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Spaced retrieval treatment of anomia

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Abstract

Background—Spaced Retrieval (SR) is a treatment approach developed to facilitate recall of information by individuals with dementia. Essentially an errorless learning procedure that can be used to facilitate recall of a variety of information, SR gradually increases the interval between correct recall of target items.

Aims—Given the success of using SR in dementia, the purpose of this study was to explore its usefulness in improving naming by individuals with aphasia. The rate of acquisition and retention of items was compared between SR and a more traditional treatment technique—cueing hierarchy (CH). Also, each oral naming treatment was run concurrently with a single word writing treatment.

Methods & Procedures—Three participants who had moderate or severe naming impairments and agraphia were studied. Single-subject design was applied across oral and written naming and treated and untreated items.

Outcomes & Results—The results indicate that for these participants, SR resulted in improved naming of specific items. The data further suggest that SR compared favourably to CH with regard to both acquisition and retention of items. The participants also benefited nicely from the writing treatment.

Conclusions—These findings suggest SR may be an alternative for managing naming impairment resulting from aphasia. Furthermore, the study supports providing treatments aimed at two different modalities concurrently.

Anomia is the hallmark impairment of aphasia and can vary considerably based on aphasia type and severity. Given that nearly all persons with aphasia experience word retrieval difficulty, most comprehensive aphasia treatment approaches utilise some type of naming treatment. Several approaches for treating anomia have been described in the literature (for review see Nickels, 2002). These methods can vary significantly based on the theory that motivates the treatment.

Several word retrieval treatment approaches spring from what proponents believe to be the underlying cause of the anomia. Many have dealt with anomia from either cognitive neuropsychological or cognitive neurolinguistic standpoint. Both perspectives, using either single-subject or group designs, have documented successful treatments for persons with aphasia (e.g., Howard, Patterson, Franklin, Orchard-Lisle, & Morton, 1985; Plaut, 1996;

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Raymer, Thompson, Jacobs, & LeGrand, 1993; Shewan & Kertesz, 1984; Thompson, Ballard, & Shapiro, 1998). Other treatment approaches have been developed with, perhaps, less emphasis on the underlying naming impairment. These include treatments in the spirit of Shuell's stimulation approach (Schuell, Jenkins, & Jimenez-Pablon, 1964) as well as compensatory techniques that capitalise on persons' preserved communication ability in the presence of a language impairment (Garrett, Beukelman, & Low-Morrow, 1989; Katz & Wertz, 1997; Sparks, Helm, & Albert, 1973).

To our knowledge, the work reported here investigates the effects of a treatment approach not systematically studied previously in aphasia. This treatment—Spaced Retrieval (SR)—is a memory intervention that was developed for individuals with dementia. Its goal is to facilitate recall of important information over progressively longer intervals of time (Brush & Camp, 1998a, 1998b). It is essentially an errorless learning procedure. Because procedural memory is thought to be relatively less affected than other memory capacities in the early and middle stages of dementia, the rationale behind SR is to strengthen it to recall factual information. For example, a person can be guided to look at a memory card to recall factual information. SR uses a stimulus presentation schedule in which correct recall of the target information is followed by doubling the time interval before the next stimulus-response pair is presented. If the target information is not then recalled correctly, the time before the next attempt is decreased by half. These intervals between stimulus presentations make it possible to incorporate another treatment task into ongoing SR training. SR has been successfully used by rehabilitation professionals to help persons with dementia to remember, for example, orientation facts, compensatory strategies for safe swallowing, and how to use adaptive equipment (Brush & Camp, 1998b; Camp, Foss, Stevens, & O'Hanlon, 1996).

Although SR research indicates that it is useful for improving function in persons with dementia, it is not yet clear how it may compare to other memory intervention approaches. Bourgeois et al. (2003) compared the results of using SR to that of a cueing hierarchy for improving recall of strategies associated with an external memory aid by 25 persons with dementia. Even though both approaches had positive effects, the results suggested that SR may be a more feasible approach in this population.

