Motor perseveration in geriatric medical patients☆

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Abstract

Perseveration has long been considered as a pathognomonic sign of neurological disease, yet, surprisingly, little research exists regarding the accuracy of this assumption. This study matched 56 geriatric medical inpatients with 56 inpatients with recent cerebrovascular accidents. Participants were given one of two measures of general cognition and four Lurian tasks of motor coordination. The results suggest that both motor incoordination and across-tasks perseveration were associated with decreased cognitive status. After controlling for cognitive status, individuals with a neurological history evidenced greater dyscoordination and increased perseveration when compared to age-equivalent general medical patients. Perseveration in participants with recent strokes appeared more related to the amount of neural system disruption as opposed to specific lesion sites. Overall, the results suggest that motor incoordination and “stuck-in-set” perseveration are more indicative of global than localizable brain dysfunction. Possible nonneurologic factors associated with this behavior are also proposed as benchmarks for future research.

Keywords: Perseveration; Motor disorders; Geriatrics

1. Introduction

Perseveration is a frequently encountered yet poorly understood neurobehavioral occurrence. Prior research has hypothesized that perseveration is a pathognomonic sign of localizable neurologic dysfunction, with much of the current thinking drawing from Luria’s (1966)
studies of motor planning and perseveration. Luria suggested that damage to the premotor regions would cause both motor incoordination and “efferent motor” perseveration, secondary to disinhibition of primitive automatic movements. The degree of disturbance in a patient’s ability to switch smoothly from one motor movement to another was taken as a sign of the extent of cortical damage. Thus, greater degrees of perseveration were hypothesized to be present when the inhibiting influence of the basal ganglia had been reduced secondary to damage to the structure itself or to pathways connecting the basal ganglia to the frontal cortex. More recent theorists have furthered these hypotheses. Sandson and Albert (1984), for example, proposed that stuck-in-set (a failure to shift to a new task) as well as two other types of perseveration [continuous (within task) and recurrent (an intrusion from a previous task)] represent dysfunction in three specific anatomical, neuropsychological, and pharmacological systems.

Subsequent research, however, has been limited and has not consistently supported these hypotheses. For example, Malloy, Webster, and Russell (1985) found that perseveration on Lurian motor tasks, while occurring more frequently in patients with frontal lesions, also was quite common in individuals with posterior lesions. Similarly, Na et al. (1999) also reported recurrent perseveration during a line cancellation task occurring in patients with solely posterior pathology, although less frequently than in patients with anterior brain pathology or large anterior/posterior strokes.

In addition, some studies have demonstrated that all subtypes of perseverative behavior can occur in the absence of a known neurologic disorder. Sandson and Albert (1987), for instance, found that between 1% and 9% of their control subjects showed perseveration (as compared to the 3–12% of their subjects who had suffered a brain injury). Another investigation ascertained that approximately one-third of the combined younger and older normal groups had at least one instance of perseveration during a 30-min oral and written neuropsychological battery (Ramage, Bayles, Helm-Estabrooks, & Cruz, 1999).

While the above-noted study did not find a significant difference between younger and older subjects, there are numerous theorists who believe that any form of perseveration is a behavioral release symptom that is a hallmark of frontal lobe dysfunction or pathological aging (e.g., Adams, Victor, & Ropper, 1997; Sohlberg & Mateer, 1989). Thus, some (e.g., Grisby, Kaye, & Robbins, 1992) have specifically included Lurian motor tasks in their tests to assess disinhibition in frontal circuits as a marker of neurological disease, particularly dementia. Preliminary research into the Behavioral Dyscontrol Scale suggested that Lurian motor tasks were not associated with general cognitive function. Thus, motoric behavioral dysregulation was hypothesized to indicate a unique neurobehavioral domain associated with disrupted anterior cortical functioning (Kaye, Grisby, Robbins, & Korzun, 1990). While these theories are compelling, they are often countered by other investigations that suggest the traditional “pathognomonic” signs of neurological disease, including perseveration, may actually reflect aspects of successful normal aging (e.g., Hotz & Helm-Estabrooks, 1995; Odenheimer et al., 1994; Troster, Salmon, McCullough, & Butters, 1989).

