ELSEVIER

Brain & Development 31 (2009) 52–57

BRAIN & DEVELOPMENT
Official Journal of the Japanese Society of Child Neurology

www.elsevier.com/locate/braindev

Original article

Predicting executive function task scores with the Rey-Osterrieth Complex Figure

Tatsuya Ogino [a,*], Kiyoko Watanabe [b], Kousuke Nakano [c], Yoko Kado [d], Teruko Morooka [b], Akihito Takeuchi [b], Makio Oka [b], Satoshi Sanada [e], Yoko Ohtuska [b]

[a] *Department of Children Studies, Faculty of Children Studies, Chugokugakuen University, Niwase 83, Okayama 701-0197, Japan*
[b] *Department of Child Neurology, Okayama University Graduate School of Medicine, Dentistry and Pharmaceutical Sciences, Okayama, Japan*
[c] *Department of Pediatrics, Matsuyama Red Cross Hospital, Matsuyama, Japan*
[d] *Department of Psychology, Faculty of Letters, Kansai University, Osaka, Japan*
[e] *Division of Special Education, Faculty of Education, Okayama University, Okayama, Japan*

Received 25 February 2008; received in revised form 15 July 2008; accepted 17 July 2008

Abstract

The Boston Qualitative Scoring System (BQSS) is one of the scoring methods of the Rey-Osterrieth Complex Figure Test (ROCF). With BQSS, 17 qualitative ratings are generated, and subsequently 6 summary scores are calculated by combining several qualitative scores. Previously we showed that 5 of 6 BQSS summary scores were correlated with the scores of the several executive function tests in children. The objective of this study was to develop a new summary score which correlates with the executive function test scores more strongly than the existing summary scores. For this purpose, we conducted multiple regression analysis to predict PEN, CA, DSM of the Wisconsin Card Sorting Test Keio Version, and the Mazes scores from WISC-III, by the BQSS qualitative scores derived from ROCF drawings in copy condition. The subjects were 78 children with various neuropsychological disorders (5 years 5 months-14 years 11 months; mean: 9 years 2 months; F 22, M 56). Significant predictive models were generated for PEN, CA, and Mazes scores. Among them the models for the Mazes scores were the most accurate. The second model for the Mazes scores was most suitable for a new summary score. Its degree-of-freedom-adjusted coefficient of multiple determination and multiple correlation coefficient reached 0.467 and 0.695, respectively. A new summary score should be applied in future studies to evaluate its clinical usefulness.

Keywords: The Rey-Osterrieth Complex Figure Test; Boston Qualitative Scoring System; Executive function; Children; Pervasive developmental disorders; Attention-deficit/hyperactivity disorder

1. Introduction

The Rey-Osterrieth Complex Figure Test (ROCF) has been widely used for the assessment of visuoconstructional ability and visual memory [1,2]. Because of the complexity of the figure, the ROCF has been said also to reflect executive functions such as organizational and planning abilities in addition to visual cognitive functions [3,4]. Though there are a variety of scoring methods for the ROCF, many of them are based on Taylor's 36-point system [5], and assess the presence and accuracy of each drawn element of ROCF. Such scoring methods, however, cannot evaluate qualitative features such as drawing steps.

The Boston Qualitative Scoring System (BQSS) for the ROCF [6,7] (Psychological Assessment Resources, Inc.) published in 1999 is one of the most recent scoring methods for ROCF which was developed to evaluate the qualitative

* Corresponding author. Tel.: +81 86 293 6860; fax: +81 86 293 3993.
E-mail address: tatsu@cjc.ac.jp (T. Ogino).

0387-7604/$ - see front matter © 2008 Elsevier B.V. All rights reserved.
doi:10.1016/j.braindev.2008.07.003

features of ROCF as well as presence and accuracy. It provides, first, a comprehensive set of 17 qualitative ratings based on the presence and accuracy of elements and the process of drawing, and second, 6 quantitative summary scores by combining the qualitative scores.

