The Effects of Circumferential Wrist Pressure on Reproduction Accuracy of Wrist Placement in Healthy Young and Elderly Adults

Mitchell Batavia,1 John G. Gianutsos,2 Wen Ling,1 and Arthur J. Nelson3

1Department of Physical Therapy, School of Education, New York University.
2Department of Rehabilitation Medicine, New York University Medical Center.
3Physical Therapy Program, College of Staten Island, City University of New York.

Background. The purpose of this study was to determine the effect of circumferential wrist pressure on reproduction accuracy of wrist placement in healthy young and elderly adults. A convenience sample of 20 young adults having a mean age of 22.9 years and 20 elderly adults with a mean age of 68.2 years participated in the study.

Method. Blindfolded subjects were asked to actively select a neutral wrist position (reference) and then, when signaled, to actively reproduce the previously selected position. Wrist joint reproduction accuracy was assessed under four pressure conditions: no contact, wrist contact, 10 mm Hg, and 20 mm Hg. A single axis dynamic wrist electrogoniometer measured three dependent variables: absolute, constant, and variable errors. Data were analyzed by means of multivariate analysis of variance (MANOVA) for repeated measures.

Results. No significant differences in reproduction accuracy under the four pressure conditions for young or elderly adults were found.

Conclusions. Healthy young and elderly adults may utilize existing intrinsic feedback and central control mechanisms to achieve accuracy during a reproduction task. Some subjects in both age groups who entered into the study with high error scores benefited from circumferential pressure by possibly relying on peripheral mechanisms. Further studies are needed to determine the effect of circumferential pressure on subjects with poor reproduction performance.

Physical rehabilitation specialists are interested in methods of enhancing motor performance in individuals whose functional abilities are limited. Previous studies using passive–active testing paradigms report improved joint position accuracy when circumferential pressure is applied around the knee joint (1–6) or ankle joint (7–9). Enhancing joint position sense is relevant in rehabilitation because of its importance in motor learning, balance, and injury prevention (1,4,5) and may be especially relevant to elderly persons reliant on joint position sense in the dark when they are prone to falls and resultant injuries.

Previous studies used passive–active paradigms that entailed having the subject actively match a joint position passively specified by the experimenter. Subjects tested under these conditions may be more reliant on afferent (sensory) feedback for accurate limb placement. Feuerbach and colleagues (7) postulated that pressure application at the ankle improves joint position sense by increasing afferent (sensory) feedback from cutaneous receptors. Passive–active paradigms place insufficient emphasis on the fact that position sense is influenced by both peripheral and central (motor outflow) contributions (10). In humans, muscle spindle activity, critical to proprioception, does not operate independently of its gamma efferents (11). Hence, muscle spindles are dynamically active during motion. Moreover, cutaneous input is inhibited by voluntary movement (12). Furthermore, passive–active paradigms do not simulate real-life challenges and, therefore, are difficult to generalize to activities of daily living (13). Shortcomings of previous studies include a lack of controlled pressure application around the joint (1–9) and have unknown instrumental validity (1,4,5,6,8).

A review of the literature has not revealed studies investigating the effect of circumferential pressure on active–active reproduction accuracy of limb position. Active–active paradigms require the subject to actively match a limb position to a target actively selected by the subject (preselection). Subjects tested with such a reproduction task may rely primarily on efferent (motor) signals derived from motor programs originating from the central nervous system and less so on afferent (sensory) feedback accompanying accurate limb placement (13). Although an age-related decline in position sense measured at a single joint has been demonstrated using passive–active matching paradigms (1,5,14–18), age may not be a factor in accuracy of joint placement under active–active conditions.

The purpose of this study was to determine if age or circumferential pressure affects accuracy of a motor task under active–active conditions. This study addressed the theoretical basis of sensory input on movement accuracy during a voluntary movement to determine if enhanced sources of afferent feedback facilitate motor control during active movement. No differences in reproduction accuracy between young and elderly adults or under the four pressure conditions for either age group were expected.

