INTELLIGENCE 4, 219-231 (1980)

Intelligence and Spontaneous Flexibility in Adulthood and Old Age

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ABSTRACT

Interrelationships among measures of intelligence and spontaneous flexibility were examined at two age levels using a multitrait-multimethod matrix design and other multivariate procedures. Measures of intelligence were Ravens Matrices and WAIS Vocabulary, WAIS Digit Symbol, and WAIS Similarities. Blots, Hidden Pictures, Brick Uses, and Impossibilities were used as measures of spontaneous flexibility. Subjects were 100 younger ($\bar{X}$ = 19.54, S.D. = 1.23) and 100 older ($\bar{X}$ = 63.99, S.D. = 2.94) men and women tested at two occasions. Adult age differences in factor structure were explored using a maximum likelihood analysis; common variances among the measures were greater for the elderly compared to the younger adults. Findings supported a dedifferentiation hypothesis with regard to both intelligence and spontaneous flexibility.

Although it is generally accepted that intelligence is a multidimensional construct and that the factor structure of intelligence changes developmentally during adulthood (Horn, 1970, 1976; Schaie, 1970), there are actually relatively few studies of adulthood age differences along multiple measures of intelligence. The crystallized-fluid distinction (e.g., Horn, 1970), the differentiation-dedifferentiation hypothesis of Reinert (1970), and issues related to age and cohort or generational factors have provided the impetus for much of the multivariate research in the area of adult intelligence.

Similarly, the major finding which has emerged from the adulthood cognitive rigidity research is that flexibility in thinking is a multidimensional construct (Botwinick, 1978; Chown, 1959, 1961; Riegel & Riegel, 1962; Schaie, 1958, 1970; Schaie & Parham, 1975). Spontaneous flexibility, defined as the capacity to generate a variety of different and appropriate responses in a given situation, is the rigidity dimension of interest in the present study. Chown (1961) and others (e.g., Guilford, Frick, Christenson, & Merrifield,

1959) have indicated that spontaneous flexibility is the rigidity dimension *least* associated with intelligence and further, there is some evidence to suggest that it is a relatively general trait represented by several different methods and measurement instruments (e.g., Botwinick, 1978; Chown, 1961; Shields, 1958).

The purpose of the present study was to systematically examine adult age differences in intelligence and spontaneous flexibility. Of major interest was whether or not spontaneous flexibility represents an individual difference characteristic which is independent of intelligence and which is generalizeable across situations and age levels. A problem encountered in previous studies of the strength of association between rigidity and intelligence dimensions has been the lack of systematic control for differences in method variance. Strength of correlation between two measures is influenced by both trait and method variables (Campbell & Fiske, 1959). In order to adequately assess the strength of intelligence-spontaneous flexibility relationships, controls for cross-trait differences in method were included in the investigation.

The present study involved a multitrait–multimethod analysis of spontaneous flexibility and intelligence, followed by confirmatory and exploratory factor analysis and canonical correlation analyses. Two adult age levels were included in the sample. It was hypothesized, based on previous findings, that evidence at each age level would support the construct validity of spontaneous flexibility. Age differences were expected in levels of performance and in the strength and pattern of variable interrelationships. Chown (1961) found evidence of differences in convergence among her measures across age levels. An age difference favoring the young adults was expected with regard to both intelligence and spontaneous flexibility performance.

METHOD

Subjects

Subjects were 100 young adults ranging in age from 18 to 23 years ($\bar{X}$ = 19.54, S.D. = 1.23) and 100 older adults ranging in age from 60 to 70 years ($\bar{X}$ = 63.99, S.D. = 2.94). Equal numbers of women and men were tested at each age level. Young adult subjects were volunteers recruited from undergraduate psychology classes at Syracuse University. Older participants were recruited from the Syracuse and Schenectady, New York, metropolitan areas. The mean educational levels for the younger and older subjects were 14.29 (S.D. = .94) and 15.03 (S.D. = 2.50), respectively. All the subjects reported themselves to be in good health. None of the subjects had any physical disabilities which impaired their performance on the tasks. All participants seemed to be mentally alert, fully capable of understanding instructions and performing tasks within the normal range.

