

Standardisation of the Rey Complex Figure Test in New Zealand Children and Adolescents

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It is essential when using neuropsychological measures to have appropriate and valid norms for evaluating an individual's performance. Most neuropsychological measures used in New Zealand have been standardised on American and British populations and may not be sensitive to the varying cultural experiences of New Zealanders. Normative data, obtained from a sample of 840 children aged between 7-18 years, are presented for the Copy and Recall Phases of the Rey Complex Figure Test. The standardisation data obtained reveals a steady improvement in performance with increasing age for both the Copy and Recall Phases of the RCFT. No gender differences were found for any of the age-groups and there were no overall ethnic differences for the Copy or Recall phases. A number of significant differences were found across the age groups, between the American standardisation data and that obtained from this study, for both the Copy and Recall Phases of the RCFT.

The Rey Complex Figure Test (RCFT) is a neuropsychological instrument that is used widely throughout New Zealand with both children and adults. The RCFT is composed of two parts - the first requires the participant to copy a complex geometric figure while the second asks him/her to recall and draw what they remember of the figure, without forewarning, after an interval. The RCFT copy phase is a measure of visuospatial constructional ability while the recall phase of the task evaluates the individual's ability with encoding complex visual information into longer-term storage and then recalling this information at a later time.

Visuospatial constructional ability is complex, comprising multiple distinct, but interrelated subcomponents;

the ability to combine elements into a meaningful wholes, the ability to discriminate between objects, distinguish between left and right, the ability to understand relationships among objects in space, the ability to adopt various perspectives and to represent and rotate objects mentally; the ability to comprehend and interpret symbolic representations of external space and the ability to work out the solution for non-verbal problems (Cronin-Galomb & Braun, 1997). Having a reliable and valid measure of this ability is important because people with visuospatial deficits can have problems in everyday life which include carrying out mathematical calculations, route finding and map reading, drawing and copying diagrams, assembling objects from parts and fixing up broken objects and items around home. As well as assessing visuospatial constructional skills and mnemonic functions, the RCFT provides information about a child's organisation, planning and problem solving skills (Karapetsas & Kantas, 1991) by evaluating the manner in which the child reproduces the figure.

Various administration procedures and scoring systems have been developed for the RCFT. Before the development of the Meyer and Meyer's (1995) scoring criteria, the most commonly used scoring procedure for these tests was that developed by Osterreith (1944) and modified by Taylor (1959). This scoring system involved breaking the figure into 18 individual elements which are scored for both distortion and placement. While these criteria are explicit about the specific elements which are to be scored, there was considerable latitude in determining what constitutes a scorable distortion or displacement. Meyer and Meyer (1995) have developed more specific and detailed criteria for scoring the RCFT and have gathered comprehensive normative data.

The Rey Complex Figure test has been found to be sensitive to laterality of cerebral lesion especially when the right hemisphere is affected (Loring, Lee, Martin and Meador, 1988). It is thought that, due to the complexity of the figure and the task demands, the RCFT provides more clinical information and is differentially sensitive to specific

kinds of brain damage such as right temporal lobe dysfunction (Loring, Lee, Martin & Meador, 1988).

No New Zealand norms for children and adolescents have been available for this test. Prior to 1995, the norms circulated for use in New Zealand for children and adolescents were actually derived from the original study of French school children published in 1944 (Osterrieth, 1944). Generally, New Zealand norms are lacking for frequently used cognitive measures, and psychologists have to rely on British or American normative data to interpret the performance of New Zealand children. Appropriate norms are essential when making inferences about an individual's performance on any psychological test since his/her performance must be measured against some ideal or normal level of functioning. Whatever the test is assessing, it is essential to know how the individual performs relative to his/her peers. This is of particular importance with children because their abilities and traits change with age. When an individual is being evaluated, it is important to do so in relation to norms, which take into consideration age, gender, educational attainment and ethnicity.

