Reliability and Validity of the RTBoardReview Item Pool
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Focus of Study
This study assessed the reliability and validity of the RTBoardReview item pool, via analysis of test-taker performance on an exam (the 'RTBR140') consisting of 140 questions randomly drawn from our item pool and distributed in the same numbers and same 17 topics specified in the NBRC detailed content outline.

Summary of Findings
- Exams generated from the RTBR item pool have high test-retest reliability
- Students’ average scores on the RTBR140 are strongly associated with their subsequent performance on the Secure NBRC Self-Assessment Exam (SAE)
- Knowledge of students’ RTBR140 average scores predicts who will pass/fail the SAE in 4 out 5 cases
- Existing data justify a cut score of 70% or higher on the RTBR140 average as equivalent to achieving a passing score of 70% on the SAE.
- A high RTBR140 score of \( \geq 80\% \) is an alternative though less precise equivalent to passing the SAE
- Students’ averages on the RTBoardReview quizzes (corresponding to the 17 NBRC content categories) exhibits only a weak association with SAE scores and should not be used to predict SAE success.

Test-Retest Reliability
The sample for test-retest reliability included all registrants on the RTBoardReview over a 100 day period selected at random who attempted a timed version the RTBR140 exam at least twice within 72 hours. Where more than 1 pair of scores existed that met these conditions, a single pair was selected at random, with the final \( N = 60 \). A Pearson product moment correlation between score pairs was computed, with \( r = .904 \) (\( t = 16.1, df = 58, p < .001; 95\%CI = .844, .942 \)), indicating a high degree of test-retest reliability, comparable to that published for commercial standardized exams.

Validity
For validity assessment, an initial sample of 95 students was identified who completed an institutional RTBoardReview comprehensive review course and for whom complete quiz, RTBR140, and SAE data were available (SAE data shared by the participating programs). After review of these 95 cases, 13 were judged invalid. Eight of these cases were deleted from subsequent analysis because none of their RTBR140 attempts were completed in less than one day (suggesting ‘open-book’ efforts). An additional five cases were eliminated because they represented far outliers in regression, having standardized residuals greater than 3.0. Typically these few cases had very high RTBR140 score averages and very low SAE scores, calling to question the validity of their unproctored RTBR140 results.

Standard Pearson product-moment bivariate correlation analysis was applied to the remaining 82 cases, assessing the strength of association of the quiz average, the RTBR140 average and the RTBR140 high score with the SAE scores. Results of this analysis are presented in Table 1.
As indicated in Table 1, all RTBR140 measures were significantly associated with SAE scores, with the RTBR140 average score being a strong predictor of SAE performance, explaining over half of the variance in this measure ($r^2 = .533$). In comparison, the RTBR140 high score exhibited only a moderate relationship with SAE performance, while the association between review course quiz averages and SAE performance was judged to be weak.

As indicated in the following scatter plot (Figure 1), the relationship between RTBR140 average scores and SAE exam performance is positive and linear, with a relatively narrow confidence interval for prediction of the mean SAE for a given RTBR140 score.

<table>
<thead>
<tr>
<th></th>
<th>RTBR140 Avg</th>
<th>RTBR140 High</th>
<th>NBRC SAE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quiz Avg</td>
<td>.472**</td>
<td>.538**</td>
<td>.285**</td>
</tr>
<tr>
<td>RTBR140 Avg</td>
<td>-</td>
<td>.743**</td>
<td>.730**</td>
</tr>
<tr>
<td>RTBR140 High</td>
<td>-</td>
<td>-</td>
<td>.482**</td>
</tr>
</tbody>
</table>

** p < .01

Figure 1. Scatter plot of RTBR140 average scores (raw) versus SAE %scores (N = 82). Red line is the least square regression line. Black lines surrounding the regression line are the 95% confidence intervals for predicting the mean SAE score based on a given RTBR140 average score.
Given its relative significance and the clear linear relationship it shared with the SAE scores, the RTBR140 average score was regressed onto the SAE score in order to derive a prediction equation. The resulting equation:

\[
\text{SAE score (%) = -.067 + (.008 * RTBR140 raw score average)}
\]

was highly significant (F = 91.13, df = 1, 80, p < .001), but with a relatively large standard error (.067) associated with predicting individual SAE scores. *Application of this formula indicated that a RTBR140 average of at least 96/140 or 68.5% would be needed to assure an SAE score of 70% (.70) or higher.* Given the relatively high standard error associated with predicting individual SAE scores, it is recommended that a RTBR140 average of at least 70% be considered equivalent to achieving a passing score of 70% on the SAE.

