UnderStandingAmericaStudy

UAS83 - SCORING EXPLANATION

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SCORING EXPLANATION

The cognitive measures (number series, picture vocabulary, verbal analogies) were taken from the Woodcock–Johnson Tests of Cognitive Abilities® (Mather and Jaffe, 2016). The tests were designed to measure the respondent's quantitative reasoning (number series) and lexical knowledge (picture vocabulary, verbal analogies). Each measure consists of 15 items in 2 parallel forms (Forms A and B). All items are scored dichotomously as correctly solved or as incorrect.

Cognitive test scores for UAS panel respondents are derived using a two-parameter logistic Item Response Theory (IRT) model. In this IRT model, the probability of correctly solving a test item is viewed as a function of a test taker's ability level and the difficulty and discrimination parameters of the test item. The difficulty parameter measures the ability level at which there is a 50% chance of answering the item correctly, whereas the discrimination parameter measures how sensitive this probability is to differences in the ability level. The two-parameter logistic model allows both the difficulty and discrimination parameters to differ across test items.

IRT scoring requires sufficient unidimensionality of the test items, which was evaluated with confirmatory factor analysis for binary outcome variables. Common criteria for adequate model fit include a root mean squared error of approximation (RMSEA) less than .06, Tucker-Lewis index (TLI) greater than .90, and comparative fit index (CFI) greater than .90. Support for unidimensionality was evaluated for form A of each test. A one factor model provided a good fit to the data for the number series and verbal analogies tests [number series: RMSEA = .041 (90% CI = .038/.044), TLI = .90, CFI = .91; verbal analogies: RMSEA = .022 (90% CI = .018/.026), TLI = .98, CFI = .98]. Adequacy of model fit was somewhat less consistent for the picture vocabulary test [RMSEA = .042 (90% CI = .039/.046), TLI = .80, CFI = .83], but was considered sufficient to support unidimensionality.

SCALE SCORE CONSTRUCTION FOR THE NUMBER SERIES TEST

Whereas the number series test items in UAS42 consisted of 15 items from Form A, the UAS83 administered 15 items from the alternate Form B (together with 4 selected items from Form A). This was done to mitigate practice effects for repeated test-takers. A critical issue when using multiple test forms over time is that how to calibrate the data onto a common scale so that they can be directly compared (e.g., in longitudinal analyses). To ensure that the number series test scores in UAS83 were calibrated on the same matric as those in UAS42, IRT linking methods were used. Specifically, when calibrating the number series test in UAS83, the item parameters of the 4 Form A items (which were used in both UAS42 and UAS83) were prefixed at the values determined in the UAS42 calibration sample. Item parameters of the 15 Form B items (as well as the mean and variance of the latent cognitive proficiency scores) were freely estimated in the UAS83 calibration sample. Such development of a common scale is theoretically justified by the invariance property of IRT modeling (Lord, 1980).

Item difficulty and discrimination parameters were calibrated based on weighted samples of 2,512 UAS respondents, with weights ensuring that the demographic variables race, sex, age, education, and household income in the survey sample match their population counterparts. The estimated item parameters are shown in Table 1. Because weights are unavailable for the LA County subsample, these were not included in the estimation. However, we compute scores for all respondents, regardless of whether they have a weight or not, provided that they answer at least one item.

The final IRT-based scaled scores are converted into T-scores, where 50 is the mean and 10 is the SD of a census-weighted sample of the general United States population. The T-score metric has widespread use in psychological testing and has been adapted, for example, by the Patient-Reported Outcomes Measurement Information System (PROMIS®, Cella et al., 2010). A score of 50 means that the person's cognitive ability is equal to that of the average person in the general population, a score of 60 means that the person's ability is one standard deviation above average, and a score of 40 means that the person's ability is one standard deviation below average.

Table 1: Item parameters of the number series test administered in UAS83 (N=2,512)

Item	Difficulty	Discrimination
nsa_21 [a]	-3.043672	2.594486
nsa_32 [a]	-1.168207	2.061662
nsa_43 [a]	0.5897162	2.468995
nsa_51 [a]	-0.0437221	3.395932
nsb_11	-3.80961	1.113636
nsb_12	-3.30536	1.959747
nsb_13	-2.1328	3.98412
nsb_21	-2.00648	3.788812
nsb_22	-1.64985	1.289345
nsb_23	-0.44817	2.373981
nsb_31	-2.3103	1.847341
nsb_32	-0.91124	1.920602
nsb_33	-0.95845	1.501001
nsb_41	0.421948	1.871299
nsb_42	-0.5944	2.341275
nsb_43	-0.16168	1.06517
nsb_51	-0.42455	1.691714
nsb_52	0.079218	2.871821
nsb_53	0.560526	2.303612

Note: a difficulty and discrimination parameters for these test items were prefixed at the values determined in the UAS42 calibration sample.

REFERENCES

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