Non-Dominant Hand Performance on the Rey Complex Figure Test across Five Age Groups

The Rey-Osterrieth Complex Figure Test (ROCFT; Osterrieth, 1944) is a nonlinguistic, neuropsychological test commonly used to evaluate visuospatial, organizational, and visual memory skills in a wide range of clinical populations. Various approaches to the ROCFT administration and scoring have been described, but the typical administration consists of copying the figure followed by two free-recall tasks, i.e., to immediate memory and after a 30 minute delay during which a different kind of task is administered. Examinees are not told that they will be asked to remember the figure, thus, the second two conditions are regarded as tests of incidental learning (Hubley, 2006). Several standardized scoring systems for the ROCFT have been developed (e.g., Meyers and Meyers, 1995). Lesak (2004) cautioned that the type of administration and the scoring system and criteria (i.e., liberal or strict) can affect the accuracy of results. The Taylor (1991) 36-point scoring system is probably the most frequently used.

Damage to the motor strip of the left cerebral hemisphere can result in upper extremity paralysis forcing use of the non-dominant left hand in right-handed individuals. The effect of non-dominant hand use on the ROCFT has not been thoroughly evaluated. This is unfortunate because the ROCFT can be used to evaluate visuospatial skills and visual memory of individuals with right hemiplegia and aphasia.

Zacharias & Kirk (1998) evaluated the ability of elderly individuals to draw from memory the seven objects in the Western Aphasia Battery drawing subtest (Kertesz, 1982) using their non-dominant hands. The drawings were found to be less complex and of poorer quality. Budd, Houtz and Lambert (2008) compared the effects on ROCFT copy scores of 154 right-handed college students using both their right and left hands to draw the figure. The authors found that scores for both conditions were at or above normal cut-off scores using the Meyers and Meyers (1995) system.

Yamashita (2010) compared hand differences in 120 right-handed undergraduates randomly assigned to one of four groups based on which hand they used for a copy and a 3-minute recall condition. No differences in scores were found between right and left hand use for the copy trial, but recall scores were significantly lower when the non-dominant hand was used for the copy condition first. He concluded that use of the non-dominant hand may underestimate visual memory skills.

The findings of Budd, et al (2008) and Yamashita (2010) can be applied only to college-aged adults. Yet, the Zacharias & Kirk (1998) study shows that drawing to memory ability is affected by age, and some studies of the ROCFT demonstrate declining age-related performance of individuals using their dominant hands (e.g., Fastenau, et al, 1999; Yamashita, 2007)

The purpose of the current study was to evaluate the ROCFT performance across five age groups when individuals used their non-dominant hand for the copy, immediate recall, and delayed recall conditions. In doing so, we aimed to establish an age-related set of nondominant-hand

scores that could be used for determining the relative performance of individuals with left brain damage who are forced to use their nondominant hand for this test.

Methods

Participants: 101 right-hand dominant adults (48 males, 53 females) ranging in age from 18-80 were grouped across five age groups (See Table 1). None had a history of neurological disease or injury, psychiatric disorders, graphomotor impairments, or reported cognitive or memory deficits.

Procedures : Each participant was tested individually in a quiet room. A digitally drawn original-sized copy of the Rey figure was placed in front of the participant (See Figure 1) and a blank piece of paper was taped to the table in landscape orientation directly under the figure. Participants were asked to copy the figure and each was instructed that different colored fine felt-tip markers would be handed to them to use throughout the task. (The use of a series of colored markers, as described by Lezak [2004], allows examiners to analyze the person's approach to reproducing the figure according to the recorded order of the colors. For this study, however, we did not perform this qualitative analysis.) After completion of their drawing both the figure and their copy were removed and participants were given another piece of paper and asked to recall the figure and redraw it. After completion of the immediate recall, a 30 minute delay, during which the participant completed a verbal memory test, was provided. The delayed recall trial was then administered.

Test Scoring: The 36-point Taylor (1991) scoring system was used and two trained scorers, who were blind to the participant information, independently scored the figures.

Results

Scoring Reliability: Inter-scorer reliabilities for all scores of the ROCFT were examined with intraclass correlation coefficient (ICC) using a two-way random effects model. The ICC of the copy scores were .98, immediate recall .95 and delayed recall .96. Because the correlations were sufficiently high the examiner's scores were used for analysis.

Performance across Age Groups: Means and standard deviations for each of the five age groups for the copy, immediate recall and delayed recall trials and 95% confidence intervals were calculated (See Table 2).

A multivariate ANOVA was conducted with the three trials of the ROCFT as the dependent measures. A significant effect for age group [Wilks' λ =.770, F (12, 248.992) = 2.15, p <. 015, η^2= .083] resulted. Given the significance of the overall test, the univariate main effects were examined and these showed no significant differences between the age groups for the copy trial (p =.090). Significant differences were found for both the immediate recall trial [F (4, 101) = 4.33, p = .003, η^2 = .153] and the delayed recall trial [F (4, 101) = 5.72, p = .000, η^2 = .192). Post

hoc analysis revealed the 55-69 year old group had significantly lower scores than the individuals in the lower two age groups on the immediate recall trial. The scores for the 55-69 year olds were also significantly lower than the 18-24 and the 25-39 year old group on the delayed recall trial. The 70-80 group had significantly lower scores than the 18-24 and the 25-39 year old group on the delayed recall trial (See Table 3).

