Age Differences in Functional Performance

Anne E. Dickerson, Anne G. Fisher

Key Words: activities of daily living evaluation • aging • function

We compared the functional performance of 20 young adult women and 20 older adult women on two types of tasks. One type of task was normal instrumental activities of daily living (e.g., meal preparation, home maintenance) that were meaningful, familiar, and well practiced. The other type was a contrived, relatively unfamiliar task of wrapping a package. Although young and old women did not differ significantly in their familiarity with the two tasks, results from two repeated measures MANOVAs revealed a significant age difference in both activities. This finding suggests that older adults show age-related decline with tasks even when those tasks are familiar, practiced, and ecologically valid.

Anne E. Dickerson, MS, OTR, is a doctoral candidate, Department of Psychology, Florida International University, Miami, Florida. At the time of this study, she was an Associate Professor, Department of Occupational Therapy, Florida International University, University Park, Miami, Florida. (Mailing address: 230 Pontiac Street, Denver, Colorado 80220)

Anne G. Fisher, PhD, OTR, is Professor, Department of Occupational Therapy, Colorado State University, Fort Collins, Colorado.

This article was accepted for publication April 7, 1993.

A number of research studies have been conducted to identify the effects of aging on motor and cognitive skills. Research findings typically reveal substantial age-related declines in performance when young and older adults are compared. Although it is widely recognized that the physiological and cognitive changes associated with age do limit performance, it is difficult to distinguish between the changes due to aging per se and those due to differing amounts of physical activity, motivation, experience, occurrence of disease, and societal expectations (Spirduso & MacRae, 1990). Specifically, studies have demonstrated that when tested in familiar environments with ecologically valid tasks (i.e., naturalistic, familiar, meaningful tasks to a person), older adults perform as well as young adults (Akiyama, Akiyama, & Goodrich, 1985; Kirasic, 1991; Sharps & Gollin, 1987). Very few studies, however, have used functional performance in activities of daily living (ADL), the domain of occupational therapy, as a context of study.

Inclusion of functional performance studies in the research on aging is important, for there is literature to question the external validity of traditional intelligence and other psychometric test instruments (Akiyama et al., 1985; Baltes & Willis, 1982; Cavanaugh, 1982; Denney & Palmer, 1981; Hartley, Harker, & Walsh, 1980; Salthouse, 1982; Sharps & Gollin, 1987). Additionally, functional performance evaluations are being recognized as superior to the self- or proxy reports generally used to report physical functioning (Guralnik, Branch, Cummings, & Curb, 1989; Rubenstein, Schayer, Wiefand, & Kane, 1984).

This study examined age differences in functional performance associated with normal aging. The objective was to compare the abilities of young adult and older adult women on meaningful and practiced daily living activities on which they were expert, and on a less familiar, more contrived daily living activity that they had less opportunity to practice. This study was based on the assumption that older persons are likely to demonstrate some motor and process deficits relative to young adults. However, when performing familiar and meaningful tasks, older adults may be able to compensate for inefficiencies or deficits and perform relatively more proficiently than when they perform a less familiar, more contrived task.

Background

Most will agree that as the body ages, physical capacities decline. For example, studies have found age-related differences in bimanual coordination processes (Stelmach, Amrhein, & Goggin, 1988), movement preparation processes (Amrhein, Stelmach, & Goggin, 1991), and postural control processes under conditions of reduced or conflicting sensory information (Woollacott, Shumway-Cook, & Nashner, 1986). Other sources (Botwinick, 1984;
Kaufman, 1982; Levy, 1986) confirmed decreases in each of the sensory modalities. Decreasing physical capacity means increased demands on the elderly person engaging in functional performance. It is also well documented that older adults have decreased speed in processing information and in performing tasks. Studies indicate that the cognitive systems of young and older adults are similar, but that older adults process information at a slower rate or less efficiently (Hess & Slaughter, 1986a, 1986b; Puglisi, Park, Smith, & Dudley, 1988; Salthouse, 1985; Salthouse & Prill, 1987; Simon & Pouraghabagher, 1978). Salthouse (1985, 1987) suggested that with more complex cognitive processes, the speed of processing may affect not only the quantity of responses, but also the quality, because earlier operations may disintegrate before the later processing operations can complete the information to use it. Other studies have shown that older adults are vulnerable to the effects of divided attention (McDowd, 1986; Mitchell & Perlmutter, 1986; Pude & Hoyer, 1986; Pond, Brouwer, & Wolffeelaar, 1988). Thus, when performing functional tasks of daily living that require attention to two or more actions, such as making eggs, toast, and brewed coffee, older adults may show deficits in skills when compared with young adults. Moreover, performance on nonverbal cognitive tasks involving psychomotor and spatial components shows greater age differences than does performance on verbal tasks (Berg, Hertzog, & Hunt, 1982; Bruce & Herman, 1986; Gaylord & Marsh, 1975; Hale, Myerson, & Wastaff, 1987; Puglisi, 1986; Salthouse, 1982, 1987; Wickens, Braune, & Stokes, 1987).

