4)	22 (84.6)	
Diagnosis[a]			
AD	18 (64.3)	16 (61.5)	
VD	1 (3.6)	3 (11.5)	
AD and VD mixed	2 (7.1)	0 (0.0)	0.334
FTD	0 (0.0)	2 (7.7)	
Unspecified dementia	7 (25.0)	5 (19.2)	
Donepezil prescribed	9 (32.1)	12 (46.2)	0.403
Psychotropics prescribed	5 (17.9)	10 (38.5)	0.131
Mobility			
Independence	14 (50.0)	15 (57.7)	
Walking aids	9 (32.1)	5 (19.2)	0.314
Wheelchair	5 (17.9)	6 (23.1)	
CDR			
0.5 (questionable)	4 (14.3)	5 (19.2)	
1 (mild)	15 (53.6)	9 (34.6)	0.557
2 (moderate)	7 (25.0)	10 (38.5)	
3 (severe)	2 (7.1)	2 (7.7)	

Values are means ± SD or numbers with percentages in parentheses. Mann-Whitney U test or Fisher's exact test were used. AD = Alzheimer's disease; VD = vascular dementia; FTD = frontotemporal dementia. [a] Clinical diagnosis assigned according to the notes of participants' consultant physicians.

control group showed a tendency of deterioration (subscale of disorientation, p = 0.054, and withdrawal, p = 0.095), but there was no significant difference. The intervention group had significantly lower scores for total score of MOSES (p = 0.048) and subscale of withdrawal (p = 0.008) than the control group after intervention.

There were no significant effects on the two cognitive tests of HDS-R and trail making test A.

Staff Interview

In terms of changes seen in the intervention group, 26 (63.4%) of the 41 staff members noticed a positive change. Staff opinions were as follows: 'improved peer relationships' (n = 12), 'a more cheerful and positive outlook' (n = 11), 'positive anticipation of session' (n = 6), and 'co-operative attitude toward the care staff' (n = 4). In terms of changes in staff, 31 (75.6%) of the 41 staff members noticed a change. Staff opinions were as follows: 'I began to listen to the participants' recollections of their younger days' (n = 16), 'I learned how to communicate with the participants in a positive manner' (n = 10), 'I learned the importance of role reversal by being taught new things by the participants' (n = 6), 'I noticed for the first time the abilities of the participants' (n = 4), and 'I learned the importance of expressing appreciation when tasks are completed well' (n = 3).

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Table 3. Change in outcome measures for the intervention (n = 28) and control groups (n = 25)

Outcome variable	Time period				Interaction		Post hoc analysis
	before test		after test				
	mean ± SD	p	mean ± SD	p	F	p	p
CDR-SB							
Intervention	8.0 ± 3.8	0.684	7.6 ± 3.5	0.200	7.190	0.015*	0.296
Control	8.5 ± 4.5		9.3 ± 4.8				0.016*
MOSES total							
Intervention	71.4 ± 12.7	0.200	69.3 ± 15.4	0.048*	4.525	0.038*	0.105
Control	76.8 ± 16.4		78.7 ± 16.6				0.168
MOSES self-care							
Intervention	14.0 ± 4.1	0.226	13.8 ± 5.2	0.186	0.405	0.527	0.692
Control	15.7 ± 5.7		15.9 ± 5.8				0.612
MOSES disorientation							
Intervention	18.8 ± 4.1	0.964	18.2 ± 4.6	0.407	6.453	0.014*	0.105
Control	18.6 ± 6.1		19.4 ± 6.4				0.054
MOSES depression							
Intervention	11.2 ± 3.4	0.394	10.9 ± 3.2	0.521	0.101	0.752	0.602
Control	12.0 ± 4.9		11.5 ± 5.0				0.353
MOSES irritability							
Intervention	11.0 ± 2.7	0.926	10.8 ± 3.2	0.488	1.159	0.287	0.630
Control	11.3 ± 2.8		11.7 ± 3.3				0.303
MOSES withdrawal							
Intervention	16.4 ± 5.4	0.104	15.5 ± 5.7	0.008*	4.955	0.031*	0.146
Control	19.1 ± 5.4		20.2 ± 5.4				0.095
HDS-R							
Intervention	13.1 ± 4.5	0.768	13.4 ± 4.6	0.903	0.078	0.781	0.722
Control	12.6 ± 5.8		13.0 ± 6.2				0.470
TMT-A							
Intervention	177.9 ± 94.7	0.300	171.2 ± 96.6	0.252	0.128	0.722	0.901
Control	218.2 ± 118.5		229.6 ± 145.1				0.707