Discussion and Conclusions

In the present study 101 individuals aged 18 - 80 years used their non-dominant hand to complete three conditions (copy, immediate memory, and delayed memory) of the ROCFT. No differences on the copy trial were found among the five age groups. On the two recall trials, age effects were noted beginning at age 59. These aging effects are consistent with those of other studies of individuals using their dominant hands.

In addition, we found that scores for all trials across all age groups were notably lower than the scores published in normative studies for individuals using their dominant hands. The current findings are important in that scores earned on the ROCFT by hemiplegic individuals who are forced to use their non-dominant hand might well fall within the disordered range using currently available norms. Our study yielded score means, standard deviations and confidence intervals of a nonclinical population. These norms can be used to determine the relative performance of right-handed individuals with right hemiplegia (especially those with aphasia) on the nonlinguistic ROCFT.

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Table 1. Mean and standard deviations for age and education for participants across the five age groups and for the total sample.

Groups	N	Age	Education (Years)
18-24	29	21.7 (1.9)	14.9 (2.1)
25-39	20	28.8 (3.7)	17.0 (2.0)
40-54	24	50.1 (2.6)	16.0 (2.5)
55-69	20	60.0 (5.2)	16.0 (2.7)
70-85	8	75.0 (3.0)	15.0 (2.0)
Total	101	41.5 (18.0)	15.7 (2.3)

TABLE 2. Means and standard deviations of raw scores and 95% confidence intervals for the copy, immediate recall and 30-minute delayed recall trials of the ROCF for right-handed adults ages 18-80 who used their non-dominant hand (left) to complete each trial.

Age	N	Copy			Immediate Recall			Delayed Recall		
		Mean (SD)	Lower limits	Upper limits	Mean (SD)	Lower limits	Upper limits	Mean (SD)	Lower limits	Upper limits
18-24	29	26.8 (4.0)	25.26	28.33	18.7 (4.5)	16.97	20.41	18.3 (5.0)	16.40	20.19
25-39	20	27.1 (3.9)	25.27	28.88	19.3 (6.2)	16.42	22.23	18.8 (5.2)	16.34	21.21
40-54	24	26.7 (4.8)	24.72	28.74	16.5 (6.3)	13.82	19.14	15.5 (5.8	13.10	17.98
55-69	20	25.0 (5.3)	22.43	27.37	13.7 (5.6)	11.03	16.24	13.1 (5.5)	10.54	15.71
70-80	8	22.6 (5.6)	17.90	27.23	13.3 (4.5)	9.52	16.98	11.4 (4.6)	7.55	15.20
Total	101	26.1 (4.7)	25.20	27.04	16.7 (5.9)	15.70	18.03	16.2 (5.8)	15.02	17.31

Table 3. Post-hoc comparisons for significance differences for age groups for the immediate recall and 30-minute delayed recall tasks.

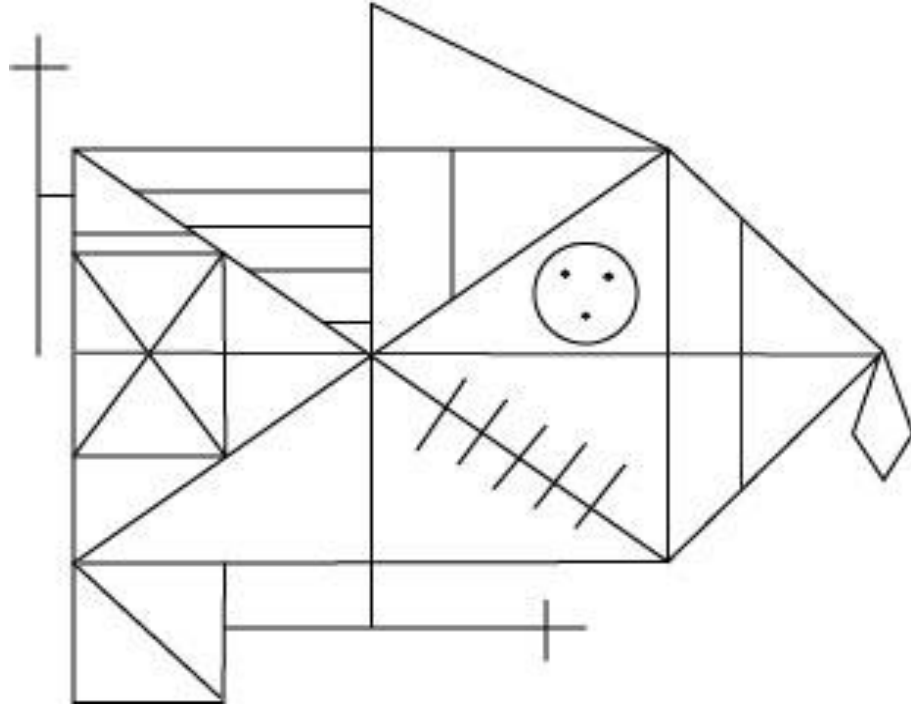| Significant Group Comparisons		Immediate	30-minute Delay
18-24	55-69	.019	.010
	70-80	ns	.013
25-39	59-69	.014	.010
	70-80	ns	.011

Figure 1. Digital copy of the Rey Osterrieth Complex Figure (Rey, 1941) drawn with Adobe Illustrator softrware.