

Perseverative behaviour in fluent and non-fluent aphasic adults

NANCY HELM-ESTABROOKS, AMY RAMAGE,
KATHRYN A. BAYLES and ROBYN CRUZ

National Center for Neurogenic Communication Disorders, University of
Arizona, Tucson, Arizona, USA

Abstract

Perseveration by type (recurrent, continuous, or stuck-in-set) was examined for 30 stroke patients, 20 of whom exhibited fluent aphasia, and 10 with non-fluent aphasia. Comparisons were made between the two aphasic subject groups on two verbal and two non-verbal tasks. Twenty-eight of the patients (93%) produced at least one instance of perseveration. The most commonly occurring type was recurrent perseveration. Instances of continuous perseveration also were common and were produced by 18 patients. Stuck-in-set perseveration was uncommon with only two patients exhibiting this form of perseveration. No differences were observed in the frequency of perseveration across the four tasks between fluent and non-fluent aphasic patients. Perseveration was significantly correlated with aphasia severity, but not with time post-onset.

Introduction

The term 'perseveration' was coined by Neisser (1895) to indicate the inappropriate repetition or continuation of an earlier response after a change in task requirements. Various forms of perseveration have been described and different labels applied to behaviours observed on both verbal and non-verbal tasks. Most of these forms can be subsumed under the taxonomy of Sandson and Albert (1984) who described continuous, stuck-in-set, and recurrent types of perseveration.

Continuous perseveration was defined by Sandson and Albert (1984) as the inappropriate prolongation or continuation of a response beyond the point of completion and without interruption by an intervening event. For example, a patient may add extra loops when writing the letter 'm'. This type of perseveration is uncommon in normal subjects and is thought to be indicative of brain pathology (Albert and Sandson 1986, Bayles *et al.* 1985, Helmick and Berg 1976, Ramage *et al.* 1997, Sandson and Albert 1987).

Stuck-in-set perseveration is the inappropriate maintenance of a framework of response after introduction of a new task (Sandson and Albert 1984). An example of stuck-in-set perseveration is when a patient continues to list animals when asked to list words beginning with 's' in a generative naming task. This type of perseveration tends to occur on tasks requiring changes in response set. It is rare in aphasic individuals (Sandson and Albert 1987) and in non-brain-damaged individuals (Ramage *et al.* 1997).

Address correspondence to: Amy Ramage M.S., National Center for Neurogenic Communication Disorders, PO Box 210071, University of Arizona, Tucson, AZ 85721, USA.

Recurrent perseveration is defined as the inappropriate occurrence of part, or all, of a previous response after a different intervening stimulus, response, or both. For example, a patient names 'red' for *red* and later 'red' for *brown* in a confrontation naming task or says 'kun' for *gun* after naming *key*. Verbal recurrent perseveration is common in aphasia resulting from left hemisphere strokes. Santo-Pietro and Rigrodsky (1982) found that 63% of all errors made by 31 aphasic stroke patients on three verbal tasks (verbal sentence completion, confrontation naming, and word reading) were recurrent perseverations, with the highest rates of perseveration occurring on confrontation naming. Similarly, Emery and Helm-Estabrooks (1989) found that 50% of the confrontation naming errors made by their 30 aphasic patients were recurrent perseverations.

Yamadori (1981) found that 87% of his 38 aphasic patients demonstrated recurrent perseverative behaviour on four verbal repetition tasks. Severity of perseveration was not related to time post-onset or to aphasia severity classified as mild, moderate, or severe. Like Yamadori, Emery and Helm-Estabrooks (1989) observed no relation between time post-onset and perseveration severity. Helmick and Berg (1976), however, found significantly higher rates of perseveration in subjects tested during the first 6 months post-onset than in those tested after 6 months.

The relation of type of aphasia to type and severity of perseveration was studied by Emery and Helm-Estabrooks (1989) who found no significant differences between fluent and non-fluent aphasic patients. Albert and Sandson (1986), however, found that perseveration in confrontation naming was associated primarily with posterior lesion aphasias. Santo-Pietro and Rigrodsky (1982) reported the opposite; that is, patients with anterior lesions had higher rates of perseveration on verbal tasks than patients with posterior lesions.

Albert and Sandson (1986) stated that perseveration is an integral part of aphasia. One might hypothesize, then, that aphasic patients will produce higher rates of perseveration on verbal tasks than on non-verbal tasks such as sequential hand movements and repeated graphomotor patterns. Helmick and Berg (1976) and Sandson and Albert (1984, 1987) used non-verbal and verbal tasks in investigating perseveration in aphasic patients, but neither team of investigators compared frequency of perseveration for the two types of tasks.