Method

Subjects.—A convenience sample of 20 healthy young and 20 healthy elderly adult volunteers between the ages of 18–30 and 60–75 years, respectively, was recruited through local advertisements and flyers in the New York City metropolitan area.
Ten men and 10 women served as subjects in each age group. With the exception of one young adult, all were right-hand dominant. Exclusion criteria included the presence of neurological disease, vascular disease, or musculoskeletal problems in the dominant upper extremity. This study was approved by the New York University Medical Center’s Institutional Review Board. Informed consent was obtained from all subjects, who were paid twenty dollars for participating.

**Instrumentation.**—A single axis dynamic wrist electrogoniometer was utilized to measure movement reproduction accuracy in the sagittal plane. This type of device is reported to be accurate, reliable, and useful in controlled laboratory investigations involving a single joint (19) and in functional wrist movement studies (20). The electrogoniometer used in this study did not provide contact cues over the wrist area and provided less than 1 mm Hg of pressure over the forearm across all conditions.

The electrogoniometer, constructed by bioengineers at NYU Medical Center, weighed 7 ounces and consisted of parallelogram-configured metal rods linked to a potentiometer mounted on a dorsal and forearm piece. Movements of the electrogoniometer falling within a 165-degree range resulted in a voltage output from the potentiometer, which was converted to a joint angle measurement (0.0225 volts = 1.0 degree) by means of a position sense software.

An aneroid sphygmomanometer, which delivered and measured circumferential wrist pressure, consisted of a newborn inflation bag and cuff of 1.5-inch width (Tyco Instruments, Model 5082-07, Arden, NC), hollow rubber tubing, a plastic T fitting, an inflation bulb, an aneroid pressure gauge, and a Velcro strap. The inflation bulb filled the inflation bag with air at pressures indicated by the gauge. The aneroid sphygmomanometer detects pressures ranging from 0 to 300 mm Hg in 2 mm Hg intervals. Pressures ranging from 0 to 20 mm Hg were utilized in this study.

Concurrent validity of the electrogoniometer was determined by comparing its voltage output with values obtained from a clinical goniometer attached to the hand and forearm piece of the electrogoniometer. Concurrent validity, ICC (2,1) = 0.99, p < .001, and test-retest reliability, ICC (2,1) = .99, p < .001, data of the electrogoniometer were good, as determined by intraclass correlation coefficients. The standard error of measurement (SEM) of the electrogoniometer on repeated measures for eight angles (within the measurement range of the study) was small, ranging from 0.023 to 0.052 with a median SEM of 0.026. The electrogoniometer had an absolute error of 0.4 degrees.

Concurrent validity of the aneroid sphygmomanometer was determined by attaching and comparing measurements of the aneroid sphygmomanometer with a mercurial sphygmomanometer. Concurrent validity and test–retest reliability of the pressure gauge were good, ICC (2,1) = .99, p < .001, and ICC (2,1) = 1.0, p < .001, respectively. Concurrent validity of the electrogoniometer and aneroid sphygmomanometer was reconfirmed at the completion of the study.

**Procedures.**—To ensure consistency of procedures, a checklist was followed. Subjects were randomly assigned to one of four possible pressure sequences. Then they completed a demographic and health questionnaire, an Orientation-Memory-Concentration test [OMCT; (21)], a physical activity question-
subject's skin with the gauge needle indicator output at 0.00 mm Hg. For the mild pressure condition, the cuff was inflated to 10 mm Hg while the wrist was actively maintained in a neutral position. For the moderate pressure condition, the cuff was secured around the subject's wrist as previously indicated with the bag inflated to 20 mm Hg. Pressure during the last two conditions was maintained by use of a hemostat.

Design.—A 2 × 4 repeated measures design with a between-group factor of age and a within factor of pressure was utilized. A balanced 4 × 4 Latin square served to counterbalance the sequence of pressure conditions for each age group (23).

Data analysis.—For each trial, peak wrist joint extension was recorded for both reference and reproduction measurements. An error score, in degrees, was derived by subtracting the reference measurement from the reproduction measurement. The error scores from the 10 trials were then averaged to calculate a subject's absolute error (AE), constant error (CE), and variable error (VE) for each condition using the unsigned differences, signed differences, and the standard deviation of the signed differences, respectively (24). Consonant with similar studies to effect comparisons, absolute, constant, and variable errors were calculated. These measurements provide information regarding the accuracy, bias, and consistency of achieving a target, respectively.

Because elderly adults have been reported to undershoot targets when tested during passive-active paradigms, constant errors were analyzed (15,16).

