

**Components of Decline:
Spatial Orientation
and Inductive Reasoning***

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Paper presented at the annual meeting of
The Gerontological Society of America,
San Antonio, Texas, November, 1984.

* We gratefully acknowledge the assistance of Tamara Lair, Julie Landy, and George McCroy. This research was supported by Grant # AG 03544 from the National Institute on Aging.

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This study examined those aspects of performance that exhibited change for elderly subjects showing reliable age-related decline on the primary abilities of spatial orientation or inductive reasoning. When ability performance of subjects showing longitudinal age-related decline are compared with subjects exhibiting no decline, several alternative hypotheses regarding the nature of decline in total score performance can be specified. One hypothesis is that score decline reflects a drop in the number of items attempted, and thus is related primarily to a slowing of response speed (Birran, Woods, & Williams, 1980). A second hypothesis is that score decline is due to an increase in wrong responses (Welford, 1977). A third hypothesis is that score decline is related to increased cautiousness, as shown in the number of omitted items within the total pool of items attempted (Botwinick, 1967). Of course, score decline may also be associated with any combination of these factors.

Subjects.

The subjects were participants in a cohort-sequential longitudinal study, who were tested in 1970 and 1977 on a battery of psychometric ability measures (Schaie, 1963). Subjects were classified as having remained stable or having shown reliable decline on one or both of the abilities between 1970 and 1977. Decline was defined as a score drop equal to or greater than one standard error of measurement (Space = 6 raw score points; reasoning = 4 raw score points). For Spatial Orientation, there were 133 (M=59, F=74) subjects showing decline and 250 subjects (M=113, F=137) classified as remaining stable. For Reasoning there were 77 (M=28, F=49) subjects showing decline, and 201 subjects (M=92, F=109) classified as stable. Mean age of subjects in 1970 in the Spatial Orientation analyses was 62.0 years; mean age of decliners was 63.1 years and mean age of stable subjects was 61.5. Mean age of subjects in the Reasoning analyses was 62.3 years; mean age of decliners was 64.5 years and mean age of stable subjects was 61.6 years. The mean age of subjects studied for each ability did not differ. As would be expected, the decliners were significantly older than the stable subjects.

Measures.

Spatial orientation performance was assessed by the PMA Spatial Orientation test (Thurstone & Thurstone, 1949), a multiple-response measure. The subject is shown a model line drawing and asked to identify which of 6 choices shows the model drawn in a different spatial orientation. There are 2 or 3 correct responses possible for each test item. Inductive reasoning ability was assessed by the PMA Reasoning test. The subject is shown a series of letters and must select the next letter in the series from 5 answer choices. Four scores per subject were derived: Correct (Number of correct responses), Wrong (Number of incorrect responses), Omits (Number of correct choices not marked within the pool of items attempted by the subject), and Attempts (Total number of items attempted). The attempts score is the sum of the correct, wrongs, and omits scores.

Results

1970-1977 Change in component scores.

1. Spatial orientation. Stable and Decline subjects' performance in 1970 and 1977 was compared on the four component scores for each ability. Figure 1 shows the number of correct, wrong, omitted, and attempted items for Stable and Decline subjects in 1970 and 1977 for Spatial Orientation. In 1970 Decline subjects answered significantly more items correctly, made significantly fewer wrong responses, and attempted significantly more items than did Stable subjects. In 1977 Stable and Decline subjects differed significantly in number of correct responses, commission errors, omissions and attempts, with Decline subjects showing a poorer performance on all score components.

Changes from 1970 to 1977 were also compared within each status group. For Decline subjects there was a significant drop from 1970 to 1977 in correct responses and items attempted, and a significant increase in wrong responses. For Stable subjects there was a significant increase in correct responses and a significant drop in wrong answers and omissions. There was not significant change in number of items attempted by Stable subjects.

2. Reasoning. Stable and Decline subjects were compared in 1970 and 1977 for Reasoning ability. Figure 2 shows the number of correct, wrong, omitted, and attempted items for Stable and Decline subjects in 1970 and 1977 for Reasoning. In 1970 Decline subjects answered significantly more items correctly, made significantly fewer wrong responses, and attempted significantly more items than did Stable subjects. In 1977 the picture is partially reversed. Stable subjects made significantly more correct responses and attempted more items. However, there was no significant difference between Stable and Decline subjects in the number of wrong responses.