Procedure

Eight tests were employed in the current study. The spontaneous flexibility and general intellectual capacity dimensions were each represented by four timed paper and pencil tests. The method dimension consisted of four discrete categories (Verbal-concrete, Verbal-abstract, Nonverbal-concrete, Nonverbal-abstract), and each category was represented by one spontaneous flexibility and one general intelligence measure. Verbal measures refer to those tests employing verbal stimulus materials, and nonverbal measures refer to those tests involving nonverbal visual stimulus materials. Dimensions critical to problem solution were directly observable in the concrete tasks, whereas abstract measures required the extraction of essential dimensions from test materials. Each of the measures yielded a single test score, which in each case was the sum of all appropriate (correct) responses. All eight measures were administered with a test–retest interval of one to two weeks for the purpose of obtaining multitrait-multimethod matrix reliabilities. The order of the tests was as presented below, so that no two trait or method measures were presented in sequence.

Matrix Measures

Brick Uses was employed as a verbal-concrete measure of spontaneous flexibility. Procedures were adopted from those used by Chown (1961). The subject's task was to list all of the possible uses for a brick in ten minutes; the score was the number of times the subject switched types of use categories. The *Advanced Progressive Matrices Test: Set I* (Raven, 1965), using standard instructions, was given as a nonverbal-abstract measure of general intellectual capacity. *Hidden Pictures* was a modification of a task employed by Chown (1961). This nonverbal-concrete measure of spontaneous flexibility consisted of a series of six puzzle pictures (one sample, five test items). The subject was asked to find as many hidden objects in each picture as possible. One minute was allowed per picture, and the score was the total number of objects correctly identified. *WAIS Similarities* was employed as a verbal-abstract measure of intellectual capacity. A series of thirteen word pairs was given and for each word pair the subject was to explain what the words had in common. The subject received 0, 1, or 2 points per item depending on the quality of the answer. Score was the total number of points earned on the thirteen word pairs. The subject was given 10 minutes for completion. *Blots* was a modification of Chown's (1961) nonverbal-abstract measure of spontaneous flexibility. A series of seven blots were shown and the subject had one minute per blot to list all of the things that this blot might be or represent. The total number of different objects listed was used as the subject's score. *WAIS Vocabulary* was used as a verbal-concrete measure of intellectual capacity. This test consisted of a list of forty words. The subject was asked to define each of the words in order. Each answer was credited with either 0, 1, or 2 points. Score for this measure was the total number of points earned on all items. Time allowed for the task was 20 minutes. *Impossibilities* was used as a verbal-abstract measure of spontaneous flexibility. Procedures were modeled after Chown (1961). The subject's task was to list as many complete and utter impossibilities as possible in 4 minutes. Score was the total number of impossibilities listed by the subject. *WAIS Digit Symbol* was used as a nonverbal-concrete measure of intellectual capacity. The subject was shown a key with a series of numbers and geometric symbols. Each number was matched with a particular geometric symbol. A series of 90 blocks each containing a single number was presented. The subject was to place the correct symbol in each numbered block, proceeding in order from one block to the next, without skipping any blocks. The key remained within the subject's view, for reference, throughout the testing phase. Ninety seconds were allowed for the completion of this task.

RESULTS

The mean scores and standard deviations for all measures by age level are presented in Table 1. Several data analytic techniques were used to evaluate the relationships between the subject factors (i.e., age and gender) and the mental ability measures (i.e., intelligence and spontaneous flexibility).