Data were analyzed utilizing a multivariate analysis of variance (MANOVA) with an alpha level set at .05 using the Statistical Program for the Social Sciences (SPSS), Advanced Windows version 6.1.2 (SPSS Inc., Chicago, IL).

RESULTS

Table 1 shows group demographics and performance on the PAQ and the OMCT. Young and elderly adults performed similarly on the PAQ, implying that the two groups had similar physical activity levels. OMCT scores, although significantly different with t tests for independent groups, t = 2.02, p = .05, indicated no memory deficit in either group. No differences between age groups were found for two-point discrimination at the wrist with t tests for independent groups, t = 0.08, p = .93.

Table 2 contains raw absolute error scores of the young and elderly adults for the four pressure conditions. Mean absolute error scores for elderly adults were smaller than those of young adult scores under all pressure conditions. Errors were greatest for both groups during the no-contact condition and smallest for both groups under moderate pressure conditions. Raw constant error scores of the young and elderly adults for the four pressure conditions are presented in Table 3. In con-

<table>
<thead>
<tr>
<th>Table 1. Group Demographics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>Age</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>PAQ*</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>OMCT†</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

*Physical Activities Questionnaire.
†Orientation Memory Concentration Test.

<table>
<thead>
<tr>
<th>Table 2. Summary of Means and Standard Deviations of Raw Absolute Errors (degrees) for Young and Elderly Adults During Four Pressure Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>No Contact</td>
</tr>
<tr>
<td>Young adults (n = 20)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Elderly adults (n = 20)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Total (N = 40)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 3. Summary of Means and Standard Deviations of Raw Constant Errors (degrees) for Young and Elderly Adults During Four Pressure Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>No Contact</td>
</tr>
<tr>
<td>Young adults (n = 20)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Elderly adults (n = 20)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Total (N = 40)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 4. Summary of Means and Standard Deviations of Raw Variable Errors (degrees) for Young and Elderly Adults During Four Pressure Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>No Contact</td>
</tr>
<tr>
<td>Young adults (n = 20)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Elderly adults (n = 20)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Total (N = 40)</td>
</tr>
</tbody>
</table>
trast to absolute error patterns, mean constant error scores for elderly adults were greater than those of young adults for all pressure conditions except for the no-contact condition.

Raw variable error scores of the young and elderly adults for the four pressure conditions are shown in Table 4. For the elderly adult group, variable error patterns were similar to the absolute error trend with progressively smaller errors occurring with increasing pressure.

**Data transformations.**—Raw variable errors were positively skewed for all pressure conditions and responded well to log 10 transformations. Consequently, log 10 transformed variable error scores were used in the analyses. In contrast, raw absolute and constant error scores were analyzed in their original untransformed states.

**Inferential statistics.**—A MANOVA was used because the dependent variables were correlated (23) and the data showed appropriate homogeneity (25). The results of the MANOVA indicate that the two groups behaved similarly. No significant differences were obtained regarding reproduction accuracy of wrist placement during the four pressure conditions in healthy young adults, in healthy elderly adults, or between healthy young and elderly adults under the four conditions. Between-subjects main effects of age group were not significant \( F(3,36) = 0.96, p = .42 \). Within-subjects main effect of pressure was not significant \( F(9,30) = 0.83, p = .59 \). The interaction effect of Age \( \times \) Pressure was not significant \( F(9,30), p = .56 \). Furthermore, a repeated measures ANOVA revealed no statistically significant differences for sequence \( F(3,114) = .45, p = .72 \], implying that a practice effect did not occur. Finally, no relationship was found between the variability in a subject's choice of target location and absolute error scores in the 40 subjects, suggesting that accuracy was not related to the subject's consistency in choosing a reference target.

**Supplementary analyses.**—In a previous study, Perlau and colleagues (4) noted a 66% improvement in position sense at the knee of healthy adults (ages 22–40) following pressure application if the subject had a pre-bandage error score of 5 degrees or more. A trend was also noted in this study, in that subjects who entered into the study with higher absolute error scores (no-contact condition) tended to demonstrate greater reduction in errors with mild pressure. This suggests that these individuals benefited most from pressure application (Figure 2).

