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Perceived Intellectual Performance Change Over Seven Years

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Actual and perceived change in intellectual performance over seven years was examined in a sample of 837 participants in the Seattle Longitudinal Study who took five subtests of Thurstone's Primary Mental Abilities (PMA) test in 1977 and 1984. In 1984 participants rated perceived change in intellectual performance from 1977 to 1984. Participants were categorized, based on their actual performance, into those who maintained earlier performance level, significantly increased their performance, or declined in performance. A typology linking actual and perceived change in performance was created: Realists *(those who accurately estimated change in their performance);* Optimists *(those who overestimated positive change); and* Pessimists *(those who overestimated negative change). Classification of participants varied across abilities. Women were more likely to be pessimists on Spatial Orientation than men. Older individuals were more likely to be pessimists on Verbal Meaning and Inductive Reasoning Abilities and to be realists on Number ability compared to younger participants.*

RESEARCH on intellectual aging has typically focused on the *objective* assessment of study participants' performance (cf. Schaie, 1990). However, more recently, there has been an interest in examining subjects' *subjective* appraisal of their cognitive performance. Such subjective assessments have been thought to exert an important role in the process of intellectual aging. Some studies have linked personal expectations of performance on tests or in real life situations to actual performance on cognitive tasks (cf. Lachman, 1983; Willis & Schaie, 1986). Several studies examining concurrent relationships between intellectual self-efficacy and ability performance have reported that both young and elderly adults are fairly accurate in estimating their intellectual performance (Lachman & Jelalian, 1984; Lachman, Lachman, & Thronesbery, 1979; Perlmutter, 1978). Both age groups, moreover, have been found to make more accurate predictions for tests on which they exhibit higher levels of performance (Lachman & Jelalian, 1984).

The directionality of the relationship between ability performance and both locus of control and self-efficacy beliefs has been examined in two short-term longitudinal studies (Lachman & Leff, 1989; Willis, Jay, Diehl, & Marsiske, 1992). Two findings were consistent across studies. First, level of ability performance at the first occasion has been found to be a significant predictor of subsequent beliefs regarding locus of control and self-efficacy; however, control and efficacy beliefs have not been found to be significant predictors of subsequent ability performance. The second finding of these studies is that fluid abilities were found to be particularly salient predictors of locus of control and self-efficacy beliefs.

These findings support self-perception theory (Bem, 1972; Cornelius & Caspi, 1986) as a model for studying relationships between self-perception and intellectual abilities. Self-perception theory would predict that a person's beliefs about control over intellectual functioning may be an outcome of ability-related task performance; thus, perceptions are considered a *consequence* rather than a cause of ability performance. Bandura (1981) has similarly suggested that performance accomplishments provide "the most influential source of efficacy information" (p. 203).

The relationship between perceived and actual performance may also be complicated by age and gender differences. Researchers have differed regarding the question of whether older adults over- or underestimate their performance on abilities on which they perform poorly. Some (e.g., Bandura, 1981) have speculated that the elderly would be likely to *underestimate* their performance. However, findings from other studies (Lachman & Jelalian, 1984) indicate that the elderly consistently *overestimated* their performance on fluid measures on which they performed more poorly. Furthermore, researchers examining concurrent relationships between self-efficacy and ability performance have often interpreted their findings to suggest that age differences in self-efficacy are ability-specific. Hence, these studies imply that the elderly do *not* subscribe to global negative perceptions of their intellectual competence.

Given gender differences in mean scores for some abilities, it is likely that women will have lower self-efficacy beliefs for abilities on which women exhibit, on average, lower performance than men, such as spatial orientation (Berg, Hertzog, & Hunt, 1982; McGee, 1979; Willis & Schaie, 1988). An important consideration is whether women base their perceptions on their own ability performance or on gender-related stereotypes of ability. There is considerable overlap in score distributions for men and women on abilities such as spatial orientation, where many women perform as well as or better than many men. However, stereotypes may lead women to adopt perceptions that are not in agreement with their own performance level. For example, Lachman and Jelalian (1984) found older women to be less confident of their performance capabilities on an abstract reasoning task than men, irrespective of either actual performance or educational level.

Also of interest is the relationship between *level* of objective intellectual performance and perceptions of *change* in functioning. There is some evidence from longitudinal research that individuals with higher test scores exhibit smaller magnitudes of objectively measured decline (Gribbin, Schaie, & Parham, 1980). The question arises of whether level of objective performance is also related to perceived magnitude of ability change. Since prior research on concurrent relationships between actual and perceived performance indicates that adults are fairly accurate in their perception (Lachman & Jelalian, 1984), it may follow that those functioning at a higher objective level also perceive less change in functioning.

Most previous studies have focused upon the concurrent relationships between perceived competence and its objective measurement (Cornelius & Caspi, 1986; Lachman & Jelalian, 1984; Lachman, Steinberg, & Trotter, 1987). The present study contributes to the literature on subjects' perceptions of ability by utilizing longitudinal data. Participants in the Seattle Longitudinal Study (SLS; Schaie, 1983, 1989a) were asked to compare their current (1984) performance on five mental abilities with their performance seven years earlier and rate whether they thought that their current performance was better, the same, or worse. These responses (same, better, worse) will be referred to as *perceiver types*.

Participants were further categorized into a typology based on the congruence between their *perceived* and *actual* performance change over time. Three *congruence* types were identified: *Realists* (those who accurately estimated change in their performance); *Optimists* (those who overestimated positive change); and *Pessimists* (those who overestimated negative change). As used in the personality-social literature, the constructs of optimism and pessimism involve a comparison of current perceived status with perceived status at another point in time (i.e., prior or future status). In research on children and young adults, the temporal comparison typically involves current vs future status. However, as concern regarding decline becomes more salient in middle and old age, temporal comparisons are often made between current vs prior levels of competence or status. For example, items on self-efficacy measures often involve comparisons of current and prior level of functioning (Levinson, 1974). It is in such a context that in this study we use the terms optimist and pessimist to refer to individuals' perceptions of current vs prior intellectual performance.

