Journal of Educational Statistics
Summer 1984, Volume 9, Number 2, pp. 93–128

IN ITEM BIAS RESEARCH

LORRIE SHEPARD
University of Colorado

GREGORY CAMILLI
Human Systems Institute

and

DAVID M. WILLIAMS
University of Colorado

and (c) construct or content validity studies of the internal structure of the test. The present research is focused on test item-bias methods, which are subwill produce invalid indices of bias in the presence of group mean differences actually easier for blacks to answer. If biased test questions were not obvious to expert judges, then perhaps statistical detection procedures could uncover more subtle changes in the meaning of items for different groups.

[redacted]

[redacted]

Merz & Grossen, 1979; Rudner, Getson, & Knight, 1980b). Because the

[redacted]

without replacement, so the samples were independent.)

Comparison 3: $W1$, $W2$ white samples from comparison 1 and compariis defined by three parameters: (a) the *a* parameter is proportional to the slope of the curve at the inflection point and represents the item's discrimination; (b) the *b* parameter reflects the item's difficulty and is a location on the θ ability dimension (when there is no guessing, *b* is the point where the probability of getting the item correct is 50%); and (c) the *c* parameter is often

Scale Equating

intervals on the θ scale and using the midpoint of each interval. Thus, probability differences in the region where the most data occur will contribute more to the index.

$$\mathrm{SOS1}_i = \frac{1}{n_W + n_B} \sum_{j=1}^{n_W + n_B} \{\hat{P}_{iW}(\theta_j) - \hat{P}_{iB}(\theta_j)\}^2.$$

The j subscript counts all instances of θ for either group ($n_W + n_B$). When θ_j is [illegible]

Signed area (SA). When the ICCs for two groups did not cross in the region from −3 to +3, the SA was equal to the UA except that a negative sign was attached if the item was biased against whites, if whites had a lower probability of getting the item right given θ. If the ICCs did cross, θ* was found as the root [redacted] and θ* to +3. The signed area was the difference between these two areas and carried the sign of the larger area.

[redacted]

analogous to SOS1. By multiplying $[\hat{P}_{iW}(\theta) - \hat{P}_{iB}(\theta)]$ times its absolute value, [redacted]

[redacted]

value greater than one was retained for rotation. An oblique solution was obtained by direct oblimin transformation with $\Delta = 0$ (Harman, 1967).

In the math test, the first unrotated factor accounted for 30% of the total

33
.54
.13
.50
.86
.16
.55
.09
.10
.11
.98
.59
.67
.69
.16
.91
.65
.31
.59
.04
.03
.27
.44
.60
.65
.20
.08
.29
.91
.21
.88*

Figure 1. [illegible] item characteristic curves for blacks and whites on several

weighted in regions where more examinees are concentrated. In Figure 2a both the signed area and SOS4 index are large; whites have a considerable advantage over blacks for θ's above -1. In Figure 2b, th

The non-zero values of each index in comparison 3 indicate the ranges in

FIGURE 3. Comparison of white and black item-characteristic curves for item 17 on

the math test for study 1 and study 2. (Example of an item found to be biased in estimated for more than one third of the items when $B1$ was rerun with pooled [redacted] will be explored. Here, we wish to discuss some methodological issues regarding the functioning of the bias statistics. Results are presented for both tests to check on the generalizability of study findings.

To examine the relationships between indices, within-study correlations were obtained for each comparison on each test. Tables II and III contain the within-comparison coefficients for the math and vocabulary tests, respec-

TABLE II

Intercorrelation[a] of Bias Indices Within Comparison on the Math Test (repeated for five comparisons)

functioning of the items due to cultural background. Only in the first row are
the correlations between two randomly equivalent ethnic comparisons. Here

at least one or both of the comparisons were between equivalent groups (either both white or both black). These correlations should show discriminant validity or the lack of method-specific correlations. These correlations should be near zero, confirming a lack of bias when none exists conceptually. However, it should be noted that these pairs of comparisons do share some consistent errors because one sample is repeated in both comparisons. For example, we expect the correlation between indices obtained in the $W1$, $B1$ study and those from the $B1$, $B2$ study to correlate zero. Bias can be present in the first

TABLE IV

Correlations[a] of Each Bias Index with Itself Across Study Comparisons

Column A	Column B
1. Number of centimeters between [illegible]	Number of centimeters between [illegible]

In practical terms we wished to quantify the effect of having biased items in the test. Therefore, we rescored the math test, deleting the seven items found to be consistently biased against blacks. We compared the new black and

B: W4, W5	
Signed	
SA	SOS4
-.05	-.15
.01	1.53
-.13	-.06
.02	-1.02
.13	2.48
.02	.21
.14	-6.74*
-.04	.73
.02	.07
.03	-.12
.00	19.28*

should be no bias. The largest values obtained in the white-white comparison were used as baselines for interpreting the size of indices in the between-ethnic comparisons. Because two items in the white-white analysis stood out as different from the typical range of values, the indices from the second-most discrepant item were used to establish the cutoffs.

The methodological results from the vocabulary test were discussed earlier

The validity and sensitivity of the IRT bias indices were supported by several findings:

1. A relatively large number of items (10 of 29) on the math test was found to be consistently biased; the results were replicated in parallel analyses. (Seven were biased against blacks, three were biased against whites.)

2. The bias indices were substantially smaller in white-white analyses. That is, with the exception of one or two estimation artifacts, indices did not find bias in situations of no bias.

Acknowledgments

We wish to thank the Council on Research and Creative Work and Dean Richard [redacted]

Ironson, G. H., & Subkoviak, M. (1979). A comparison of several methods of assessdetecting test-item bias with both internal and external ability criteria. *Journal of Educational Statistics, 6,* 317–375.

Wood, R. L., & Lord, F. M. (1976). *A User's Guide to LOGIST.* Research Memorandum. Princeton, NJ: Educational Testing Service.

Wood, R. L., Wingersky, M. S., & Lord, F. M. (1976). *LOGIST: A Computer Program for Estimating Examinee Ability and Item Characteristic Curve Parameters.* Research Memorandum. Princeton, NJ: Educational Testing Service.