Will treatment facilitate learning of a problem solving strategy by persons with Alzheimer's disease?

ABSTRACT

Deficits in problem solving are a prominent feature of Alzheimer's disease (AD). The present study aimed to determine whether or not persons with AD could learn to use a strategy for solving problems. Four individuals with AD were taught to use a reduction strategy to solve twenty questions problems (20Q). Although results of this study indicate that individuals did not learn to use the stressed strategy, participants did improve their ability to solve problems using strategies already familiar to them. This suggests that treatment should focus on skills the person with AD is already using rather than teaching new strategies.

BACKGROUND

Deficits in problem solving are a prominent feature of Alzheimer's disease (AD) (Cummings & Benson, 1992; Lubinksi, 1995). Simple activities of daily living (ADLs) require problem solving and one's ability to solve problems has great consequences for independent living (Lezak et al., 2004). Patients with AD may require nursing home placement if they are unable to perform basic ADLs to remain safely at home (Gilley et al., 2004). Since ADL limitations could accelerate nursing home placement and most ADLs call for problem solving, it is important to determine if treatment can improve the problem solving ability of persons with AD.

Largely, treatments to improve or compensate for deteriorating functional limitations in AD have targeted memory deficits rather than problem solving (Bayles & Kim, 2003; Bayles et al., 2004; Bourgeois, 1991; Camp & McKitrick, 1992; Hawley & Cherry, 2004; Hopper et al., 2010). Marshall et al. (2007) examined the effects of treatment on the solving of twenty questions (20Q) problems in three women with early stage AD. Participants improved their ability to solve 20Q problems after 12 sessions of treatment. Treatment gains reflected increased proficiency in asking category-based questions and reduced guessing. However, no efforts were made to teach the participants a "strategy" for solving 20Q problems. The present study aimed 1) to confirm the results of the Marshall et al. study and 2) to expand on this study by determining whether or not persons with AD could learn to use a strategy for solving 20Q problems.

METHOD

Participants

Four adults with early stage AD gave informed consent to participate in this study. Participants met pre-determined inclusion criteria and were administered a selected battery of cognitive and executive function tests before and after treatment. Results of these tests and other biographical information on the participants are shown in Table 1.

Treatment

Treatment occurred three times per week for four weeks. Ten 20Q problems were solved at each of the training sessions. Problems were constructed similarly to the picture-based problems of the Rapid Assessment of Problem Solving Test (RAPS; Marshall et al., 2003). Table 2 shows one of the problems used in treatment with directions provided by the examiner.

Five questions were constructed for each problem and typed separately on index cards. Questions were sequenced to target larger, then smaller numbers of words in order to identify the "target word" and solve the problem after the fifth question. This "reduction" strategy is typically used by normal subjects to solve problems on Mosher & Hornsby's 20Q task (Hartley & Anderson, 1983; Mosher & Hornsby, 1966), the RAPS, and tests of fluid reasoning (Carroll, 1993; Horn & Cattell, 1967).

During treatment, the examiner (1) presented the word problem; (2) provided instructions; (3) handed the questions to the participant one-at-a-time; (4) the participant read each question aloud; (5) the examiner answered each question "yes" or "no;" (5) the examiner crossed out the words eliminated by the question; and (6) the examiner commented on the impact of the question in solving the word problem.

Measurement

The RAPS was administered four times: (1) pre-treatment; (2) before the 7^{th} treatment session (mid-treatment); (3) after the 12^{th} treatment session (post-treatment); and (4) one month after the 12^{th} treatment session (follow-up). Scores from the RAPS served as the dependent variable. Detailed information on the RAPS materials, administration, scoring, and psychometric properties can be found in Marshall et al. (2003) and Marshall and Karow (2008).

Four scores from the RAPS were used to assess the effects of treatment: mean number of questions (MQ), percent constraint questions (%C), mean question efficiency (MQE), and integration planning (IP). In addition, the proportions of multi-category, category-specific, and narrowing questions asked by participants for each administration of the RAPS were calculated.

RESULTS

Table 3 shows participants' MQ, %C, and MQE scores on all administrations of the RAPS. Participants solved problems with fewer questions and increased their %C scores. Treatment resulted in participants asking more constraint-induced questions and doing less guessing. MQE scores, with the exception of participant 2, changed little across the four tests.

Table 4 shows participants' IP scores and the percentages of each question type for the tests. Participants' IP scores changed very little or were quite variable across the four administrations of the RAPS. Additionally, participants asked predominantly category-limited questions for every test. These findings indicate that the participants did not apply the problem solving strategy used in treatment to solve problems on the RAPS.

DISCUSSION

Participants with AD improved their ability to solve problems on the RAPS. Improved scores on the RAPS primarily resulted from asking more category-limited constraint questions and doing less guessing. This result is similar to that of a 2007 study (Marshall et al., 2007). While improved MQ and %C scores in the 2007 and present studies is encouraging, these were small N studies in which data analyses were limited to examination of trends. This suggests a need to view improved scores on the RAPS after training cautiously.