The purposes of this study were four-fold: (i) to document the types of perseveration in aphasic patients, (ii) to compare perseveration in fluent versus non-fluent aphasia, (iii) to compare patterns of perseveration on non-verbal and verbal tasks, and (iv) to examine the relations among perseveration severity, aphasia severity, and time post-onset.

Methods

Subjects

Thirty adults with aphasia resulting from single left hemisphere strokes were tested with the Aphasia Diagnostic Profiles (ADP, Helm-Estabrooks 1992). The ADP yields aphasia classification profiles and aphasia severity levels based on weighted standard scores consisting of lexical retrieval, speech fluency, auditory comprehension, and repetition. Speech fluency is determined in the ADP with phrase length (number of words produced in a breath group or without a significant

pause), the average of the three longest phrases as elicited from three speech samples. Patients producing five or fewer words per phrase are considered non-fluent, those producing eight to ten words are borderline fluent, and those with greater than ten words are fluent. For the purposes of the present study, patients considered borderline fluent were excluded. Twenty subjects had a type of fluent aphasia (seven anomic, eight conduction, and five Wernicke's) and ten subjects had non-fluent aphasia (Broca's).

All patients spoke English as their primary language and were pre-morbidly right-handed. Nine of the 10 non-fluent and seven of the 20 fluent individuals had residual right-sided hemiparesis. All subjects had sufficient hearing acuity, aided or unaided, to pass a speech discrimination test at 80% or better accuracy and sufficient visual acuity, aided or unaided, to read newsprint. The characteristics of study participants are displayed in table 1. Fluent and non-fluent groups did not differ significantly in age ($t(28) = 2.42, p = 0.022$), estimated pre-morbid IQ ($t(28) = -0.88, p = 0.385$), years of education ($t(28) = -1.32, p = 0.20$), or ADP Aphasia Severity¹ ($t(28) = 1.94, p = 0.06$) (Bonferroni adjusted $\alpha = 0.01$). The groups did differ significantly in months post-onset ($t(28) = -3.85, p = 0.001$) with the non-fluent group being longer post-stroke. Subjects were recruited from community rehabilitation centres or from the University of Arizona Aphasia Clinic.

Tasks

Four tasks known to elicit various forms of perseveration were administered in a single session. Two of the tasks required non-verbal responses (Alternating Graphomotor Sequences (AGMS) and Three-Step Hand Movements (Luria 1965)) and two required verbal responses (confrontation naming and generative naming). The Appendix provides descriptions of each task and examples of perseveration scoring procedures. All verbal responses were tape recorded for transcription and non-verbal responses were recorded at the time of testing. To obtain the rate of inter-judge agreement, the responses of five randomly selected transcripts for the four tasks from each group were scored for presence and type of perseveration by two experienced speech-language pathologists. The total number of agreements in number of perseverations by type was divided by the total number of possible judgements. The inter-judge agreement was 88%.

Data analysis

Perseveration was computed as the proportion of the number of perseverations to the total number of responses. This made it possible to compare severity of perseveration between subjects who differed on the number of responses they produced and allowed for group comparisons with scaled scores across tasks. All perseveration scores were calculated in this manner for use in all statistical analyses.

¹ Four of the fluent aphasia patients achieved ADP Aphasia Severity standard scores of 125 or greater, placing them at or above the 95th percentile. However, these subjects were still considered aphasic based on their Lexical Retrieval standard scores (a composite of scores from the Personal Information, Information Units, and Naming sections) with all four subjects ranking at the 91st percentile for Lexical Retrieval.

Table 1. Demographic characteristics for the fluent and non-fluent aphasia groups

Variable	Mean (SD) Range	
	Fluent aphasia <i>n</i> = 20 (8 females, 12 males)	Non-fluent aphasia <i>n</i> = 10 (1 female, 9 males)
Age (years)	68 (10) 43–81	58 (12) 47–83
Education (years)	13 (3) 8–16	14 (3) 12–18
Estimated pre-morbid IQ ^a	108 (8) 93–122	111 (7) 104–125
Time post-onset (months)	23 (20) 3–76	88 (71) 2–205
ADP aphasia severity	108 (15) (65th %ile) 78–135 (7–99th %ile)	98 (11) (45th %ile) 7–117 (5–87th %ile)

^a Wilson *et al.* 1979.