Thus, given the limited and conflicting evidence, this study was undertaken to examine the nature and incidence of motor incoordination and perseveration in a population of older medical patients. The extant research has postulated a relationship between perseveration (particularly the “stuck-in-set” subtype) and anterior dysfunction and/or abnormal aging. We
hypothesized that perseveration, while occurring in both groups, would show a greater incidence in neurologic than general medical patients. In addition, we expected to see a higher rate of perseveration in patients with documented anterior pathology.

2. Method

Four tasks of reciprocal coordination [e.g., (1) alternating palms up/palms down, (2) alternating putting fingers out then making a fist, (3) alternating knocking twice with the right hand/once with the left, and (4) knocking twice with the left hand/once with the right] were included in a neuropsychological screening battery. In order to expose disinhibition in the motor system, we utilized Malloy and Richardson’s (1994) criteria of 10 consecutive (untimed) alternations as the standard for successful completion of each reciprocal coordination task. A gross motor planning score was obtained by summing the number of motor tasks failed (range 0–4). While errors in motor planning frequently occurred due to an inability to correctly obtain the motor pattern, this score also included those with failure due to loosing set or failure secondary to within-or across-tasks perseveration. In addition, specific “stuck-in-set” perseverations were recorded when a previously learned motor set was continued after the patient was asked to perform a new motor task (e.g., continuing to place palms up and down when asked to make a fist; range 0–3).

2.1. Participants

Participants were drawn from a sample of 172 consecutive geriatric (age 60 or greater) rehabilitation inpatients admitted to an urban academic medical center that were willing and capable of completing the 30–60-min screening battery. Fifty-six of these patients had suffered a recent stroke (within the previous month). Stroke location was classified according to localization information provided by the radiology record. Consistent with prior studies (Malloy et al., 1985), individuals were classified as having frontal or other cortical (parietal, temporal, or occipital) pathology. In addition, we also classified two other groups with strictly subcortical (basal ganglia, thalamus, caudate, and brainstem) or mixed cortical/subcortical pathology (either a lesion extending into two of the above noted categories or more than one lesion in two of the above locations). Five of the above patients had normal CT scans upon admission and lesion location. All five were classified as subcortical lesions based on the evaluation and diagnosis rendered by the attending neurologist of specific motor deficits in the presence of grossly intact cognition.

One hundred twelve individuals had no neurological history and were placed in an orthopedic/general medical group, the majority of whom were recent total knee or hip joint replacements. Fifty-six of these individuals were matched on demographic variables of age, education, number of prior medical conditions, and number of prescribed medications to the 56 participants in the neurologic group. Orthopedic/general medical and neurological groups were not statistically different in terms of basic demographic variables (see Table 1). Mean age of the subjects was 70.1 years (S.D. = 5.6), and mean education level was 9.5 years (S.D. = 2.9). A total of 39 males (35%) and 73 females (65%) were included; 52
Table 1
Demographic characteristics of the orthopedic/general medical and neurological groups by test given