Subjects were therefore regrouped, regardless of age, into a low error group \( n = 26 \) if they scored below 5 degrees of error during the baseline (no-contact) condition or into a high error group \( n = 14 \) if they scored at or above 5 degrees of error during the baseline (no-contact) condition (4). Of the 14 subjects in the high error group, 8 were young adults and 6 were elderly adults. There was no significant relationship between age and square root transformed absolute error scores in the high error group, \( r = .01, p = .97 \) or the low error group, \( r = -.17, p = .38 \).

Means for low and high group raw absolute errors during the four pressure conditions are plotted in Figure 3 and reveal a small increase in errors for the low error group and a large decrease in errors for the high error group under the mild pressure condition. Absolute errors were square root transformed because of significant positively skewed distributions.

Although significant, MANOVA was not conducted because the multivariate Box's M test for homogeneity was not satisfied (25). Rather, to explore the effect of circumferential pressure on high and low error groups, a two-way repeated measures ANOVA with one between (error group) one within (pressure) was conducted.

Unweighted square root absolute error means (unique sums of square) were used in the analysis because of unequal sample size. Homogeneity of variance tests was not significant for the two-way ANOVA. A nonsignificant Mauchly sphericity test indicated that the assumption of compound symmetry was satisfied. Error Group \( \times \) Pressure interactions were significant \( F(3,114) = 5.32, p = .002 \). Simple main effects were significant for the high error group \( n = 14 \), \( F(3,114) = 5.88, p < .01 \), but not for the low error group \( n = 26 \), \( F(3,114) = 0.59, p > .05 \).

Post hoc Tukey tests were significant only for the high error group between the no-contact and mild pressure and the no-contact and moderate pressure conditions. The two error groups were significantly different under the no-contact condition \( F(1,38) = 98.52, p < .001 \) and wrist contact condition \( F(1,38) = 24.14, p < .001 \). The two error groups were not significantly different under the mild pressure condition \( F(1,38) = 1.6, p = .21 \) or using a Mann-Whitney comparison, under the moderate

![Figure 2](https://example.com/figure2.png)  
**Figure 2.** Bar graph of baseline untransformed absolute error scores under no contact conditions and change in absolute error scores during mild circumferential pressure conditions (\( N = 40 \)).

![Figure 3](https://example.com/figure3.png)  
**Figure 3.** Absolute error of low and high error groups during four pressure conditions.
pressure condition, suggesting that performance of the high
error group improved relative to that of the low error group with
mild and moderate circumferential pressure. It should be noted
that for the high error group, either a practice effect or a regres­sion
to the mean is possible.

Finally, t tests yielded no significant differences between the
high and low error groups on the PAQ, two-point discrimina­tion,
wrist joint range of motion, or OMCT scores.

**DISCUSSION**

**Central mechanisms and movement reproduction.**—This study
showed that circumferential wrist pressure did not universally af­fect
reproduction accuracy of wrist placement in healthy young or
elderly adults during an active–active paradigm. As detailed in
Tables 2 through 4, differences between elderly and young adults’
errors were small and not statistically significant. An active–active
testing paradigm was used, and for some, but not all subjects, in­formation
from motor outputs and existing intrinsic feedback was
sufficient to enhance accuracy during the task. Note that one
source of variance may be related to the fact that an electro­
goniometer was used in this study. Camera-based motion analysis
was not used in the present study because unwanted contact cues
emanating from the reflective markers, which are applied directly
over the joint of interest, would confound the effects of pressure
application. In addition, Klein and DeHaven (26) report that mo­tion
analysis systems inherently increase measurement error as a
neutral position (i.e., 180 degrees) is approached (a joint position
well within the range used in this study).

The theories of Kelso and Wallace (13) hold that active–active
testing paradigms rely predominately on central motor control
mechanisms through corollary-discharge signals present during
active target selection.

In this study, active testing may have enabled subjects to pro­cess incoming information about target location efficiently dur­ing
both phases of the task. Stelmach and Sirica (17) also main­tain
that corollary discharge has a preselection effect for target
location, whereby motor signals prepare sensory mechanisms
for the sensory consequences of movement.

Neuroanatomic pathways that support the corollary dis­charge
hypothesis include ascending flexor reflex afferent (FRA)
paths and extensive interconnections between the motor cor­tex and anterior lobe of the cerebellum (27). In addition, de­scent­ing control of muscle spindles provides a central (effort­
ent) control mechanism for maintaining sensitivity of muscle
spindles length and can ensure continued supply of information
about muscle length to higher centers (28).

