TEST-RETEST RELIABILITY OF THREE DYNAVISION TASKS

PETER KLAVORA, PETER GASKOVSKI, AND RICHARD D. FORSYTH

School of Physical and Health Education
University of Toronto

Summary.—The test-retest reliability of three Dynavision tasks of graded difficulty was estimated as high, with intraclass R correlation coefficients ranging from .88 to .97, and paired correlation coefficients ranging from .74 to .92. Recommendations are made for reliable testing procedures.

A preliminary study of reliability of the Dynavision apparatus had only moderate test-retest reliability (Klavora, Gaskovski, & Forsyth, 1994). The present study was designed to assess whether higher reliabilities could be obtained with a greater number of retests than in the previous study using similar Dynavision tasks.

The Dynavision apparatus, designed to measure and train a number of perceptual and psychomotor abilities, measures approximately 165 cm by 120 cm by 20 cm, in length, width, and depth, respectively. It weighs 130 kg and must be wall-mounted. The training surface houses 64 small square buttons, each button being illuminated by a small lightbulb, arranged in a pattern of five rings. A successful hit is acknowledged by a beep signal. The total number of hits is recorded by the apparatus. A computerized display panel and a printer are built into the side of the apparatus and provide immediate feedback to the subject. A light-emitting diode (LED) display is positioned just above the centre of the training surface. It can project up to seven computer-selected random numbers every five seconds for brief, pre-selected exposure periods, i.e., from 0.01 to 1.0 sec. The board is easily adjustable to accommodate users of different heights. For most efficient use of the board, a darkened environment is preferred.

The main performance variable on the Dynavision apparatus is the number of hits a subject can achieve under various conditions, easy or demanding, within the specified unit of time. In self-paced tasks the target button remains illuminated until struck. Then it moves to another random location on the board. In the more challenging apparatus-paced tasks, a target button that is not struck within a preset time period, e.g., 1 sec., extinguishes automatically, and a new target immediately appears elsewhere on the board. The most challenging tasks combine the striking of buttons with-
in the apparatus-paced tasks and the calling out of digits displayed on the LED panel.

**Method**

The subjects were a group of 102 university students (51 men and 51 women) whose ages ranged between 19.8 and 26.0 yr. and with an average of 21.1±1.0 yr. Subjects were randomly assigned to one of three groups and performed different Dynavision tasks. The tasks were 60 sec. in duration, and the dependent variable was the number of 'hits,' i.e., buttons struck, with a greater number of hits representing faster performance. The three tasks were graded in difficulty.

On the self-paced Simple Task, subjects using their hands struck as many illuminated buttons as possible, which remained illuminated until struck. Thirty-seven subjects started the 8-wk. testing protocol, but only 34 (16 men and 18 women) had complete data.

In the apparatus-paced Moderate Task, subjects struck as many buttons as possible, which automatically extinguished after a 1-sec. interval regardless of whether it was hit. Simultaneously, subjects called out 4-digit series which appeared on the LED screen for a duration of 1 sec. every 5 sec. Thirty-four subjects initially participated, but only 29 (16 men and 13 women) had complete serial data.

The Complex Task was identical to the Moderate Task, except that illuminated buttons extinguished after only 0.5 sec. Thirty-one subjects started the testing trials, but only 17 (8 men and 9 women) showed complete data.

Subjects were tested over five occasions (Trials 1 to 5). To reduce the carry-over effect of learning skills from trial to trial, the subjects were tested at 2-wk. intervals (Neter, 1990). Each test involved a 30-sec. practice trial followed by a 60-sec. test trial. To reduce familiarization effects (which may be initially high on the Dynavision; see Klavora, et al., 1994), a special procedure was followed at Trial 1. Subjects performed a series of 30-sec. practice trials until the number of hits in the most recent trial was less than, equal to, or no more than one hit greater than the number of hits in the preceding trial. Once this criterion was met, the 60-sec. test trial was administered. Only one-third of the subjects required more than three practice trials on Trial 1, and only 14 subjects required more than four.

The subject-by-trial repeated-measures analysis of variance was a randomized block design. Analysis was conducted only on complete data. The intraclass reliability coefficient (R) (Baumgartner, 1989) was calculated with the first trial (T1) deleted, since the significant trials factor could violate the assumption of independence among trials.

**Results**

Table 1 provides a summary of mean results: hits for five trials. For the
Simple Task, a repeated-measures analysis of variance showed that the mean number of hits across trials was significantly different \( (F_{43} = 9.27, p < .0001) \), and a Duncan multiple-range test (Cody & Smith, 1991) showed all significant differences occurring between Trials 1 and 2. The intraclass reliability \( (R) \) coefficient for Trials 1 vs 5 was .88, with a Pearson correlation coefficient between Trials 3 and 4 at .79 and between Trials 4 and 5 at .81.

