Practical Intelligence: Still Stable Over All These Years?

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RUNNING HEAD: PRACTICAL INTELLIGENCE

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Abstract

Practical Intelligence as measured by the ETS, Basic Skills Assessment Test was studied in a sample of 871 Participants (394 males and 477 females) who participated in the Seattle Longitudinal Study in 1984 and 1991, ranging in age from 22 to 85 years. The study examined how Practical Intelligence changes over time and how age and gender influence the nature of this change. Exploratory and Confirmatory Factor Analysis identified four factors: Inferences from Text, Facts from Text, Commercial Information, Directions and Charts. A repeated measures analysis of covariance (ANCOVA) using a factorial design tested main effects for Age Grouping, Gender, and Time and their interactions. Statistically significant Time, and Time by Age-grouping effects were found for all four factors. The results also show remarkable stability in Practical Intelligence over 7-years for all but the oldest group.

Practical Intelligence: Still Stable Over All These Years?

The inability to care for oneself and to live independently in the community is a salient fear for most older people. A person's ability to continue living independently is partially determined by how well they can perform the tasks necessary for daily living. Everyday competence represents the potential or capability of the individual to perform certain tasks, not the actual daily behaviors of the individual. Competence, defined here, represents the capacity to perform an action or activity when necessary, despite the fact that a person may not perform this activity on a daily basis (Willis, 1991).

Cognitive psychologists have recently focused on Everyday Problem Solving or Practical Intelligence (Poon, Rubin, & Wilson, 1989). Everyday problem solving, in contrast to academic or information processing approaches traditionally studied in the laboratory, focuses on "real world" problems that occur naturalistically, are of intrinsic concern to the subject, and may involve multiple or ambiguous solutions (Wagner, 1986).

Sternberg, Conway, Ketron, and Bernstein (1981) found that practical intelligence is an important component of intelligence. Specific examples such as "sizes-up situations well", "determines how to achieve goals", "displays awareness to world around him or her", and "displays interest in the work at large" emphasize the usefulness of understanding how practical intelligence may be developed and used. Three attributes of competence have been identified: (a), the ability to select features from the environment that are necessary to initiate a course of action or planning; (b), starting a series of movements designed to achieve

the planned objectives or initiation; and (c), to formulate new plans based upon past experiences (Schaie, 1978).

Negative indices of well-being are associated with the inability to perform activities associated with independent living and effectively limit an individual's everyday competence. Some examples of such indices would include the inability to prepare a meal for oneself; the inability to take a bath independently; the inability to take one's medication; and the inability to drive oneself to the doctor. However, large epidemiological studies have focused on how well-being affects mortality rather than how it affects the loss of independence (Willis, 1991). It may be argued that the stress and discomfort associated with loss of independence is largely psychological rather than physical in nature, for many older people. Some research shows that dependency affects the older person's self-concept and life satisfaction more than physical pain or social isolation (Kuriansky, et al., 1976).

Intelligence-Competence Relationship

Some researchers suggest that competence refers to intelligence in its broadest sense (Connolly & Bruner, 1973); that is, in its aspect of "knowing how, rather than knowing that" (Schaie, 1978). The intelligence-competence distinction may be summarized, by proposing that competence is the phenotypic expression of genotypic intelligence factors which, will enable adaptive behavior within a specific situational context provided minimal levels of motivation. Intelligence is a spectrum of genotypic factors that may be interpreted from adaptive behaviors measured across situations (Schaie, 1978).

Measurement of Everyday Functioning

Neither academic performance nor entry-level work-related skills are useful criterion tasks for studying practical intelligence in later adulthood. Intellectual functioning is reflected in social competence and in tasks of daily living. Thus, how traditionally measured intelligence relate to everyday functioning in old age is a concern (Willis & Schaie, 1986).

Practical intelligence in later adulthood is measured not by emergent behaviors (e.g., Piagetian, Information Processing) but by acquired skills and intact abilities (Willis & Schaie, 1986). Research has focused on common everyday types of problem solving that the elderly experience. More emphasis is placed on the older person's ability to apply acquired skills to novel situations rather than the emergence of new behavior.

