Using the Rey–Osterrieth and Modified Taylor Complex Figures with Older Adults: A Preliminary Examination of Accuracy Score Comparability

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Abstract

Although considerable research has now shown that the Rey–Osterrieth Complex Figure (ROCF) and its original companion figure, the Taylor Complex Figure (TCF), are “not” comparable measures of visuospatial learning and memory, recent studies have provided evidence to suggest that the Modified TCF (MTCF) is a comparable measure to the ROCF. The primary aim of the present study was to examine the comparability of ROCF and MTCF accuracy scores with older adults using the traditional incidental learning procedure. A secondary aim was to examine whether performance on the two figures showed comparable gender effects and relationships with age and education. Comparable recall performance, but not copy performance, was found for the two figures in this sample of older adults. No gender differences were found on either figure and similar relationships with age and education were reported for the two figures. These findings are discussed within the context of previous research with consideration given to the clinical implications of the findings and future research recommendations.

Keywords: Complex figure; Memory; Visuospatial abilities; Validity; Score equivalence; Older adults

Introduction

Complex figures, such as the Rey–Osterrieth Complex Figure (ROCF; Rey, 1941), are commonly used to assess visuospatial, perceptual, and executive functioning in older adults (e.g., Gasparini et al., 2008; Grace et al., 2005; Ivgi, Beeri, Rabinowitz, & Davidson, 1999; Lincoln, Drummond, & Berman, 1997; Marshall et al., 2007; Qi-hao, Jun-chao, & Zhen, 2005; Robinson et al., 2007; Uc, Rizzo, Anderson, Qian, et al., 2006; Uc, Rizzo, Anderson, Sparks, et al., 2005). At times, one may simply want to use an alternate figure to which the person has not been exposed (e.g., due to a previous assessment, clinical training, or a breach of test security). More commonly, there are a number of situations (e.g., surgery, drug treatment, rehabilitation) in which a clinician or researcher may want to evaluate visuospatial, perceptual, and/or executive functioning more than once. Complex figures are often used in these situations but, to minimize practice effects associated with using the same complex figure twice (or multiple times as required in some situations), it is recommended procedure to use a different, but equally difficult, complex figure (or figures). At one time, the Taylor Complex Figure (TCF; Taylor, 1969) was treated as though it was comparable to the ROCF and the figures were used interchangeably in both clinical and research settings. However, subsequent research has clearly demonstrated that the TCF is less difficult to learn and remember than the ROCF (e.g., Delaney, Prevey, Cramer, & Mattson, 1992; Hamby, Wilkins, & Barry, 1993; Strauss & Spreen, 1990; Tombaugh, Faulkner, & Hubley, 1992; Yamashita, 2006). Since then, the TCF was revised to make it more difficult (Hubley, 1996; Hubley, Tombaugh, & Hemingway, 2003) and several studies have demonstrated that the Modified TCF (MTCF) provides comparable accuracy scores to the ROCF (Hubley & Jassal, 2006; Hubley & Tremblay, 2002; Yamashita, 2006).

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Surprisingly little research comparing alternate forms of complex figures has been conducted with older adults (Hubley & Tombaugh, 2003) and no studies comparing the ROCF and MTCF have focused solely on this age group. One reason for comparing the ROCF and MTCF in a sample comprised only of older adults is that age effects have been documented consistently in the recall of complex figures and less consistently in the reproduction (i.e., copy) of these figures (Hartman & Potter, 1998; Hubley & Tombaugh, 2003; Knight, 2003). Thus, is performance on the two figures comparable when examined solely in older adults? The issue here is about the level of difficulty of these figures for older adults given age-related changes to executive functioning, learning, and memory. On the one hand, any potential differences between the ROCF and MTCF might be masked by the increased difficulty of the task for older adults (for an example of this phenomenon with children, see Sadeh, Ariel, & Inbar, 1996). On the other hand, it is possible that any subtle differences in difficulty reproducing or recalling the two figures (given the individual features or the gestalt) might become more apparent with older adults (see the findings for children with attention-deficit hyperactivity disorder [ADHD] in Sadeh et al., 1996, and commentary by Hubley & Tombaugh, 2003). For clinicians and researchers working with older adults and in situations in which alternate forms of the complex figure test are needed (e.g., diagnosis of, and tracking cognitive change in, cases such as mild cognitive impairment and dementia), a comparison of performance on the ROCF and MTCF specifically with an older sample will be informative.

The primary aim of the present study was to determine if MTCF accuracy scores were comparable to those on the ROCF using an incidental learning procedure with older adults. Given past research comparing the ROCF and MTCF, it was hypothesized that there would be no statistically significant differences in mean accuracy scores obtained on the MTCF and ROCF on copy, immediate recall (IR), or delayed recall (DR) trials. A secondary aim of this study was to examine whether performance on the ROCF and MTCF showed comparable gender effects and relationships with age and education. It was hypothesized that similar gender effects and similar patterns of relationships with age and education would be obtained with the two figures.