Repeated measures ANCOVA with the covariates of age and sex was used, and post hoc analysis with Bonferroni correction was conducted. TMT-A = Trail making test A. * $p < 0.05$.

Discussion

The results indicate the effect of intervention based on the principles of BAR on the improvement or maintenance of two observation scales, CDR-SB and MOSES, especially disorientation and withdrawal, although no improvement was shown in terms of the two cognitive tests of HDS-R and trail making test A. In a previous randomized controlled trial, the effect of a group care program, which consisted of reminiscence and reality orientation, was examined using an observation scale (MOSES) and a cognitive test (MMSE) as outcome measures [15]. The study found improved orientation and withdrawal subscales of MOSES, agreeing with our current study. In a randomized controlled trial on 168 demented elders in nursing homes, a comprehensive program of counseling, life review, interpersonal therapy, behavioral therapy, and rehabilitation reduced multiple psychiatric symptoms, suggesting the importance of a person-oriented approach [16]. Activities adjusted to 'personality style of interest' reduced agitation and passivity of demented elders. Furthermore, the activities adjusted to both functional level and personality style of interest brought greater pleasure

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than activities partially adjusted or non-adjusted to individual preferences and needs [17]. In the current study, we tried to adapt the contents of the sessions to each participant by collecting information on life history, although intervention sessions were conducted in a group setting.

Due to the basis of the 5 principles of BAR, participants looked cheerful and the average attendance was extremely high (95.5%). When the staff took care of the participants by following the principles of BAR, staff became more receptive and provided care that encouraged demonstration of each participant's abilities. The responses to questions by the staff also supported these findings. Intervention with BAR principles enhanced understanding between staff and participants, as well as between participants [6]. The benefit was generalized to participants' daily life. Therefore, participants may gain a sense of self-worth and a desire to live, and the behavioral and psychological symptoms of the participants may be reduced. In fact, in this study, withdrawal was alleviated. Intervention following the BAR principles also improved apathy and social ability in elderly participants with mild cognitive impairment and mild dementia [18]. The concept of person-centered care can be described as follows: it acknowledges that the individual is a person who can experience life and relationships, despite progressive disease; involves inclusion of the person's past life and history in their care, and it focuses on what the person can do, rather than abilities that have been lost owing to the disease [19]. The concept of person-centered care is widely accepted in the field of dementia care. BAR is also a concept but not a technique. We expect BAR to be widely accepted in the field of dementia rehabilitation.

Our randomized controlled trial revealed that intervention based on BAR principles promoted intersubjectivity between participants and therapists/care staff and was effective for maintaining and improving emotional and daily life functions in the current study. Participants may regain their confidence. BAR principles of enjoyable stimulation, communication, and role reversal contribute to providing an environment where elderly participants with dementia can laugh and be themselves.

We revealed the effectiveness of dementia rehabilitation based on the principles of BAR by a randomized controlled trial. A pleasant atmosphere, communication, praising, social role, and supportive care are essential in rehabilitation for dementia.

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Disclosure Statement

The authors declare that they have no conflicts of interest.