### TABLE 1

<table>
<thead>
<tr>
<th>Task</th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Trial 3</th>
<th>Trial 4</th>
<th>Trial 5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M  SD</td>
<td>M  SD</td>
<td>M  SD</td>
<td>M  SD</td>
<td>M  SD</td>
</tr>
<tr>
<td>Simple</td>
<td>67.0 12.6</td>
<td>73.7 9.2</td>
<td>76.2 10.9</td>
<td>79.1 12.6</td>
<td>79.3 13.0</td>
</tr>
<tr>
<td>Moderate</td>
<td>47.4 15.5</td>
<td>51.7 13.2</td>
<td>53.8 15.0</td>
<td>54.6 13.9</td>
<td>55.8 15.7</td>
</tr>
<tr>
<td>Complex</td>
<td>21.4 19.5</td>
<td>33.6 19.9</td>
<td>31.0 22.0</td>
<td>34.7 22.0</td>
<td>37.8 21.8</td>
</tr>
</tbody>
</table>

For the Moderate Task, a repeated-measures analysis of variance showed that the mean number of hits across trials was significantly different \( (F_{428} = 3.11, p < .01) \), and a Duncan multiple-range test showed significant differences occurring between Trials 1 and 2 only, with no differences occurring between Trials 2 and 5. The intraclass R coefficient for the final four tests was .92, with the Pearson correlation between Trials 3 and 4 at .74 and between Trials 4 and 5 at .79.

For the Complex Task, a repeated-measures analysis of variance showed that the mean number of hits across trials was significantly different \( (F_{4,16} = 16.69, p < .0001) \), and a Duncan multiple-range test showed significant differences occurring between Trials 1 and 2 but none between Trials 2 and 5. The intraclass R for the final four tests was .97. The Pearson correlation between Trials 3 and 4 was .92 and between Trials 4 and 5 was .90.

**Discussion**

The reliability of the Simple, Moderate, and Complex Tasks was shown to be extremely high at .88, .92, and .97, respectively. These values are much higher than those in a previous study by Klavora, et al. (1994) in which reliability estimates for two similar Dynavision tasks were .71 and .73. The improved reliabilities of the present study are likely the result of the increased number of test-retests and the familiarization procedure used at Trial 1. As in the previous study, relatively higher score variability was observed on the more difficult tasks.

To eliminate learning effects, it is recommended, based on the present findings, that prior to the implementation of formal Dynavision testing in research or clinical settings, subjects participate in at least one familiarization session on the apparatus. Thus the first practice session (Trial 1) should con-
sist of a minimum of three and a maximum of five 30-sec. trials (on the
relevant task) prior to testing. A record of scores during the familiarization
period should indicate when a performance plateau has been attained and
when actual testing (60-sec. trial) may begin. The components of familiariza-
tion should include instructions about the stance, optimal distance from the
board, importance of focusing the eyes on the LED panel, i.e., centre of the
board, and using peripheral vision, trying various striking techniques, and
adjusting to a darkened environment, etc. See Klavora, et al. (1994) for more
details on the general performance components of familiarization.

Subsequent sessions should consist of at least one 30-sec. warm-up run.
The present findings suggest that by following the suggested protocol, one
test score (Trial 2) may be sufficient to establish the baseline data against
which subsequent performance changes are compared. However, for better
reliability, the initial baseline score should be based upon the average of two
testings (Trials 2 and 3). Ultimately, the test protocol must accommodate
subjects of different performance levels and their availability, but subjects
should not be given too many familiarization sessions, which may generate a
training effect.

Further research with the apparatus should produce a procedure that
may yield a high test-retest reliability but within a minimum number of re-
tests to facilitate a rapid and efficient testing of subjects in research with the
Dynavision.

REFERENCES

Wood (Eds.), Measurement concepts in physical education and exercise science. Champaign,

York: Elsevier Science.


NETER, J (1990) Applied linear statistical models: regression, analysis of variance, and experi-
mental design. (3rd ed.) Homewood, IL: Irwin.

Accepted March 27, 1995.
This article has been cited by:


3. Joseph M. Pellerito. Assessments in Driver Rehabilitation 679-720. [CrossRef]

4. TIMOTHY N. WELSH, PETER KLAVORA. 2003. RESPONSE TO VISUAL STIMULI BY ADULTS WITH DEVELOPMENTAL DISABILITIES. *Perceptual and Motor Skills* 96:3, 867-874. [Citation] [PDF] [PDF Plus]


6. PETER KLAVORA, MARY WARREN. 1998. REHABILITATION OF VISUOMOTOR SKILLS IN POSTSTROKE PATIENTS USING THE DYNAVISION APPARATUS. *Perceptual and Motor Skills* 86:1, 23-30. [Citation] [PDF] [PDF Plus]