Meyers and Meyers (1995) have published excellent norms for the Rey Complex Figure for 505 children aged between 6 year 0 months to 17 years, 11 months in the Midwestern United States. However, there are concerns about the validity of using such norms when applied to children from other ethnic and cultural backgrounds (Knight, 1997; Lezak, 1995). New Zealand has a diverse ethnic population that is not duplicated elsewhere, with an influential Maori population and a significant proportion of people with a Pacific Island background. This factor along with others, such as educational programs and cultural influences, highlight the need for norms that are standardised on the New Zealand population. Dudley (1997) in a New Zealand study, comparing the performance of Maori and Pakeha adults aged between 16 and 30 years, found that there was no significant difference between the groups on either the copy or the delayed recall phases and there were no significant gender differences. She postulated that the Rey Complex Figure Test does not disadvantage Maori and may contain less cultural bias than is the case with other measures of cognitive functioning. There have been no such studies carried out with the paediatric population.

Karapetsas and Kantas (1991) found gender differences with females outperforming males from eight years of age onwards. The researchers speculated that this may reflect earlier and greater lateralisation of brain functions among females. However, Meyers and Meyers' (1995) did not find any significant gender differences in their relatively large sample. The aim of this project is to provide appropriate age-related norms for clinicians using the RCFT with children and adolescents in New Zealand and to examine such potentially influencing factors as ethnicity, socio-economic status and gender.

Method

Participants

A sample of 840 children living in the Auckland and North

Auckland regions were recruited for voluntary participation. Ages ranged from seven to eighteen years. The sample comprised 407 females and 433 males. Table 1 outlines the ethnic composition of the sample and compares it with the ethnic composition data obtained from the 1996 New Zealand census.

There was some variation in the number of participants in each age-group due to differing return rates from the various schools sampled. Of the total sample, 63.5% were Pakeha/European, 11.9% were Maori, 13% were Pacific Islanders and 11.6% were from other cultures, predominantly Asian. This is very similar to the 1996 census data findings on the ethnic composition of Auckland. There were approximately equal numbers of females (48.5%) and males (51.5%). The numbers of participants in each age level ranged from 15 to 134 (see Table 2). Children for whom English was a second language were excluded if they had not achieved an age-appropriate grasp of English and teachers' judgement was relied on to ascertain this. Children who had a past history of major head injury, neurological or psychiatric problems were excluded.

Table 1. Ethnic Composition of Participants in Comparison with Auckland 1996 Census Data

Ethnicity	Participants (%)	Auckland 1996 (%)
Pakeha	63.5	59.0
Maori	11.9	9.0
Pacific Island	13.0	12.0
Other	11.6	13.0

Measures

The Rey Complex Figure Test is a detailed diagram. Subjects are first asked to copy the figure to assess their visuospatial constructional ability, and then 30 minutes later, are asked to reproduce the figure from memory. This assesses subjects' capacity for encoding complex visuospatial information into memory and then their ability with retrieving the information at a later time. For scoring purposes, the diagram is divided up into 18 scoring units. A maximum of two points, one for accuracy and one for placement, are allocated to each scoring unit so that highest possible number of points is 36.

Procedure

Whole classes of pupils from five primary schools, four intermediate schools and two secondary schools were sampled from the Auckland and North Auckland areas. Schools were selected by suburb to ensure that an adequate range of socio-economic and ethnic groups were included in the sample. Schools were selected from areas where housing reflected high middle and low price ranges from the list of median house prices in Auckland and North Auckland (Valuation New Zealand, 1992). The sample size varied from 134 participants in the twelve-year age group to 15 participants in the eighteen-year age group.

The research protocol was piloted with a sample of 20 children aged between 7 and 17 years to ensure that the instructions and questions asked could be easily understood by the majority of the participants. One class at each year level was selected from each school. Unstreamed classes were selected to ensure that a range of ability levels was sampled. Parent and pupil information/permission forms were handed out to potential participants and only those with signed parental permission participated in the study. Participants were given a code number and no names were placed on the forms to ensure anonymity and confidentiality. At the beginning of each testing session, children received a careful explanation about what they would be required to do. They were then able to ask questions and the two researchers assisted the children if they had any problems with understanding any of the written questions during the testing. Participants were tested in the classrooms and they were separated from one another as much as possible.