Although there is not consensus concerning the mechanisms underlying cognitive age-related differences, (i.e., whether there is a deficiency in temporal resources, energy, attentional resources, or working memory capacity), all the cited studies have shown significant age-related differences in performance. Therefore, we hypothesized that these deficiencies or decreases in cognitive performance among older adults would be translated into decreased performances during functional daily living tasks.

However, there is evidence that highlights some of the limitations of this hypothesis. For example, motivation may affect an older adult's performance, particularly if the tasks are meaningless and unfamiliar (Adams & Rebek, 1982–83; Hulicka, 1967). Older adults not only appear to need and want to do tasks that are meaningful and relevant, but also are disproportionately benefited when material is relevant and familiar (Botwinick, 1984). Accordingly, the ecological validity of traditional laboratory or psychometric tests has been questioned. It seems that when more ecologically valid tasks are used, the detrimental effect of age is not always observed (Akiyama et al., 1985; Sharps & Gollin, 1987).

Others have emphasized the greater variability of older adults compared with a younger age group (cf. Baltes, 1987; Baltes & Willis, 1982; Hale, Smith, Myerson, & Poon, 1988). When Craik, Byrd, and Swanson (1987) compared memory performance of three elderly samples and one young adult sample, their results indicated that, although there were age-related differences in some of the tests (paired associates and free and cued recall), the differences on the tasks were influenced by the characteristics of the elderly subjects, such as socioeconomic circumstances, levels of verbal ability, and activity level.

Moreover, health or physical fitness may be more related to performance than age is. Spirduso (1980) reviewed studies concerning the relationship between physical fitness, age, and psychomotor speed. She found that the psychomotor speed of older, physically active men was more like that of younger men than like that of their older, less active counterparts and underscored the between-subject variability in the older adult population. More recently, Spirduso and Macka (1990) identified factors that minimize age differences in psychomotor speed, including practice effects, predictability of target sets, physical fitness level, and effects of exercise.

Denney (1982, 1985) proposed a model of life span development in which he distinguished unexercised abilities from optimally exercised abilities. She asserted that, because optimally exercised abilities are frequently used, they are performed at the highest level possible. Further, the performance level of any one skill depends on the amount of practice. Thus, the argument can be made that older adults will do relatively better when performing ecologically relevant tasks of daily living because they are routinely practiced. In contrast, they will not do as well as younger adults when performing contrived or laboratory experiments. This assertion is supported by Salthouse (1985) and others (Bybsh, Hoyer, & Roody, 1986) who suggested that extensive experience or expertise can compensate for or overshadow the negative effects of aging on functional performance. However, recent studies have suggested that expertise neither mediates nor moderates age-related differences (Salthouse, 1991; Salthouse, Babcock, Skovronek, Mitchell, & Palmon, 1990; Salthouse & Mitchell, 1990). Salthouse (1990) expressed caution regarding the generalizability of these recent findings to more complex measures of cognitive functioning because his studies were concerned with basic cognitive functioning and have minimized the contribution of knowledge factors.

