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ABSTRACT

The internal consistency reliability and discriminant validity of the adult version of the Matching Familiar Figures Test (MFF) were determined for a sample spanning adulthood; age and sex differences were also investigated. Sixty-three men and 63 women ranging from 18 to 78 years of age, with at least 12 years of schooling, were administered Kagan's MFF and the vocabulary subtest of the Wechsler Adult Intelligence Scale (WAIS). While internal consistency reliability was high for the latency scores, it was only moderate for the error scores. As expected, error and latency scores were strongly related and were orthogonal to verbal ability. Results of a multivariate analysis of variance and follow up analyses indicated that older adults had significantly longer latencies than middle-aged and younger adults. Reflectivity in older adults was suggested to be part of a general pattern of slowing down in both cognitive and pscyhomotor activities. Therefore, further research aimed at modifying the cognitive tempo of young, middle-aged, and older adults was advocated. However, such research must be preceded by revision of the adult version of the MFF so that it is more reliable. (Author/RD)

Adult Age Differences in Cognitive Tempo

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Abstract

The purposes of this study were to determine the internal consistency reliability and discriminant validity of the adult version of the Matching Familiar Figures Test (MFF) for a sample spanning adulthood; and to ascertain whether there are age and sex differences in cognitive tempo. To this end, 63 men and 63 women ranging from 18 to 78 years of age, with at least 12 years of schooling, were administered Kagan's MFF and the vocabulary subtest of the WAIS. While internal consistency reliability was high for the latency scores, it was only moderate for the error scores. As expected, error and latency scores were strongly related and were orthogonal to verbal ability. Results of a MANOVA and follow up analyses indicated that older adults had significantly ($p < .001$) longer latencies than middle-aged and younger adults. Further research was advocated to determine the impact of treatment variables on adult age differences in MFF performance. However, such research must be preceeded by revision of the adult version of the MFF so that it is more reliable.

Adult Age Differences in Cognitive Tempo

Cognitive styles characterize individual differences in the mode of human information processing (Kogan, 1971). Kogan (1971, p. 244) has offered the following definition:

> Cognitive styles can be most directly defined as individual variations in modes of perceiving, remembering, and thinking, or as distinctive ways of apprehending, storing, transforming, and utilizing information. It may be noted that abilities also involve the foregoing properties, but a difference in emphasis should be noted: Abilities concern level of skill-the more and less of performance-whereas cognitive styles give greater weight to the manner and form of cognition.

One distinct cognitive style is cognitive tempo, a person's relative disposition to respond quickly or slowly in a situation of high response uncertainty in which several alternatives are generated simultaneously. "Impulsives" tend to make fast decisions and many errors, while "reflectives" tend to make slower decisions and fewer errors. This temporal dimension of cognitive style is conceptualized as measuring only the manner in which cognitive functions are executed and as being independent of measure of intellectual ability. Evidence for discriminant validity is provided by studies which show that response time and number of errors on the Matching Familiar Figures Test (MFF) are orthogonal to verbal ability (e.g., Kagan, 1965a; 1965b).

A plethora of studies examine age trends in cognitive tempo in childhood (see Kagan & Kogan, 1970). In contrast, there is a dearth of research investigating age differences in cognitive tempo in adulthood. The results of the handful of studies comparing the performance of adult age groups on the MFF, the primary measure of cognitive tempo, are inconclusive. Salkind and Denney (Note 1) found that age was positively correlated with impulsivity in an elderly sample; and Coyne, Whitbourne, and Glenwick (1978) reported that elderly adults were more impulsive than young adults. On the other hand, Andrulis and Bush (1977) concluded that age was inversely correlated with impulsivity in a middle-aged sample.

Researchers in geropsychology commonly have ignored the issue of the equivalence of measures across age and cohort groups (Schaie, 1977). Inasmuch as the pre-adolescent's version of the MFF has been criticized with regard to construct validity (Block, Block, & Harrington, 1974) and psychometric properties (Ault, Mitchell, & Hartmann, 1976), it would seem important to assess the characteristics of the adult MFF form in studies of adult age differences in cognitive tempo. However, researchers administering the adult form of the MFF to different age groups have not reported analyses of internal consistency reliability and discriminant validity (Andrulis & Bush, 1977; Coyne et al., 1978; Salkind & Denney, Note 1).

Researchers in cognitive tempo (see Ault et al., 1976) have often classified subjects into quadrants with a median-split according to latencies and errors, i.e. slow/inaccurate, impulsive, reflective, fast/accurate. This procedure has been criticized with regard to (1) the importance of response speed; (2) the use of sample-defined criteria for classification; (3) the stereotypic categorization of subjects within quadrants; and (4) the potential for misclassification (Salkind & Wright, 1977).