This study examines individual differences with regard to two ways of characterizing perception of change in ability functioning: perceiver types and congruence types. The definition of perceiver type is similar to that previously used in the literature, but assesses perception of change rather than current level of functioning. Research on concurrent relationships between ability performance and perception suggests accuracy of perception is moderated by level of ability performance, age, and gender (Lachman & Jelalian, 1984; Perlmutter, 1978). Both old and young adults have been found to make more accurate predictions of their performance on abilities on which they performed at a higher level. In addition, some studies report that older adults overestimate their performance on abilities on which they perform poorly. Furthermore, women were found to perceive themselves to do more poorly on spatial and reasoning ability. With regard to perceiver types, we first examine whether perception of change on each of five mental abilities is moderated by age, gender, or level of ability performance. Second, we examine the accuracy of perceiver types by relating perceiver type to objective change in ability test scores.

The second way in which this study characterizes perception of change is by means of congruence types. There is little or no prior literature related to this construct, since prior research has been cross-sectional and has not examined the congruence between subjects' perception and the accuracy of ability change via the development of a relevant typology. First we describe the distribution of congruence types for each of the five abilities for the total sample and broken down by age and gender. We then consider whether congruence types are moderated by age, gender, and level of actual ability performance, as has been done for perceiver types.

METHOD

Subjects

Participants were panel members of the Seattle Longitudinal Study (SLS), a study that has now been in progress for 35 years and whose purpose is to assess cognitive development in adulthood. The SLS participants are recruited at random, stratified by age and gender, from the adult membership of a Health Maintenance Organization. The sampling frame is a community-dwelling population representing a wide range of occupational, educational, and economic backgrounds.

The subsample selected for this particular study comprised those individuals who were tested in 1977 and who returned for the next assessment in 1984. This criterion resulted in a sample of 837 participants (383 men and 454 women) with a mean age in 1984 of 68.36 years (SD = 13.34; range: 29–95 years) and a mean educational level of 14.14 years (SD = 3.07). To examine possible age differences among perceiver and congruence types, the sample was divided into three subsets by age in 1984: younger (n = 168, M = 41.76, SD = 5.20, range = 29–49 years); middle-aged (n = 441, M = 60.63, SD = 5.73, range = 50–70 years); and older adults (n = 228, M = 77.24, SD = 5.74, range = 71–95 years).

Measures

As part of a larger cognitive test battery, all subjects were given the Primary Mental Abilities (PMA) test (Thurstone & Thurstone, 1949).

The Primary Mental Abilities battery is composed of five tests, as follows:

Verbal Meaning (V). — This test measures the range of the subject's passive (recognition) vocabulary. Each stimulus word must be matched by a word which is the same or similar from four multiple-choice alternatives.

Spatial Orientation (S). — This is a measure of the ability to visualize and rotate objects in two-dimensional space.

Abstract stimulus figures must be matched from six other representations of the same stimulus which have been rotated and some of which are mirror images. The subject's task is to match all those figures which, if rotated, would represent the original stimulus.

Inductive Reasoning (R). — This test measures whether a person can identify a rule or principle from individual instances. The measurement operation involves letter series that require identification of one or more rules needed to identify which letter from a multiple-choice set would continue the series.

Number (N). — This is a measure of subjects' ability to add sums of numbers quickly and accurately. The subject must identify whether the sum provided for each addition is correct or incorrect.

Word Fluency (W). — This is a measure of the subject's active (recall) vocabulary, indicating the speed and ease of using words.

Procedure

After completing the five PMA tests (given in a constant order = V, S, R, N, W), study participants answered the Primary Mental Abilities Retrospective Questionnaire (PMARQ). This questionnaire reminded the participants that they had taken the same five ability tests several years earlier and asked them to reflect on how their performance on the tests just completed (in 1984) compared with their earlier performance (in 1977).

Creation of perceiver types. — Subjects evaluated their relative performance for each of the five abilities using a 5-point scale with the categories: 1 = much better today; 2 = better today; 3 = about the same; 4 = worse today; 5 = much worse today. Fewer than 3% of the subjects selected the "much better today category" for any ability, and fewer than 5% selected the "much worse today" category. Because of the low number of persons who chose these extreme categories (1 or 5), data were collapsed into a 3-point scale, resulting in three *perceiver* types: better, same, and worse.

Creation of congruence types. — Study participants were classified according to how their actual PMA performance had changed between the two test occasions on each of the five abilities. Difference scores between the 1977 and 1984 performance were computed, and subjects were classified into groups showing reliably higher, similar, or lower performance for each ability. The classification criteria for a positive or negative change were that the subjects in 1984 performed at least 1 *SEM* below or above their 1977 performance (cf. Dudek, 1979; Schaie, 1989b).

Cross-tabulations between actual performance change and perceived performance change were next examined. Based on the patterns in these tables, the sample was then categorized into three congruence types for each ability: (1) Pessimists — individuals who perceived greater negative change or less improvement in performance relative to their actual change (1977 to 1984); (2) Realists — those individuals who accurately predicted change or stability; (3) Optimists — those who perceived greater positive change or stability than indicated by their actual performance (see Table 1).

Analyses

Categorical data were analyzed by means of contingency tables evaluated with the χ^2 statistic. Comparisons of proportions across individual cells of the tables utilize Pearson's χ^2 with 1 df. Comparisons across different abilities are evaluated with McNemar's test for correlated proportions (McNemar, 1969).