The first technique is a special case of multiple regression analysis which is analogous to factorial multiple discriminant analysis. By using the group factors (i.e., age, gender, and age × gender) as effects-coded dichotomous dependent measures, multivariate as well as univariate group differences on the mental ability measures were assessed. Age, gender, and the age by gender interaction effects were tested at time 1 and time 2 by computing three multiple discriminant analyses on all matrix variables. In cases where significant *F*'s were found, Pearson *r*'s and Beta weights were examined to determine the total and unique association of each variable with the effect.

At time one the main effect for age, $F(8, 191) = 45.45, p < .001$, gender, $F(8, 191) = 2.31, p < .02$, and the age by gender interaction, $F(8, 191) = 2.32$, $p < .02$, were significant, accounting for 65.6, 8.8, and 8.9 percent of the variance (R^2 values), respectively. As indicated by the Beta weights, Brick Uses, $t(191) = -2.01$, $p < .005$, Ravens, $t(191) = -6.47$, $p < .001$, Similarities, $t(191) = 2.34$, $p < .05$, Blots, $t(191) = 3.68$, $p < .001$, Vocabulary, $t(191) = 3.38$, $p < .001$, and Digit Symbol, $t(191) = -6.49$, $p < .001$, each accounted for unique portions of the age variance with contributions of the other variables removed. The correlations of these variables with age are shown in Table 1.

At time 2, only the main effect of age, $F(8, 191) = 62.25, p < .001$, attained statistical significance, accounting for 72.3 percent of the variance. Brick

TABLE 1
Mean Scores, Standard Deviations, and Correlations with Age for All Measures

	Young Adults		Elderly		
Measures	Mean Score	S.D.	Mean Score	S.D.	*r*
Spontaneous Flexibility:					
Verbal-Concrete					
Brick Uses—Time 1	13.55	4.41	11.11	3.88	-.28**
Brick Uses—Time 2	16.36	5.81	12.20	4.10	-.38**
Verbal-Abstract					
Impossibilities—Time 1	8.45	3.41	7.66	2.89	-.12
Impossibilities—Time 2	8.96	3.18	8.04	2.84	-.15*
Nonverbal-Concrete					
Hidden Pictures—Time 1	12.62	4.18	9.92	3.52	-.33**
Hidden Pictures—Time 2	17.06	4.77	12.24	3.74	-.49**
Nonverbal-Abstract					
Blots—Time 1	16.09	6.17	19.50	8.46	.23**
Blots—Time 2	18.07	7.08	21.44	9.17	.20**
Intelligence					
Verbal-Concrete					
Vocabulary—Time 1	56.88	7.63	63.15	9.31	.35**
Vocabulary—Time 2	58.20	7.66	64.41	9.06	.35**
Verbal-Abstract					
Similarities—Time 1	18.35	3.00	18.78	3.50	.07
Similarities—Time 2	19.13	2.90	19.56	3.24	.07
Nonverbal-Concrete					
Digit Symbol—Time 1	67.43	10.36	49.51	9.28	-.68**
Digit Symbol—Time 2	75.38	9.06	52.95	9.81	-.77**
Nonverbal-Abstract					
Ravens—Time 1	10.87	1.25	8.30	1.86	-.63**
Ravens—Time 2	11.37	1.31	9.04	1.96	-.58**
Age	19.54	1.23	63.99	2.94	
Years Education	14.29	.94	15.03	2.50	

*$p < .05$.
**$p < .01$.

Uses, $t(191) = -2.18$, $p < .05$, Ravens, $t(191) = -5.19$, $p < .001$, Hidden Pictures, $t(191) = -2.22$, $p < .05$, Similarities, $t(191) = 2.12$, $p < .05$, Blots, $t(191) = 3.03$, $p < .005$, Vocabulary, $t(191) = 4.87$, $p < .001$, and Digit Symbol, $t(191) = -9.43$, $p < .001$, each accounted for unique portions of the age variance with contributions of the other varaibles removed.