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Pitfall Intention Explanation Task with Clue Questions (Pitfall task): assessment of comprehending other people's behavioral intentions in Alzheimer's disease

Tomoharu Yamaguchi,[1,2] Yohko Maki[1,3] and Haruyasu Yamaguchi[1]

[1] *Gunma University Graduate School of Health Sciences, Gunma, Japan*
[2] *Department of Rehabilitation, Gunma University of Health and Welfare, Gunma, Japan*
[3] *Geriatrics Research Institute and Hospital, Gunma, Japan*

ABSTRACT

Background: In Alzheimer's disease (AD) patients, deficits in contextual understanding and intentions/beliefs of other people (theory of mind; ToM) cause communication problems between patients and caregivers. To evaluate deficits of contextual understanding/ToM, we developed the Pitfall Intention Explanation Task with Clue Questions (Pitfall task).

Methods: We recruited 26 healthy older adults in clinical dementia rating (CDR) 0, and 62 outpatients: 12 with amnestic mild cognitive impairment (aMCI) in CDR 0.5; 36 mild AD in CDR 1; and 14 moderate AD in CDR 2. The Pitfall task consists of a single-frame cartoon that shows a character's intention and seven serial questions that provide clues for contextual understanding/ToM.

Results: The total score (0–7) was decreased with progression of AD (CDR 0, 5.4 ± 2.6; CDR 0.5, 3.7 ± 2.7; CDR 1, 1.9 ± 3.1; CDR 2, 0.0 ± 0.0; respectively). In CDR 0, two-third of the participants responded correctly without clue questions. In CDR 0.5, one-third of the participants responded correctly without clue questions, and half of them understood with the help of the clue questions. In CDR 1, one-fourth of the participants responded correctly without clue questions, and the clue questions did not increase the correct response. In CDR 2, none responded correctly. Additionally, the Pitfall task provided the chance for patients' families to observe patients' responses.

Conclusion: Contextual understanding/ToM, a kind of social cognition, was impaired with progression of AD. The Pitfall task evaluates the function quickly with low burden for memory function, and may provide helpful clues for caregivers to achieve good communication with AD patients.

Key words: dementia, carers, behavioral and psychological symptoms of dementia (BPSD), cognitive assessment, family therapy

Introduction

Evaluating communication problems between caregivers and patients is important, when caring for Alzheimer's disease (AD) patients. These problems could potentially arouse feelings of anxiety, and lead to conflict in their relationship, depression, social isolation, and caregiver burden (Potkins *et al.*, 2003; Savundranayagam *et al.*, 2005). Furthermore, communication problems trigger behavioral and psychological symptoms of dementia (BPSD) in AD patients (Gitlin *et al.*, 2007). Therefore, education for caregivers to attenuate communication problems is effective in reducing BPSD (Ripich *et al.*, 1998; Gitlin *et al.*, 2007). Thus, in AD patients, it is important to assess the communication problems, one of the social skill deficits, in order to provide information to caregivers for appropriate care with attenuated communication problems.

Communication skills include both linguistic and non-linguistic skills. Linguistic communication skills, such as subtle spontaneous language, idiosyncratic pragmatic skill, linguistic changes in verbal expression, and referential communication, were reported to decline from the mild cognitive impairment (MCI) stage or very early stage of AD (Carlomagno *et al.*, 2005; Forbes-McKay and Venneri, 2005; Cuetos *et al.*, 2007; de Lira *et al.*, 2011). Therefore, the ability to comprehend complex references or difficult phrases

Correspondence should be addressed to: Tomoharu Yamaguchi, 3-39-15 Showa-machi, Maebashi, Gunma, 371-8514, Japan. Phone: +81-27-220-8946; Fax: +81-27-220-8946. Email: yamaguchi@shoken-gakuen.ac.jp. Received 1 Apr 2012; revision requested 18 Apr 2012; revised version received 26 May 2012; accepted 30 May 2012.

(e.g. understanding the story line of a TV drama or a complex conversation) is impaired with progression of AD. We have also reported impaired comprehension of figurative proverbs, which is associated with disinhibition, excuse, and confabulation in patients with dementia (Yamaguchi *et al.*, 2011).