Post-hoc comparisons of means for the continuous data entering the analyses of variance utilize Tukey's Honest Significance Difference (HSD) test as adapted for unequal cell sizes by Spjotvoll and Stoline (1973).

RESULTS

Age and Gender Differences in Perceiver Types

Table 2 presents the proportion of subjects by perceiver type, age, and gender for each of the five abilities. Overall, the proportion of subjects reporting that their performance had become better ranged from 13.3% for Spatial Orientation to 22.3% for Inductive Reasoning. The proportion of subjects reporting that their performance had remained the same ranged from 47.3% for Spatial Orientation to 71.5% for Verbal Meaning. Those who reported themselves as having performed worse than on the previous test occasion ranged from 8.4% for Verbal Meaning to 39.4% for Spatial Orientation. Reports of perceived change differed significantly from the chance probability of .33 for all five abilities (χ^2 (V)[2, n = 818] = 553.21, $p < .001$; χ^2 (S)[2, n = 818] = 155.11, $p < .001$; χ^2 (R)[2, n = 818] = 164.37, $p < .001$; χ^2 (N)[2, n = 819] = 191.05, $p < .001$; χ^2 (W)[2, n = 815] = 150.88, $p < .001$).

For the total sample there was a significant relationship between age and perceiver type for four of the five abilities (χ^2 (V)[4, n = 818] = 58.35, $p < .001$; χ^2 (S)[4, n = 818] = 13.61, $p < .01$; χ^2 (R)[4, n = 818] = 45.18, $p < .001$; χ^2 (N)[4, n = 819] = 27.51, $p < .001$). On both Verbal Meaning and Inductive Reasoning, more old subjects than young reported that they had become worse (χ^2 (V)[1, n = 43] = 26.20, $p < .001$; χ^2 (R)[1, n = 89] = 23.82, $p < .001$), while more young subjects than old reported having become better (χ^2 (V)[1, n = 83] = 24.44, $p < .001$; χ^2 (R)[1, n = 84] = 20.96, $p < .001$); the middle-aged were in between. On Spatial Orientation young subjects reported more improvement than did the old (χ^2[1, n = 52] = 6.08, $p < .05$), while the old reported more decline than did the

Table 1. Schema for Classification Into Congruence Types

Actual Change	Perceived Change		
	Better	Same	Worse
Improved	R	P	P
Same	O	R	P
Declined	O	O	R

Note. R = Realist, P = Pessimist, O = Optimist.

Table 2. Proportion of Study Participants Reporting Perceived Change in Performance by Ability, Age, and Gender

	Males			Females			Total		
	Better	Same	Worse	Better	Same	Worse	Better	Same	Worse
Verbal Meaning									
Young	31.5	67.1	1.4	36.2	60.6	3.2	34.1	63.5	2.4
Middle-aged	17.9	78.6	3.5	19.9	71.7	8.4	19.0	74.9	6.1
Old	13.9	71.3	14.8	9.8	70.7	19.5	11.6	71.0	17.4
Total	19.5	74.4	6.1	20.5	69.1	10.4	20.1	71.5	8.4
Spatial Orientation									
Young	26.0	48.0	26.0	12.8	46.8	40.4	18.6	47.3	34.1
Middle-aged	9.5	61.0	29.5	16.7	39.9	43.4	13.3	49.8	36.9
Old	13.0	49.0	38.0	6.5	37.4	56.1	9.4	42.6	48.0
Total	13.7	55.2	31.0	13.0	40.7	46.3	13.3	47.3	39.4
Inductive Reasoning									
Young	27.4	61.6	11.0	39.4	52.1	8.5	34.1	56.3	9.6
Middle-aged	20.0	56.5	23.5	25.4	56.6	18.0	22.9	56.5	20.6
Old	13.0	53.0	34.0	11.4	56.9	31.7	12.1	55.2	32.7
Total	19.6	56.6	23.9	24.5	55.7	19.8	22.3	56.1	21.6
Number									
Young	28.8	35.6	36.6	19.3	40.9	39.8	23.5	38.5	38.0
Middle-aged	20.4	51.2	28.4	18.9	59.2	21.9	19.6	55.5	24.9
Old	18.8	65.4	15.8	18.7	61.8	19.5	18.7	63.4	17.9
Total	21.6	52.0	26.4	18.9	56.1	25.0	20.2	54.2	25.6
Word Fluency									
Young	30.1	43.8	26.0	32.3	47.3	20.4	22.3	43.4	34.3
Middle-aged	25.9	53.2	20.9	21.5	57.9	20.6	20.5	50.4	29.1
Old	19.2	54.6	26.3	27.3	55.4	17.3	15.9	49.1	35.0
Total	24.9	51.7	23.3	25.3	55.0	19.7	19.6	48.6	31.8

young ($\chi^2[1, n = 164] = 5.33, p < .05$) or middle-aged ($\chi^2[1, n = 265] = 4.85, p < .05$). However, on Number, the age relationship was reversed, with more older individuals reporting that they remained stable than the young ($\chi^2[1, n = 206] = 15.04, p < .001$) or the middle-aged ($\chi^2[1, n = 380] = 5.35, p < .05$), and more younger persons reporting that they got worse than the old ($\chi^2[1, n = 103] = 11.01, p < .001$), or the middle-aged ($\chi^2[1, n = 170] = 7.63, p < .01$).

The relationship between age and perceiver type was similar across genders. However, we did find a significant relationship between gender and perceiver type for Spatial Orientation ($\chi^2[2, n = 818] = 21.05, p < .001$). The proportion of men and women who reported having become better did not differ, but more men than women reported having remained the same ($\chi^2[1, n = 387] = 9.06, p < .01$), and more women than men reported having gotten worse ($\chi^2[1, n = 322] = 11.88, p < .001$).