As pointed out by Kogan (1973), the relation between response speed and errors has been extensively investigated by experimental psychologists working with elderly subjects (Birren, 1964). Although little of this research has focused directly upon perceptual tasks involving response uncertainty, there is, nonetheless, strong indication that older adults slow down in order to avoid mistakes (Botwinick, 1978). In the context of verbal learning studies, it is a well established fact, that older adults have a predilection to make errors of omission rather than errors of commission (see Botwinick, 1967). This configuration of errors has been interpreted as indicating a tendency on the part of elderly subjects toward cautiousness in venturing responses (Okun, Siegler & George, 1978). Thus, studies of adult age differences in cognitive tempo may help to further our understanding of factors contributing to the speed-accuracy tradeoff associated with aging (Welford, 1976).

The present study was designed to overcome three limitations of previous studies on the relation between adult age and cognitive tempo. First, a sample of men and women was drawn ranging from 18 to 78 years of age which permitted a characterization of age trends over the span of adulthood. Second, the internal consistency and the discriminant validity of the MFF were examined which provided data on the suitability of the adult version of the MFF for post-adolescent populations. Third, a MANOVA model was employed to analyze the data which took into account the theoretical and empirical relation between latencies and errors (Kogan, 1973).

Method

Subjects

Subjects were 42 elderly men and women (age 55-78 years, $\underline{M}$ = 66.45), 42 middle-aged men and women (age 36-53 years, $\underline{M}$ = 47.43), and 42 young men and women (age 18-33, $\underline{M}$ = 22.96). Volunteers were recruited from the Arizona State University Alumni Association and from advertisements placed in local newspapers in the greater Phoenix area who were offered and paid a nominal sum for their participation. Participants had to have completed at least 12 years of schooling. This screening criterion was used since, as Kogan (1974) noted, ". . . the least that one has a right to expect in comparisons of cognitive functioning across the adult age span is that younger and older samples have been reasonably equated for educational level (p. 220)."

Procedure

Subjects were individually administered the vocabulary Subtest of the Weschler Adult Intelligence Scale (WAIS) and the adult version of the MFF. The Vocabulary subtest was always administered prior to the MFF.

Verbal Ability Measure

Verbal ability was measured by the WAIS vocabulary raw scores.

Cognitive Tempo Measure

Using the standard format of the MFF (Kagan, 1965c), each adult was presented with a picture of a familiar object (the standard) and a set of highly similar variants where only one of the set of variants was exactly the same as the standard. The task was to select from the set of 8 variants the one that was exactly the same as the standard. If the response was correct, the adult went on to the next item. If incorrect, the adult chose again, until s/he selected the correct response. The dependent measures employed were latency to first response and number of errors, summed across all items.

Results

To estimate internal consistency reliability of the component measures of cognitive tempo, coefficient alpha was calculated for both the latency and the error scores. While latency reliability was very high ($r = .95$), error reliability was only moderate ($r = .64$).

Correlations were computed to ascertain the interrelation among error scores, latency scores and WAIS vocabulary scores. As expected, error and latency scores were highly correlated ($r = -.52$, $p < .001$) and error scores ($r = -.14$, ns) and latency scores ($r = .10$, ns) were only minimally related to WAIS vocabulary scores.

Age and sex differences in cognitive tempo were analyzed with a 3 (age) by 2 (sex) multivariate factorial design, with total latency and error scores as the dependent variables. Means and standard deviations, separately by age and sex, for each age-sex cell, and for the total group are presented in Table 1.

Insert Table 1 here

Results of the multivariate and univariate *F* tests are presented in Table 2.

Insert Table 2 here

From Table 2, it can be seen that there was a significant main effect of age [multivariate F (4,238) = 11.72, $p < .001$]. Subsequent univariate analysis of variance, as shown in Table 2, revealed statistically significant differences among age groups on the latency scores [F (2,120) = 14.62, $p < .001$]. Follow up tests employing Tukey's Wholly Significant Difference method (see Games, 1971) indicated that older adults (M = 773.52) had significantly longer latency scores than middle-aged adults (M = 503.57) [q (3,120) = 5.43, $p < .005$] and young adults (M = 407.00), [q (3,120) = 7.38, $p < .005$].

Since the correlational and multivariate analyses computed in the present study only measure the magnitude of linear relations, scatter diagrams were constructed to ascertain whether there were any strong nonlinear relations among age, sex, latency scores, error scores, and WAIS scores. Inspection of the scatter diagrams revealed little evidence of nonlinear trends.

Discussion

The reported test-retest and internal consistency reliabilities of the error scores on the pre-adolescent form of the MFF, despite their statistical significance, have tended to be low to moderate by most psychometric standards (Cairns & Cammock, 1978). The magnitude of the internal consistency reliability estimates observed in the present study for the error scores ($r = .64$) and the latency scores ($r = .95$) are comparable to those reported by Ault et al. (1976) who reported mean internal consistency reliability estimates of .52 and .89 for errors and latencies, respectively. It would appear that because of the inadequate reliability of the error scores, a more reliable version of the adult MFF needs to be developed (see Cairns & Cammock, 1978).