Limited data are available to address whether SR could be used with disorders other than dementia. Recent work by Bourgeois and colleagues has used the SR paradigm in individuals with TBI, another problem that is accompanied by memory difficulties (Melton & Bourgeois, in press). Only one published study has reported using SR with a person with aphasia. Brush and Camp (1998b) employed SR with two persons defined as having had a stroke (one of whom appeared to have aphasia) and seven individuals with dementia. They found that SR facilitated recall of clinician's name, patient's room number, and a compensatory technique for naming difficulty. The persons with stroke learned the clinician's name faster than the persons with dementia (three vs nine sessions). However, only one aphasic individual participated in the study, and only limited documentation of the study design was provided.

The interstimulus intervals during SR administration provide an opportunity to treat another impairment in aphasia concurrently. Yet few investigators have provided details concerning what is done in the increasingly long intervals, or given guidelines concerning how to fill them. Therefore, we chose to fill these intervals with a second treatment task that was rigorous, simple to undertake, and not in conflict with the naming task central to this study. We chose Copy and Recall Treatment (CART)—an approach first described by Beeson (1999)—to work on single word writing. CART has been found to result in improved single word writing in persons with aphasia; its utilisation has been described and supported in the literature (Beeson, 1999; Beeson, Hirsch, & Rewega, 2002; Beeson, Rising, & Volk, 2003).

Given that SR can be used to improve recall of factual information by persons with dementia, it also might serve to strengthen lexical representations or access to lexical representations in persons with aphasia. The purpose of the present study was to explore the use of SR in improving lexical retrieval in persons with aphasia. It was also of interest to determine the relative treatment effect of SR when compared to another treatment approach designed to improve naming in aphasia. Therefore, SR was compared to a more traditional naming treatment (a cueing hierarchy) in terms of rate of acquisition and retention of trained items. CH was selected because it is a common technique for treating naming in aphasia, and thus likely to provide comparative data that would be meaningful to clinicians. CH was first described by Linebaugh and Lehner (1977) and has been used clinically and as a research methodology since that time. Because SR is an item-specific treatment approach, participants selected treatment items whose successful recall they thought might improve their quality of life.

METHOD

Participants

Three persons with aphasia served as participants. Participant 1 (P1) was a 58-year-old man who had an intracerebral haemorrhage at the age of 30 that initially resulted in global aphasia, evolving later to Broca's aphasia. P1 lived by himself for many years and takes care of all of his affairs with minimal assistance from his sister. At the time of this study, he had been a member of a university-based aphasia group for 8 years. His *Western Aphasia Battery* (WAB; Kertesz, 1982) aphasia quotient (AQ) was 67.9 with spontaneous speech characterised by minimal grammatical organisation and intermittent stereotypical utterances (Table 1). On the *Boston Naming Test* (BNT; Kaplan, Goodglass, & Weintraub, 1983), P1 scored 32 out of 60 possible points. When writing single words to dictation from the *Psycholinguistic Assessments of Language Processing in Aphasia* (PALPA; Kay, Lesser, & Coltheart, 1992), P1's responses were all phonologically implausible nonwords (e.g., b-e-g-e-a for swan).

The second participant (P2) was a 71-year-old man who was 12 years post ischaemic stroke which resulted in Wernicke's aphasia that later evolved to anomia. P2 lived with his wife in a retirement community and, like P1, had been a member of an aphasia group for several years. P2's spontaneous speech was marked by frequent word-finding difficulty and circumlocutions. His WAB AQ was 82.4 (see Table 1). He scored 35/60 on the BNT. P2 wrote 17 out of 40 words correctly on the "writing single words to dictation" subtest of the PALPA. Responses were marked by letter substitutions and deletions. A length effect was noted; that is, shorter words were written more accurately than longer words.