As predicted, age level was found to be strongly related to performance at both testing occasions. The number, pattern and strength of associations were remarkably similar at the two times of measurement. The same six variables were significantly correlated with age at time one and time two. Furthermore, six of the same variables were involved in unique associations with the age effect at each time of measurement. The proportions of variance accounted for by gender (R^2 = 8.8%) and by the age by gender interaction (R^2 = 8.9%) at time one were too small to warrant further analysis. These effects were not statistically significant at time two.

Multitrait-Multimethod Matrices

Separate multitrait-multimethod matrices were formed at each age level, using mean correlations and test-retest reliabilities. Each matrix was analyzed for the construct validity of spontaneous flexibility and intelligence in accordance with the recommendations of Campbell and Fiske (1959). Test-retest reliabilities are reported on the diagonals of the two matrices in Table 2 (young adult) and Table 3 (elderly). Each reliability attained significance at the .01 level, and 12 of 16 reliabilities were greater than .7 showing very strong dependabilities over time. A minimal condition for convergent validity is significant correlations among measures of the same trait. For the intelligence construct, there was insufficient evidence to support convergent validity for all four measures at either age level. As can be seen in Tables 2 and 3, intelligence measure correlations were stronger for the older than for the younger adults. For spontaneous flexibility, low intercorrelations also precluded convergent validation for all four measures at each age level. With the exception of the relationship between Brick Uses and Blots, correlations

TABLE 2
Multitrait-Multimethod Matrix for Young Subjects—Mean Correlations (N = 100)

		Verbal				Nonverbal			
		Concrete		Abstract		Concrete		Abstract	
		A_1	B_1	A_2	B_2	A_3	B_3	A_4	B_4
Verbal-Concrete									
Vocabulary	A_1	.90***							
Brick Uses	B_1	−.01	.76***						
Verbal-Abstract									
Similarities	A_2	.22*	.16	.72***					
Impossibilities	B_2	.00	.14	.03	.64***				
Nonverbal-Concrete									
Digit Symbol	A_3	.04	.12	.01	.30***	.81***			
Hidden Pictures	B_3	.12	.38***	.17*	.01	.21*	.84***		
Nonverbal-Abstract									
Ravens Matrices	A_4	.10	.11	.19*	.06	.13	.09	.50***	
Blots	B_4	.01	.46***	.00	.20*	.14	.12	.06	.88***

*$p < .05$.
**$p < .01$.
***$p < .005$.

TABLE 3
Multitrait-Multimethod Matrix for Old Subjects—Mean Correlations (N = 100)

		Verbal				Nonverbal			
		Concrete		Abstract		Concrete		Abstract	
		A_1	B_1	A_2	B_2	A_3	B_3	A_4	B_4
Verbal-Concrete									
Vocabulary	A_1	.92***							
Brick Uses	B_1	.37***	.86***						
Verbal-Abstract									
Similarities	A_2	.66***	.38***	.80***					
Impossibilities	B_2	.18*	.32***	.22*	.67***				
Nonverbal-Concrete									
Digit Symbol	A_3	.10	.14	.27***	.20	.84***			
Hidden Pictures	B_3	.33***	.43***	.35***	.16	.23**	.76***		
Nonverbal-Abstract									
Ravens Matrices	A_4	.47***	.27***	.53***	.10	.28***	.36***	.69***	
Blots	B_4	.17**	.40***	.16	.59***	.19*	.15	.00	.86***

*$p < .05$.
**$p < .01$.
***$p < .005$.

among the spontaneous flexibility measures were found to be higher for the elderly than for the young adults.

