

Note: this document may not describe the most recent version of this cognitive test available from TestMyBrain. TestMyBrain cognitive test documentation will be updated over the next several months to align with current test versions.

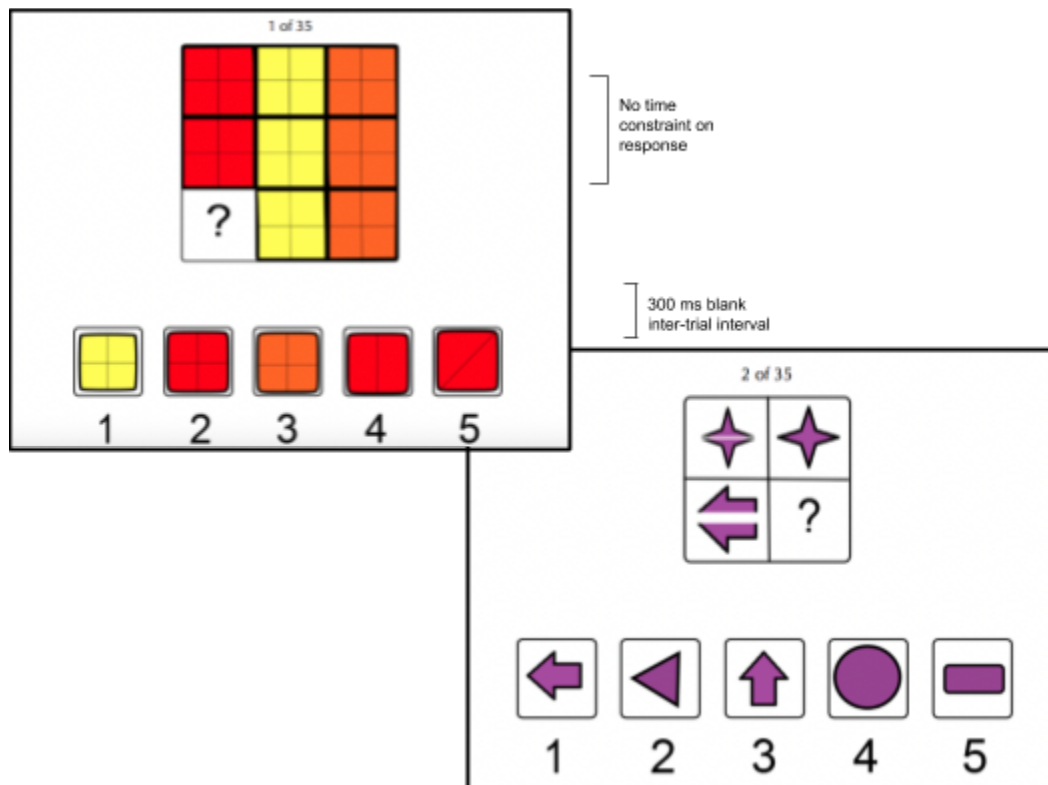
TMB Matrix Reasoning

Constructs Measured: Cognition, attention, perception, cognitive control, working memory; Also general cognitive ability, general intelligence, fluid intelligence, and nonverbal reasoning.

Duration: 8.5 minutes

Sample size for which normative data are available: 20,510

Description of procedure: Identify the image or pattern that completes an incomplete matrix of patterns, based on a logical rule.



This test is based on a well-validated and widely used matrix reasoning format, similar to tests that have been used in clinical neuropsychology for decades. Advantages of the task are that it is can be administered easily on a mobile device, is considered enjoyable by participants (despite its length), can be used to measure general cognitive ability, and performance can be interpreted with respect to a large body of existing literature. Drawbacks are specific to a field test setting and include a benefit of poor performance (task is shorter when performance is poorer due to stopping rule).

Psychometric Characteristics

Here we focus on accuracy (number correct or proportion correct) as the primary outcome measure or score. There are other reaction time-based measures that could be derived from this test (e.g. mean response time), but since this is not a speeded test the interpretation of these measures would not be clear.

The TMB Matrix Reasoning Test has similar reliability to the original WASI II Matrix Reasoning test (Cronbach's $\alpha = 0.77$; Spearman-Brown corrected split-half reliability, computed as in the WASI II manual, which counts all trials after its three-consecutive-incorrect stopping rule as incorrect, is 0.89).