The final participant (P3), a 42-year-old man, suffered a stroke 14 months prior to study inclusion. At the time of stroke onset, P3 was employed as a construction worker, and he has not returned to work. P3 is a member of an aphasia group at a university speech and hearing centre. His language profile was consistent with anomia; he produced frequent semantic paraphasias but responded well to phonemic cues while naming common objects. P3's speech contained some phonemic paraphasias when describing the picture scene at the beginning of the WAB. His AQ was 75.4 (see Table 1). P3 scored 37 on the BNT and was able to write 15 of 40 words correctly on subtest 53 (written naming) of the PALPA.

Design

A single-subject design was employed across behaviours (oral vs written naming) and items (trained vs untrained items). Three words were trained per session for both oral and written naming. Because the oral naming treatments were administered concurrently with a single word writing treatment, untrained items used for writing were probed periodically during both oral

naming treatments, making it reasonable to determine experimental control by monitoring written performance on untrained words. As trained items were mastered, previously untrained items were added to each treatment protocol. Experimental control was further demonstrated by probing untrained words selected for the oral naming treatments. Two 45-minute treatment sessions were administered per week.

Treatment items

To make treatment as personally meaningful and functionally relevant as possible, each participant chose 30 words for the oral naming treatments and 30 words for the writing treatment (Table 2). Words were selected during an interview before treatment began. Also, P2's wife and P3's caregiver provided additional words for treatment. As is evident from the word lists, all three aphasic individuals chose general themes for their words. P1, having just recently received his driver's licence, was mainly interested in words related to car repair, but he also wanted to be able to write a grocery list. Before he participated in this study, he relied on drawing pictures of the items he needed to shop for. Being active on a neighbourhood committee, P2 wanted to be able to name its streets, as well as some of the tools that he used regularly in his woodworking shop. P3 was mostly interested in being able to name and write the names of items related to gardening and his former occupation. For all participants, words selected for oral naming were divided between SR and the comparison treatment so that they were balanced for word length and the number of proper and common nouns.

Treatments

Spaced retrieval—Three words were trained per session. Stimuli consisted of coloured or black-and-white pictures of each target item on a 6" × 4" note card. For P2, street names were elicited by highlighting the target street on a black-and-white map also presented on a note card. At the start of each session, the participant repeated the names of the three target items, followed by a 1-minute interval during which the same three pictures were presented again. If an item was named correctly, the time interval for the next stimulus-response trial was doubled for that specific item. If the picture was not correctly named, the participant was instructed to repeat the target word and the time before the next presentation of that specific item was halved. The time intervals were independent for each item; that is, it was not necessary for all three items to be named correctly for an increase in the time interval for the next stimulus presentation. For example, if an item was named correctly, then its interval was doubled; if the other two items were incorrect, then the time until the picture presentation was halved. To accurately track the interstimulus intervals for each of the three words, three stopwatches were used during each session. The shortest time interval was 1 minute; the longest was 16 minutes. For the verbal naming treatments, mastery of an item was determined as correct naming of the item at the beginning of a new treatment session. Following mastery of an item, an untrained item was entered into treatment. SR treatment was terminated when all 15 items had been mastered. To estimate the time spent on SR, an observer timed each SR-related interchange between the clinician and participant for two consecutive sessions. Based on these measures the total time used for administration of SR per session was estimated to be 12–15 minutes.

Cueing hierarchy—The cueing hierarchy was arranged by increasing the explicitness of the cues provided for each stimulus item (Table 3). Cueing was presented until the target word was elicited with fewer direct cues provided for each subsequent trial. All 15 items selected for the CH were drilled during the last 12–15 minutes of each CH session—providing equal time for both verbal naming treatments per session. For P1 and P2, CH was initiated when all 15 SR words had been mastered—to control for order effect, the order was reversed for P3.