Criterial tasks that assess practical intelligence in later adulthood proceed from the assumption that certain classes of everyday activities are necessary for adaptive functioning. A major concern in old age is maintenance of independent living; these activities focus on tasks associated with effective independent functioning. For example, the inability to read and understand a medicine bottle label so that medication may be properly taken, or improper use of the phone directory's yellow pages may curtail independent living for many older people. Despite the analogue nature of any paper and pencil task, an individual is assumed to apply the same relevant cognitive skills and information to the test item that he/she would in a real-life problem (Willis & Schaie, 1986).

Denney (1982) suggests that optimally exercised abilities are those that lie well within the person's experience and would likely be those for which processes of task performance are at least partially automatized. Conversely, unexercised cognitive abilities may be those that lie outside of a person's experience (i.e., that are relatively novel) and whose component processes of task execution have yet to be automatized.

The Seattle Longitudinal Study (SLS) has shown that there are large individual differences in the onset and magnitude of intellectual decline. Almost one half (46%) of subjects over age 65 showed no statistically reliable decline on either of the primary abilities studied over the previous 14-year period (Schaie & Willis, 1986). However, the onset of decline varies significantly across different abilities. For example, less than one quarter of the SLS subjects showed decline on both Space and Reasoning (Schaie & Willis, 1986). Longitudinal research documents a later onset of significant decline than stereotypic notions have previously assumed. When intraindividual change is assessed beginning with young adulthood, significant normative decline is not evident until the late sixties. Schaie (1980) concludes that the "use-it-or-lose-it" principle does not only apply to the maintenance of muscular flexibility, but also to the maintenance of flexible life-styles and related high level of intellectual performance.

Considering the linkage between everyday competence and intelligence it may be reasonable to examine how competence, measured by the ETS, Basic Skills Assessment Test will change over time. Moreover, how will factors such as age and education

influence the nature of this relationship. Four ETS, Basic Skills Assessment Test factors have been identified and longitudinal change will be considered within this context.

Method

Subjects

The longitudinal data included 871 community-dwelling persons (394 males and 477 females) that were examined in the fifth SLS cycle (1983-85) and the sixth SLS cycle (1990-92). The mean age for males was 56.00 (SD = 14.22; Range: 25 - 85) and females was 55.91 (SD = 13.82; Range: 22 - 85). The mean number of years of education for males was 15.20 (SD = 3.13; Range: 6 - 20) by comparison females had 14.30 years of education (SD = 2.64; Range: 7 - 20). The average time between testings was 7 years. The sample was divided into 8 age-related groups, mean age and years of education are presented in Table 1.

Insert Table 1 About Here

Occupational levels were rated on a scale from 0 (unskilled) to 9 (professional occupations). Subjects that were employed at the time of assessment most frequently held occupations as skilled tradespersons, clerical-sales, managerial and semi-professional jobs (Schaie, 1995).

Sample Attrition

In 1984 a total of 1495 people completed the ETS, Basic Skills Assessment Test. This sample included 693 males and 802 females. Of the 1495 participants, 624 did not return in 1991, 299 males and 325 females. The mean age of the nonreturning

participants was 66.25 in 1984 (SD = 14.46 Range: 22 - 95). The average number of years of education of that subsample was 13.78 (SD = 3.07; Range: 4 - 20). Marital status for the nonreturning sample was 28 single, 4 separated, 45 divorced, 123 widowed, and 414 married. About 87% of the respondents in the subsample held occupations as skilled craftspersons, clerical-sale, semi-professional, and professional positions. The nonreturning participants approximates other samples of noninstitutionalized older people on educational level. For example, the median years of schooling for persons aged 25 and older in the United States is 12.7 years (Kominski & Siegel, 1993).

Analyses conducted to compare 1991 returnees to the total group on age and education found significant group differences on these variables ($F(1, 2354) = 46.75$, $p = .001$; $F(1, 2354) = 9.47$, $p = .002$) respectively

Covariance analyses were then conducted between 871 returnees and all 1984 participants. A MANCOVA using age and education as covariates and the four Basic Skills Assessment Test factors was not statistically significant ($F(8, 2350) = 1.0994$, $p > .3603$; Wilks Lambda = .9962).