Differences Among Perceiver Types in Level of PMA Scores

Differences in ability level were examined for participants who had reported that they remained stable, improved, or declined, regardless of the accuracy of their report. A 3 (Perceiver Type) × 3 (Age Group) × 2 (Gender) ANOVA was conducted separately for each ability (see Table 3 for the ANOVA summary and Table 4 for the associated means). Significant main effects for age in this and subsequent ANOVAs are not discussed because they follow the well-established cross-sectional patterns reported previously (Schaie, 1983, 1990, 1994). For all abilities the young perform at significantly higher levels than the middle-aged, and the middle-aged perform at significantly higher levels than the old.

Significant type differences were found for Spatial Orientation [$F(2,798) = 37.33, p < .001$] and for Word Fluency [$F(2,796) = 31.49, p < .001$]. In both instances, PMA scores were significantly higher for individuals who had reported positive change or who reported no change than for those reporting negative change ($p < .001$). For Word Fluency, those reporting positive change were also significantly higher than those reporting no change ($p < .001$).

Significant Perceiver Type by Age interactions were also found for Spatial Orientation [$F(4,798) = 3.53, p < .01$] and Number [$F(4,800) = 2.23, p < .05$]. The Type by Age interaction for Spatial Orientation indicated that, although there was virtually no difference in ability level among the three types for the old group, in the young and middle-aged groups those who perceived themselves to have improved and those who rated themselves the same, indeed performed much better than those who perceived themselves to have declined ($p < .001$). The Type by Age interaction for Number conversely indicates that, whereas there was little difference in test scores among the types for either the young

Table 3. Analyses of Variance for 1984 Performance Level by Perceiver Types by Ability, Age Group, and Gender

	Verbal Meaning		Spatial Orientation		Inductive Reasoning		Number		Word Fluency	
Effect	F	ω^2	F	ω^2	F	ω^2	F	ω^2	F	ω^2
Perceiver Type	.05		37.33***	.078	2.04		.62		31.49***	.070
Age Group	54.56***	.125	83.69***	.177	135.14***	.285	6.95***	.014	37.72***	.084
Gender	1.07		9.33***	.009	2.49		7.26*	.008	9.29***	.009
Perceiver Type × Age	.61		3.53**	.011	1.76		2.23*	.006	.74	
Perceiver Type × Gender	.35		1.29		.24		.44		.28	
Age × Gender	1.84		.67		.07		1.21		7.06***	.014
Perceiver Type × Age × Gender	.81		1.64		1.48		2.75*	.008	3.98**	.014

*$p < .05$; **$p < .01$; ***$p < .001$.

Table 4. Mean T-Scores for 1984 Performance Levels by Perceiver Type by Ability, Age Group, and Gender

	Males			Females			Total		
	Better	Same	Worse	Better	Same	Worse	Better	Same	Worse
Verbal Meaning									
Young	57.00	56.53	61.00	56.82	58.40	53.67	56.91	57.47	57.33
Middle-aged	56.09	54.37	52.57	53.24	54.37	51.58	54.67	54.37	52.76
Old	43.86	46.03	39.73	47.25	46.68	42.63	45.55	46.35	41.18
Total	52.31	52.31	51.10	52.44	53.15	49.29	52.38	52.73	50.20
Spatial Orientation									
Young	63.21	58.17	55.58	61.25	57.25	48.32	62.23	57.71	51.95
Middle-aged	54.58	56.87	49.08	54.05	52.82	46.74	54.32	54.85	47.91
Old	43.92	47.92	43.26	45.25	44.67	41.97	44.59	46.29	42.62
Total	53.90	54.32	49.31	53.52	51.58	45.67	53.71	52.95	47.49
Inductive Reasoning									
Young	57.67	57.50	61.62	61.11	58.11	61.14	59.39	57.80	61.38
Middle-aged	53.07	53.52	53.19	52.26	54.45	56.58	52.66	53.99	54.89
Old	45.11	44.90	45.33	47.43	45.29	44.58	46.27	45.10	44.96
Total	51.95	51.97	53.38	53.60	52.62	54.10	52.78	52.30	53.74
Number									
Young	48.80	52.07	58.12	50.22	50.51	46.12	49.51	51.29	52.12
Middle-aged	53.98	52.23	50.64	48.71	49.98	51.00	51.34	51.10	50.82
Old	51.23	48.75	44.32	50.50	47.11	45.31	50.87	47.93	44.82
Total	51.34	51.02	51.02	49.81	49.20	47.48	50.57	50.11	49.25
Word Fluency									
Young	57.00	52.06	50.58	57.90	56.05	52.58	57.45	54.06	51.58
Middle-aged	56.29	50.23	46.98	52.41	53.08	45.49	54.35	51.65	46.23
Old	46.58	46.09	36.92	53.91	47.09	44.43	50.24	46.59	40.68
Total	53.30	49.46	44.83	54.74	52.07	47.50	54.01	50.77	46.16

or the middle-aged, it was the older adults who perceived themselves to have improved who performed at a significantly higher level than did those who perceived themselves to have declined ($p < .05$).

Significant triple interactions, moreover, were found for Number [$F(4,800) = 2.75$, $p < .05$] and Word Fluency [$F(4,811) = 3.98$, $p < .01$]. The triple interaction on Number reflects the fact that although both older adult males and females who perceive themselves to have declined had lower test scores than those who perceived themselves to have improved ($p < .01$), young males showed the opposite pattern ($p < .01$). That is, those who perceived themselves to have declined actually had higher mean scores than those who perceived themselves to have improved or remained stable ($p < .001$). The triple interaction on Word Fluency reflects the finding, first, that ability scores for men who perceive themselves to have improved or declined are significantly higher for the young and middle-aged than for the old ($p < .05$). Second, ability scores for women who perceive themselves to have declined or improved are significantly higher for the young than for either the middle-aged or the old ($p < .01$). Third, ability scores for men and

Table 5. Correlations Between Perceived and Actual Change

Actual Change	Perceived Change: Verbal Meaning	Spatial Orientation	Inductive Reasoning	Number	Word Fluency
Verbal Meaning	.112***	.056	.080*	.046	.012
Spatial Orientation	.068	.206***	.055	−.045	.037
Inductive Reasoning	.101**	.035	.141***	.047	−.030
Number	.151***	.076*	.123***	.134***	.064
Word Fluency	.083*	.015	.041	−.039	.210***

Note. Convergent validities are underlined.
*$p < .05$; **$p < .01$; ***$p < .001$.

women who perceived themselves to have remained stable are both significantly higher for the young and middle-aged than for the old ($p < .05$).