Results

Perseveration by type of aphasia and task

Eighteen of the 20 fluent subjects had at least one instance of perseveration on a task (18/20 produced a recurrent perseveration, 13/20 continuous, and 0/20 stuck-in-set). All 10 of the non-fluent aphasia patients had an instance of perseveration (10/10 produced a recurrent perseveration, 6/10 continuous, and 2/10 stuck-in-set).

Recurrent perseveration was observed on all tasks, both verbal and non-verbal, and accounted for 76% (223/294) of all perseveration. Continuous perseverations also occurred on all tasks and accounted for 23% (69/294) of all perseveration. Stuck-in-set perseveration was uncommon (0.6%, 2/294) and occurred only on the verbal tasks (one instance on generative naming and one on confrontation naming). Perseveration by type on each task is presented in table 2. Recurrent perseveration most commonly occurred on the Confrontation Naming task, whereas most of the continuous perseveration occurred on AGMS.

Perseveration in fluent versus non-fluent aphasia and across tasks

Mean perseveration on each task produced by the fluent and non-fluent aphasic patients is presented in table 3. Perseveration for fluent and non-fluent subjects, across the four tasks, was compared using a mixed ANOVA design with one repeated factor (task) and one between factor (group membership) (see table 4). Neither main effects nor the interaction were significant thereby indicating no difference in perseveration for individual tasks or between the fluent and non-fluent groups. Additionally, effect sizes (partial η^2) were small, indicating that sample sizes would have to be considerably larger for significance to be achieved, given the differences among means.

Table 2. Perseveration type by task represented as percentage of total perseveration and percentage of perseveration on task

Task	Perseveration type					
	Recurrent		Continuous		Stuck-in-set	
	% Total	% Task	% Total	% Task	% Total	% Task
AGMS	4	16	20	84	0	0
Three-step	10	86	2	14	0	0
Confrontation naming	48	97	1	3	0.3	1
Generative naming	13	95	0.3	2	0.3	2

AGMS = Alternating Graphomotor Sequences, Three-step = Three-Step Hand Movements.

Table 3. Mean* (standard deviation) and range for perseveration by task and subject group

Tasks					
AGMS	Three-step	Confrontation naming	Generative naming	Composite verbal	Composite non-verbal
Fluent aphasia group					
0.13 (0.16)	0.08 (0.11)	0.07 (0.12)	0.09 (0.15)	0.16 (0.18)	0.21 (0.18)
0-0.55	0-0.33	0-0.47	0-0.50	0-0.51	0-0.55
Non-fluent aphasia group					
0.10 (0.18)	0.09 (0.11)	0.13 (0.11)	0.25 (0.31)	0.39 (0.36)	0.19 (0.22)
0-0.57	0-0.27	0-0.39	0-1	0-1	0-0.69
Entire sample					
0.12 (0.17)	0.08 (0.11)	0.09 (0.12)	0.14 (0.23)	0.23 (0.27)	0.20 (0.19)
0-0.57	0-0.33	0-0.47	0-1	0-0.51	0-0.69

* All perseveration was calculated as perseveration divided by total responses.
AGMS = Alternating Graphomotor Sequences, Three-step = Three-Step Hand Movements.

Table 4. Results from mixed ANOVA for perseveration by task and group membership

Source	MS	F	p	Effect size
Group	0.06	2.79	0.106	0.09
Error	0.02			
Task	0.03	1.27	0.292	0.04
Group × task	0.05	1.75	0.163	0.06
Error	0.03			

Perseveration on non-verbal versus verbal tasks

Because tasks could also be classified as verbal or non-verbal, perseveration composite scores were calculated for the two non-verbal (composite non-verbal) and two verbal (composite verbal) tasks and these were analysed using a mixed ANOVA. The repeated factor in this analysis was task (score defined as verbal and

non-verbal composite) and the between factor was group membership. Results were insignificant for both main effects and the interaction. Again, the effect sizes were small, ranging from 0.09 to 0.12 (partial η^2). Thirteen of the 30 patients perseverated on both non-verbal and verbal tasks. Of the remaining 17 cases, 11 perseverated only on verbal tasks, four on non-verbal and two on neither.

Relation between perseveration severity, aphasia severity, and time post-onset

The correlation of perseveration and aphasia severity, as measured by the ADP, was $r = 0.62$ ($p < 0.001$) for all subjects combined, $r = -0.48$ ($p = 0.03$) for fluent aphasia subjects only, and $r = -0.82$ ($p = 0.004$) for non-fluent aphasia subjects. As Aphasia Severity standard scores increased (language improved), perseveration decreased. The correlation between perseveration and time post-onset was not significant (all subjects: $r = -0.13$, $p = 0.486$; fluent aphasia subjects: $r = -0.22$, $p = 0.35$; non-fluent aphasia subjects: $r = -0.55$, $p = 0.102$).