Everyday Task Performance

Everyday task performance was measured by the Basic Skills Assessment Test (Educational Testing Service, 1977). The 65-item test measures a person's ability to understand everyday tasks that involve charts and forms (e.g., weight charts, application forms), labels (e.g., instructions on a medicine bottle or food label), technical documents (e.g., appliance guarantees or contracts), and

text material (e.g., letter to newspaper editor, or three to four paragraph stories).

An Exploratory Factor Analysis (EFA) was conducted on all of the subjects that completed the Basic Skills Assessment Test in 1984. Prior to the factor analysis test questions were categorized into discrete parcels of 2 to 4 items. The stimulus material from which the individual test items were generated provided the organizing structure for the item parcels. Test items originally scored dichotomously as correct (1) or incorrect (0) were summed for each parcel. An Exploratory Factor Analysis using Principal Components Analysis (PCA) and an oblique rotation to simple structure revealed four factors. Further analysis of this four factor solution using Confirmatory Factor Analysis (CFA) validated the primary four factor solution (X^2 = 1241.00, df=267, GFI = .932, AGFI = .917). Orthonormalized factor scores were created and used for further analyses. The four factors include: Inferences from Text, Facts from Text, Commercial Information, and Directions and Charts. Table 2 provides the four empirically factored domains and sample a question from each domain.

Insert Table 2 About Here

Assessment Procedure

The measures described were administered to small groups of subjects as part of a broader 5-hour battery distributed over two sessions. The tests were administered by an examiner assisted by a proctor. Testing occurred at familiar sites close to the homes of the study's participants.

Results

A repeated measures analysis of covariance (ANCOVA) using a factorial design tested main effects for Age Grouping, Gender, and Time and their interactions. Four repeated measures ANCOVAs assessed change over time by Age Group and Gender on each of the Basic Skills Assessment Test Factors. These findings provide a look at age- and gender-related changes in everyday task competence from 1984 to 1991. ANCOVAs for each Basic Skills Assessment Test factor were computed using BMDP4V. Follow-up analyses were conducted in two ways. First, in order to evaluate the effects of change over Time, Tukey's Honest Significant Difference (HSD) test was used. Second, follow-up analyses to test any Time by Age grouping or Gender interactions were conducted by creating orthogonal contrasts between the desired vectors (Keppel, 1982; Scheffé, 1953; Tabachnick & Fidell, 1989, pg. 470).

The repeated measures analysis of Factor 1 (Inferences from Text) revealed an effect for Time ($F(1, 855) = 43.95$; $p < .001$) and a Time by Age-group interaction ($F(7, 855) = 14.17$; $p < .001$). Time by Gender and Time by Age Group by Gender were not statistically significant. Tukey's HSD follow-up analyses on the main effect for Time revealed statistically significant differences from 1984 to 1991 for Age-groups 1 (the oldest) and 2 (second oldest). Follow-up analyses conducted on the Time by Age-grouping effects revealed significant differences between Age-group 1, (the oldest age group) and the seven younger groups. Group 1 and 2 displays change profiles of declining ability from 1984 to 1991 concerning Inferences from Text while the other

groups showed little or no reliable decline. Figure 1 illustrates these differences.

Results on Factor 2 (Facts from Text) showed similar effects for Time ($F(1, 855) = 47.74$; $p < .001$) and Time by Age-grouping ($F(7, 855) = 20.20$; $p < .001$). Tukey's HSD follow-up analyses on the main effect for Time revealed statistically significant differences from 1984 to 1991 only for Age-group 1 (the oldest). Follow-up analyses conducted on the Time by Age-Grouping interaction revealed significant differences between Age-Group 1, (oldest age group) and the seven younger groups. Significant Time by Age Group differences were also observed between Age Groups 2 and 4, 2 and 5, 3 and 4, and 3 and 5. No statistically significant differences emerged in the Time by Gender or the Time by Age Group by Gender interaction. Group 1 and 2 again show change profiles with the greatest decline in ability from 1984 to 1991 and are illustrated in Figure 1.