Finally, Salthouse (1990) differentiated between cognitive abilities and cognitive competence, emphasizing that how the older adult performs on traditional laboratory tests does not adequately reflect the older adult’s ability to perform daily living tasks. It may be impossible to predict real world functioning on the basis of laboratory performance; that is, performance on laboratory tasks may not be generalizable to well practiced instrumental activities of daily living performed in the context of everyday life (Salthouse, 1985). However, even in daily living...
tasks, the effects of motivation, ecological validity, practice, and expert knowledge must be studied.

The present study, therefore, examined the effects of motivation, practice, and ecological validity on activities of daily living. We hypothesized that there would be no significant differences between young and older adults in mean motor or process skill ability when they performed familiar, practiced daily living tasks, but there would be a significant difference between mean motor and process skill abilities of young and older adults when they performed a more unfamiliar and contrived activity.

**Method**

**Subjects**

Subjects for this study were 40 community-living healthy white women; 20 were between 57 and 84 years of age ($M = 71.3, SD = 7.2$) and 20 were between 20 and 35 years of age ($M = 27.7, SD = 4.9$). The subjects were recruited through letter and telephone requests and were not paid for their participation. There was no significant difference ($t[38] = 1.18$) in the mean educational level between the young group ($M = 15.80$ years, $SD = 2.1$) and the older group ($M = 14.95, SD = 2.4$). Restricting the selection to women controlled for possible effects of gender and reflected that women constitute approximately two thirds of the older population.

**Instrument**

The Assessment of Motor and Process Skills (AMPS) (Fisher, 1990, 1992) was used to assess the ability to perform familiar, practiced complex or instrumental activities of daily living (IADL). The AMPS consists of two scales, motor and process, which are hypothesized to represent universal taxonomies of component skills required for all IADL task performances (Fisher, 1990, 1992). Motor skills are observable actions used to move the body or the objects used during task performance. Process skills are observable operations that are used to logically organize and adapt actions to effect efficient and timely completion of a specified IADL task. A complete list of the 35 skill items used in this study is shown in Appendix A. The IADL tasks used in this study are listed in Appendix B.

For each performed task, the rater gives a score for each process and motor skill item. Scores range from 1 (deficit: skill item deficit is severe enough to result in task breakdown, risk, or danger, or an unacceptable slowing of the task progression) to 4 (competent: no evidence of a skill item deficit impacting performance) (Fisher, 1990, 1992). It should be noted that some problems are encountered by most people during routine task performance, provided the task offers appropriate challenge. Therefore, a few scores of 2 or 3 are expected for nondisabled persons.

Although it is assumed that cognitive (e.g., memory, problem-solving) and physical (e.g., strength, movement, and postural control) deficits affect functional performance, it has been difficult to describe how these deficits specifically affect performance of daily living tasks because they cannot be observed directly. Thus, the conceptual model or the AMPS distinguishes between underlying cognitive and physical abilities within a mind–brain–body system and the observable AMPS motor and process skills. Moreover, deficits in any of the underlying constituents of this mind–brain–body system (cognitive, neurological, musculoskeletal, cardiopulmonary) can result in either motor or process skill deficits. Because the AMPS is used to assess directly the effect of observable, discrete motor and process skills (Appendix A) on global IADL task performance, the AMPS may be a more sensitive measure functional ability (Fisher, 1992).

Several studies have supported interrater and intrarater reliability among trained raters, and the concurrent and construct validity of the AMPS (Fisher, 1992; Fisher, 1993; Fisher, in press; Fisher, Liu, Velozo, & Pan, 1992; Fisher et al., in press). The IADL tasks used in the AMPS are calibrated on an equal-interval scale. As discussed in more detail below, ability is adjusted to account for the relative challenges of the tasks performed.

**Procedure**

Each subject was videotaped in her home performing two familiar IADL tasks and the less familiar, more contrived activity. Half of the subjects in each age group were randomly assigned to complete the IADL tasks first and the other half to complete the unfamiliar task first. All were given the same instructions for all tasks, according to the standardized instructions in the AMPS manual (Fisher, 1992). Consistent with the standardized AMPS administration procedures, each subject could choose from among the eight tasks used in this study (Appendix B) two tasks that were familiar and practiced as part of the subject’s usual living routine.