Social cognition, one of the higher cerebral functions, includes recognition of emotions, theory of mind (ToM), and behavioral regulation, and its deficits may cause communication problems. The ToM, which requires both linguistic and non-linguistic skills, is reported to be preserved in mild to moderate AD, because failure in false-belief task, a representative ToM test, is secondary to impairment of other functions such as memory (Gregory *et al.*, 2002; Zaitchik *et al.*, 2004; Fernandez-Duque *et al.*, 2009). The ToM tasks were originally developed for children (Baron-Cohen *et al.*, 1985). Therefore, we tried to develop a kind of ToM task for AD, where memory function is impaired.

We focused on deficits in contextual understanding and intentions/beliefs of other people (ToM), rather than linguistic aspects. As a brief task available in a clinical setting, we developed a new cognitive task, the Pitfall Intention Explanation Task with Clue Questions (Pitfall task), to assess the ability for contextual understanding/ToM by explanation of a character's behavioral intentions/beliefs in a cartoon. The task consisted of a single-frame cartoon and seven clue questions to help contextual understanding/ToM step-by-step. We hypothesized that we could demonstrate decline of contextual understanding/ToM with AD progression qualitatively and quantitatively by using a kind of ToM task associated with low burden for memory function.

Methods

Participants

Healthy older adults (n = 26) were recruited from community dwellers who participated in the "Prevention of mental decline project" in Takasaki City, Gunma, Japan, and outpatients who visited the Geriatrics Research Institute and Hospital, Gunma, Japan. These participants were judged as normal, corresponding to clinical dementia rating (CDR) 0 based on the results of cognitive tests and medical interviews by a neurologist specializing in dementia.

We recruited 62 participants, who were diagnosed as having amnestic MCI (aMCI) or AD in an outpatient clinic. All the participants were classified according to CDR by the neurologist. The criteria of aMCI, mild AD, and moderate AD were CDR 0.5 (n = 12), CDR 1 (n = 36), and CDR 2 (n = 14), respectively. In this study, the AD patients were diagnosed based on the criteria of the National Institute of Neurological and Communicative Disorders and Stroke and Alzheimer's Disorders and Related Disorders Association (NINCDS-ADRDA) (Dubois *et al.*, 2007). Similarly, the aMCI patients were diagnosed based on a previous study (Petersen, 2007). CDR 0.5 was regarded as MCI, although a different classification was proposed, whereby CDR 0.5 encompasses both mild and earlier dementia (Reisberg *et al.*, 2008) or very mild dementia (Grundman *et al.*, 2004). Exclusion criteria were: problems with alcoholism, motor deficits such as paralysis, or neurological and psychiatric disorders other than the primary diagnosis of AD or aMCI.

The demographic data and clinical characteristics are shown in Table 1. All the participants reported normal or corrected-to-normal vision, and they were unaware of the purpose of the experiment. The Ethics Board of Gunma University School of Health Sciences approved all procedures (nos. 21–27), and signed informed consent was obtained. All the participants underwent the Mini-Mental State Examination (MMSE) (Folstein *et al.*, 1975).

Procedure

In the present study, we developed a new task. The task consisted of a single-frame cartoon (19 cm long and 25.5 cm wide), which was drawn on A4-size paper, and seven serial questions (Figure 1). The Q2–Q6 are clue questions. The cartoon depicts a scene of a misbehaving child: the person in the center is hiding behind a tree and imagines that the other person (on the left) falls into a pitfall (top right circle).

Protocol

1. The cartoon is placed in front of the sitting participant.
2. The examiner asks the participant whether the participant can see all parts of the cartoon or not, and then asks seven simple questions:
   Q1: "What is happening in this cartoon?"
   Q2: "What do you think this person on the left is doing?" (The examiner gives instructions by pointing to the leftmost person.)
   Q3: "What is this person in the center doing?" (Pointing to the center person.)
   Q4: "What is this?" (Pointing to the top right circle.)
   Q5: "What is this?" (Pointing to the bottom left pitfall.)
   Q6: "What do you think is going to happen to the person on the left?" (Pointing to the leftmost person.)