Participants first filled out a sheet requesting demographic information. The responses to a question about parental occupation had to be discarded because many participants did not know their parents' occupation and/or could not be specific enough. Following this, the participants were asked to copy the Rey Complex Figure as carefully as possible with a pencil. Once they completed this task, they then handed in their copies and then filled in the Eating Attitudes Test (EAT; Garner, Olmstead, Bohr & Garfinkel, 1982) which served as a filler task. Twenty minutes later, irrespective of whether participants had finished filling in the EAT, they were asked to redraw the Rey Complex Figure from memory. It was stressed that the participants should avoid looking at others' work and desks were separated whenever possible. Researchers circulated throughout the room during this period observing children, making reminders about not looking at others' work if necessary and noting

if copying occurred. When participants were detected copying from someone else, a note was made of this and their protocols were excluded from the study.

The specific criteria developed by Meyers and Meyers (1995) were used to score the Rey Complex Figure copy and recall trial. Interscorer reliability was facilitated by having all the researchers score ten copy and recall test forms on three occasions. Any discrepancies were discussed to increase the consistency of scoring among the researchers. Using a Pearson Product-Moment Correlation, the interscorer reliability was calculated as being $r=0.84$.

Results

For the statistical evaluation of the results, independent-sample t-tests and one- and two-way analyses of variance were used. Table 2 presents the means and standard deviations for the 12 age groups of children. As no overall gender differences were found for either the copy ($F[1,838] = 0.38, p < .54$) or the recall ($F[1,834] = 0.72, p < .40$) phases, the results for males and females have been combined (see Table 3). Further analyses revealed that there were no gender differences for any of the individual age-groups with the copy or recall phases of the RCFT. Overall, there was a steady increase in mean scores with increasing age for both the copy and recall phases of the RCFT test. The standard deviation for each age group, in both the copy and recall phases, decreased with increasing age meaning that, as children get older, there is less overall variability in their performance.

The 7-10 year age-groups obtained means which were most frequently significantly different from those of other age-groups for both the Copy and Recall Phases of the RCFT. Over the entire sample, no ethnic differences were found for either the copy ($F[3,836] = 3.40; p < 0.02$) or recall phases ($F[3,832] = 0.18, p < .91$). The results are outlined in Table 3.

Table 2. Normative Data for Children Aged 7-18 Years on the Rey Complex Figure Test: Copy and Recall Phases

Age	Copy Phase			Recall Phase		
	N	Mean	SD	N	Mean	SD
7.00-7.11 years	58	20.88	7.52	57	10.48	6.36
8.00-8.11 years	75	24.27	6.44	75	13.33	7.00
9.00-9.11 years	95	25.79	6.35	95	15.88	6.59
10.00-10.11 years	99	28.10	5.74	99	17.83	6.94
11.00-11.11 years	124	30.12	4.11	124	19.52	7.06
12.00-12.11 years	134	31.13	3.71	133	20.92	7.00
13.00-13.11 years	57	32.14	3.49	57	23.98	6.32
14.00-14.11 years	45	32.26	2.94	45	23.22	5.75
15.00-15.11 years	50	34.10	1.36	49	27.12	4.15
16.00-16.11 years	41	32.82	3.83	39	23.94	6.45
17.00-17.11 years	47	33.21	2.46	47	25.00	5.71
18.00-18.11 years	15	33.37	2.04	15	24.34	4.24

Table 3. Means and Standard Deviations for Gender and Ethnicity Variables Across the Total Sample for the Copy and Recall Phases of the Rey Complex Figure Test.