Materials and Methods

Participants

Study participants were recruited using (a) posters or recruitment tables placed in various locations in the community (e.g., shopping malls, pharmacies, grocery stores, seniors’ groups), (b) a list of individuals from the community who had volunteered to take part in future research, (c) advertisements in various local newsletters to seniors, and (d) word of mouth. No honoraria were provided for participation. Inclusionary criteria were that study participants had to be at least 55 years of age, living independently in the community, and speak and read English as a first language. Exclusionary criteria were that the participants could not have a history of stroke, seizures, multiple heart attacks, or serious head injury; nor could they have a current diagnosis of dementia or screen positive for depression or cognitive impairment.

Participants consisted of 64 predominantly White community-dwelling older adults (16 men and 48 women) aged 55–78 years (M = 65.5, SD = 6.33) living in a small northern Canadian city. Their years of education ranged from 9 to 18 (M = 12.9, SD = 2.37). Nearly all (93.8%; n = 60) were right-handed. A between-groups design was used wherein participants received either the ROCF (n = 32) or the MTCF (n = 32). Participants in the two groups were individually matched for age (within 4 years; ROCF: M = 65.6, SD = 6.23; MTCF: M = 65.5, SD = 6.53; t (62) = 0.06, p = .95, d = 0.02) and education (within 2 years; ROCF: M = 12.9, SD = 2.48; MTCF: M = 12.8, SD = 2.29; t (62) = 0.16, p = .88, d = 0.04). There were 7 men and 25 women in the ROCF condition and 9 men and 23 women in the MTCF condition. A χ² test for independence (using Yates Continuity Correction and Fisher’s Exact Test) indicated no significant association between gender and figure, χ²(1, n = 64) = 0.083, p = .77, phi = −0.07.

Participants were asked about the following medical history conditions and, with the exception of diabetes, showed similar numbers (ROCF:MTCF) of participants reporting such conditions: Heart attack and other heart conditions (3:3), hypertension (11:10), vascular disease or stroke (0:0), thyroid problems (8:6), seizures or epilepsy (0:0), diabetes (1:5), head injury/concussion (2:3), diagnosed dementia (0:0), other notable medical conditions (0:0), and no medical conditions (14:12). All participants scored >24 on the Mini-Mental State Examination (MMSE; M = 28.6, SD = 1.28), indicating no significant cognitive impairment on this screen, and ≤14 on the Geriatric Depression Scale (GDS; M = 4.1, SD = 3.26), indicating no significant depressive symptomatology on this screen.

Materials

A demographic form recording sex, birthdate, age, handedness, years of education, and medical history was completed via interview. The tests administered included the MMSE (Folstein, Folstein, & McHugh, 1975), GDS (Yesavage et al., 1983), and either the ROCF or MTCF. The standard 36-point scoring system developed by Osterrieth (1944) and refined by Taylor (1959)
and Taylor (1989, as cited in Strauss, Sherman, & Spreen, 2006) was used to score the ROCF. A very similar 36-point scoring system, developed by Hubley (1998) that also focuses on accuracy and placement, was used to score the MTCF. (The MTCF figure and an abbreviated version of the scoring system can be viewed in Lezak, Howieson, and Loring [2004] or Strauss et al. [2006]; a detailed version of the scoring system can be obtained from the author upon request.) Two scorers (the author, as primary scorer, and a senior undergraduate psychology student research assistant, SJ) independently scored all the complex figure reproductions for each study participant. Finally, a series of questionnaires about aging (e.g., knowledge of aging, anxiety about aging, social value of the elderly, subjective age) not relevant to the present study question were used as filler tasks during the DR interval of the complex figure test.

**Design and Procedure**

Each participant was tested individually by trained senior undergraduate student research assistants. Participants first were administered the MMSE and the GDS. Next, they were shown the complex figure and asked to copy the design as accurately as they could while observing the figure. This task employed the traditional incidental learning procedure in which the participants were not informed in advance that there would be IR and DR trials following the copy trial. Immediately after their copies were completed and removed, participants were asked to reproduce the complex figure from memory (IR). Upon completion of this task, participants spent the next 20 min completing a series of questionnaires on aging as filler tasks. Participants who had not completed the questionnaires within the delay interval were asked to put the questionnaires aside momentarily and then reproduced the complex figure one last time (DR). Finally, participants completed the questionnaires on aging, if they had not already done so.