Table 1. Demographics and clinical characteristics

	ALL	CDR 0[a]	CDR 0.5[b]	CDR 1[c]	CDR 2[d]
Number	88	26	12	36	14
Male/female	30/58	11/15	6/6	12/24	1/13
Age, year	77.1 ± 6.5	73.2 ± 6.3	74.4 ± 5.0	79.2 ± 5.8	81.0 ± 5.5
Education, year	10.4 ± 2.7	12.5 ± 2.4	9.5 ± 2.8	9.5 ± 2.1	9.8 ± 2.4
MMSE	22.4 ± 5.9	28.9 ± 1.3	25.0 ± 3.2	19.9 ± 3.3	14.1 ± 3.1
Total task score	2.9 ± 3.2	5.4 ± 2.6	3.7 ± 2.7	1.9 ± 3.1	0.0 ± 0.0

Note: CDR – Clinical dementia rating; MMSE – Mini-Mental State Examination. Data are presented as mean ± SD.
[a]Healthy older adult.
[b]Amnestic mild cognitive impairment (aMCI).
[c]Mild AD.
[d]Moderate AD.

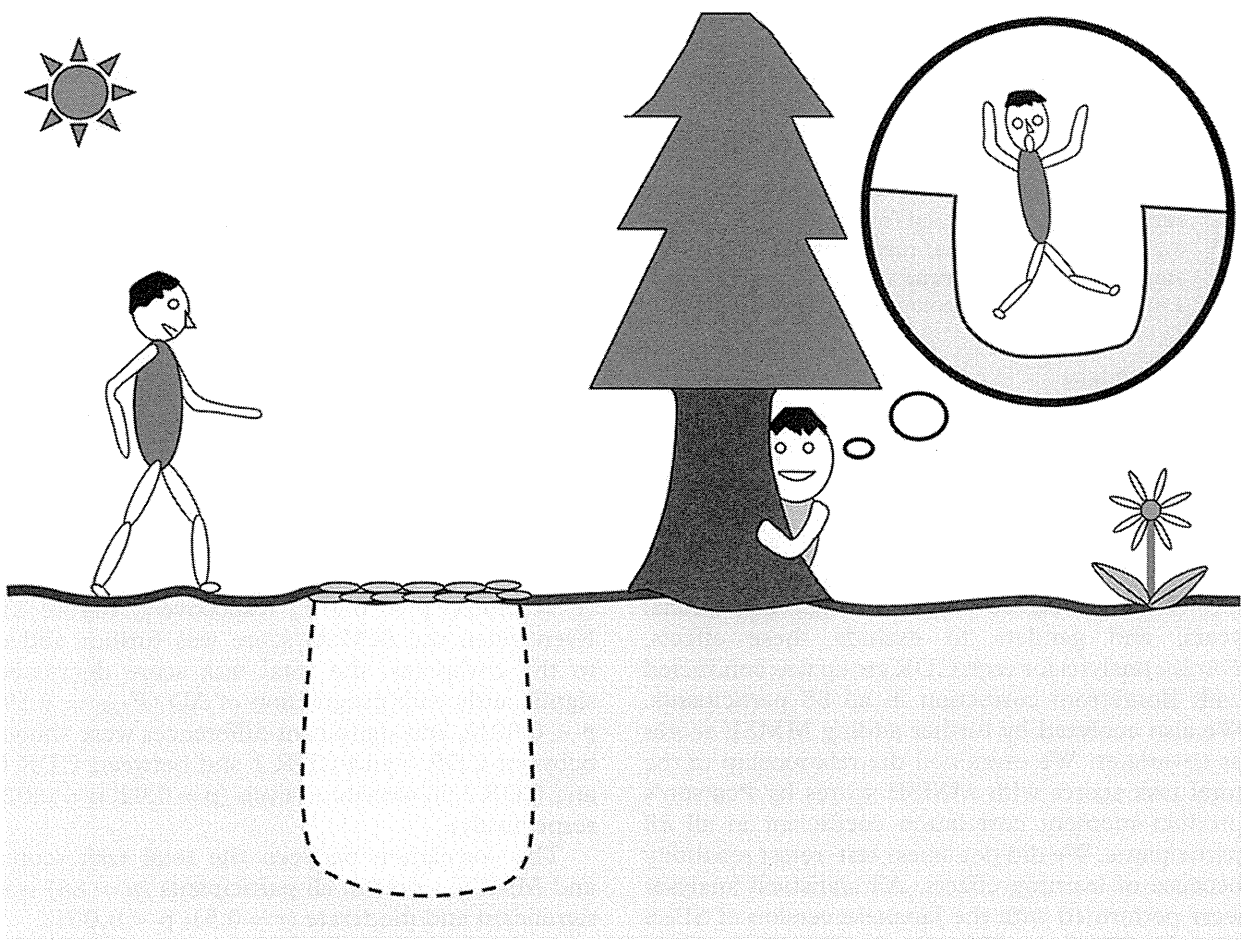

Figure 1. The cartoon for the Pitfall Task. The single-frame cartoon depicts a scene of a misbehaving child: the person in the center is hiding behind a tree and imagines that the other person (on the left) falls into a pitfall (top right circle).

Q7: "What do you think the person in the center intends to do?" (Pointing to the center person.)

3. If the participant says nothing within 30 sec or does not understand the question, skip the question. The participant is required to respond within 1 minute for each question.
4. The examiner records the response.
5. If visual loss is suspected, the participant's visual impairment can be checked by pointing to the flower and the sun, and asking the participant what they are.

Guideline for scoring

The total task score is 0–7 points (1 point for each question), and the score is determined by whether each question is responded to correctly or not. Some examples are as follows:

Q1: If the participant can explain the scene correctly, with terms such as "Mischief" or "Pitfall," the score is 1 point. If the participant does not explain the correct context, for example "There are three children playing hide-and-seek" or "Walking and resting under the shade of a tree," the score is 0 points.