Accuracy of Perceiver Type: Correlation Between Perceived and Observed Change

Table 5 presents the correlations between perceiver types (better, same, worse) and actual change on the ability measures as classified into three categories (see Methods section). Positive correlations in Table 5 reflect agreement between perceived and actual change. Table 6 presents the intercorrelation of perceptions of change across abilities. Although the correlations between perceived and actual change for the same ability (convergent validity) were statistically significant ($p < .001$) and for the most part were larger than cross-ability correlations (divergent validity), they were quite small (see Table 5). Indeed, significantly larger correlations were found among ratings of perceived change across abilities (Table 6), suggesting that the ratings of perceived change are associated with *global* perceptions of change in intellectual functioning, in addition to the perceptions of change that are specific to a given ability.

Given the categorical nature of the judgment of perceived change, the correlations do not necessarily give a good picture of the accuracy of the respondents' perceptions. We therefore turn next to analyses of the congruence types.

Distribution of Congruence Types

Total sample. — Table 7 shows the proportion of each congruence type for each ability. These proportions are also broken down further by age and gender in Table 7. Assuming that the expected chance probability of being assigned to one of the three response congruence types was .33, chi-square analyses determined that assignment to type differed significantly from chance for all five abilities (χ^2 (V)[2, n = 818] = 315.99, $p < .001$; χ^2 (S)[2, n = 818] = 104.03, $p < .001$; χ^2 (R)[2, n = 818] = 94.95, $p < .001$; χ^2 (N)[2, n = 819] = 76.86, $p < .001$; χ^2 (W)[2, n = 815] = 103.39, $p < .001$). Approximately half of the participants were *realistic* in their perception of change or stability over the 7-year period. Participants were most accurate (realistic) in estimating stability or change on the Verbal Meaning test. The highest proportion of pessimists (overestimation of decline) occurred for Spatial Orientation (34%), while pessimists were the fewest for Verbal Meaning (10.3%). Approximately 30% of the sample was *optimistic* (underestimation of decline) about their performance change for all abilities except Spatial Orientation.

Table 6. Correlations Among Perceptions of Change for the Different Abilities

	Verbal Meaning	Spatial Orientation	Inductive Reasoning	Number
Spatial Orientation	.275***[a]			
Inductive Reasoning	.351***[a]	.237***[a]		
Number	.229***[a]	.090**	.180***	
Word Fluency	.298***[a]	.139***	.247***	.277***[a]

[a]Intercorrelation is significantly larger ($p < .05$) than the corresponding validity coefficient in Table 2.
**$p < .01$; ***$p < .001$.

Consistency in congruence types across the 5 PMA tests was examined, but no consistent pattern was evident. Some study participants who were categorized as a pessimist for one ability were likely to be a realist on another, and possibly an optimist on a third. There are 120 possible permutations of congruence types across all five abilities. Almost all permutations were observed. The most frequently observed permutation accounting for less than 4% (n = 30) of the total sample was the pattern of being a realist across all five abilities.

Age and gender differences. — Gender differences in the distribution of congruence types were found for only one ability, Spatial Orientation (χ^2[2, n = 818] = 6.40, $p <$ .05). A greater proportion of women were found to be pessimistic about change in their spatial ability than men (χ^2[1, n = 278] = 3.85, $p < .05$).

Significant age differences in congruence types were found for Verbal ability (χ^2[4, n = 818] = 9.38, $p < .05$). Inductive Reasoning (χ^2[4, n = 818] = 14.73, $p < .01$), and Number (χ^2[4, n = 819] = 16.95, $p < .01$). On Verbal ability the old were more pessimistic than the young (χ^2[1, n = 44] = 3.86, $p < .05$) with respect to their ability change. On Inductive Reasoning a greater proportion of the oldest group of subjects was more pessimistic about change in this ability than both the young χ^2 (R)[1, n = 92] = 13.13, $p < .001$) or the middle-aged (χ^2 (R)[1, n = 155] = 13.58, $p < .001$). However, a greater proportion of the youngest

group was pessimistic in the assessment of their performance change on the Number test than were the old ($\chi^2[1, n = 90] = 12.36, p < .001$) or the middle-aged ($\chi^2[1, n = 160] = 6.17, p < .05$). The middle-aged were also more pessimistic than the old ($\chi^2[1, n = 140] = 6.37, p < .05$).

Differences Among Congruence Types in Level of Ability Scores

Differences among congruence types in level of 1984 PMA scores were examined via 3 (Congruence Type) × 3 (Age Group) × 2 (Gender) ANOVAs conducted separately for each of the five abilities (see Table 8 for the ANOVA summary and Table 9 for the associated means). Significant differences by type were found for Verbal Meaning [$F(2,798) = 11.36, p < .001$] and for Inductive Reasoning [$F(2,795) = 3.76, p < .02$]. Both realists ($p < .001$) and pessimists ($p < .05$) had significantly higher 1984 Verbal Meaning scores than optimists. Realists' 1984 Inductive Reasoning scores were significantly higher than those of pessimists ($p < .05$).