<table>
<thead>
<tr>
<th></th>
<th>NCSE group</th>
<th>DRS group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ortho/med</td>
<td>Neurologic</td>
</tr>
<tr>
<td>Age (mean/S.D.)</td>
<td>69.3/5.4</td>
<td>69.0/5.5</td>
</tr>
<tr>
<td>Years of education (mean/S.D.)</td>
<td>9.5/2.3</td>
<td>8.8/3.2</td>
</tr>
<tr>
<td>Number of prior medical conditions (mean/S.D.)</td>
<td>4.2/1.7</td>
<td>4.1/1.5</td>
</tr>
<tr>
<td>Number of prescribed medications (mean/S.D.)</td>
<td>3.9/2.0</td>
<td>5.0/1.7</td>
</tr>
<tr>
<td>NCSE total</td>
<td>65.4/8.4</td>
<td>57.1/13.9</td>
</tr>
<tr>
<td>&gt;1 Motor task failed (%)</td>
<td>46 (13/28)</td>
<td>86 (24/28)</td>
</tr>
</tbody>
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As part of a larger study, subjects were randomly assigned by room number to be administered either the Mattis Dementia Rating Scale (DRS; Mattis, 1987) or the Neurobehavioral Cognitive Status Examination (NCSE; Kiernan, Mueller, Langston, & Van Dyke, 1987), now known as Cognistat. This resulted in four groups of 28 individuals who were matched on diagnosis and screening instrument given. The DRS manual provided normative data for this population. Norms for the NCSE from Drane, Yuspeh, Huthwaite, Klinger, and Hendry (1999) were used, whereby normal older subjects obtained a mean NCSE total score of 72.8 with a standard deviation of 4.8.

3. Results

Nineteen of the 112 individuals (17%) failed the tasks of motor planning secondary to across-tasks perseveration. Patients with known neurological disorders showed a 25% (7/28) rate of perseveration for both the DRS and NCSE groups, as opposed to the 4–14% rate for the orthopedic/medical groups. While demographic variables were not related to motor task performance, both the number of motor tasks failed (DRS group, \( r = -0.57, P < .001 \); NCSE group, \( r = -0.54, P < .001 \)) and the number of perseverations (DRS, \( r = -0.32, P < .05 \); NCSE, \( r = -0.35, P < .01 \)) were associated with general cognitive status. Perseveration was generally not seen in individuals who scored within two standard deviations of expected norms on their respective cognitive screening instrument, with the highest score of an individual who evidenced this behavior being 128 (−1.35 S.D.) on the DRS. Similarly, repeated perseveration was associated with significantly compromised cognitive status. Five of the six patients with multiple perseverations were also classified as impaired (>2 S.D. below the mean) on their respective cognitive screening instruments, with the other patient falling just above the cutoff (DRS total score of 124). Statistically controlling for cognitive status revealed that individuals with neurological diagnoses evidenced more failures on tasks of motor planning than the
Table 2
Performance on motor coordination tasks and perseveration by lesion location ($N = 56$)

<table>
<thead>
<tr>
<th></th>
<th>Frontal ($n = 7$)</th>
<th>Other cortical ($n = 11$)</th>
<th>Subcortical ($n = 25$)</th>
<th>Mixed cortical/ subcortical ($n = 13$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of participants failing at least one motor task</td>
<td>71 (5/7)</td>
<td>82 (9/11)</td>
<td>92 (23/25)</td>
<td>92 (12/13)</td>
</tr>
<tr>
<td>Percentage of patients perseverating</td>
<td>0 (0/7)</td>
<td>9 (1/11)</td>
<td>28 (7/25)</td>
<td>46 (6/13)</td>
</tr>
</tbody>
</table>

orthopedic/general medical group [DRS group, $F(1, 53) = 23.4, P < .001$; NCSE group, $F(1, 53) = 30.3, P < .001$] and also more perseverations [DRS group, $F(1, 53) = 10.1, P < .01$; NCSE group, $F(1, 54) = 5.6, P < .05$].

The effect of lesion location on motor planning abilities and perseveration was also examined. The 56 patients who had suffered recent strokes were divided into the four previously described groups based on lesion location. While between-groups differences were not statistically significant [$\chi^2(9, N = 56) = 11.8, \text{ns}$], patients with radiologically documented subcortical and mixed subcortical/cortical lesions tended to exhibit poorer motor planning and perseverate across tasks more frequently than frontal or other cortical lesions (see Table 2). Perseveration was not associated with anterior lesions in this sample, as none of the seven patients with solely anterior cortical pathology exhibited this behavior.