Changes from 1970 to 1977 were also compared within each status group for Reasoning performance. For Decline subjects there was a significant decrease in correct responses and in the number of items attempted. There were no significant changes in any of the score components for the Stable group.

Componential analysis of drop in correct responses.

To obtain a clearer understanding of the relative contribution of the various score components (commission, omissions, attempts) to decline in correct responses, the proportion of change associated with each score type was computed. For each component (rights, wrongs, omissions, attempts), the 1977 score was subtracted from the 1970 score to yield a mean difference score. To determine the proportion of change in rights attributable to the change in commissions, omissions, and attempts, the mean difference score for that component (commissions, omissions, attempts) was divided by the mean difference score for rights.

1. Spatial orientation. The proportion of decrease in correct responses for Decliners on Spatial Orientation which is attributable to change in wrongs, omissions, and attempts is shown in Figure 3. Seventy-six percent (76.14%) of the change in number of correct responses is due to a decrease in the number of items attempted; 21.98% of the change is due to an increase in wrong responses.

2. Reasoning. Figure 4 shows the proportion of decrease in rights for Decliners on Reasoning attributable to the various components. Ninety-two percent (92.2%) of the change in correct responses is attributed to a decrease in the number of items attempted. Only 7.8% of the decline in rights is attributable to an increase in wrong responses.

Net change in component scores

The above analyses on decline in correct responses are confounded, however, due to the significant drop in the number of items attempted from 1970 to 1977. To examine net change in accuracy we estimated the mean expected values for correct responses, wrongs, and omissions in 1977 based on the Decliners' performance in 1970. To do so, the proportions of attempted items in 1970 attributed to correct answers, wrong responses, and omissions were computed, and these proportions were then applied to obtain the expected values of corrects, wrongs, and omissions in 1977. The differences between these expected values and the obtained values in 1977 were then computed. These values represent net changes in accuracy above and beyond those changes which would be expected to occur with the drop in attempted items.

1. Spatial orientation. The net change in rights, wrongs, and omissions for Stable and Decline subjects on Spatial Orientation is shown in Figure 5. For Decliners there was a mean decline in right responses of 2.78 raw score points and a mean increase in wrong responses of 2.24 points. For Stable subjects there was a mean increase in right responses of 2.83 points and a mean decline in wrongs of .90 points.

2. Reasoning. Figure 6 shows the net change in correct responses, wrongs, and omissions for Stable and Decline subjects on Reasoning. For Decline subjects there is a mean decrease of 1.85 raw score points in correct responses and a mean increase of 1.25 points in wrong responses. For the Stable subjects there is a mean increase of .31 points in correct responses, and a mean decrease of .19 points in wrong responses.

Summary

Longitudinal change in the performance of subjects above the age of 40 on Spatial Orientation and Inductive Reasoning was examined from 1970 to 1977. Subjects were classified as having remained stable or having shown significant decline on each of the two abilities from 1970 to 1977. The components of performance (rights, wrongs, omissions, attempted items) showing change for Stable and Decline subjects was examined. The findings address three major questions regarding the nature of longitudinal change in performance on the two abilities studied.

First, what are the components of performance that change for stable and decline subjects?

Decline subjects on both abilities showed a significant decrease in the number of right responses and in the number of items attempted. In addition, Decline subjects on Spatial Orientation showed an increase in wrong answers.

Stable subjects on Spatial Orientation showed a significant increase in correct responses and in attempted items and a significant decrease in wrong responses. There was no significant change on any of the performance components for subjects stable on Reasoning.

Second, to what is the drop in right responses for the Decline subjects attributable?

The drop in right responses was primarily due to a decrease in the number of items attempted. This was true for both abilities. In addition, approximately 22% of the decline in right responses on Spatial Orientation was due to an increase in wrong responses.

Third, if the drop in number of items attempted is controlled for, is there a decrease in accuracy of performance for Decline subjects? Accuracy is defined as a drop in correct responses and an increase in wrong answers.