Variables		Copy Phase		Recall Phase	
		Mean	SD	Mean	SD
Gender	Female	29.38	6.44	19.76	7.97
	Male	29.12	5.65	19.29	7.76
Ethnicity	Pakeha	29.51	5.86	19.56	7.91
	Maori	28.10	6.33	19.03	7.06
	Polynesian	28.20	6.86	19.50	8.12
	Other	30.16	5.49	19.83	1.18

Tables 4 and 5 present a comparison between Meyers and Meyers' American norms and current data. Data for the Copy Phase are outlined in Table 4 and data for the Recall Phase in Table 5. An Independent-samples t-test was used to compare the two sets of means. As shown in Table 4, the mean scores for eight of the 12 age-groups were significantly different for the Copy Phase of the RCFT. Table 5 reveals that the means for four of the twelve age-groups were significantly different for the Recall Phase of the RCFT.

Discussion

The results from this current study indicate that there is a steady improvement with age in visuospatial constructional ability and skill with encoding complex visual information into longer-term storage and then recalling this information at a later time as evaluated with the copy and recall phases of the Rey Complex Figure Test. There is less variation in performance with increasing age, as evidenced by lower

standard deviations in the older age levels sampled. This is most likely because copying and recalling the Rey Complex Figure is a much more difficult and challenging task for younger as compared with older children and therefore there will be more variation in their performance. The older children were better able to respond to the demands of the task and, therefore, there was less variability in their performance.

Karapetsas and Kantas (1991) found that between the ages of seven and twelve years, there are considerable changes in the perception and recognition of complex figures. Table 4 reveals that there are a greater number of significant differences among younger children, i.e. between seven to eleven years, and that there is greater consistency in performance in the older age-groups from about 12 years of age. This is when the improvement in performance with increasing age slows down and starts to level out. The results obtained for Recall Phase of the RCFT showed this same age-related pattern. This is entirely consistent with the findings of Meyers and Meyers (1995) where they found that Copy and Recall scores increased significantly from 6 years to 11 years and increased less dramatically from 12-17 years of age.

There were no gender differences found in any of the age-groups. This is in contrast to the study by Karapetsas and Kantas (1991) but consistent with Meyers and Meyers' (1995) findings. There is an improvement in visuospatial constructional ability and visuospatial learning and recall with age in both genders. Males and females seem to develop these skills at approximately the same rate. No significant ethnic differences were found across the entire sample. The different age-groups could not be compared in terms of ethnicity because of some of the small sample sizes (n<10). This may indicate that the varying cultural experiences

Table 4. Comparison of Meyers and Meyers' (1995) American Norms and the New Zealand Norms on the Rey Complex Figure Test: Copy Phase

Age	New Zealand Norms			American Norms			t
	N	Mean	SD	N	Mean	SD	
7.00-7.11 years	58	20.88	7.52	57	23.70	5.90	2.19*
8.00-8.11 years	75	24.27	6.44	41	28.39	4.97	3.54***
9.00-9.11 years	95	25.79	6.35	41	31.45	4.12	4.83***
10.00-10.11 years	99	28.10	5.74	19	33.24	3.51	3.75***
11.00-11.11 years	124	30.12	4.11	47	33.99	2.99	5.45***
12.00-12.11 years	134	31.13	3.71	44	34.06	2.60	4.88***
13.00-13.11 years	57	32.14	3.49	48	33.78	2.34	2.73**
14.00-14.11 years	45	32.26	2.94	32	33.44	2.22	1.50
15.00-15.11 years	50	34.10	1.36	43	33.39	2.23	0.83
16.00-16.11 years	41	32.82	3.83	42	33.92	2.38	1.57
17.00-17.11 years	47	33.21	2.46	42	35.36	2.66	3.91***
18.00-18.11 years	15	33.37	2.04	88	35.10	1.81	1.90

*p<.05

**p<.01

***p<.001

Table 5. Comparison of Meyers and Meyers' (1995) American Norms and the New Zealand Norms on the Rey Complex Figure Test: Recall Phase