4. Discussion

The current study represents a preliminary investigation into the nature and incidence of motor perseveration. Two main findings emerged from this exploration: (1) motor or “stuck-in-set” perseveration did not localize to any particular brain region in our small sample of individuals with known neurologic illness; and (2) the behavior is closely tied to general cognitive status. Regarding prior hypotheses of anterior cortical involvement in this type of perseveration, we found that this behavior can potentially occur after an insult to any area of the brain (although our seven patients with frontal lesions surprisingly did not evidence motor perseveration). Consistent with Luria’s (1965) observations, we found a trend toward a greater expression of perseveration when several (e.g., subcortical and cortical) structures or neural networks were affected.

The suggestion that “stuck-in-set” perseveration is more a global than localized phenomena is also seen in this report’s failure to replicate the preliminary study of Kaye et al. (1990), whereby perseveration was hypothesized to be dissociable from general cognitive status (thus representing a unique neurobehavioral process arising from anterior dysfunction). Poor motor planning and perseverative behaviors were consistently associated with our two cognitive screening instruments. These results were particularly striking for the six participants who perseverated more than once, as their level of performance was at least 1.9 standard deviations below the mean on the cognitive screening instruments.

The association of motor perseveration with cognition also suggests that factors that influence cognitive status other than frank neurological disease can potentially affect the occurrence
of this behavior. For instance, this “pathognomonic sign” of neurologic dysfunction was also seen in our sample of individuals with general medical conditions. Granted, a neurologist did not screen our medical patients, and a portion of them may have had dementia or delirium as the cause of their cognitive decline. Equally as likely, however, is that acute and chronic medical conditions that are recognized as having cognitive sequelae were present in a percentage of the medical group (Ruchinskas, 2002). Similarly, it has been suggested that perseveration may occur as part of the normal aging process. While this study could not adequately address this issue due to the lack of a nonmedical control group and the restricted age range of the participants, future exploration regarding the status of perseveration in the continuum of normal to pathological aging is warranted.

Several additional limitations to our conclusions must be noted. For example, the restricted sample of solely frontal lobe lesioned individuals \( (n = 7) \) compromises power and restricts our ability to examine the role of anterior pathology in perseveration. Still, none of the seven patients with frontal lesions perseverated despite the fact that five of the seven were classified as impaired on their respective screening instruments. Additionally, precise neuroanatomical localization and specific lesion volume were not available, and it is well known that injuring different frontal lobe areas can result in different behaviors (Malloy, Bihrlle, Duffy, & Cimino, 1993). Also of note is that the evidence of structural abnormalities available for this study does not necessarily provide insight regarding neural network disruption. For example, individuals in this study with subcortical lesions evidenced high rates of motor dyscoordination and/or perseveration, a finding that is not surprising given these areas’ involvement in motor activation and subcortical/cortical networks (Heilman, Watson, & Valenstein, 1993; Lamar et al., 1997).

In conclusion, the results suggest that performance on tasks of reciprocal coordination and the occurrence of “stuck-in-set” perseveration are reflective of decreased general cognitive status that can likely, but not solely, be caused by neurologic disease. In patients with known neurologic disease, the presence of motor perseveration does not uniquely aid in ascribing damage to any particular brain area. Rather, the occurrence of this type of perseveration signals that many possible determinants (including decreased cognitive status, globalized brain dysfunction, and the possible effects of other medical diseases) need to be explored both in clinical practice and in future research. Allison (1966) has proposed that perseveration must be pronounced to be considered a pathognomonic sign of neurologic dysfunction. The current report echoes this standard and suggests interpretive caution when a single across-tasks motor perseveration is observed. Above all, our report emphasizes the need for a better conceptualization of perseveration that moves away from viewing this behavior as “all or nothing” phenomenon that indicates localized neurologic dysfunction. Continued investigation into the different potential nonneurologic contributors to “stuck-in-set” perseveration as well clarification of where this behavior falls in the continuum of normal to abnormal aging is clearly indicated.

References