Sociodemographic effects were estimated based on a sample of 3271 participants. The distribution of scores is relatively normal, with some ceiling effects (see Figure 1). Performance is variable across the lifespan, with steep developmental improvements and modest age-related decline (see Figure 2). Based on age corrected scores, there is a small gender difference that favors males (gender differences calculated on age range 18-25) (see Figure 3) and an effect of education where participants with higher educational attainment also show superior performance (see Figure 4). Practice effects on this test would be considerable without the establishment of alternate forms, as once a participant figures out the rule the puzzles are easy to solve. Alternate forms would protect against such effects.

Validation

Measures of matrix reasoning are among the best indices of fluid intelligence and also of general intelligence more broadly (Carroll, 1997). The TMB Matrix Reasoning test was modeled after the well-validated Matrix Reasoning test used in the Wechsler Abbreviated Scale of Intelligence II (Wechsler & Hsiaopin, 2011). Matrix Reasoning tests have been used for many decades as a measure of general cognitive ability and as a “hold” test or test of “premorbid iq”, since performance is relatively insensitive to variations in health in the short-term, psychological state, or many forms of brain damage (Lezak et al., 2012). For this reason, Matrix Reasoning tests provide a good control or baseline measure where measures that load on verbal ability (e.g. Vocabulary) are less desirable.

The TMB Matrix Reasoning test correlates robustly with SAT math ($\rho=0.41$, $n=1345$, 95% CIs [.37, .45]); this correlation is comparable to prior reports of correlations between well-validated matrix reasoning tests and SAT math (Rohde & Thompson, 2007). As expected (Rohde & Thompson, 2007), Matrices correlates to a lesser degree, but still robustly, with SAT verbal ($\rho=0.22$, $n=1358$, 95% CIs [0.17, 0.27]) and Vocabulary ($\rho=0.31$, $n=10,000$, 95% CIs [0.29, 0.33]).

Controlling for participant age, the TMB Matrix Reasoning test performance correlates modestly with performance on both easy and hard versions of the TMB Vocabulary test (30 item easy: $\rho = 0.29$, $n = 1686$, 95% CIs [0.25, 0.33]; 20 item hard: $\rho = 0.35$, $n = 1511$, 95% CIs [0.31, 0.39]) and well as the TMB Digit Symbol Matching test (processing speed) ($\rho = 0.38$, $n = 1210$, 95% CIs [0.33, 0.43]).

Appropriateness for Field Test Use

Overall, the TMB Matrix Reasoning test is an interesting and engaging test for participants with minimal technical barriers. Practice items and increasing difficulty from the beginning to the end of the test ensure that participants know what they are supposed to do and there are minimal barriers to completion.

Device Effects. The TMB Matrix Reasoning test is relatively easy to administer across a range of devices. With some items, there may be a concern that stimuli are too complicated to perceive accurately on smaller screens, but the data do not clearly reflect this (e.g. iPad mean = 27.4, SD = 4.2, N = 1561; iPhone mean = 27.2, SD = 4.2, N = 1854). There is an effect of portable vs. nonportable device type that probably indicates differences in administration

environment (Macintosh desktop / laptop mean = 28.8, SD = 3.8, N = 3788), although further analyses would be needed to better understand these differences.

Participant Burden. The TMB Matrix Reasoning test is considered enjoyable by participants despite its length. Ratings on this test (3.83 / 5 stars) compare favorably with average ratings on TestMyBrain.org (3.67 / 5), despite its relatively long length (avg = 8.7 minutes), with completion rates that are higher than the rest of the site (90% TMB Matrix Reasoning vs 81% sitewide completion among consented participants).