Campbell and Fiske (1959) described two types of discriminant validity. The first type refers to the strength of the convergent validities relative to the heterotrait–heteromethod correlations. For the second type of discriminant validity the criterion is satisfied if a variable is correlated more highly with an independent measure of the same trait than it does with measures employing similar methods indicating independent traits. There was insufficient evidence to support discriminant validity for all four intelligence measures at either age level. Among older subjects, however, the clustering of Vocabulary-Similarities–Ravens passed all discriminant validity as well as convergent validity criteria. The discriminant validity of the Digit Symbol–Ravens pairing was supported in all but one instance. Among young subjects, pairings of Vocabulary–Similarities and Similarities–Ravens passed all criteria for discriminant validity. Discriminant validity criteria were also not met for all four spontaneous flexibility measures, but support was found for several more restricted variable groupings. For the elderly, discriminant validity of the Brick Uses-Impossibilities-Blots constellation was supported in all but two instances. Criteria were passed in every instance for Brick Uses–Hidden Pictures, Brick Uses–Blots, and Impossibilities–Blots pairings. Among young subjects, discriminant validity criteria were met in every instance for the Brick Uses–Hidden Pictures and Brick Uses–Blots pairings, and in all but one instance for the Impossibilities-Blots pairing.

Confirmatory and Exploratory Analysis

In addition to the multitrait–multimethod analysis, a factor analytic technique based on Joreskog's (1971, 1974) maximum likelihood procedures was employed. The program SIFASP (see Joreskog, 1971), which allows test of fit of a model to a single group or to multiple groups of data, was used. The purpose of these analyses was to test the stability of the model which best represented the relationships among tasks for the groups selected. The technique chosen is superior to others (e.g., principal component analysis) for several reasons: (1) statistical tests (chi-squares) are available for assessing goodness of fits of various model parameters; (2) both oblique and orthogonal models can be tested; (3) unique and common variances are estimated; (4) covariance matrices which allow for group differences in test variance are analyzed (instead of correlation matrices with unities on the diagonals). Furthermore, starting values which aid in the solution are obtained from preliminary theoretical and empirical analysis, thereby constraining the final model in a way which attenuates the arbitrariness of factor analysis.

The initial confirmatory factor analyses led to the decision to pool across gender groups at each age level. The simple two-factor model (i.e., two traits each represented by four methods) was rejected in each case (both p's $< .05$, hence, data did not fit the model). Additionally, there was evidence that factor structures were significantly different for the young and elderly subjects; simultaneous factor analysis yielded X^2 (20) value of 104.21, $p < .001$.

The maximum-likelihood techniques were then applied in an exploratory fashion in order to discover the best-fitting models for each age group. Preliminary exploratory analyses supported a four common factor (trait) model for both age groups, although the structures were different between ages. Starting values were selected from preliminary principal component analysis (varimax rotation) of four components separately for each age group. Hence, the required fixed parameters (to achieve a determined solution) differed for the two samples. Subsequently, the covariance structures were analyzed with the maximum-likelihood procedures. While oblique structures wre analyzed, they were redundant with the orthogonal structures and only the orthogonal structures are reported. For the elderly subjects, the model with four common factors (see Table 4) yielded a $X^2(12) = 10.93$ $p = .54$; for the young subjects, $X^2(12) = 14.32$, $p = .28$.

Clearly, in contrast to the initial hypotheses and analyses, the eight measures did not factor into any simple cluster patterns. Common variance was greater for the elderly subjects, as evidenced by the greater number of

TABLE 4
Estimated Parameter Values from the Maximum-Likelihood (Orthogonal) Analyses by Age at Time 2

Λ for Young Adults					
Tests	1	2	3	4	Ψ
Brick Uses	89*	0*	0*	0*	38
Ravens	0*	0*	0*	95	32
Hidden Pictures	39	11	-09	07	90
Similarities	12	19	-17	16	95
Blots	38	-01	16	-02	90
Vocabulary	0*	84*	0*	0*	55
Impossibilities	0*	0*	82*	0*	58
Digit Symbol	09	17	29	13	92

Λ for Elderly Adults					
Tests	1	2	3	4	Ψ
Brick Uses	42	32	14	34	72
Ravens	62	-10	25	06	74
Hidden Pictures	29*	0*	20*	83*	40
Similarities	79	03	24	-00	56
Blots	0*	87*	0*	0*	54
Vocabulary	86*	0*	0*	0*	58
Impossibilities	07	60	04	02	79
Digit Symbol	0*	0*	92*	0*	41

*Designates a parameter value fixed prior to solution. Decimals omitted. Loadings to hundredths place.