Findings for Factor 3 (Commercial Information) show significant Time ($F(1, 855) = 17.22$; $p < .001$) and Time by Age Grouping effects ($F(7, 855) = 12.36$; $P < .001$). Once again, Tukey's HSD test applied on the main effect for Time revealed statistically significant differences from 1984 to 1991 for Age-group 1 (the oldest) only. Follow-up analyses applied to the Time by Age-Group interaction showed statistically significant effects between Age Group 1 the seven younger groups. There were no statistically significant effects for Time by Gender or the Time by Age Group by Gender interaction. Figure 2 displays these results for Factor 3.

Finally, results for Directions and Charts (Factor 4) revealed a significant Time ($F(1, 855) = 16.60$; $p < .001$) and Time by Age Grouping effects ($F(7, 855) = 7.35$; $P = .001$). Once again, Tukey's HSD test applied on the main effect for Time revealed statistically significant differences from 1984 to 1991 only for Age-group 1 (the oldest). Follow-up analyses between Age Groups revealed statistically significant differences between Age Group 1 and the seven younger Age-Groups. There were no statistically significant effects for Time by Gender or the Time by Age-Group by Gender interaction.

Discussion

The purpose of this study was to assess longitudinal change over a seven-year period where adults' everyday task competence defined by four factors on the Basic Skills Assessment Test. The question: "Is practical intelligence still stable over all these years"? is pertinent. Of particular interest were Age-group and Gender based longitudinal change. The four factors of the Basic Skills Assessment Test are theoretically associated with skills that are needed to function effectively and efficiently on a daily basis.

An important finding is that the change in mean level scores reflects a linear decline for the oldest group on all four practical intelligence factors. It is notable that the oldest group markedly declined on all four factors to a greater extent than the seven younger groups. Although, these data show ubiquitous decline in all four factors for the oldest group and some patterns of declining performance for Age Group 2 (second oldest) from 1984 to 1991 the youngest groups (Age-Groups 3

through 8) demonstrated the greatest stability. It is notable that some groups decline in specific abilities (although not significantly), which suggests individual differences in the pattern and trajectory of change. Similar patterns of change are reported in more traditional cognitive abilities (Schaie & Willis, 1986, Schaie et al., 1995).

These results suggest that declining abilities in everyday task competence is primarily confined to those moving into advanced old age. Change for the oldest group is more pronounced across some abilities while other domains of everyday functioning compare reasonably well to other age groups. Therefore, change in everyday task abilities is not necessarily predicted by chronological age but may be influenced more by the context and the environment in which the person lives.

These finding must be tempered in light of two issues. First, the Basic Skills Assessment Test is not a comprehensive functional measure. It best represents an individual's performance on written or printed material and does not assess social or emotional competence in everyday life. Second, the Basic Skills Assessment Test is a self-report paper and pencil measure given with ample time constraints. As a result, performance on this measure should be considered in light of these time limitations. Performance would undoubtedly improve if no time constraints were imposed and may further worsen if stricter time limitations were imposed.

In summary, these data illustrate the nature of developmental change in everyday task competence across the life-span. Most studies of everyday task competence have been cross-sectional in

nature and have not measured a variety of different age groups longitudinally. This study provides much needed data on the nature of developmental change on everyday tasks at different ages and further strengthens past research in the area.

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Table 1
Means, Standard Deviations, and Ranges for Education and Age by Gender and Age-Group.