Q2: If the response is similar to "He (or she) is walking and does not know about the hole" or "He is walking and does not know about the pitfall," the score is 1 point.
Q3: If the response is similar to "He (or she) is looking at another child who is walking and does not know about the pitfall, and is imagining that the other (left) child will fall into the pitfall," the score is 1 point.
Q4: If the response is similar to "This is an image of his (center child's) expectation," the score is 1 point.
Q5: If the response is similar to "Pitfall" or "A trap for the child on the left," the score is 1 point.
Q6: If the response is similar to "Fall into a pitfall" or "Walk into a trap," the score is 1 point.
Q7: If the response is similar to "He (or she) wanted to surprise his (or her) friend (or another person) with a pitfall that he (or she) made" or "He (or she) is annoying his (or her) friend (or another person) with a malicious and intentional act (or with a pitfall)."

Data analyses

We calculated the total task scores, and analyzed the number of correct responses and the effect of clue questions for each CDR group. Furthermore, the participant's responses were analyzed qualitatively.

To analyze the CDR group differences of the total task scores, we used analyses of covariance (ANCOVA) with covariates of age, educational years, and genders to exclude these effects. *Post hoc* analysis for each CDR group was conducted with Bonferroni correction in all 88 participants. We also analyzed by further adding MMSE scores as covariates. We examined the relationship of the total task scores with MMSE scores by Pearson's product–moment correlation coefficient in all 88 participants. We did not assess test–retest reliability because of learning effects. All statistical analyses were performed with the Japanese version of SPSS 19.0 for Windows (IBM Com., New York, NY). The results are reported at a significance level of $p < 0.05$.