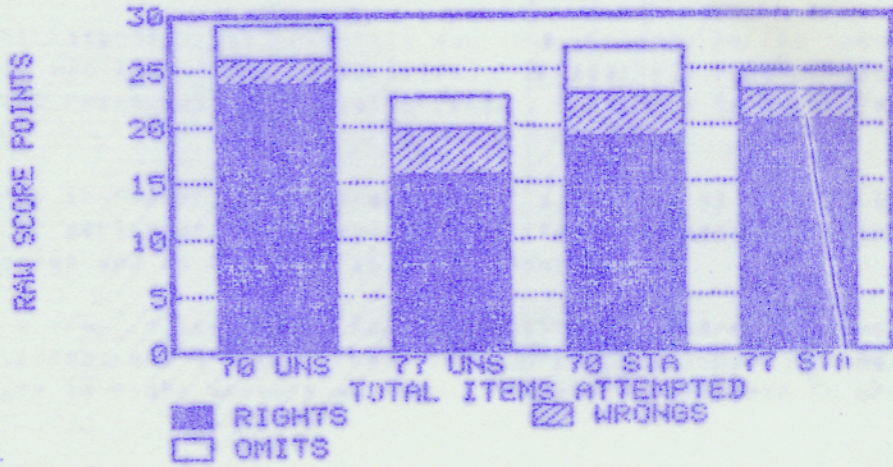
There is indeed a drop in accuracy. For both abilities, there was a net decrease in right responses and a net increase in incorrect responses for Decline subjects. The decrease in right answers was greater than the increase in wrong responses.

In summary, much of the drop in total score for Decline subjects on both abilities can be attributed to a significant decrease in the number of items attempted. Inductive Reasoning appears to be somewhat more speeded, since a larger proportion (91.75%) of change in number of correct responses was accounted for by a drop in the number of items attempted than occurred on Spatial Orientation. Decline in Spatial Orientation performance is also attributable to an increase in the number of incorrect responses; this was not found for Reasoning. Contrary to what might be hypothesized on the basis of the cautiousness literature, the number of items skipped does not account for much of the change in total score. A second major finding is that when the decline in attempted items is controlled for, the accuracy of the Decline subjects is shown to decrease from 1970 to 1977. Subjects answered fewer items correctly and committed more commission errors.

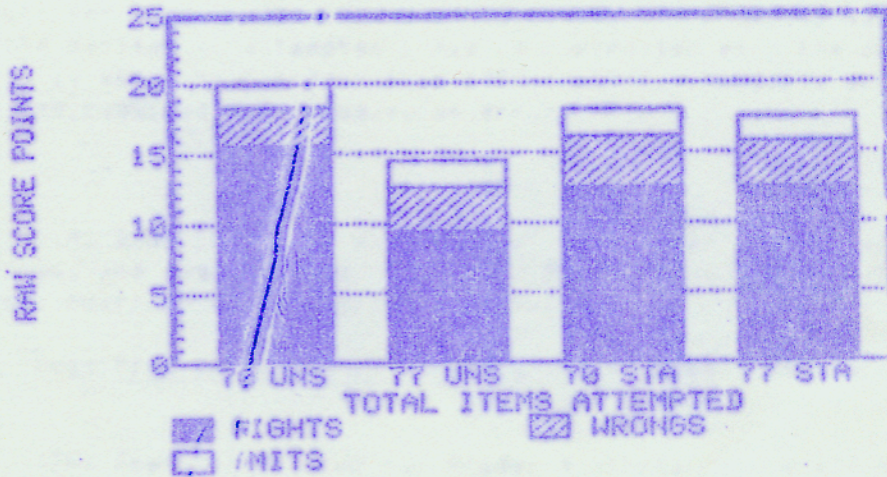
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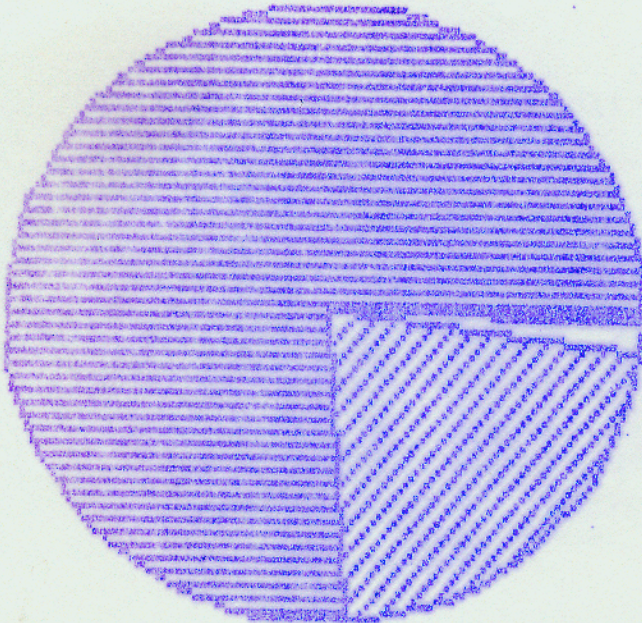
SPACE CHANGES 1970-1977