The contrived task was preparing a package for mailing; it involved wrapping two glasses and two small square boxes in a 10-in. × 12-in. × 5-in. box. The subjects were required to use tissue paper or newspaper to protect the glasses from breakage, use a brown paper grocery bag as an outside cover, seal the package with mailing tape, and address the mailing label. Before starting the task, the subjects were told that they should wrap the package as if they were going to mail it through the U.S. Postal Service.

After completion of all three tasks, the subjects were instructed to rate their familiarity with the performed IADL and package tasks using a 5-point Likert scale (1 = unfamiliar, never do this activity; 5 = familiar, do this activity frequently). A $2 \times 2$ (age × task type) mixed analysis of variance (ANOVA) revealed no significant dif-
ference between groups for familiarity with the IADL or the package tasks ($F[1,38] = 58.45, p < .0001$); both groups were significantly less familiar with the package task than with the IADL tasks. Additionally, there was no significant difference between young and older groups in the reported frequency of performing the package task during normal daily living; $\chi^2 (6, N = 39) = 5.98, p < .43$.

All of the videotaped task performances ($n = 120$) were rated by one or two of four trained, calibrated AMPS raters. All four raters had met the criteria for acceptable interrater and intrarater reliability; the proportion of unexpected ratings in this study was 5% (see Fisher, in press, for more details).

Analysis

Many-faceted Rasch analysis (Linacre, 1988, 1989) was used to generate four measures for each subject: a process and a motor ability measure for the familiar IADL task and a process and motor ability measure for the package task. Many-faceted Rasch analysis permits the calibration of item difficulty and task challenges on the same linear scale. Calibration refers to the process whereby the difficulty of the AMPS items and the challenge of the AMPS tasks become represented as positions on a common linear continuum. Tasks are positioned along the line in hierarchical order, from easiest to hardest. Because the distance between tasks is a linearization of relative challenge of the tasks, it is possible to adjust the subject ability measures for the challenges of the tasks performed. The methods used to calibrate tasks are described elsewhere (Fisher, 1993, in press).

To test the study hypothesis, two ($2 \times 2$, age $\times$ task) multivariate analyses of variance (MANOVAs) with repeated measures on task were performed. Our hypothesis would be supported by a significant age $\times$ task interaction effect. When significant main effects for age or significant interaction effects were found, we planned to locate the significant differences in mean ability by performing post hoc univariate $F$ tests.

Results

The mean motor and process scale ability measures for each group under the IADL and package task conditions are shown in Table 1. Under all conditions, the younger subjects had higher overall AMPS ability measures. For both the motor and process skills scales, the magnitude of the difference in ability between the groups appeared to be similar under both conditions, that is, the difference between young and older subjects' motor ability measures was about 1.30, and the difference between young and older subjects' process skill ability measures was about .50 under both conditions.

The results of the MANOVAs are shown in Table 2. Although there is a significant age effect for both the motor and process ability measures, and a significant task effect for the motor task, there were no significant interactions effects. Post hoc univariate $F$ tests revealed that the young and older adults differed significantly in the mean AMPS ability (motor and process) under all conditions ($F > 5.92, p \leq .02$). The significant task effect resulted because for the motor scale, the package was significantly harder than the IADL tasks; the difficulty of the two task conditions was similar for the process scale. Considered together, these results failed to support our hypothesis; young and older adults differed significantly in AMPS motor and process ability on tasks that were familiar and practiced (e.g., IADL tasks) as well as on a task that was less familiar and unpracticed (e.g., package).

Discussion

The results of this study indicate that older adult women have age-related deficits of both a motor and process nature. They had lower performance on both the IADL and package tasks and were not differentially benefited when the task was familiar and practiced. This finding suggests that even with ecologically valid, practiced tasks, age-related decline is still demonstrated.