Age	New Zealand Norms			American Norms			t
	N	Mean	SD	N	Mean	SD	
7.00-7.11 years	57	10.48	6.36	57	13.75	5.10	3.03**
8.00-8.11 years	75	13.33	7.00	41	16.65	5.38	2.60*
9.00-9.11 years	95	15.88	6.59	41	19.06	5.50	2.72**
10.00-10.11 years	99	17.83	6.94	19	20.74	5.51	1.79
11.00-11.11 years	124	19.52	7.06	47	21.80	5.44	1.82
12.00-12.11 years	133	20.92	7.00	44	22.46	5.32	1.34
13.00-13.11 years	57	23.98	6.32	48	22.89	5.19	1.21
14.00-14.11 years	45	23.22	5.75	32	23.26	5.09	0.64
15.00-15.11 years	49	27.12	4.15	43	23.77	5.05	3.45***
16.00-16.11 years	39	23.94	6.45	42	24.58	5.11	0.64
17.00-17.11 years	47	25.00	5.71	42	25.88	5.31	0.75
18.00-18.11 years	15	24.34	4.24	88	25.11	4.69	0.60

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

children have been exposed to do not exert differential effects in terms of copying or recalling the Rey Complex Figure.

Since the data from this study were collected, different administration regimes of the recall part of the task including, a 3-minute immediate recall and a recognition recall format have become more frequently used. This study did not obtain norms for the immediate recall phase but typically there is little variation between performance on the immediate and delayed recall phases (Meyers and Meyers, 1995).

It is interesting that significant differences were found between the American normative data (Meyers and Meyers, 1995) and this New Zealand sample across many of the age-groups sampled for both the copy and recall phases. Therefore, it would be advisable to use the New Zealand normative data when administering the copy phase and the recall phase 20-30 minutes after the copy. Since the sample was collected, different administration regimes of the recall part of the task including, a 3-minute immediate recall and a recognition recall format have become more frequently used. New Zealand norms are not available for the immediate recall phase but typically there is little variation between performance on the immediate and delayed recall phases (Meyers and Meyers, 1995).

There are some limitations which are associated with the research. Socio-economic status was determined by choosing schools from areas that reflected local housing prices. The second measure that was to be used to determine socio-economic status was that of mothers and fathers occupations but this was unable to be used because of the children's lack of specificity about their parents' occupations. This study therefore relied solely on housing valuation for determination of SES which has some

problems associated with it. The first is that a minority of children may have been attending school outside of their area of residence and the second is that even though a family may be living in a certain SES area, this does not always mean that they belong to that SES category in terms of parental education and occupation.

The participants were evaluated in a group situation rather than individually and this may limit the validity of the norms. However, the participants were scrutinised carefully to ensure that they did conform, as much as possible, to the individual testing protocol. To obtain a large standardisation sample, group administration was the most efficient and practical way to obtain the data.

Anxiety can affect children's performance in psychological test situations (Sattler, 1988). Therefore, efforts were made by the researchers to reduce anxiety in the participants in the normal assessment procedure (e.g. encouraging children try their best, and emphasising that there are no right and wrong answers) at the beginning of the testing situation. Students appeared to enjoy their participation in the research and an offer of support was made available to them both verbally and on the written permission form. There were no students who requested this support following their participation. Only a small sample of eighteen-year-olds was obtained ($n=15$) and this is because pupils turn eighteen during the course of their final year at school (Year 13), often towards the end of the year. In this research, schools were sampled during the beginning and middle parts of the year when most Year 13 pupils were still seventeen years of age.

In conclusion, this study has produced comprehensive New Zealand norms for children and adolescents for the Copy and 20-minute Recall Phases of the Rey Complex Figure Test. The research has supported prior findings

that there are no overall gender or ethnic differences for either the copy or recall phase. The steady increase in scores across the age-groups for both the copy and recall phases suggests that the RCFT reflects the developmental changes which are occurring in visuospatial constructional abilities and the encoding and recall of complex visuospatial information.

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