A major aim of this study was to determine if participants would apply a problem solving strategy stressed in treatment to the solving of problems on the RAPS. Results indicated that participants did not use this strategy after training. Participants' IP scores did not change after treatment. Participants asked predominantly category-limited questions, and asked very few multi-category and narrowing questions. Post-hoc analysis of participants' question sequences indicated that no participant ever solved a problem using the reduction strategy stressed in treatment.

Participants' failure to employ a reduction strategy may have been due to the fact that the treatment provided was not sufficiently engaging to facilitate learning a strategy. This study and the prior study by Marshall et al. (2007) had participants read prepared questions to solve treatment problems rather than create their own questions. While this maximized the efficiency of questions and ensured all problems would be solved, this paradigm did not prompt participants to formulate a reduction strategy. Findings of this study differ from those of two other studies (Marshall et al., 1999; Marshall et al., 2004). In these studies, participants were trained to solve 20Q word problems using an interactive paradigm in which problem solving strategies were modeled and the roles of problem solver and examiner were alternated. Participants did use the problem solving strategies taught in treatment. This suggests that it may be prudent to allow AD participants to create their own questions and to discuss good and poor questions with the examiner.

While participants did not apply the strategy taught in treatment, they did increase the number of category-limited questions asked in solving problems on the RAPS. However, some participants were asking these types of questions before treatment. It is encouraging that all participants used *a* strategy, but unfortunately it was not the efficient reduction strategy drilled upon in treatment. Thus treatment appeared to improve upon what some of the participants were already doing. In this regard, it may be that the ability to ask category-limited questions is a strength for AD patients, particularly in the early stages of the disease. Results of this study suggest that one way to approach this clinical issue might be to base problem solving treatment on skills the person with AD is already using rather than to teach new strategies.

References

Bayles, K. A., & Kim, E. (2003). Improving the functioning of individuals with Alzheimer's disease: Emergence of behavioral interventions. *Journal of Communication Disorders, 36,* 327-343.

Bayles, K. A., Tomeoda, C. K., Kim, E. S., & Hopper, T. (2004). *Treating dementia: What research tells us.* Paper presented at American Speech-Language-Hearing Association, Philadelphia, PA.

Bourgeois, M. S. (1991). Communication treatment for adults with dementia. *Journal of Speech and Hearing Research, 34,* 831-844.

Camp, C. J., & McKitrick, L.A. (1992). Memory interventions in Alzheimer's type dementia populations. Methodological and theoretical issues. In R. L. West & J. D. Sinett (Es.) *Everyday memory and aging: Current research and methodology* (pp.155-172). New York: Springer-Verlag.

Carroll, J. (1993). *Human cognitive abilities: A survey of factor-analytic studies.* New York: Cambridge University Press.

Cummings, J., & Benson, F. (1992). [Review of the book *Dementia: A clinical approach* (2nd ed.) by Burns, A.]. *International Journal of Geriatric Psychiatry, 7,* 920.

Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). "Mini-mental state." A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research, 12,* 189-198.

Gilley, D. W., Bienias, J. L., Wilson, R. S., Bennett, D. A., Beck, T. L., & Evans, D. A. (2004). Influence of behavioral symptoms on rates of institutionalization for persons with Alzheimer's disease. *Psychological Medicine, 34,* 1129-1135.

Hartley, A. A., & Anderson, J. W. (1983). Task complexity and problem-solving performance in younger and older subjects. *Journal of Gerontology, 38,* 72-77.

Hawley, K. & Cherry, K. (2004). Spaced-retrieval effects on name-face recognition in older adults with probable Alzheimer's disease. *Behavior Modification, 28,* 276-296.

Hopper, T., Shawn, D., Bayles, K., Tomoeda, C., & Dinu, I. (2010). The effects of modified space-retrieval training on learning and retention of face-name associations by individuals with dementia. *Neuropsychological Rehabilitation, 20,* 81-102.

Horn, G. J., & Cattell, R. B. (1967). Refinement and test of the theory of fluid and crystallized general intelligence. *Journal of Educational Psychology, 57,* 253-270.

Lezak, M. D., Howieson, D. B. & Loring, D. W. (2004). *Neuropsychological Assessment* (4th ed.). New York, NY: Oxford University Press.

Marshall, R. C., & Karow, C. M. (2008). Update on a clinical measure for the assessment of problem solving. *American Journal of Speech-Language Pathology, 17,* 377-388.

Marshall, R. C., Capilouto, G. J., & McBride, J. M. (2007). Treatment of problem-solving in Alzheimer's disease: A short report. *Aphasiology, 21,* 235-247.