For occupational therapists working with older adults who may be at risk for independence due to acute or chronic disease, the implication of these results is that therapists should not assume that persons can perform the tasks of daily living as efficiently or as competently as younger people just because the tasks are done regularly. Observing the client performing familiar and practiced tasks, particularly ones in which safety may be an issue, may be necessary to ensure safe independence. Using AMPS as the assessment tool would be desirable, because

### Table 1

<table>
<thead>
<tr>
<th>Tasks Performed</th>
<th>Young ($N = 20$)</th>
<th>Older ($N = 20$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activities of daily living</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor</td>
<td>4.21 ± .77</td>
<td>2.83 ± 1.16</td>
</tr>
<tr>
<td>Process</td>
<td>2.13 ± .69</td>
<td>1.68 ± .47</td>
</tr>
<tr>
<td>Motor</td>
<td>3.32 ± .98</td>
<td>2.02 ± 1.14</td>
</tr>
<tr>
<td>Process</td>
<td>2.11 ± .60</td>
<td>1.60 ± .64</td>
</tr>
</tbody>
</table>

### Table 2

<table>
<thead>
<tr>
<th></th>
<th>MS</th>
<th>$F(1,38)$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age scale</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>36.03</td>
<td>25.04</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Task</td>
<td>14.46</td>
<td>21.89</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Age $\times$ task</td>
<td>.03</td>
<td>.04</td>
<td>.894</td>
</tr>
<tr>
<td>Process scale</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>4.62</td>
<td>9.28</td>
<td>&lt;.004</td>
</tr>
<tr>
<td>Task</td>
<td>.06</td>
<td>.28</td>
<td>.599</td>
</tr>
<tr>
<td>Age $\times$ task</td>
<td>.02</td>
<td>.07</td>
<td>.796</td>
</tr>
</tbody>
</table>
the Rasch measurement model allows observation of two or three tasks to predict performance on many other IADL tasks (Fisher, 1992, 1993).

It has been hypothesized that young adults are at an unfair advantage in traditional laboratory experiments when the experimental tasks are unfamiliar or unmotivating or require older adults to exercise abilities that they do not typically use. In this experiment, young and older adult women were compared on a relatively unfamiliar, contrived task and on tasks of daily living that were familiar, meaningful, and exercised by both groups. Further, the IADL tasks were motivating to young and older subjects in that they were allowed to select which activities they would perform.

It could be argued that, although the subjects were given a choice of IADL activities to perform, they were limited even in this choice and therefore had limited motivation for performance. Although this may be a possible argument for the tasks not being meaningful, it seems unlikely that young and older adults would be differentially affected by the motivational factors related solely to the test design. That is, young adults should be just as likely to find the tasks unmotivating and not meaningful as the older adults. Moreover, the activities were performed in each person’s home, thus eliminating the effect of a new or unfamiliar environment on the older adults’ performance. Additionally, many persons arranged with the examiner to perform the tasks at the normal time of occurrence during their daily routine.

The fact that older adults’ performance was still significantly lower than that of young adults, despite familiar conditions, suggests that age-related differences found in aging studies are not artifacts of contrived laboratory experiments. Further, this study does not support the concept that expertise or practice can compensate for age-related decline, at least for those daily living activities used in this study. Assuming older adults have performed IADL tasks for more years than young adults, they should be more expert in such tasks, and such expertise should give the older adult an advantage in performance (Salt­house, 1985; Denney, 1982). However, this was not shown to be the case. Thus it appears that practice of IADL tasks over long periods of time is not differentially beneficial for the older adult. If it is, the benefit is not great enough to adequately or fully compensate for declines.

One possible reason for this may be that activities of daily living become practiced or over-learned early in life, and as creatures of habit, older adults may be less inclined to change their performance patterns to become more efficient or effective unless forced to do so. Thus, older adults may not develop compensatory mechanisms for tasks of daily living when cognitive or motor deficits occur. This view contrasts with Salthouse’s (1984) findings that people develop compensatory mechanisms to maintain high levels of performance despite declines in perceptual and motor processes. It may be that older adults develop compensatory mechanisms only when compelled to for powerful reasons (e.g., job security).