**Results**

Inter-scorer reliabilities for the ROCF and MTCF are reported using both Pearson’s $r$ and the intraclass correlation (ICC). The ICC reported here uses a two-way random effects model that provides a measure of inter-scorer agreement (rather than consistency) when the scores from a single (rather than averaged) scorer will be used for subsequent analyses (Laschinger, 1992; McGraw & Wong, 1996; Shrout & Fleiss, 1979). The use of absolute agreement provides a stricter criterion because scores that differ in absolute value are treated as disagreements. Table 1 shows the obtained Pearson’s $r$ and ICC values. Only the scores from the primary scorer were used in subsequent analyses.

Gender differences were examined on each of the ROCF and MTCF trials. Given some non-normality in the data, nonparametric statistics were conducted. A series of Mann–Whitney $U$-tests revealed that no significant differences in accuracy score performance were found between men and women on the ROCF trials (copy: $U = 70.50, z = -0.78, p = .43, r = .14$; IR: $U = 79.50, z = -0.37, p = .72, r = .06$; DR: $U = 53.50, z = -1.55, p = .12, r = .27$) or the MTCF trials (copy: $U = 96.50, z = -0.30, p = .76, r = .05$; IR: $U = 86.50, z = -0.71, p = .48, r = .13$; DR: $U = 100.50, z = -1.26, p = .90, r = .02$).

Copy and recall trial performance for the ROCF and MTCF is shown in Table 2. Again, given some non-normality in the data, nonparametric statistics were conducted. The results of a Mann–Whitney $U$-test revealed a statistically significant difference between the figures in performance on copy, $U = 310.50, z = -2.75, p = .006, r = .34$, with moderately higher performance on the MTCF (Median = 35.0) than the ROCF (Median = 32.0). There were no significant differences in performance between the two figures on IR, $U = 416.50, z = -1.28, p = .20, r = .16$, or DR, $U = 468.00, z = -0.59, p = .55, r = .07$. Given that the statistically significant difference between the figures on the copy trial could impact recall performance, Mann–Whitney $U$-tests were conducted on percent-retained scores (i.e., recall scores divided by copy scores and multiplied by 100). These tests revealed no significant differences between the figures in percent retained performance at IR, $U = 454.0, z = -0.78, p = .44, r = .10$, or DR, $U = 511.0, z = -0.01, p = .99, r = .002$.

Table 1. Inter-scorer reliability estimates for the ROCF and MTCF

<table>
<thead>
<tr>
<th>Trial</th>
<th>ROCF</th>
<th>MTCF</th>
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<tbody>
<tr>
<td></td>
<td>Pearson’s $r$</td>
<td>ICC</td>
</tr>
<tr>
<td>Copy</td>
<td>.86</td>
<td>.81</td>
</tr>
<tr>
<td>IR</td>
<td>.97</td>
<td>.97</td>
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<tr>
<td>DR</td>
<td>.97</td>
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**Notes:** ROCF = Rey–Osterrieth Complex Figure; MTCF = Modified Taylor Complex Figure; ICC = intraclass correlation; IR = immediate recall; DR = delayed recall.
Correlations between performance on the complex figures and each of age and education were examined to determine whether the pattern of correlations were similar for the ROCF and MTCF. The results are shown in Table 3. Using Fisher’s Z-tests to compare these coefficients, none of the correlations were statistically significantly different between the ROCF and MTCF. Overall, the correlations tended to be small (ranging between $r = .23$ and .37) and nonsignificant.

**Discussion**

The primary purpose of the present study was to examine the comparability of accuracy score performance between the ROCF and MTCF using an incidental learning procedure with older adults. On the basis of previous research, it was hypothesized that there would be no statistically significant differences in mean accuracy scores obtained on the MTCF and the ROCF. This hypothesis was only partially supported. There were no significant differences in IR and DR trial performance on the ROCF and the MTCF, which suggest that these two figures do provide comparable accuracy scores when assessing visuospatial memory using an incidental procedure in older adults. This finding is consistent with previous research comparing the ROCF and the MTCF in samples of younger adults (Hubley & Tremblay, 2002; Yamashita, 2006) and in a mixed age adult sample (Hubley & Jassal, 2006). Surprisingly, however, the MTCF was found to be significantly easier than the ROCF to copy (i.e., visuospatial construction) in the present sample of older adults. There was an average difference of 1.6 points (out of 36) between the mean copy scores on the two figures, which is a low moderate effect and on the borderline of being clinically meaningful. This unexpected finding is contrary to all previous research comparing the ROCF and the MTCF in samples of younger adults (Hubley & Jassal, 2006; Hubley & Tremblay, 2002; Yamashita, 2006) and even research that has been conducted with older adults comparing the ROCF and the original and “easier” TCF (Berry, Allen, & Schmitt, 1991; Kuehn & Snow, 1992; Vingerhoets, Lannoo, & Wolters, 1998).