Λ is the factor pattern (structure) matrix.

Ψ is the vector of unique variance.

relatively high loadings on the common factors. Young adults showed comparatively fewer clusters. By comparison with the variable clusters found by the traditional multitrait-multimethod analysis, it can be seen in Table 4 that highly similar clusters were found but the clusters were embedded in larger common factors.

Canonical Correlation Analysis

Two canonical correlation analyses were also carried out; each compared the four predesignated intelligence measures with the four spontaneous flexibility measures for each age group. The purpose of using yet another multivariate technique to evaluate the task interrelationships was to insure that the conclusions concerning convergent and discriminant validities were appropriate. This particular technique is useful due to the information yielded (e.g., standardized weights, within-and between-trait correlations, canonical correlations). These analyses in conjunction with the results reported above provide a thorough test of our hypotheses. These results are presented in Table 5. Several types of statistical indices were computed as follows:

Redundancy defined as that portion of the total variance of one set of variables which can be accounted for by a second set of variables (Cohen & Cohen, 1975). A redundancy value is mathematically equivalent to the average squared multiple correlation which would be generated by using one set of variables as a predictor and taking each individual variable of the other set as a criterion (Stewart & Love, 1968). Redundancy values reflect the strength of the relationship between two sets of variables. If two sets of measures are indeed tapping two different traits, then redundancies should be low. In other words redundancies provide an overall evaluation of discriminant validity. *Structure coefficients:* correlations between each variable and its respective variates. These give an indication of the relative contribution of each variable to the variates and hence the cross-trait redundancies. That is, each structure coefficient represents an effect on convergent validity. *Cross-trait correlations:* correlations of each variable for cross-trait variates. These reflect the effect of each variable on discriminant validity by assessing the extent of the variable's contribution to cross-trait relationships.

TABLE 5
Structure Coefficients, Cross-Correlations, and Canonical Correlations for Elderly and Young Adults at Time 2

	Structure Coefficients		Cross-Correlations	
Tests	Young	Elderly	Young	Elderly
Spontaneous Flexibility (X)				
Brick Uses	46	95	17	48
Impossibilities	78	31	28	16
Hidden Pictures	61	75	22	37
Blots	21	32	08	16
Intelligence (Y)				
Vocabulary	07	82	03	41
Similarities	12	93	04	47
Digit Symbol	96	41	34	20
Ravens	40	69	14	35

	Young	Elderly
Canonical Correlation	36 ($p > .05$)	50 ($p > .001$)
Redundancy	X = 05	11
	Y = 05	14

Note: Decimals omitted. Correlations to hundredths place.

As can be seen in Table 5, there was one significant canonical root for the elderly subjects. The corresponding redundancies reflected the greater common variance among the eight measures for the elderly subjects. While the redundancies for the young subjects suggested discriminant validity, the structure coefficients were not strongly indicative of convergent validity for either trait. The strongest cluster was that of Impossibilities–Hidden Pictures. However, these measures were also correlated with intelligence. Overall, for the young adults, the canonical analysis failed to evidence any strong traits. Consistent with the previous analyses, the results for the elderly adults were indicative of stronger interrelationships. While in each case within-trait correlations exceeded cross-trait correlations, the cross-correlations were sufficient to reject a case for discriminant validity (see Table 5).