When end results of a task such as preparing a tossed salad are compared, an appropriate outcome could be achieved by both young and older adults. However, AMPS is sensitive to ineffective compensation strategies during performance that result in unexpected or inefficient deviations in performance. If the older adult is more likely to forget to add an ingredient she intended to include, that person is more likely to get a lower score. Although the end product otherwise may be acceptable, early signs of ineffective compensation strategies for memory decline appear to be emerging. Similarly, the motor scale of AMPS, unlike other evaluations, is sensitive to early declines in fine motor and subtle postural mechanisms (Fisher, in press). As such, AMPS has the potential to be an essential tool for occupational therapy practice and for aging research. If AMPS can identify early signs of cognitive decline, therapists can identify compensation strategies for the person or family and prevent or minimize loss of independence and ensure safety. In terms of research, AMPS may be an effective tool for identifying how specific declines in cognitive or physical abilities, determined with traditional assessments, are translated into daily life task performance.

Finally, the results of this study demonstrated individual variability of performance. Although there is a significant age effect, the scores for both motor and process measures indicate that some of the older subjects did just as well as the most able of the younger subjects. Further, some of the young and older adults performed better on the package than on the IADL tasks. In fact, it could be argued that there was no age x task interaction effect because the package task was not enough of an unfamiliar or contrived activity. This study limitation indicates that future research should use more clearly contrived activities. It may be that there is a continuum of tasks: that is, the package task is more familiar than the contrived traditional laboratory task, but less familiar than the IADL. That subjects had no choice in the contrived activity is another limitation. Future studies might use a larger sample, include male subjects, use totally unfamiliar and contrived tasks, incorporate choice into both conditions, and determine the basis for the individual variability of performance.

In summary, older adult women in this study demonstrated poorer performance on an unfamiliar, contrived package task, and on activities of daily living that they rated as very familiar and practiced, even when those activities were selected by the persons and performed in their familiar home environments. Thus, this study supports the hypothesis that older adult women demonstrate age-related decline in functional performance even with activities that take motivational, experiential, and ecological validity components into account.
### Appendix A
Motor Skill and Process Skill Items

<table>
<thead>
<tr>
<th>Motor Skill Items</th>
<th>Process Skill Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stabilizes</td>
<td>Attends</td>
</tr>
<tr>
<td>Aligns</td>
<td>Chooses</td>
</tr>
<tr>
<td>Positions</td>
<td>Uses</td>
</tr>
<tr>
<td>Walks</td>
<td>Handles</td>
</tr>
<tr>
<td>Reaches</td>
<td>Heeds</td>
</tr>
<tr>
<td>Bends</td>
<td>Inquires</td>
</tr>
<tr>
<td>Coordinates</td>
<td>Notices</td>
</tr>
<tr>
<td>Manipulates</td>
<td>Initiates</td>
</tr>
<tr>
<td>Flows</td>
<td>Continues</td>
</tr>
<tr>
<td>Moves</td>
<td>Sequences</td>
</tr>
<tr>
<td>Transports</td>
<td>Paces</td>
</tr>
<tr>
<td>Lifts</td>
<td>Terminates</td>
</tr>
<tr>
<td>Calibrates</td>
<td>Searches</td>
</tr>
<tr>
<td>Grips</td>
<td>Gathers</td>
</tr>
<tr>
<td>Endures</td>
<td>Organizes</td>
</tr>
<tr>
<td></td>
<td>Restores</td>
</tr>
<tr>
<td></td>
<td>Accommodates</td>
</tr>
<tr>
<td></td>
<td>Adjusts</td>
</tr>
<tr>
<td></td>
<td>Navigates</td>
</tr>
<tr>
<td></td>
<td>Benefits</td>
</tr>
</tbody>
</table>

### Appendix B
AMPS IADL Tasks Used in this Study

- Preparing egg(s), toast, and brewed coffee
- Preparing a fresh fruit salad
- Preparing a tossed green salad
- Preparing a grilled cheese sandwich and beverage
- Preparing a tuna sandwich
- Reporting a small houseplant
- Vacuuming a living room
- Changing the sheets on a bed

### References


Klein, L. L. (1986). Sensory changes and compensation. In L. J. Davis & M. Kirkland (Eds.), *The role of occupational therapy with the elderly* (pp. 49–88). Rockville, MD: American Occupa-
tional Therapy Association.