Results

The total score and its relationship with cognitive tests

The demographic data and the total score for all the participants are shown in Table 1. The total task score (mean ± SD) in CDR 0 (5.4 ± 2.6, n = 26) was the highest of the four CDR groups, and next was that in CDR 0.5 (3.7 ± 2.7, n = 12). The mean total score decreased further in CDR 1 (1.9 ± 3.1, n = 36), and no patients scored any points in the CDR 2 (0.0 ± 0.0, n = 14). The total task score decreased significantly with progression of AD, as demonstrated by ANCOVA with covariates of age, educational years, and genders ($F_{6,81} = 10.65$, $p < 0.001$). The results of a *post hoc* analysis with Bonferroni correction indicated a significant difference between CDR 0 and CDR 1, and between CDR 0 and CDR 2 ($p = 0.004$, $p < 0.001$; respectively; Figure 2). Even when the MMSE score was further added to the covariates, the total task score decreased significantly with progression of AD ($F_{7,80} = 9.19$, $p < 0.001$), and significant differences were shown between CDR 0 and CDR 1 and between CDR 0 and CDR 2 on *post hoc* analysis ($p = 0.02$, $p = 0.02$; respectively).

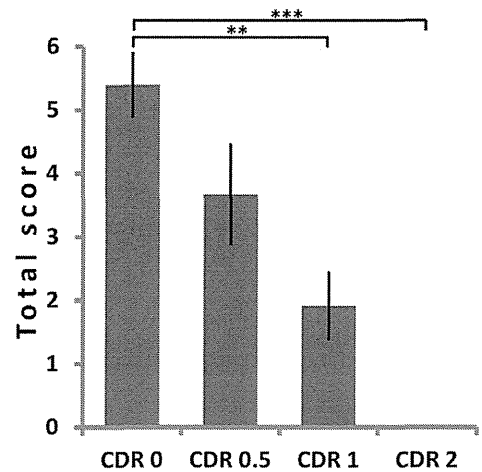

Figure 2. The total scores in the CDR groups. Total score (mean ± SE) was decreased with progression of AD (CDR 0, 5.4 ± 0.5; CDR 0.5, 3.7 ± 0.8; CDR 1, 1.9 ± 0.5; CDR 2, 0.0 ± 0.0; respectively). **p < 0.01, ***p < 0.001 (ANCOVA with covariates of age, educational years, and genders).

The correlation between the total task scores and MMSE scores in all participants (n = 88) was significant and moderate ($r = 0.51$, $p < 0.001$).

When did participants understand the context?

The question at which participants understood the context of the cartoon was analyzed in each CDR group (Figure 3).

In CDR 0, two-third of the participants (65.4%, n = 17) responded correctly from the first question (Q1), and some understood at Q2 (3.8%, n = 1), Q4 (7.7%, n = 2), Q5 (3.8%, n = 1), and Q6 (7.7%, n = 2). The correct response increased up to 88.5% (23/26) at Q7.

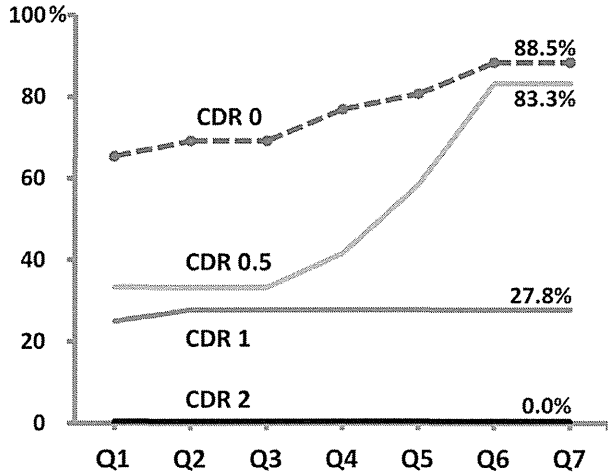

Figure 3. Rate of correct response (contextual understanding/ToM). In CDR 0, most of the participants understood the context from the first question (Q1). In CDR 0.5, the rate of correct response at Q1 was one-third, and the rate increased between Q4 and Q6. In CDR 1, one-fourth of the participants understood at Q1, and the rate did not increase with the clue questions. In CDR 2, none of the participants responded correctly.