Discussion

For over 100 years the phenomenon of perseveration, broadly defined as the inappropriate continuation or recurrence of an activity, has been noted in brain-damaged adults, including those with aphasia. In fact, perseveration is so common in aphasia that Albert and Sandson (1986) suggested that it 'may even comprise an integral part of [the] specific language deficits in aphasia' (p. 105). In their 1986 study, Albert and Sandson administered two verbal (confrontation naming and word list generation) tasks and two non-verbal (drawing objects to command and design generation) tasks to 18 aphasic patients. Responses were scored for three forms of perseveration: stuck-in-set, continuous, and recurrent. In summarizing their findings they stated that 'the nature of perseveration in aphasia is consistently recurrent' (p. 114). The present finding that 18 of 20 fluent and 10 of 10 non-fluent aphasic patients produced recurrent perseverations would appear to confirm that statement.

To account for recurrent perseveration, several investigators have cited memory impairments in the form of abnormal (or persistent) post-activation of memory traces of earlier responses (e.g. Buckingham *et al.* 1979, Hudson 1968, Albert and Sandson 1986, Santo-Pietro and Rigrodsky 1982, Shindler *et al.* 1984). According to this account, earlier responses remain active in working memory and act as a 'prime' for subsequent recurrent perseverations, especially when the new target stimulus is semantically related to a previous response (e.g. 'apple' for *pear* after previously naming 'apple'). Sometimes, however, the recurrent perseveration involves carry-over of a part of the phonemic make-up of a previous, semantically unrelated response (e.g. 'kack' for *jack* after naming 'kite'). Emery and Helm-Estabrooks (1989) conjectured that this form of perseveration occurs when motor speech memory traces fail to decay. In both types of recurrent perseveration, therefore, hyperactive memory for previous words has been cited as the responsible underlying mechanism. An alternative explanation is that previously spoken words remain in working memory as part of normal language processes and the problem in aphasia is the inability to inhibit the utterance of all, or part, of a previous response. According to this explanation, recurrent perseveration would be linked to disinhibition. In support of this hypothesis, Helm-Estabrooks *et al.* (1987) found

that some patients show greatly reduced production of recurrent perseveration when forced to inhibit or delay naming responses for a few seconds during a perseveration treatment programme.

Unlike Albert and Sandson (1986) who found little continuous perseveration in their aphasic subjects, in the present study 13 of 20 fluent and six of 10 non-fluent patients produced this form. The probable explanation for the different findings in the two studies relates to the nature of the tasks used. The two instances of continuous perseveration observed by Albert and Sandson occurred on the task of drawing a hand in which an extra finger was drawn. In contrast, the task of Alternating Graphomotor Sequences (AGMS) was employed in the present study and elicited 69 instances of continuous perseveration. Clearly, then, the nature of the task influences the rate and type of perseveration produced.

The AGMS task was devised by Luria (1965) to assess patients' ability to regulate and maintain a motor programme over time; a test of frontal lobe integrity. Luria proposed that 'efferent perseveration' (his term for continuous perseveration) results from pathological inertia of movement or a failure to stop a motor activity once begun. Lesion information was not available for the present study, but if Luria was correct, then it might be assumed that the seven fluent and four non-fluent aphasic patients who did not have instances of continuous perseveration had little or no frontal lobe damage. Hotz and Helm-Estabrooks (1995) and Ramage and colleagues (1997), however, found that AGMS elicited occasional continuous perseverations (approximately 2% of the total perseveration) in normal, non-brain-damaged subjects. This suggests that continuous perseveration is not solely resultant of frontal lobe damage, but instead may be the result of momentary lapses of attention and failure to monitor responses. Thus, there may not be a single underlying mechanism that is responsible for continuous (or recurrent) perseveration.

Stuck-in-set perseveration is thought to be caused by an inability to shift response criteria and has been linked to prefrontal lesions (Luria 1965). In the present study, none of the fluent patients and only two of the non-fluent patients studied displayed this form of perseveration. It should be pointed out, however, that only the task of generative naming (switching from naming fruits to then name animals) was likely to elicit stuck-in-set perseveration and largely failed to do so. Classically, this form is elicited by the Wisconsin Card Sorting Test (Heaton 1981) and subjects with various forms of brain damage produce stuck-in-set perseverations when taking this test. Thus, the finding that stuck-in-set perseveration was virtually absent in this study does not mean that aphasic stroke patients are not likely to produce this form of perseveration. Once again, the nature of the clinical task will dictate the occurrence of various forms of perseveration.