Writing treatment—The Copy and Recall Treatment (CART; Beeson, 1999) was utilised to facilitate single word writing. It is a clinician-directed homework programme where treatment

sessions are used to establish correctly written names for a series of pictured items. Repeated writing of the target during treatment sessions was used to ensure that the participant could correctly complete the homework. Participants were expected to practice writing these picture names at home during the week, copying each word between 20 and 25 times daily. Three words were targeted simultaneously and mastery was determined as correct written naming of a picture for two consecutive sessions. As with the oral naming treatments, untrained items were added when previously targeted items were mastered. In cases when all CART items were mastered before the oral naming treatments were completed, the participants selected new words to be trained.

Baselines

Baseline performance for treatment items was measured in three consecutive sessions. No items targeted for the oral naming treatments were named correctly during this phase by P1 and P3. However, P2 named 1 of the 30 items correctly during a baseline session. Probing for this item was continued in the following session and a baseline of three incorrect responses was established.

Procedure

During treatment sessions, the participant was seated across a desk from the clinician in a room equipped with sound and video recording capabilities. Each treatment session started with a probe of previously trained items. The clinician presented a picture of each item and the participant was instructed to name it. No feedback was given until the probe was completed. To be scored as correct, the response had to match the target exactly, with no added or deleted phonemes. Participants were allowed to use carrier phrases if this facilitated correct naming. P1 occasionally used this strategy and sometimes named items by saying, for example, "I drive over overpass, ... it is an overpass."

After previously trained items were probed, SR was initiated. The time between SR stimulus presentations was spent on writing the words used as homework in the previous session. CH sessions followed the same general format. That is, a probe of previously targeted items was conducted at the beginning of the session, then homework was reviewed and written items were probed.

RESULTS

Response to naming treatment

Figure 1 shows oral naming treatment baseline and acquisition data for all three participants. As can be seen, both approaches were successful as naming treatments for these three participants. All 15 SR treatment items were mastered by P1, P2, and P3 in 14, 9, and 10 sessions, respectively. Correspondingly, CH training was completed in 13, 12, and 15 sessions. The average number of sessions needed for mastery of all SR items by the three participants was 11 compared to 13.3 for CH. Generalisation was not observed from trained to untrained items during the treatment phase, suggesting that experimental control was maintained throughout the study.

Post-treatment probes were administered at 3, 6, and 12 weeks after completion of each treatment phase by certified speech-language pathologists blinded to the purpose of the study. P1 correctly named 13, 9, and 13 SR trained items and 7, 9, and 6 CH trained items at 3, 6, and 12 weeks, respectively. Comparable numbers for P2 were 10, 11, and 8 on SR trained items and 7, 6, and 7 CH items. Finally, P3 correctly named 11, 7, and 8 SR trained items and 3, 6, and 7 CH trained items at 3, 6, and 12 weeks. When the data were compared by collapsing across the three subjects and the three post-treatment probes (that is, did one treatment approach

result in better recall across the three probes?), a distinct difference between the two approaches emerged. The total number of SR items named correctly was 90 compared to 58 CH items, resulting in a statistically significant difference between the two approaches, $\chi^2(2, N = 135) = 15.312, p < .0001$.

Writing treatment

All three participants consistently completed their weekly writing homework, and stable pre-treatment baselines were observed throughout. It took P1 30 sessions to reach mastery for the 30 CART items, P2 took less time (24 sessions), and P3 finished in 20 sessions. Because the oral naming treatment phase had not been completed for P3 when the 30 CART items had been mastered, 10 more items were added for CART. On the post-treatment probes, P1 was able to write 28, 23, and 23 of the words correctly at 3, 6, and 12 weeks, respectively (Table 4). Comparable numbers were 16, 11, and 16 for P2, and 11, 10, and 7 for P3. A correct response to an untrained item was not observed before or during the treatment. That is, no generalisation was noted from one treatment to the other or from trained to untrained written items.