In CDR 0.5, the rate of correct response at Q1 was only one-third (33.3%, $n = 4$). Many participants understood at Q4 (8.3%, $n = 1$), Q5 (16.7%, $n = 2$), and Q6 (25.0%, $n = 3$) with the exclusion of two participants (16.7%) who did not understand. The rate of correct response increased between Q3 and Q6, and finally became 83.3% (10/12). The rate of correct response at the last question (Q7) in CDR 0.5 was comparable with that in CDR 0.

The result in CDR 1 was interesting. Although a quarter of participants understood the context at first Q1 (25.0%, $n = 9$), none understood at Q3–Q7. They did not understand with the help of clue questions, except one participant who understood the context at Q2. Thus, the rate of correct response did not increase with each clue question, and was maintained at 27.8% (10/36) to the last question in CDR1.

In CDR 2, none of the participants understood the context at any question.

Characteristic incorrect responses in each CDR group

At Q1, the most common incorrect response in CDR 0 to CDR 1 was an explanation of the interrelation between the two characters in the cartoon; the typical response was "They are playing hide-and-seek" or "He is looking for his friend who is hiding behind the tree." The ratio of this type of response to all the incorrect responses decreased with progression of AD (66.7% of incorrect responses in CDR 0, $n = 6$; 62.5% in CDR 0.5, $n = 5$; 44.4% in CDR 1, $n = 12$; 7.1% in CDR 2, $n = 1$; respectively) (Figure 4a). In contrast, incorrect responses that lacked interrelation between the characters, such as "There is a child" or "There is a flower" increased with progression of AD (11.1% of incorrect responses in CDR 0, $n = 1$; 12.5% in CDR 0.5, $n = 1$; 18.5% in CDR 1, $n = 5$; 28.6% in CDR 2, $n = 4$; respectively) (Figure 4a). These responses did not include interrelation between the two characters. Participants in CDR 2 had difficulty in seeing the cartoon as a whole.

The characteristic incorrect responses at Q2–Q6 reflected a part of the cartoon; for example,

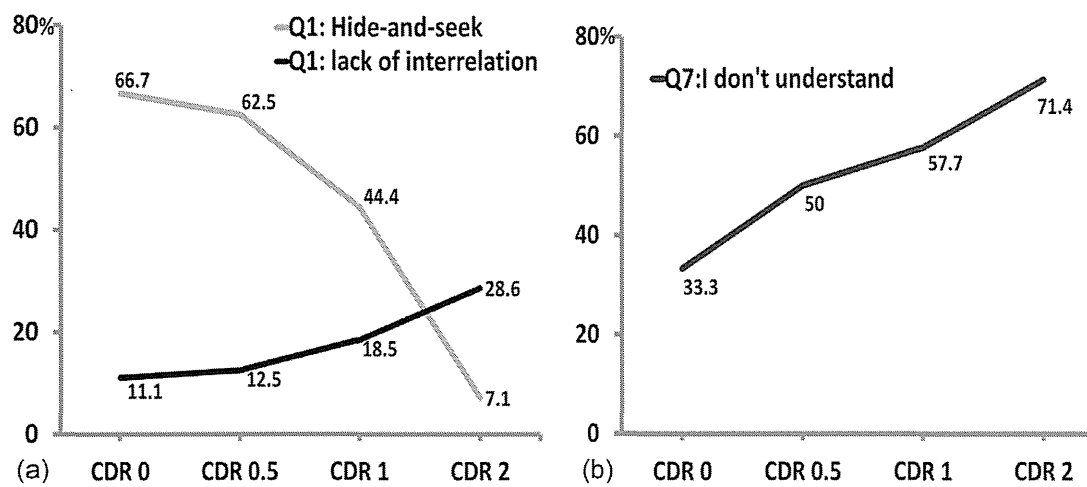

Figure 4. The ratio of response to all incorrect responses for Q1 and Q7. (a) At Q1, the ratio of incorrect response of "Hide-and-seek," which indicated an interrelation between the two characters in the cartoon, decreased according to AD progression, whereas explanations that lacked interrelation between the two characters increased. (b) At Q7, the ratio of incorrect response of "I don't understand" to total incorrect response increased according to AD progression, and was prominent at CDR2.