Significant age main effects occurred for all abilities. Gender main effects favored men for Spatial Orientation (p

Table 7. Proportion of Study Participants in Congruence Categories by Ability, Age, and Gender

	Males			Females			Total		
	Pessimists	Realists	Optimists	Pessimists	Realists	Optimists	Pessimists	Realists	Optimists
Verbal Meaning									
Young	8.2	60.3	31.5	7.4	54.3	38.3	7.8	56.9	35.3
Middle-aged	7.5	69.2	23.4	11.1	59.7	29.2	9.4	64.2	26.4
Old	12.9	57.4	29.7	14.6	55.3	30.1	13.8	56.3	29.9
Total	9.1	64.3	26.7	11.3	57.3	31.4	10.3	60.5	29.2
Spatial Orientation									
Young	21.9	50.7	27.4	37.2	50.0	12.8	30.5	50.3	19.2
Middle-aged	30.0	52.5	17.5	33.8	46.9	19.3	32.0	49.5	18.5
Old	35.0	44.0	21.0	44.7	39.8	15.5	40.4	41.7	17.9
Total	29.8	49.9	20.4	37.5	45.6	16.9	34.0	47.6	18.4
Inductive Reasoning									
Young	16.4	53.4	30.1	14.9	44.7	40.4	15.6	48.5	35.9
Middle-aged	23.0	48.5	28.5	18.9	51.3	29.8	20.8	50.0	29.2
Old	34.0	45.0	21.0	26.0	48.8	25.2	29.6	47.1	23.3
Total	24.7	48.5	26.8	20.0	49.2	30.8	22.1	48.9	29.0
Number									
Young	32.9	43.8	23.8	33.3	44.1	22.6	33.1	44.0	22.9
Middle-aged	29.4	43.8	26.9	20.2	49.1	30.7	24.5	46.6	28.9
Old	13.9	52.5	33.7	17.1	51.2	31.7	15.6	51:8	32.6
Total	25.9	46.1	28.0	22.1	48.6	29.3	23.8	47.5	28.7
Word Fluency									
Young	23.3	49.3	27.4	21.5	38.7	39.8	22.3	43 4	34.3
Middle-aged	20.9	50.2	28.9	20.2	50.4	29.4	20.5	50.4	29.1
Old	18.2	49.5	32.3	14.0	48.8	37.2	15.9	49.1	35.0
Total	20.6	49.9	29.5	18.8	47.5	33.7	19.6	48.6	31.8

Table 8. Analyses of Variance for 1984 Performance Level of Congruence Types by Ability, Age Group, and Gender

	Verbal Meaning		Spatial Orientation		Inductive Reasoning		Number		Word Fluency	
Effect	F	ω^2	F	ω^2	F	ω^2	F	ω^2	F	ω^2
Congruence Type	11.36***	.023	.26		3.75*	.005	.18		1.34	
Age Group	85.74***	.188	93.27***	.267	148.14***	.269	10.21***	.029	37.75***	.085
Gender	.16		24.39***	.025	1.15		5.69*	.007	12.75***	.014
Congruence Type × Age	.39		1.08		1.86		.37		1.64	
Congruence Type × Gender	1.12		.40		.54		.11		1.60	
Age × Gender	.87		1.29		.65		1.03		4.62**	.009
Congruence Type × Age × Gender	1.29		1.25		1.78		1.86		.53	

*$p < .05$; **$p < .01$; ***$p < .001$.

Table 9. Mean T-Scores for 1984 Performance Levels by Congruence Type, Age Group, and Gender

	Males			Females			Total		
	Pessimists	Realists	Optimists	Pessimists	Realists	Optimists	Pessimists	Realists	Optimists
Verbal Meaning									
Young	60.00	56.66	56.04	57.86	59.51	55.06	58.93	58.08	55.55
Middle-aged	53.14	54.95	54.04	54.52	55.45	50.53	53.83	55.20	52.29
Old	44.46	46.57	41.50	46.72	46.97	43.68	45.49	46.77	42.59
Total	52.53	52.73	50.53	53.03	53.98	49.75	52.78	53.35	50.14
Spatial Orientation									
Young	58.69	57.46	61.40	53.31	54.83	53.96	56.00	56.14	57.66
Middle-aged	54.18	54.67	53.71	48.65	50.60	52.91	51.42	52.63	53.31
Old	45.85	46.82	42.67	43.54	42.94	42.79	44.69	44.88	42.73
Total	52.91	52.98	52.59	48.50	49.46	49.87	50.70	51.22	51.23
Inductive Reasoning									
Young	60.25	59.92	56.73	55.93	60.81	60.29	58.08	60.37	58.51
Middle-aged	52.87	54.13	52.58	56.14	54.74	53.06	54.36	54.44	52.82
Old	42.72	46.33	45.62	43.25	46.38	46.32	42.99	46.36	45.97
Total	51.85	53.46	51.64	51.77	53.98	53.33	51.81	53.72	52.43
Number									
Young	50.62	52.38	52.53	50.26	49.83	49.86	50.44	51.10	51.19
Middle-aged	51.47	51.42	54.15	48.52	51.22	48.49	50.00	51.32	51.32
Old	48.79	48.21	45.62	46.95	46.67	47.33	47.87	47.44	51.19
Total	50.30	50.67	50.77	48.58	49.24	48.56	49.80	50.07	49.60
Word Fluency									
Young	53.59	51.67	55.50	57.05	55.25	56.00	55.31	53.46	55.75
Middle-aged	49.57	51.42	51.72	51.52	52.23	49.79	50.55	51.82	50.76
Old	39.41	44.10	45.53	48.24	47.37	50.04	43.82	45.74	47.79
Total	47.52	49.06	50.92	52.27	51.61	51.94	50.28	50.52	51.07

$< .001$) and Number ($p < .05$), but favored women for Word Fluency ($p < .001$). The only significant Age × Gender interaction occurred for Word Fluency, reflecting greater age differences for women between the younger and middle-aged groups ($p < .001$), and for men between the middle-aged and old groups ($p < .001$).