Figure 1. Distribution of scores

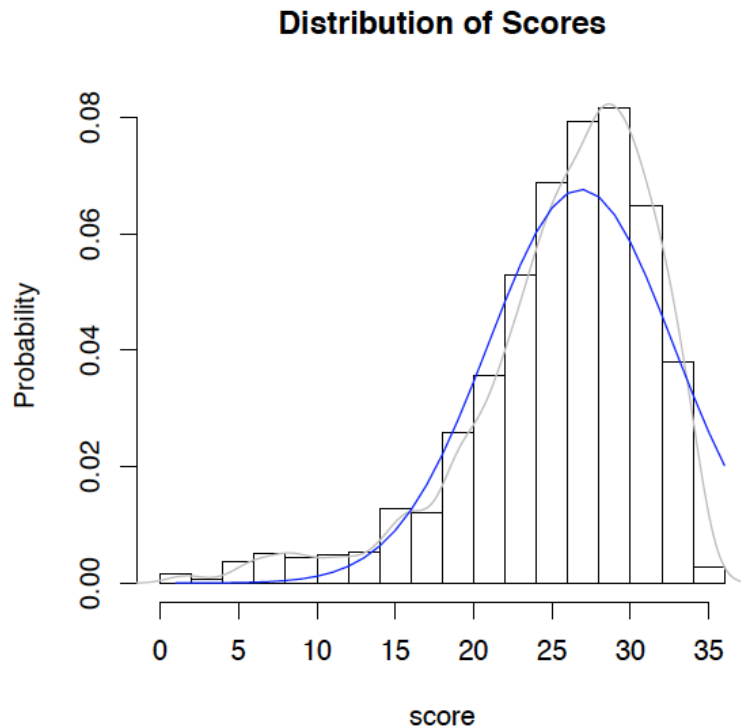


Figure 2. Age-related differences in performance

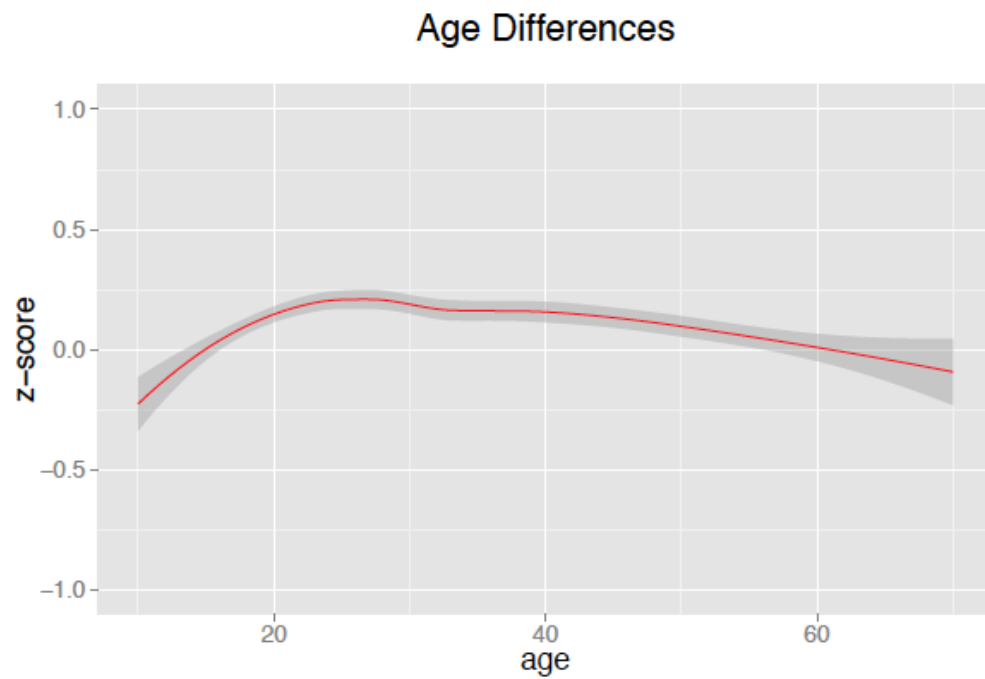


Figure 3. Sex differences in performance

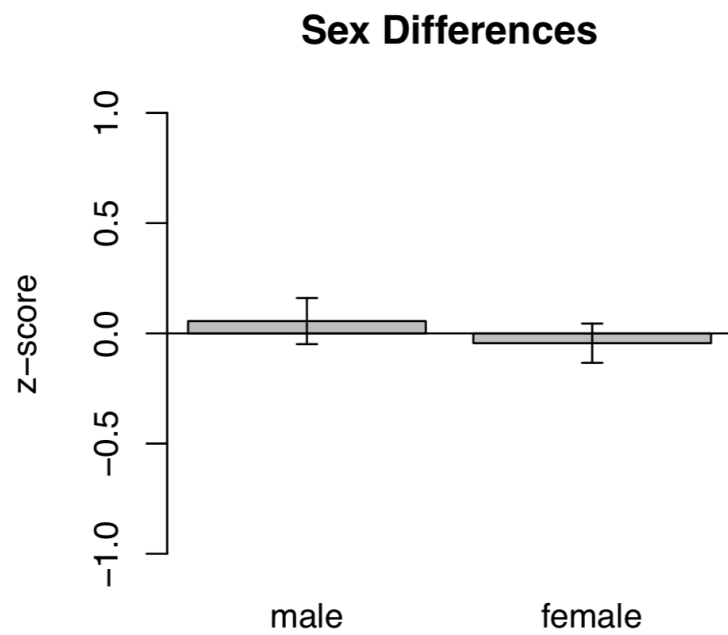


Figure 4. Education-related differences in performance