Generalisation

Although response generalisation was not specifically assessed in this study, we recorded qualitative data supporting the notion that the treatments did make a “meaningful” improvement in participants’ quality of life. For example, when P1 returned for his 3-week retention probe of SR items, he brought in a grocery list that he had used the day before. He further stated that, for the first time, he was able to tell his mechanic that the windshield wipers on his car needed to be changed. P2 provided little information regarding his use of the treatment items in real-life situations; however, his wife reported that their children noted improvement in their father’s language when they talked to him on the phone. Finally, P3’s caregiver noted that his language was improving and it was getting much easier to understand his speech. It was also noted that as P3 improved in treatment, so did his confidence to communicate in aphasia group.

DISCUSSION

Based on these preliminary results, SR appears to be a viable approach to improve naming by persons with aphasia. Overall, SR compared favourably to CH, although a consistent pattern across participants was not observed on acquisition or retention probes. Collectively, fewer sessions were needed to master the SR items compared to CH items, and more SR than CH items were correctly named on the post-treatment probes.

These results can be compared to findings by Bourgeois et al. (2003) with Alzheimer’s disease patients. In their study both SR and CH proved to have a positive effect but, unlike the present study, there was no significant difference in the number of sessions needed to reach mastery criterion. However, the present study was consistent with Bourgeois et al. in that retention of SR treatment goals was greater than for CH goals at 1 week and 4 months post-treatment.

It is important to point out that acquisition and retention of items differed across the three participants and time-points. A total of 25 persons participated in the study by Bourgeois et al., suggesting that their results may be more robust compared to the present findings. It is equally important to keep in mind that the present participants were suffering from a static disorder—aphasia—as opposed to progressive dementia as in the group study by Bourgeois et al.

Although the present data support SR as a treatment for anomia, it is not entirely clear why it works. Certainly, the minimisation of errors that characterise the procedure is a factor to be

considered. Nevertheless, the effect of single word repetition on delayed retrieval of the same words has demonstrated only minimal or no treatment effect in aphasic individuals (Howard et al., 1985). However, Hillis and Caramazza (1994) suggested that continued oral repetition may facilitate in lowering the activation threshold for lexical items. It is possible that this occurred in the present study—lexical activation was probably maintained while participants worked on an alternative task, the writing treatment. This is consistent with findings that suggest improved retention in motor learning where series of stimulus–response pairs are interrupted by an unrelated task (Gabriele, Hall, & Buckolz, 1987; Gabriele, Lee, & Hall, 1991). However, results from studies of motor learning differed from this, in that longer time was required for acquisition compared to a stimulus schedule in which no interference occurred.

Although the focus of the present research was on the effects of SR as a naming treatment, the study also strongly supports the value of CART in improving single word writing. This result is consistent with previous findings by Clausen and Beeson (2003) who used CART successfully with four persons with severe aphasia and agraphia. Moreover, the present study suggests that CART can be used simultaneously with treatments targeting other behaviours without an apparent negative effect on the writing treatment. It is of interest to point out that the present study demonstrated the promising effects for interspersing treatments for two distinct behaviours, an approach given little attention in the language treatment literature.

Even though single subject designs are excellent for demonstration of experimental control, only limited assumptions can be drawn about external validity. Therefore, it is important that the effects demonstrated here be investigated further. It might be fruitful, for example, to study how SR works with persons who, in addition to aphasia, have problems with attention. The interference presented during the interstimulus interval may, in this case, affect the acquisition process so that SR might not be feasible. Finally, in some treatment situations it may be difficult for clinicians to keep close track of the interstimulus intervals. Therefore, it would be appropriate to investigate whether the tight control of interval timing is essential for SR to work as a naming treatment.

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Figure 1.

Oral naming treatment data for P1, P2, and P3. The solid line with round markers represents SR data while the dotted line with square markers represents CH; corresponding baselines for each treatment are presented along the Y-axis. Post-treatment probes are presented on the right. The vertical dotted line depicts when treatment started for each approach.