Congruence Type Differences in Magnitude of Ability Change

Differences among congruence types in magnitude of ability change (1977 to 1984) were examined via 3 (Congruence Type) × 3 (Age Group) × 2 (Gender) ANOVAs conducted separately for each ability (see Table 10 for ANOVA results and Table 11 for the associated mean changes), and followed by Tukey's HSD post-hoc tests. Note that these analyses are designed primarily to confirm the adequacy of assignment to the congruence types. Significant type differences in magnitude of change were found for all abilities: Verbal Meaning [$F(2,798) = 105.59$, $p < .001$]; Spatial Orientation [$F(2,798) = 53.47$, $p < .001$]; Inductive Reasoning [$F(2,795) = 60.83, p < .001$]; Number [$F(2,801) = 53.28$, $p < .001$]; and Word Fluency [$F(2,796) = 47.40, p < .001$]. For all abilities, each type differed significantly from the others in magnitude of change. As would be expected from the type definitions, the optimists experienced greater average decline (respectively less gain) than either realists or pessimists, and the pessimists experienced objectively the least decline (all differences significant at or beyond the .001 level of confidence). The difference between pessimists and optimists exceeded .5 *SD* for all abilities and was greatest for Verbal Meaning.

A Congruence Type by Age interaction was found for Verbal Meaning [$F(2,798) = 3.18, p < .001$]. The young pessimists gained significantly more over time than did the middle-aged or old pessimists ($p < .001$). Likewise, the old optimists declined significantly more than did their young counterparts ($p < .01$). Also, the young realists gained significantly more over time than did the middle-aged ($p < .05$) and old realists ($p < .001$). A significant Congruence Type by Gender interaction occurred for Word Fluency [$F(2,796) = 3.01, p < .05$]. This interaction reflected significantly greater gain over time for the female than the male pessimists ($p < .05$). Finally, a significant triple interaction was obtained for Spatial Orientation [$F(4,798) = 2.62, p < .05$]. This interaction reflects significant gain over time for the middle-aged male pessimists, but stability for the middle-aged female pessimists ($p < .001$).

Discussion

We assume in this study that community dwelling adults are capable of making subjective judgments of change in performance on cognitive tests taken seven years apart. It could be argued that what the subjects actually do is more likely to be a projection of their feelings on how they think

Table 10. Analyses of Variance for Magnitude of Change of Congruence Types by Ability, Age Group, and Gender

	Verbal Meaning		Spatial Orientation		Inductive Reasoning		Number		Word Fluency	
Effect	*F*	ω^2	*F*	ω^2	*F*	ω^2	*F*	ω^2	*F*	ω^2
Congruence Type	105.59***	.190	53.47***	.111	60.83***	.124	52.28***	.111	47.40***	.100
Age Group	31.59***	.056	11.33***	.022	17.52***	.034	3.05*	.004	7.53***	.014
Gender	5.17*	.004	3.11		.18		.20		3.01	
Congruence Type × Age	3.18**	.004	.80		1.11		2.06		.74	
Congruence Type × Gender	.94		.46		.37		.34		3.01*	.004
Age × Gender	.14		.15		1.72		.46		2.46	
Congruence Type × Age × Gender	.97		2.62*	.007	.50		1.61		.18	

*$p < .05$; **$p < .01$; ***$p < .001$.

Table 11. Mean T-Scores for Magnitude of Change from 1977 to 1984 by Congruence Type, Ability, Age Group, and Gender

	Males			Females			Total		
	Pessimists	Realists	Optimists	Pessimists	Realists	Optimists	Pessimists	Realists	Optimists
Verbal Meaning									
Young	−8.83	−.43	1.35	−7.57	−.65	2.53	−8.20	−.54	1.94
Middle-aged	−5.53	.70	3.55	−3.20	.53	5.35	−4.27	.62	4.45
Old	−3.54	1.68	8.63	−.50	3.13	8.43	−2.02	2.39	8.53
Total	−5.90	.64	4.51	−3.76	1.01	5.44	−4.83	.82	4.97
Spatial Orientation									
Young	−1.81	−.19	3.85	−2.11	1.26	5.25	−1.96	.53	4.55
Middle-aged	−3.32	2.07	6.00	.29	2.85	3.87	−1.51	2.46	4.69
Old	.09	3.02	7.00	.51	4.51	8.58	.30	3.77	7.79
Total	−1.68	1.63	5.62	−.44	2.87	5.74	−1.06	2.25	5.68
Inductive Reasoning									
Young	−3.50	−.18	2.09	−3.93	.26	1.66	−3.71	.04	1.87
Middle-aged	−1.70	.71	4.58	−2.28	1.12	3.47	−1.99	.92	4.02
Old	−.06	1.44	4.38	.31	2.27	6.35	.13	1.86	5.37
Total	−1.75	.66	3.68	−1.97	1.22	3.83	−1.86	.94	3.76
Number									
Young	−1.42	.16	1.88	−1.71	1.80	2.48	−1.56	.98	2.18
Middle-aged	−.97	1.49	2.74	−1.91	1.04	4.97	−1.44	1.27	3.86
Old	−2.07	1.94	6.44	−1.80	1.81	2.48	−1.94	1.88	5.80
Total	−1.48	1.20	3.69	−1.81	1.55	4.20	−1.65	1.37	3.94
Word Fluency									
Young	−2.41	.61	1.75	−4.90	.67	2.78	−3.66	.64	2.27
Middle-aged	−1.48	.57	4.41	−3.02	2.03	5.03	−2.25	1.30	4.72
Old	1.56	2.78	5.88	−2.53	1.19	4.89	−.49	1.98	5.38
Total	−.78	1.32	4.01	−3.48	1.29	4.23	−2.13	1.31	4.12

Note. Negative values represent mean gain from 1977 to 1984.

their cognitive competence has changed, with the current test providing no more than a projective stimulus. However, the data suggest that much more systematic judgments are made.