The present findings are consonant with those of upper ex­tremity
movement reproduction studies in humans in which healthy subjects demonstrated significantly lower errors in the
reproduction task only during an active condition (29–30). Our
findings are also consistent with multi-joint upper extremity dis­placement studies in which intrinsic feedback, reportedly dimi­nished in the elderly subjects (31), did not affect accuracy in
the elderly adults as compared to the accuracy of young adults
under active testing conditions (17,18). According to Stelmach
and Sirica (17), central control mechanisms operating during
preselected movements can compensate for diminished propri­oeception in elderly adults by enhancing the encoding of infor­mation about the sensory consequences of movement. Previous

studies that have found age-related position sense differences
have tested subjects under passive conditions, where central
control mechanisms may not be invoked. In contrast, no age-re­lated differences in the reproduction task were found in the pre­sent
study, because the active–active paradigm allows access to
utilization of central control mechanisms.

Age seems to be a factor in determining accuracy of move­ment
reproduction under passive conditions. Both Meeuwsen
and colleagues (16) and Kaplan and colleagues (15) noted that
elderly adults tend to undershoot target position during passive
testing. These researchers speculate that the elderly adults at­
tempt to monitor their movements to a greater extent than
young adults by relying on sensory feedback (15).

Although comparison of elderly adults’ performance during
passive movement was not examined in the present study, one
could speculate that elderly people may operate under different
modes of control during active testing versus passive testing.
Under passive testing conditions, the elders may be monitoring
their performance, albeit with diminished peripheral feedback,
resulting in a more cautious performance and greater underesti­mation of joint targets as compared with a younger adult group.
However, under active testing procedures used in the present
study, elderly adults actually overshot their targets more so than
young adults. The healthy elderly group may have been relying
on motor programs requiring less monitoring during perform­ance,
thereby resulting in less cautious performance than is
more characteristic of the young adult group.

The findings in the present study contradict those in previous
research found under passive testing conditions comparing posi­tion
sense accuracy of young and elderly adults (1,5,14,16). Age­related neurological and morphological changes found in elderly
adults (31,32) have been postulated as the cause of diminished
proprioceptive performances in elders. Proprioceptive perform­ance in the elderly group, however, was commonly tested pas­sively in previous studies (4), thereby negating the important con­tribution of central control mechanisms (such as corollary
discharge) to proprioception during voluntary movement. Few
functional activities in life are analogous to passive position sense
tests (10,13). Testing under active conditions may better simulate
conditions that approximate real life, such as reaching, transfer­ring, or walking in dark surroundings. From this viewpoint, it is
more reasonable to test proprioception in elderly adults using an
active–active paradigm in order to assess the contribution of cen­tral
control mechanisms to enhance functional performance.

**Peripheral mechanisms and movement reproduction.**—
Supplementary analysis in this study was prompted by previ­ously
reported findings that subjects with poorer position sense may
derive greater benefit from circumferential pressure than
those with good position sense. Error is one of a number of
ways that subjects could have been assigned to groups. The
findings in this study suggest that the subject’s entering perfor­mance
could have been tested passively in previous studies (4), thereby negating the important
contribution of central control mechanisms (such as corollary
discharge) to proprioception during voluntary movement. Few
functional activities in life are analogous to passive position sense
tests (10,13). Testing under active conditions may better simulate
conditions that approximate real life, such as reaching, transfer­ring, or walking in dark surroundings. From this viewpoint, it is
more reasonable to test proprioception in elderly adults using an
active–active paradigm in order to assess the contribution of cen­tral
control mechanisms to enhance functional performance.

Regardless of age, joint reproduction accuracy was enhanced
through sensory feedback derived from circumferential pres­sure in subjects entering with high error scores, and failed to be
enhanced in their low error entering performance counterparts.
As Figure 3 illustrates, additional sensory input reduced abso­lute
errors (1.90 degrees) in the high error group, but increased
them slightly (0.54 degrees) in the low error group. Subjects having higher entering error scores may have engaged (i.e., been more actively involved) in the task only when additional augmented feedback in the form of circumferential pressure was imposed.