Emery and Helm-Estabrooks (1989) found no difference for perseveration between fluent and non-fluent patients on a confrontation naming task. The current study also found no difference in perseveration between the two groups on confrontation naming or across the four tasks. Additionally, no difference was observed in terms of perseveration for the verbal versus the non-verbal tasks. Importantly, 73% (22/30) of the aphasic patients displayed perseverations on non-verbal tasks, indicating that aphasic adults' perseveration is not confined to the verbal domain.

Only one previous investigator (Yamadori 1981) addressed the relationship between perseveration and aphasia severity. He reported that the two were not

significantly related, but failed to specify the measure used to quantify aphasia as mild, moderate, or severe. In the current study the composite, weighted standard score of aphasia severity from the ADP and perseveration were significantly related (i.e. the milder the aphasia the fewer perseverations were observed). Thus, perseveration appears to be an important clinical consideration for patients with more severe forms of aphasia.

No relation was observed between frequency of perseveration and time post-onset for subjects in this study. However, only two of the 30 subjects were within 6 months post-onset. In fact, the mean time post-onset was 45 months. Helmick and Berg (1976) reported that left-hemisphere stroke patients who were within 6 months post-onset had higher rates of perseveration than those who were more than 6 months post-onset. Had our subject sample contained more individuals who were within 6 months post-onset, a relationship may have been found between perseveration and time post-onset. However, only four of the 17 patients in the Helmick and Berg study were greater than 6 months post-onset and these were classified with mild to moderate aphasia, whereas the 13 patients tested during the first 6 months ranged from mild to severe. Thus, their finding of a relationship between perseveration and time post-onset may have been confounded by a relationship between aphasia severity and perseveration.

Summary and implications

The present study described frequencies and types of perseveration observed in fluent and non-fluent aphasia patients on verbal and non-verbal tasks. Perseveration, especially recurrent perseveration, appears (as suggested by Albert and Sandson 1986) to be a co-existing symptom of aphasia. Recurrent perseveration was the most common type observed, followed by continuous, with only a few instances of stuck-in-set perseveration occurring. No group or task effect for perseveration was observed. Perseveration was significantly related to aphasia severity, but not to time post-onset of aphasia. Results of this study indicate that perseveration continues to be a long-term problem for aphasic patients and affects both verbal and non-verbal performance.

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Appendix: Task descriptions

Non-verbal tasks

In the Alternating Graphomotor Sequences (AGMS) task, subjects were required to write a series of alternating graphic patterns ('m' and 'n'). Subjects who were not hemiplegic used their preferred hand. All other subjects used their non-dominant left hand. Both continuous and recurrent perseveration may occur on this task which was scored for the number of correct sequential elements and number of perseverations. Recurrent perseverations on this task occur when a subject produces an incorrect element (e.g. an 'm' with four humps) as part of the sequence and then repeats that graphic after intervening elements. A perseveration ratio was calculated by dividing the total number of perseverations produced by the total number of elements produced for each subject.

Example



Total elements: 15; continuous perseverations: 1; Ratio: 0.067.

In the Three-Step Hand Movements task, subjects were required to learn and then repeat (five times) three sequential hand movements (slap, fist, chop) with their left hand. All subjects were trained to perform the hand movements, using their left hand, until they were able to produce them without error and then five trials were performed independently for scoring. Movements were produced slowly and were recorded on-line. Both continuous and recurrent perseveration can occur on this task. Perseveration ratios were computed by dividing the total number of perseverations by the total number of hand movements produced by each subject.

Verbal tasks

In the Confrontation Naming (Boston Diagnostic Aphasia Examination or Treatment of Aphasic Perseveration stimuli) task, subjects were asked to name 38 pictured items representing seven semantic categories. Recurrent, stuck-in-set, and continuous perseveration can occur in this task. Perseveration ratios were computed by dividing the number of items that elicited at least one perseveration by 38 (total number of items).

In the Generative Naming task subjects were asked to name as many items as possible in 1 minute each for fruits or animals and words beginning with 's' or 'f'. Recurrent, stuck-in-set, and continuous perseveration can occur in this task. Perseveration ratios were computed by dividing the total number of perseverations by the total number of responses (correct and perseverative).