DISCUSSION

As predicted, the multivariate F for age level was statistically significant and the strength of the R^2 value was psychologically meaningful. Age level had a strong negative association with performance on Brick Uses, Ravens Matrices, Hidden Pictures, and Digit Symbol, and a strong positive association with performance on Vocabulary. These results are consistent with previous findings (e.g., Botwinick, 1977; Horn, 1976; Matarazzo, 1972). Generally, young adults have been found to outperform older adults on spontaneous flexibility and fluid intelligence (e.g., Ravens Matrices, Digit Symbol) measures (see Botwinick, 1978; Chown, 1961; Horn, 1970, 1976). Performances on verbal or crystallized indices (e.g., Vocabulary), however, have been reported as being well maintained or even improving with advanced age (see Botwinick, 1978; Horn, 1976). The Beta weight analysis confirmed the pervasiveness and magnitude of the age effect. Age was *uniquely* associated with six of the eight matrix measures. Thus, the many strong measure–age associations are not attributable to each measure loading on the same factor (e.g., speed).

With regard to the contention that spontaneous flexibility represents an individual difference characteristic independent of intelligence or general intellectual capacity, analyses revealed that the pattern and strength of variable interrelationships differed across age levels. There was greater convergence or dedifferentiation of intellectual abilities in the elderly than in the younger group. This relationship held for all intelligence measure pairings, and for all but one of the spontaneous flexibility measure pairings (i.e., Brick Uses–Blots). Thus a positive manifold within and across traits was much more apparent at the older than at the younger age level. These results support Reinert (1970), who suggested that with advance age there is an increasing convergence of intellectual skills. While there was a general age difference in convergence, the degree of difference was not equivalent across all variable pairings. Specifically, more spontaneous flexibility (and intelligence) measure pairs attained construct validity for the old than for young adults. Even though spontaneous flexibility trait appears to represent a more global characteristic for the elderly than for young adults, there was little indication that spontaneous flexibility is as general as previously thought at either age level. It is possible that instrument selection (i.e., Digit Symbol, Hidden Pictures) was responsible in part for the restricted range of the trait validation obtained herein. Replication of the present results employing a somewhat modified battery of measures would be sufficient support for a restricted trait hypothesis.

Several more global implications can be drawn from the overall pattern of results. These relate to the importance of age in trait analysis, the pervasiveness of rigidity dimensions, and evidence of negative types of intellectual change with advanced age. First, the age variable was strongly related to trait structure. Trait composition and number of dimensions differed across age levels as reflected by the distinctive pattern of variable interrelationships found for each age group. If age level were disregarded, analysis might have yielded a matrix which would not be representative of such interrelationships as they exist at either age level. Thus, future trait and construct validation studies should be conducted using multiple and discrete age ranges. Cognitive decline hypotheses need to be considered in light of both specific constructs and theoretical (e.g., differentiation–dedifferentiation) frameworks.

Results of this study suggested that there was an age-associated decline in spontaneous flexibility and fluid intelligence. Young subjects outperformed old subjects on two of four spontaneous flexibility measures (Brick Uses, Hidden Pictures) and on both measures of fluid intelligence (Digit Symbol, Ravens Matrices). Similar findings have been reported for spontaneous flexibility (see Botwinick, 1978; Chown, 1959, 1961) and fluid intelligence (see Horn, 1970, 1976). In the present study, however, cohorts were of comparable SES and educational levels. The ineffectiveness of such matching in reducing age-associated performance deficits suggests the robustness of adulthood intellectual decline. For the average individual both intelligence and spontaneous flexibility apparently decline with advancing age. Two points should be stressed however, if these cross-sectional data are to be viewed as suggesting age-related intraindividual decline. First, in terms of spontaneous flexibility, age differences were not uniform across all measures. There was no age difference for the Impossibilities task, and older subjects outperformed younger subjects on the Blots measures. Therefore, age differences in flexibility may not have broad generalizability. Second, several older persons performed at the highest levels on Digit Symbol, Ravens, Brick Uses, and Hidden Pictures. Thus, while decline may be a general rule in the domain of intelligence and spontaneous flexibility, it is certainly not universal.

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