The BQSS was introduced predominantly for adults. However, the BQSS should also be useful for children because it enables us to evaluate ROCF multidimensionally, and its scoring criteria are very clear. In fact, Nakano et al. [8] found that 5 of 6 summary scores showed continuous development throughout childhood. In addition to this, some differences were noted in the age ranges during which each score showed the most rapid development. Furthermore, Watanabe et al. [9] showed that, among children with neuropsychiatric impairment, the BQSS summary scores significantly correlated with the scores of various executive function tasks such as the Wisconsin Card Sorting Test (WCST). Watanabe et al. also stated that among those examinations, the correlation between the summary scores and the scores of the Mazes task was strong. However, there was no summary score which showed specifically high correlation with the scores of executive function tasks. Unexpectedly, the partial correlation coefficients between the Organization score, which is considered to represent organization abilities by the authors of BQSS, and the scores of WCST or Mazes were smaller than those between other summary scores and the executive function task scores. The salient features of BQSS are that it provides abundant qualitative scales, and by using the qualitative scale scores we can calculate quantitative summary scores. Therefore, it might be possible to develop a new summary score with new properties by combining qualitative scores.

Here, we tried to predict the scores of executive function tests using BQSS qualitative scores with multiple regression analysis in order to develop a new summary score which correlates specifically with the scores of executive function tests. As executive function tests, we adopted WCST, which is considered to serve as a standard index of general executive functions [10], and the Mazes task, which showed the strongest correlation with BQSS summary scores in the study by Watanabe et al. [9]. Our aim was to clarify the correlations that exist innately between the test scores, not to uncover the characteristics of specific disorders. Therefore, we chose patients with various kinds and degrees of brain dysfunctions without mental retardation as the subjects in order to maximize the variance of variables.

2. Subjects and methods

2.1. Subjects

The subjects consisted of 78 individuals (22 girls and 56 boys) aged 5 years 5 months to 14 years 11 months (mean: 9 years 2 months), who were examined at the Department of Child Neurology, Okayama University Hospital between April 2002 and July 2005. All subjects were diagnosed as having various neuropsychological disorders: pervasive developmental disorders, 24 cases; attention-deficit/hyperactivity disorder, 27; epilepsy, 25 (including 2 with pervasive developmental disorders, 5 with attention-deficit/hyperactivity disorder); and other disorders, 9. Their full-scale IQs were 70 or higher (71–127; mean: 93.0) as evaluated by the Wechsler Intelligence Scale for Children Third Edition (WISC-III; Nihon Bunka Kagakusha Co. Ltd, Tokyo). Though all examinations were done for clinical purposes, we received written consent from all parents of the participants following a full explanation of the assessments and future publications. We presented small gifts to the subjects after the tests. Fifty-six of 78 subjects were the same as those of the previous study [9].

2.2. Procedure

Each subject underwent ROCF, several executive function tasks including WCST, and WISC-III. The details were described in the previous paper [9]. The WISC-III was administered on a different day from other tests.

The ROCF was administered strictly according to the BQSS manual [6]. Three examination conditions, copy, immediate recall and 20- to 30-min delayed recall were performed. The ROCF was drawn with six colored felt pens which were changed in a fixed order to enable the examiner to track the drawing sequence. The point rating was strictly based on the criteria described in the BQSS manual.

In the WCST, the subjects were instructed to classify each card by one of three attributes: color, shape and number. We used the Keio version (WCST-K) [11], which includes two sessions, each of which is composed of 48 trials. Mazes, one of the subtests of the WISC-III, was used as a Mazes task.

2.3. Data analysis

The BQSS divides the ROCF into three sets of elements, namely, configural elements, clusters, and details. These are hierarchically arranged in terms of structural importance. For each of the three ROCF conditions, 17 kinds of qualitative scores were calculated by evaluation of the presence, accuracy and placement of each element, the accuracy of the size and orientation, the neatness of drawing, and the drawing order and planning (Table 1). All these qualitative scores, except Asymmetry, are based on an ordinal scale of 0 (extremely poor) to 4 (excellent). We used 16 qualitative scores for the copy condition, with the exception of Asymmetry, as independent variables. The reason why we chose