This study extends prior research on intellectual self-efficacy in two ways. Most prior research has been cross-sectional, comparing young and older adults' perception of their *level* of intellectual functioning with their concurrent performance on ability measures (Lachman & Jelalian, 1984; Perlmutter, 1978). In this study we examine perceptions of age-related *change* in ability functioning for three age groups (young, middle-aged, older adults). Furthermore, we propose a typology for examining the congruence between perceptions of change and actual age-related change in intellectual functioning. The typology categorizes three congruence types: the Realists, those who correctly estimated change or stability; the Pessimists, those who thought they had declined more than they actually had; and the Optimists, those who thought they did better than the objective data reflected. The typology was examined with

respect to five primary mental abilities. We were able to verify this typology by showing that the three groups differed significantly in absolute magnitude of change in the expected direction on all five abilities; that is, pessimists declined the least or gained, optimists declined the most, and realists were in between.

With respect to subjects' perception of change in ability functioning (regardless of the accuracy of perceptions), we find that a greater proportion of older adults than young or middle-aged adults perceive themselves to have declined on three of the abilities studied (Verbal, Reasoning, Spatial Orientation). For Number ability, by contrast, a significantly smaller proportion (18%) of older adults perceive themselves to have declined than young adults (38%). No Age by Perceiver Type interaction was found for Word Fluency. There are two possible implications of these findings. First, prior research findings (Lachman & Jelalian, 1984) are supported in that age differences in perceptions are ability-specific; the old do not hold global perceptions of universal decline across all abilities. Second, the findings suggest a possible cohort effect in ability perceptions. Prior cohort-sequential analyses within the Seattle Longitudinal Study indicate that cohort differences in ability performance are multidirectional and vary by ability (Schaie, 1983, 1990, 1994). Of particular interest is the fact that the pattern of cohort differences for Number ability reflects an inverted-U, with birth cohorts 1917 and 1924 showing the highest Number performance, compared to earlier and more recent cohorts. The older group in the present study then represents cohorts whose Number ability was particularly high compared to more recent cohorts, and this may contribute to the age differences in perception of decline on Number ability found in the study.

When perceptions of cognitive change over seven years are compared with objectively measured change (congruence typology), we find that approximately half of our sample could accurately categorize their performance change over time (i.e., they were realists), albeit the correct attribution in most instances turned out to be their judgment that no change had occurred. This finding supports and extends prior research that has examined accuracy of self-perceptions with respect to concurrent performance (Lachman & Jelalian, 1984; Perlmutter, 1978). The present study findings indicate that subjects are not only aware of their *concurrent* levels of performance, but can make reasonably accurate estimates of *change* in performance over a seven-year period.

Study participants did not, however, predict change in their performance with equal accuracy across all the abilities measured. Prior research findings have suggested two caveats regarding accuracy of predictions. First, adults are believed to be more accurate in estimating performance on abilities on which they perform very well (Lachman et al., 1979; Lachman & Jelalian, 1984). Second, on abilities where older subjects perform poorly, some studies have found underestimates while others have observed overestimates of performance (Bandura, 1981; Lachman & Jelalian, 1984). Our study found only limited evidence that subjects performing at a higher level on a given ability were more accurate in estimating change on that ability. We note that the realists (the most accurate) had higher scores only on Verbal Meaning and Inductive Reasoning, but not on the other three abilities. On the issue of whether the elderly over- or underestimate performance on abilities on which they do poorly, we found that the old did more poorly than the young on all abilities. The lack of a Congruence Type × Age interaction suggests, however, that ability scores did not differ among age groups by congruence type; that is, ability performance did not differ for the old who over- or underestimated change in their intellectual functioning.

The variables of age and gender were found to moderate accuracy of perceptions of ability change (i.e., congruence typology). Women were found to be more pessimistic than men regarding their decline on Spatial Orientation. In our society, women, particularly older women, frequently report themselves to be less competent at tasks involving Spatial Orientation, such as map reading and giving directions (Linn & Petersen, 1985; McGee, 1979). Our findings suggest that women's overly pessimistic views of decline in Spatial Orientation ability (compared to those of men) may be fostered by negative gender stereotypes, since their individual performance profiles do not warrant such pessimism. Finally, the old (compared to the young) were more pessimistic regarding age-related decline in their Verbal and Inductive Reasoning abilities than the performance data would support. Of particular concern is the elderly subjects' pessimism regarding decline in their Verbal ability. Longitudinal research indicates that for most older adults verbal ability remains relatively stable until the mid-70s, suggesting that older adults should feel fairly confident of their verbal skills in old age (Schaie, 1990).

In summary, in this study we have examined the accuracy of older adults' perceptions regarding an issue of considerable concern to this age group — whether or not their intellectual abilities are declining. Study findings indicate that perceptions of ability decline are not limited to old age, but that there are young and middle-aged individuals, as well as the old, that perceive themselves to have declined. These perceptions vary across abilities, age, and gender. Fortunately, the majority of adults of all ages perceive their performance to have remained stable over the prior seven-year period, and their perceptions were found to be fairly accurate in that approximately 50% of subjects were categorized as realists in their estimates of ability change. There were age and gender differences among the congruence types of realists, optimists, and pessimists. However, accuracy of prediction was not strongly related to ability level. Finally, aging stereotypes of universal intellectual decline with increasing age appear not to be supported either by adults' perceptions or by the accuracy of their estimates.

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