TABLE 1

Performance on WAB, BNT, and PALPA

	<i>P1</i>	<i>P2</i>	<i>P3</i>
WAB		Total of Aphasia Quotient	
Spontaneous speech	13	16	12
Comprehension	7.95	8.3	9.1
Repetition	5.8	8.4	9
Naming	7.2	8.5	7.6
Aphasia Quotient	67.9	82.4	75.4
BNT			
Total score	32	35	37
PALPA 53		Writing single words to dictation	
Raw score	0/40	17/40	15/40

Summary of participants' performance on the WAB, BNT, and the writing part of subtest nr. 53 on the PALPA.

TABLE 2

Treatment items selected by the participants

<i>Treatments</i>	<i>P1</i>	<i>P2</i>	<i>P3</i>
Spaced retrieval	Antenna, gas pump, windshield wiper, VCR, windshield, exit ramp, answering machine, orange, Lacy, Turn signal, gray, air filter, Dr. Holland, overpass, fanbelt	Via del Tejedor, sundial, calculator, Pica Maderos, casino, highway crossing, Tubac, Canoa Hills, box car, Iceland, answering machine, tape measure, Hacksaw, computer, crescent wrench	Stadium, panther, Charlie, broccoli, sprayer, MRI, pinecone, microwave, lettuce, Q-tip, pepperoni, bumper, celery, remote control, lobster
Cueing hierarchy	Dipstick, battery, thermometer, hatchback, brown, gutter, Julius, median, radiator, Dr. Beeson, lane, rearview mirror, wheel, break pads, remote control	Camino del Sol, cutter, air conditioning, Camino de Estilar, remote control, caliper, Via de la Urraca, hand drill, spatula Via del Tordo, pruning shears, Asia, Dr. Beeson, space shuttle, cultivator	Zucchini, rectangle, clipboard, plunger, shrimp, stroke, gloves, tanker truck, clover, artichoke, cassette, Leigh, grill, raspberries, mushrooms
Copy and recall treatment	Medicine, avocado, melon, milk, lettuce, yogurt, juice, bologna, bread, cookies, grapes, lunch, cereal, dinner, Carol, Julia St., razor, mangos, apples, oranges, papayas, corn, bananas, cantaloupe, soda, cat food, candy, pears, soap, deodorant	Cactus, Republican, aphasia, therapy, military, foreman, couch, estimation, carpenter, Packers, planning, teacher, garage, university, golf cart, refrigerator, garden, picture, furniture, desert, coffee table, living room, carpenter, stool, dining room, Lutheran, cabinets, kitchen, USS Rochester, pansies	Cucumber, fence, wheelbarrow, apricot, okra, cauliflower, pear, pineapple, spinach, pumpkin, caterpillar, watermelon, soil, lizard, banana, cantaloupe, grapefruit, shove, nest, fertilizer, tomato, rake, onion, garlic, butterfly, grasshopper, squash, lawnmower, cabbage

TABLE 3

Cueing hierarchy

<i>Cueing strength</i>	<i>Cue</i>
1	What's this called?
2	Can you tell me what you do with it?
3	Can you show me what you do with it?
4	You write with it. It's a. . .
5	You write with a ballpoint_____
6	You write with a [p]_____
6	Say pen

A cueing hierarchy used for facilitation of lexical retrieval described by Linebaugh and Lehner (1977). The order of cueing strength varies from 1 (weak) to 7 (strong).

TABLE 4**Results**

	<i>P1</i>	<i>P2</i>	<i>P3</i>
Sessions needed for mastery	30	24	20
Number of correct items on post treatment probes			
3-week probe	28	16	11
6-week probe	23	11	10
12-week probe	23	16	7

Number of sessions needed to complete the 30 CART items and the number of correctly written items on treatment probes administered at 3 and 6 weeks following treatment completion.