To further assess the RTBR140 average as a predictor of SAE performance, a standard discriminant analysis was performed, with the RTBR140 average serving as the independent variable and SAE pass/fail as the dichotomous outcome measure (pass = 70% or higher). The resulting canonical correlation of .629 was highly significant (Wilks’ Lambda = 0.604; Chi-Square = 40.05, p < .001). Table 2 provides the classification results for this analysis, *indicating that foreknowledge of the RTBR140 average score provides an overall accuracy of 79.3% in predicting whether a student will pass or fail the SAE.*

Table 2
Discriminant Function Analysis
Actual vs. Predicted SAE Results using RTBR140 Average as Predictor

<table>
<thead>
<tr>
<th></th>
<th>Predicted</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fail</td>
<td>Pass</td>
</tr>
<tr>
<td>Fail</td>
<td>32 (76.2%)</td>
<td>10 (23.8%)</td>
</tr>
<tr>
<td>Pass</td>
<td>7 (17.5%)</td>
<td>33 (82.5%)</td>
</tr>
<tr>
<td>Total</td>
<td>39 (47.6%)</td>
<td>43 (52.4%)</td>
</tr>
</tbody>
</table>

Based on this analysis, about 1 in 5 (18%) of the 39 students whose RTBR140 averages predicted that they should fail went on to pass the SAE (false positive). On the other hand, about 1 in 4 (23.8%) of the 43 students whose RTBR140 averages predicted that they should pass went on to fail the SAE (false negative). Overall foreknowledge of the RTBR140 average is slightly better at predicting those who pass (positive predictive value = 83%) than those who fail (negative predictive value = 76%).

To provide decision-makers with alternatives in using the RTBR140 instead of the SAE, a similar analysis to that conducted on the RTBR140 average was performed using the RTBR140 *high scores* as the predictor of SAE performance. As indicated previously, students’ RTBR140 high scores exhibited a moderate positive association with SAE scores (r = .482, p < .01). Regression of the RTBR140 high scores onto the SAE score yielded the following prediction equation:

\[
\text{SAE score (%) = -.073 + (.007 * RTBR140 raw high score)}
\]
Which was highly significant ($F = 24.19, df = 1, 80, p < .001$), but with a larger standard error (.086) than that observed using the RTBR140 average as the predictor. **Application of this formula indicated that a RTBR140 high score of at least 110/140 or 78.9% would be needed to assure an SAE score of 70% (.70) or higher.** Given the high standard error associated with this formula, it is recommended that if used, a RTBR140 high score of at least 80% be used as equivalent to achieving a pass score of 70% on the SAE.

Discriminant analysis with the RTBR140 high score as the dependent variable and SAE pass/fail as the outcome measure (pass = 70% or higher) yielded a canonical correlation of .444, which was highly significant ($\text{Wilks' Lambda} = 0.803; \text{Chi-Square} = 17.19, p < .001$). **Foreknowledge of the RTBR140 high score provides an overall accuracy of 70.4% in predicting whether a student will pass or fail the SAE.**

**Recommendations**

Because the validity portion of this study involved only unproctored RTBR140 results obtained without time limit and with the high score as the threshold/cut score, care must be taken in applying these results. Even so, NBRC-like exams generated from the RTBoardReview item pool exhibit excellent test-retest reliability and are very good predictors of NBRC SAE exam performance. Therefore, in order to maximize both the reliability and validity of the RTBoardReview RTBR140 in RT program settings, we recommend that (1) test administration be time-limited and proctored (to minimize any ‘open-book’ effects), and (2) use of the exam for threshold decision-making (e.g., passing a course, graduating, etc.) be based on students’ average score on the RTBR140, not their high score.