	Male		Female		Total	
	Education	Age	Education	Age	Education	Age
Age_Group 1						
M	13.43	75.02	13.63	75.11	13.54	75.06
SD	3.87	3.61	2.81	3.43	3.32	3.50
Range	7-20	71-85	8-19	71-85	7-20	71-85
n	68	68	83	83	151	151
Age_Group 2						
M	14.93	67.34	13.68	66.37	14.23	66.80
SD	2.81	1.83	2.53	1.88	2.72	1.91
Range	8-20	64-70	7-20	64-70	7-20	64-70
n	71	71	91	91	162	162
Age_Group 3						
M	15.19	60.31	13.93	59.89	14.58	60.11
SD	3.00	2.00	2.52	1.94	2.84	1.98
Range	6-20	57-63	8-20	57-63	6-20	57-63
n	59	59	54	54	113	113
Age_Group 4						
M	15.69	53.92	14.40	53.28	14.94	53.54
SD	3.18	1.94	2.47	1.98	2.85	1.98
Range	9-20	50-56	11-20	50-56	9-20	50-56
n	62	62	87	87	149	149
Age_Group 5						
M	16.13	46.02	15.12	46.06	15.55	46.04
SD	2.71	2.10	2.78	1.93	2.79	2.00
Range	9-20	43-49	12-20	43-49	9-20	43-49
n	54	54	73	73	127	127
Age_Group 6						
M	16.13	39.97	15.04	39.65	15.51	39.36
SD	2.44	1.99	2.40	1.98	2.46	2.00
Range	12-20	36-42	12-20	36-42	12-20	36-42
n	32	32	51	51	90	90
Age_Group 7						
M	15.84	32.44	15.04	32.24	15.49	32.35
SD	2.40	2.00	2.23	2.31	2.34	2.13
Range	12-20	29-35	12-20	29-35	12-20	29-35
n	32	32	25	25	57	57
Age_Group 8						
M	15.44	26.44	14.92	25.77	15.14	26.05
SD	2.07	0.88	2.66	1.54	2.40	1.33
Range	12-19	25-28	9-18	22-28	22-28	29-35
n	9	9	13	13	22	22

Table 2

ETS, Basic Skills Assessment Test Factors and Domain Specific Questions

Factor 1 - Inferences from Text

Questions 5-6 refer to the following part of a medicine label.

CAUTION: Not for frequent or prolonged use. If . excessive dryness of the mouth occurs, decrease dosage. Stop use if rapid pulse, dizziness, skin rash, or blurring of vision occurs.

5. What does the label describe as prolonged use?

a. Less than 5 days
b. 6-8 days
c. More than 10 days
d. The label does not say.

Factor 2 - Facts from Text

Questions 32-33 refer to the following instruction.

This new refrigerator will give you trouble-free service if a few simple precautions are taken.

---Do not install it near sources of heat such as radiators and stoves; where temperatures may fluctuate rapidly such as near exterior doors; or near sources of high humidity such as washing machines and dishwashers.
---Dust the cooling coils behind the unit regularly.
---Keep the rubber seal around the door free of oil and grease. Do not let solvents such as acetone touch the seal.
---Do not use abrasive cleaners or. exterior or interior surfaces. Do not use ammonia or bleach on interior plastic surfaces.

32. You should put the refrigerator in a place that is

a. warm and humid
b. warm and dry
c. cool and humid
d. cool and dry

Table 3 (Continued)

Factor 3 - Commercial Information

Questions 49-51 refer to the following article:

At last night's Board of Education meeting, Thelma Smith, president of the Board, accused Samuel Minsky, Superintendent of Schools, of illegally using school property. Minsky admitted using a school bus for a camping vacation during the summer, but said that he had received permission from the Director of Transportation, James Osgood. Osgood agreed with Minsky's statement and said that Minsky had paid for use of the bus.

Many of the 87 parents attending the meeting were outraged by the accusation. Sarah Rakoff, president of the PTA, told reporters after the meeting, "Smith has been after Minsky ever since she was elected. This is just another example of her lies and false accusations." Marvin Fields, Board attorney, said that he believed that the Director of Transportation had the right to authorize use of the bus.

49. The president of the Board of Education is

a. Thelma Smith
b. James Osgood
c. Sarah Rakoff
d. Marvin Fields

Factor 4 - Directions and Charts

Questions 56-57 refer to the following information from an application for a driver's license.

EXAMINATION FEE

All driver's license applicants are required to pay a $3.00 examination fee for each examination.

If you fail any part of the examination which includes written, road sign, or driving test, another $3.00 fee will be required before the next examination.

An examination fee of $35.00 is required for reinstatement following any revocation and $15.00 following a department suspension.