At present, the current study supports the comparability of the two figures when used to assess visuospatial recall when used with older adults, but calls into question the comparability of the two figures when used to assess visuospatial construction in this group. Further research is needed to determine whether this is a robust finding with older adults or reflects a Type I error. If the finding is
robust, then either a modification needs to be applied to MTCF design (which would require an exploration of the cause of the differences in copy performance in the figures across studies) or a correction needs to be applied to older adults’ copy scores on the MTCF.

A secondary purpose of this study was to examine whether performance on the ROCF and the MTCF showed comparable gender effects and relationships with age and education. It was hypothesized that similar gender effects and similar patterns of relationships with age and education would be obtained with the two figures. These hypotheses were supported. No gender differences in accuracy scores were found on either the ROCF or the MTCF. This finding is consistent with the majority of research on gender differences in complex figures (see summary by Hubley & Tombaugh, 2003). The few studies that have reported gender differences (e.g., Bennett-Levy, 1984; Tombaugh, Faulkner, et al., 1992) have found that these differences were negligible.

Correlations between figure performance and age were small (ranging from $r = -0.31$ to 0.18) and nonsignificant on both figures. This finding is contrary to that of previous research (e.g., Berry et al., 1991; Boone, Lesser, Hill-Gutierrez, Berman, & D’Elia, 1993; Chiulli, Haaland, LaRue, & Garry, 1995; Gallagher & Burke, 2007; Hubley & Jassal, 2006; Knight, 2003; Rosselli & Ardila, 1991; Vingerhoets et al., 1998) but may reflect the restricted age range present in a sample of older adults. Correlations between figure performance and education were small and positive (ranging from $r = 0.17$ to 0.39) and, with one minor exception, nonsignificant. These findings seem to reflect much of the inconsistency in the literature; that is, some research has found that education has little relationship with complex figure performance (e.g., Berry et al., 1991; Boone et al., 1993; Delaney et al., 1992; Hubley & Jassal, 2006), whereas other research reports positive correlations between education and either copy or recall performance (e.g., Ardila & Rosselli, 2003; Frazier, Adams, Strauss, & Redline, 2001; Vingerhoets et al., 1998). More importantly, in the present study, none of the correlations between complex figure performance and each of age and education were statistically significantly different between the ROCF and the MTCF. Only three studies appear to have conducted comparability studies by examining the respective patterns of correlations between different complex figure scores and demographic variables (Frazier et al., 2001; Hubley & Jassal, 2006; Vingerhoets et al., 1998). In the only previous study comparing the ROCF and the MTCF, Hubley and Jassal (2006) also found a similar pattern of correlations between the ROCF and the MTCF.

The present study has focused on examining the comparability of ROCF and MTCF accuracy scores in a cognitively intact community sample of older adults using a between-groups design and an incidental procedure. In exploring the comparability of the ROCF and the MTCF, there are other types of scores, samples, research designs, and administration procedures that can also be used and should be explored in future research. The vast majority of complex figure comparability studies have focused on accuracy scores. However, many clinicians and researchers believe that information about the process (e.g., strategies, sequencing, errors) used in the construction or recall of a complex figure provides additional unique information (Hubley, 2006; Poreh, 2006). Information about the comparability of ROCF and MTCF process scores may also inform research on the comparability of accuracy scores for the two figures. Whereas the present study focused on a community sample of older adults, future research should explore the comparability of ROCF and MTCF accuracy and process scores in clinical samples of older adults (e.g., dementia, stroke).

The present study also used a between-groups design and an incidental procedure in the administration of the ROCF and MTCF. Between group designs are commonly used to assess the comparability of different complex figures and have particular advantages (e.g., easier sample recruitment, less sample attrition, less restrictive statistical assumptions) but also some disadvantages (e.g., less control over individual differences between groups). Future research should also consider using a within-subjects design with counterbalancing. Notably, although the incidental procedure used in the present study is the most commonly used method of administering the complex figure test, there are a variety of potential problems with this approach, especially when the complex figures are administered in a within-subjects (test–retest) design (Hubley & Tombaugh, 2003; Tombaugh, Schmidt, & Faulkner, 1992). For example, a participant who has been administered the complex figure using an incidental procedure during the test portion often expects the memory component when a similar figure is presented during the retest portion and thus shifts to a more intentional approach for the second figure. Research examining the comparability of ROCF and MTCF accuracy (and process) scores in older adults should also be conducted using an intentional learning procedure, in which the study participant is informed in advance that there is a memory component to the test and multiple learning trials can be incorporated.

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Conflict of Interest

A.M.H. is the developer of, and holds the copyright on, the Modified Taylor Complex Figure (MTCF).

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