The findings in the supplementary analyses of this study are consistent with the results of Perlau and colleagues (4) in which a 66% improvement in position sense resulted following elastic bandage application in a poor position sense group, whereas no measurable changes were found in the good position sense group. Interestingly, individuals in the present study who entered with low error scores did not tend to benefit, and in some cases even deteriorated during pressure application (Figure 2). This trend substantiates Perlau and coworkers’ (4) suggestion that enhanced afferent stimulation may serve to confuse individuals who have inherently good position sense. Possible detrimental effects of sensory feedback have been demonstrated with visual (13), auditory (31) and cutaneous inputs as well (12).

Other studies have shown the efficacy of circumferential pressure on position sense in patients with osteoarthritis or total knee replacements who tested poorly on position sense (1,5). In contrast, following elastic bandage application, position sense was not improved in subjects with good position sense.

The notion of improved accuracy with augmented sensory feedback in high error groups is not without merit when one considers the importance of proprioceptive inputs, derived from cutaneous, joint, and muscle spindle receptors to joint position sense (33), or that cutaneous afferents are the defining input for proprioception (34). Cutaneous mechanoreceptors have both a facilitative (35) and specific role (36) in position sense. Rapidly adapting receptors may respond to dynamic stimuli such as the movement of a bandage over the skin (2,4). Slowly adapting receptors, such as Ruffini cutaneous receptors, may provide both static and dynamic proprioceptive input in response to pressure (4).

Evarts (37) studied monkeys and found that kinesthetic inputs involve short latency responses to and from cerebral cortex of the order of 35 msec. This suggests that there is sufficient time for kinesthetic inputs to influence motor output during voluntary movements. It is therefore entirely possible that during the present study, there was adequate time for peripheral mechanisms to influence movement reproduction.

Conclusions.—Healthy young and elderly adults do not differ in their ability to actively reproduce a wrist movement and may utilize existing intrinsic feedback and central control mechanisms to achieve accuracy during a reproduction task. Circumferential pressure did not enhance accuracy in either age group.

Some subjects in both age groups who entered into the study with high error scores may have benefited from circumferential pressure, possibly by relying on peripheral mechanisms. However, because the present study was not designed to examine the effects of circumferential pressure on reproduction accuracy in high and low error groups, further studies, using active–active paradigms in a planned comparison, are needed. In addition, studies that examine the effect of circumferential pressure on reproduction accuracy in individuals with central nervous system disorders are warranted.

Acknowledgments

This work was funded in part by a grant from the U.S. Department of Education, National Institute of Disability and Rehabilitation Research for physical therapy clinical research. It was accepted as an abstract and platform presentation at the APTA Physical Therapy 1998 Scientific Meeting and Exposition, Orlando, FL.

We gratefully acknowledge Dr. Sharon L. Weinberg for her feedback on statistical analyses; Carl Mason and Aaron Beattie for their technical support of instrumentation and computer programs; Linda Medford for her assistance in the fabrication of material for the electromyograph; and Christine K. Wade for her English translation of a German journal article.

This study was completed in partial fulfillment of the requirements for Dr. Batavia's Doctor of Philosophy degree in the School of Education, New York University.

Address correspondence to Dr. Mitchell Batavia, Department of Physical Therapy, New York University, 380 Second Avenue, 4th Floor, New York, NY 10010. E-mail: mitchell.batavia@nyu.edu

References


Received August 22, 1997
Accepted May 28, 1998

---

Nominations for Editor-in-Chief

THE GERONTOLOGIST

The Gerontological Society of America Publications Committee is seeking nominations for the position of Editor-in-Chief of The Gerontologist, to become effective January 1, 2000. The usual term is four years. The Editor will make appointments to the editorial board, work with reviewers and authors, and take the final responsibility for the acceptance of articles for the journal. The editorship is a voluntary position. Candidates must be members of The Gerontological Society of America and dedicated to developing a premier multidisciplinary journal.

Nominations and applications may be made by self or others but must be accompanied by a curriculum vitae and a statement of willingness to accept the position. **Deadline for nominations is April 15, 1999.** They should be addressed to:

Heather Worley  
Director of Publications  
The Gerontological Society of America  
1030 15th Street, NW, Suite 250  
Washington, DC 20005-1503.