The correlation found in the present study between error and latency scores ($r = -.52$) is consistent with the median correlation of -.56 noted by Ault et al. (1976). The lack of substantial association between WAIS vocabulary scores and error scores ($r = -.14$) and latency scores ($r = .10$) is within the range of correlations reported by other investigators (see Kagan & Kogan, 1970). In light of the above findings, it appears that, for both children and adults alike, latency and error scores are related and are orthogonal to verbal ability.

Cognitive tempo is considered to be a process that undergoes developmental change in childhood (Kagan, 1965c). In the present research, this process was investigated with respect to age differences in adulthood. Through comparison of elderly, middle-aged and young adults on the adult version of the MFF, older subjects were found to have a generally slower cognitive tempo than the younger subjects. This result, in conjunction with data obtained in research on children (Salkind, Kojima & Zelniker, 1978), suggests a moderately strong linear relation between age and cognitive tempo. However, for children, response latencies increase and errors decrease with age (Kagan, 1965c). In contrast, for adults, although latencies also increase with age, errors are unrelated to age (Andrulis & Bush, 1977).

This conclusion needs to be qualified by consideration of other studies in which researchers found that older subjects had a faster cognitive tempo than their younger counterparts (Coyne et al., 1978; Salkind & Denney, Note 1). An explanation for the apparent inconsistency in the above studies can not be provided from the present data. Differences in samples with regard to demographic variables may, in part, account for the inconsistent findings. For example, age trends toward faster cognitive tempo were not observed in the present study which used a well-educated adult sample but were reported in a study which used less educated adults (Coyne et al., 1978).

Furthermore, it is important to note that all of the studies of adult age differences in cognitive tempo have used cross-sectional designs. Thus, in order to disentangle cohort from age variance, it will be necessary for researchers to employ sequential designs (Schaie, 1977).

Although Maccoby and Jacklin (1974) report few consistent sex differences in cognitive tempo, Salkind and Denney (Note 1) found that elderly women had longer latencies and made fewer errors than elderly men. The lack of sex differences in MFF performance observed in the present study does not replicate the results of the Salkind and Denney (Note 1) study, and suggests that broad generalizations concerning sex differences in older adults' performance on the MFF are unwarranted.

The writings of Kagan and his associates reveal a bias favoring the reflective pole of the cognitive tempo dimension in children. Although one might expect that the results of the present study indicating that older adults are more reflective than younger adults provides a positive view of the elderly, it is not necessarily true. As Kogan (1973) points out, reflectivity in older adults may be interpreted as part of a general pattern of slow-down in both cognitive and psychomotor activities. Thus, it seems to be important to conduct further research aimed at modifying the cognitive tempo of young, middle-aged and older adults. By manipulating variables which impact on MFF performance, researchers may be able to specify the dynamics of adult age differences in the cognitive tempo dimension

(Salkind & Denney, Note 1). However, before this research can be undertaken, attention must be paid to constructing a more reliable version of the adult MFF.

Reference Note

1. Salkind, N. J., & Denney, N. W. Correlates of cognitive tempo among the elderly. Paper presented at the meeting of the American Psychological Association, San Francisco, August, 1977.

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Table 1. Means and Deviations for Latency and Error Scores by Age Group and Sex

Sex	AGE GROUP						TOTAL	
	Young Adults		Middle-Aged		Elderly			
Men	LAT	ERR	LAT	ERR	LAT	ERR	LAT	ERR
	M= 427.76	10.38	M= 513.52	11.48	M= 738.00	10.95	M= 559.76	10.94
	SD= 269.64	5.86	SD= 359.72	6.87	SD= 353.98	6.44	SD= 350.71	6.31
Women	LAT	ERR	LAT	ERR	LAT	ERR	LAT	ERR
	M= 386.24	9.24	M=493.62	11.76	M= 809.05	10.43	M= 562.97	10.48
	SD= 203.42	5.23	SD=329.23	6.60	SD= 380.50	6.44	SD= 357.40	6.11
TOTAL	LAT	ERR	LAT	ERR	LAT	ERR	LAT	ERR
	M= 407.00	9.81	M=503.57	11.62	M= 773.52	10.69	M=561.35	10.71
	SD= 236.84	5.52	SD=340.73	6.65	SD= 364.74	6.36	SD=352.66	6.19

Table 2. Multivariate and Univariate Analyses of Variance of Age and Sex Differences on Latency and Error Scores

Dependent Variable	Source of Variation	df	F
	Multivariate Analysis		
Mean Vectors	Age	4,238	11.72*
	Sex	2,119	.11
	Age/Sex	4,238	.40
	Univariate Analysis		
Error	Age	2,120	.88
	Sex	1,120	.17
	Age/Sex	2,120	.14
Latency	Age	2,120	14.62*
	Sex	1,120	.00
	Age/Sex	1,120	.36

*$p < .001$