56. If you fail the examination, how much does it cost to take it again?

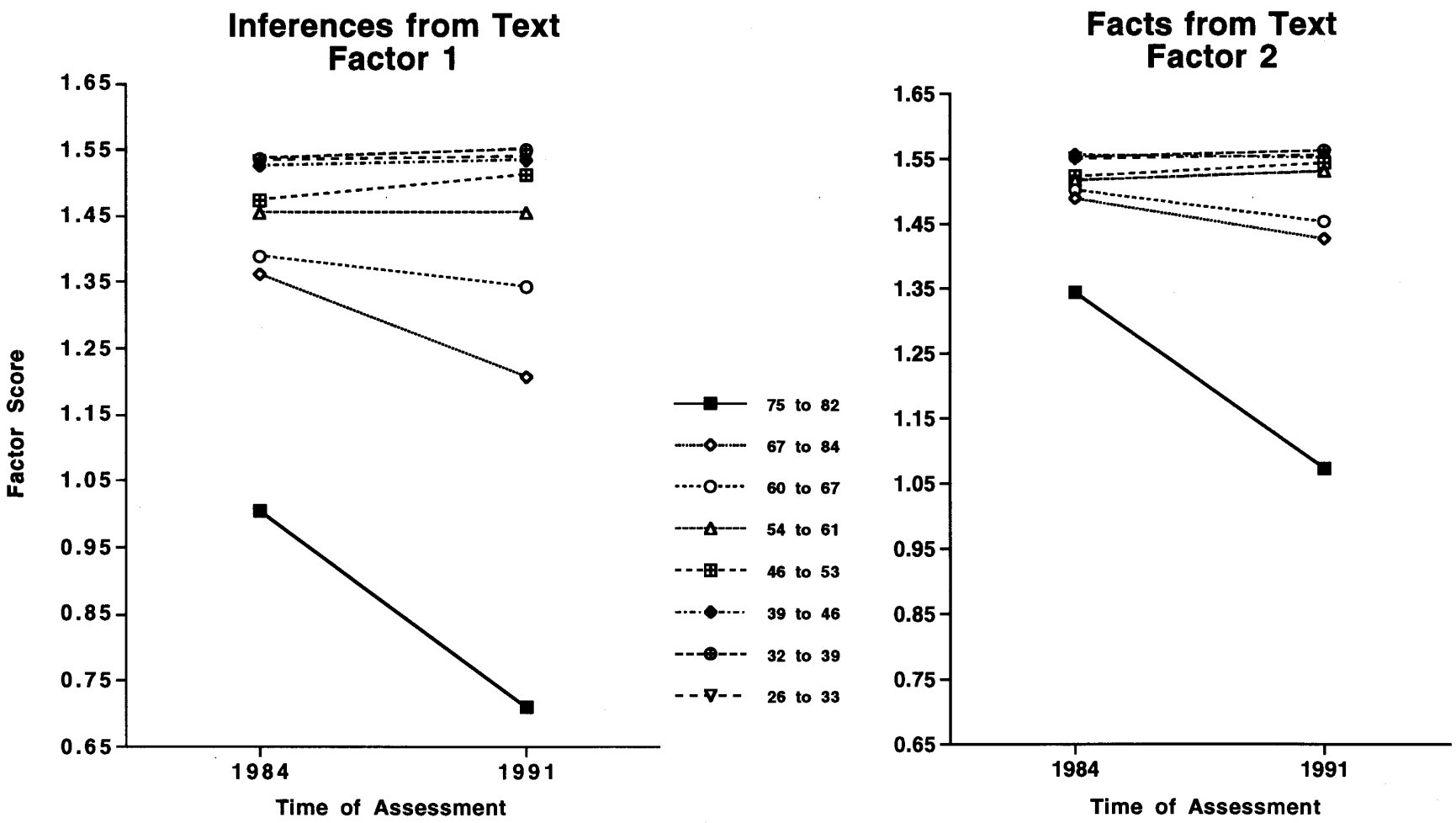
a. Nothing
b. $3.00
c. $15.00
d. $35.00

Figure Captions

Figure 1. Plot of Mean Factor Scores for Factors 1 and 2 by Age-Groups.

Figure 2. Plot of Mean Factor Scores for Factors 3 and 4 by Age-Groups.

BASIC SKILLS ASSESSMENT TEST - ETS
FACTOR SCORES BY AGE GROUP
FACTORS 1 & 2



BASIS SKILLS ASSESSMENT TEST - ETS
FACTOR SCORES BY AGE GROUP
FACTORS 3 & 4