REASONING CHANGES 1970-77

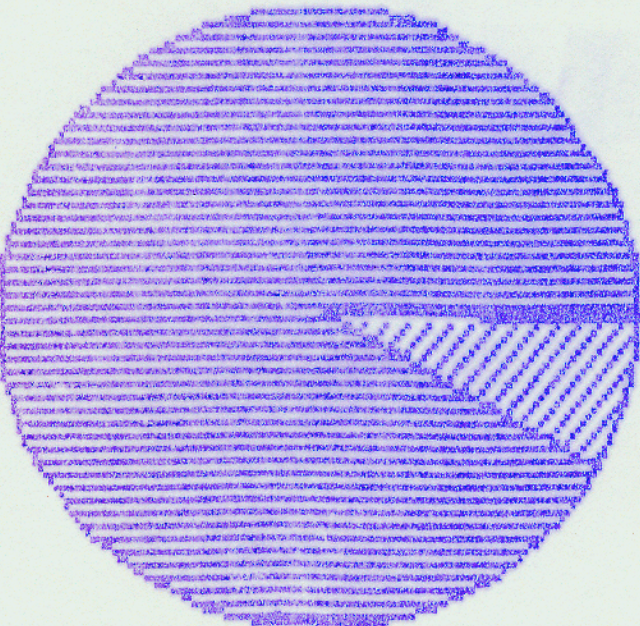


DROP IN CORRECT RESPONSES



1.88%
 FEWER OMITTS
 21.98%
 MORE WRONGS
 76.14%
 FEWER ATTEMPTS

PMA SPACE TEST 1970-77

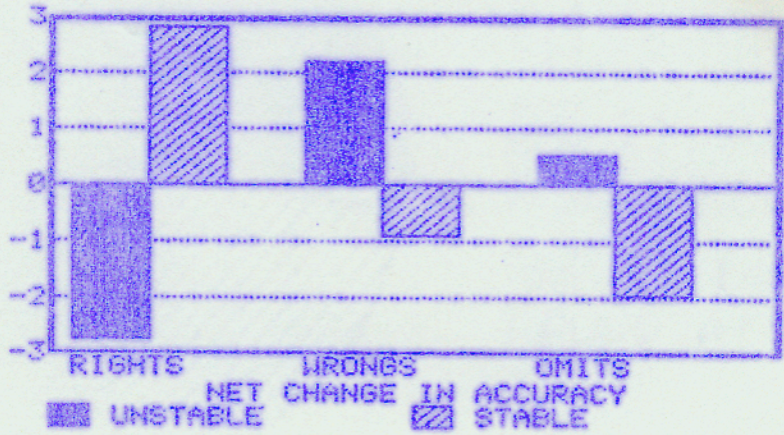


0.32%
 FEWER OMITTS
 7.92%
 MORE WRONGS
 91.76%
 FEWER ATTEMPTS

PMA REASONING TEST 1970-77

SPACE DECLINE 1970-1977

RAW SCORE POINTS



REASONING DECLINE 1970-77

RAW SCORE POINTS

