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Brief report

Modified Wisconsin Card Sorting Test: proposal of a supplementary scoring method

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Abstract

To assess categorizing ability, we propose a new scoring criterion for the MCST, the "categorizing efficiency", taking into account the number of cards used by the subject to complete a maximum of six categories. The advantage of adding that parameter to traditional ones is evaluated in a small population of normal children and adults and those affected with pathologies.

Keywords: MCST; WCST; Executive functions

The Modified Card Sorting Test (MCST, Nelson, 1976), a simplification of the Wisconsin Card Sorting Test (WCST, Grant & Berg, 1948; Heaton, Chelune, Talley, Kay, & Curtiss, 1993), consists of two sets of only 24 cards. The MCST excludes the 40 cards of the WCST sharing more than one of the three attributes (color, shape and number) with each of the three stimulus cards. In the MCST, only six consecutive correct responses are required to complete a category, and not 10. Two other modifications are that the complete first sorting is always accepted as correct and once completing each category, the participant is told "now the rules have changed".

MCST scoring is mainly based on the number of categories completed and the number of errors, classified as "perseverative" and "non-perseverative".

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Other indices like "failure to maintain set", "percent of conceptual level responses" or "learning to learn" are sometimes employed, using criteria similar to those of the WCST, although the clinical significance of such parameters in the MCST remains invalidated.

The capability to categorize and avoid perseveration are of greater clinical significance, and on this basis the MCST has proved useful in studying frontal lobe lesions or dysfunctions in adults (for a review see de Zubicaray & Ashton, 1996).

In the MCST (as well as in the WCST) the "categories completed" and "non-perseverative errors" parameters are the principal indicators of categorizing ability, but the relative simplicity of the test makes it easy for a considerable number of subjects, even children, to obtain the top score of six categories. This may reduce the test's ability to diagnose mild dysfunction and differentiate grades of normal performance. Moreover, the results distribution in a normal population is strongly skewed, creating potential problems in statistical evaluation (see, for example, Obonsawin et al., 1999).

A supplementary scoring method is proposed. The current "categories completed" parameter does not reflect the number of cards used to achieve a goal of 6. Clearly, completing six categories using 36 cards is quite better from performing the same task using with 48 cards.

Therefore, we suggest scoring six points for each completed category and, for those who complete the six categories, awarding one supplementary point for each of the 48 cards that has been "spared", or not used. Therefore, a subject completing six categories using only 36 cards has 12 spare cards, and his score is $36 + 12 = 48$. At the other extreme, a subject using 48 cards has no spares and scores 36. This parameter, "categorizing efficiency", should more correctly and accurately measure categorizing ability.

1. Trial

The new scoring criterion was used with 100 normal children aged 9–13 years, 50 males and 50 females, and to 20 adults, 10 females and 10 males, aged 18–63. We compared results using the new criterion with those obtained using traditional "categories completed" and "non-perseverative errors". Mean scores ± S.D. of the three parameters at different ages are shown in Table 1. The new parameter is slightly more correlated with age (Pearson's r): categories completed $r = .203$, $P = .042$, non-perseverative errors $r = -.108$, $P = .286$, categorizing efficiency $r = .233$, $P = .020$.

Subsequently, we evaluated the distribution of scores for the same three parameters in a group of 50 ten-year-old normal children (25 males and 25 females, including the twenty 10-year-old males and females belonging to the population of 10-year-old children cited in the

Table 1

	Mean ± S.D. (M = 10, F = 10)					
	9 years	10 years	11 years	12 years	13 years	Adults
Categories completed	4.6 ± 1.3	4.7 ± 1.3	4.9 ± 1.4	5.1 ± 1.1	5.2 ± 0.7	5.4 ± 0.7
Non-perseverative errors	8.5 ± 5.1	9.9 ± 5.6	8.2 ± 5.1	7.7 ± 6.3	7.6 ± 4.3	4.7 ± 2.6
Categorizing efficiency	28.6 ± 9.1	29.1 ± 9.3	31.9 ± 10.9	33.6 ± 9.2	34.1 ± 7.5	34.4 ± 6.7

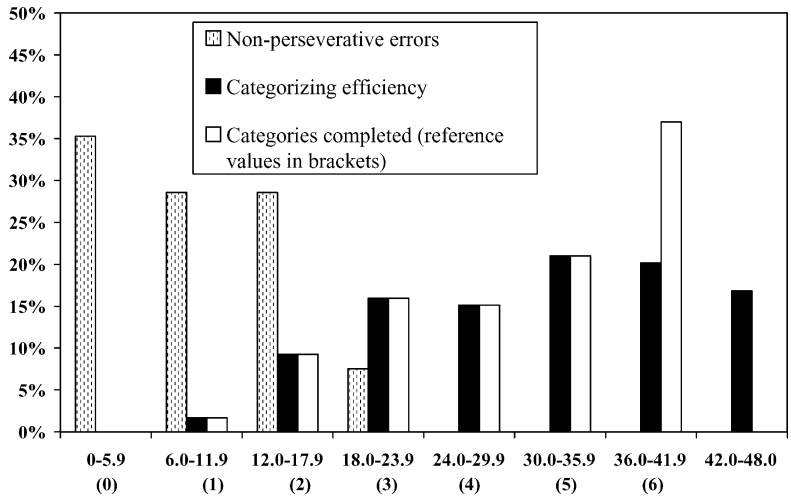

Fig. 1. Distribution of scores (percent values) obtained using the different parameters. In abscissæ, 0–5.9 to 42.0–48.0 refer to "categorizing efficiency" values, (0)–(6) to "categories completed". Percent values of "non-perseverative errors" refer to subjects having the values of "categories efficiency" and "categories completed" indicated in abscissæ.

preceding paragraph and reported in Table 1). Results are shown in Figure 1. Score distribution for "categories completed" and for "non-perseverative errors" is strikingly asymmetrical, while that of "categorizing efficiency" approach normal distribution.

Finally, we compared 16 normal and 16 pathological subjects who completed six categories, therefore not distinguishable on the basis of the "categories completed" parameter. Of the 16 normal subjects, 12 were 10–13 years old and four ranged in age from 35 to 57 years. Children with known neurologic pathology were matched by age within ± 1 year with normals, while adults were matched to ± 5 years. Four had high functioning pervasive developmental disorder, five had attention deficit hyperactive disorder, and seven had concussive head trauma. On the "categorizing efficiency" parameter, the 16 normal subjects scored a mean 40.3 ± 3.2 versus 38.2 ± 1.8 for the 16 pathological ones, a significant difference ($t = 2.28$, $P < .05$). On the "non-perseverative errors" parameter, normal subjects scored 4.0 ± 2.3 versus 5.9 ± 3.1 for the pathological group ($t = 1.97$, P n.s.). The standard errors for "categorizing efficiency" were much smaller relative those observed for "non-perseverative errors".

2. Discussion

Rewarding spare (unused) cards to compute "categorizing efficiency" adds a potential 12 extra points and more range to detect differences in functioning.

As compared with the "categories completed" parameter, this is confirmed by better correlation between results and subject age and by the possibly superior differentiation among persons who reach all six categories. "Categorizing efficiency" also appears more promising as a measure than "non-perseverative errors", owing to the relatively tighter distribution of scores.

We believe our proposed parameters enhance the diagnostic potential of the MCST, and suggest that WCST might also benefit from similar modification of scoring criteria.

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