Marshall, R. C., Dixon, J., Iden, K., Karow, C. M., & Morelli, C. M. (1999, November). *Problem solving efficiency of elderly subjects: Effects of strategy-modeling training.* Paper presented at the Annual Convention of the American Speech-Language-Hearing Association, San Francisco.

Marshall, R. C., Karow, C. M., Morelli, C., Iden, K., & Dixon, J. (2003) . Problem solving by traumatically brain injured and neurologically intact subjects on an adaptation of the twenty questions test. *Brain Injury, 17,* 569-608.

Marshall, R. C., Karow, C. M., Morelli, C., Iden, K., Dixon, J., & Cranfill, T. B. (2004). Effects of interactive strategy modeling training on problem-solving by persons with traumatic brain injury. *Aphasiology, 18,* 659-673.

Marshall, R. C., McGurk, S. R., Karow, C. M., Kairy, T. J., & Flashman, L. A. (2006) Performance of subjects with and without severe mental illness of a clinical test of problem solving. *Schizophrenia Research, 84,* 331-344.

Mosher, F. A., & Hornsby, J. R. (1966). On asking questions. In J. S. Bruner, R. R. Olver, & P. M. Greenfield (Eds.), *Studies in cognitive growth* (pp. 86-102). New York: Wiley.

Raven, J. C. (1995).*The Colored Progressive Matrices.* New York: The Psychological Corporation.

Rosen, W. G., Mohs, R. C., & Davis, K. L. (1984). A new rating scale for Alzheimer's disease. *The American Journal of Psychiatry, 141,* 1356-1364.

Table 1. Demographic and test information for participants

	P1	P2	P3	P4
Gender	Female	Female	Male	Male
Age (years)	69	87	74	83
Time since diagnosis (months)	20	26	18	16
Education (years)	16	8	16	16
Pre-Testing/Post Testing				
MMSE (0-30)	27/26	25/24	26/25	25/22
ADAS-COG (0-70)	21/22	16/18	19/14	20/22
RCPM	25/26	9/6	20/25	16/23

Mini-Mental State Exam (MMSE; Folstein et al., 1975)
Alzheimer Disease Assessment Cognitive Scale (ADAS-COG; Rosen, et al., 1984)
Raven Colored Progressive Matricies (RCPM; Raven, 1965)

Table 2. Example of a treatment problem and questions developed to solve the problem with five questions

Examiner directions: "We are going to play a game like 20 questions. I am thinking of one of these words and I'm writing the word on a piece of paper that you cannot see. I am going to ask you to read five questions one-at-a-time that will help you find out what this word is."

Fork	Three Musketeers	Fall	Dime	Pot	Baby Ruth	Knife	Butterfinger
Wonder Woman	Nickel	Bowl	Pencil	Superman	Quarter	Markers	Batman
Snickers	Pen	Spring	Twix	Winter	Pan	Summer	Plate
Penny	Spoon	Spiderman	Cup	Half Dollar	Mounds	Crayons	Dollar Bill

Questions:

1. Is it a candy bar or writing implement?
2. Is it a kitchen item or a season?
3. Is it a super hero?
4. Is it a man with a cape?
5. Is it wonder woman?

Table 3. Participants' scores on the RAPS for the pre-treatment, mid-treatment, post-treatment and follow up assessments.

	Pre-treatment	Mid-treatment	Post-treatment	Follow-up
Participant 1				
MQ	5.3	6.7	5.3	3.7
%C	50	65	69	83
MQE	.44	.43	.40	.48
Participant 2				
MQ	10	7.3	5.3	6.7
%C	0	23	58	15
MQE	.06	.11	.42	.27
Participant 3				
MQ	5.0	3.7	6.0	5.0
%C	71	82	72	80
MQE	.56	.59	.42	.57
Participant 4				
MQ	8.3	5.0	5.3	4.67
%C	62	73	73	71
MQE	.37	35	.49	.50

Table 4. Integration planning scores (IPS) and percentage of multi-category, category-limited, and narrowing questions asked by participants for the pre-treatment, mid-treatment, post-treatment, and follow-up administrations of the RAPS.

	Pre-treatment	Mid-treatment	Post-treatment	Follow-up
Participant 1				
IPS	4.67	4.00	3.00	3.00
Multi-category	13	0	0	0
Category-limited	87	100	100	80
Narrowing	0	0	0	20
Participant 2				
IPS	1.00	1.00	4.33	3.33
Multi-category	0	0	0	0
Category-limited	0	100	100	100
Narrowing	0	0	0	0
	3.67	5.00		
Participant 3				
IPS	3.33	4.67	3.67	4.00
Multi-category	0	13	0	0
Category-limited	85	50	92	83
Narrowing	15	33	8	17
Participant 4				
IPS	5.00	2.67	4.67	4.67
Multi-category	0	14	0	0
Category-limited	81	57	91	73
Narrowing	19	29	9	27