

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.

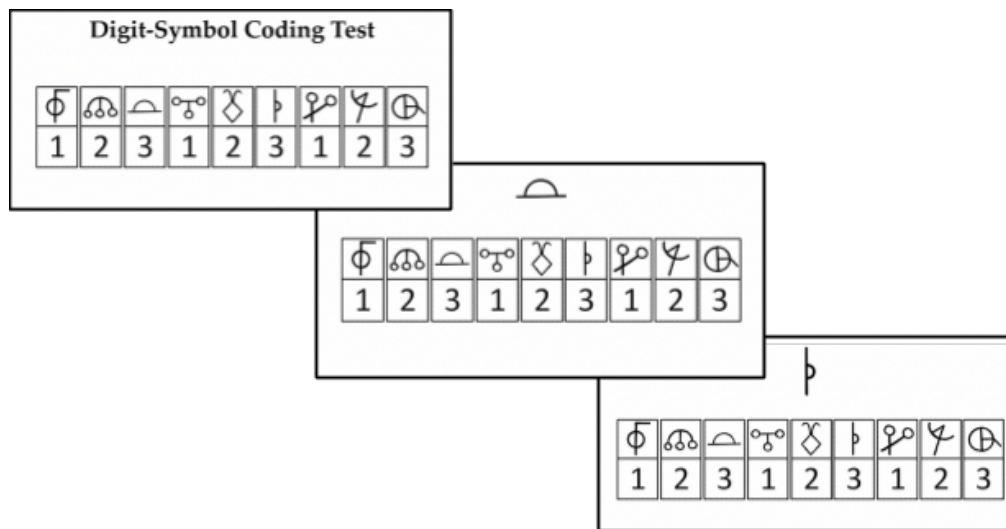
TMB Digit Symbol Matching Test

Constructs Measured: processing speed, visual short-term memory

Duration: 2.9 minutes

Sample size for which normative data are available: 45,295

Description of procedure: Using a symbol-number key shown on screen, match as many symbols and numbers as possible in 90 seconds.



This test is based on a well-validated and widely used measures of processing speed (e.g. WAIS digit symbol coding or digit symbol substitution tests) of a comparable format that have been used in clinical neuropsychology for decades. Advantages of the task are that it is very short, can be administered quickly and easily on a mobile device, and performance can be interpreted with respect to a large body of existing literature. Drawbacks are an inconsistent number of trials per individual, potentially complicating time series and standard psychometric analyses.

Psychometric Characteristics

The main outcome measure for this test is number of trials correctly completed in 90 seconds, which is proportionate to mean response time. Scores on this time are very reliable, with internal reliability (split-half) was 0.93 and test-retest reliability was 0.72 (calculated using data from the 1026 participants enrolled through the Aurora project, who took the test on multiple occasions).

Sociodemographic effects were estimated based on the pool of 40,977 participants for whom demographic data was availability. This sample had a mean age of 30.06 and was 45.70% female. The distribution of scores is normal (see Figure 1). Score on this test is variable over the life course, with scores increasing (indicating faster reaction time) throughout adolescence and young adulthood, plateauing from approximately age 20 to age 30, and decreasing from age 30 into older adulthood (see Figure 2). There are no significant differences in score between male

and female participants (see Figure 3). Scores increase somewhat with education, though this effect is not apparent in the most educated groups (see Figure 4).

Our data show minimal practice effects for this test. Participants taking the test for the first time had a mean score of 48.22, while participants repeating the test had a mean score of 50.41 (Cohen's $d = 0.15$).

Validation

The TMB Digit Symbol Matching task correlates with other measures of cognitive processing speed. It is moderately correlated with response speed in a simple reaction time test ($r = 0.32$, $n = 21023$) and a choice reaction time test that also requires participants to act quickly based on visual input ($r = 0.39$, $n = 12441$). It also shows moderate to high correlation with more complex tasks loaded on cognitive processing speed and visual perception, such as the TMB Flicker Change Detection task ($r = 0.48$, $n = 2641$), a letter and number trail-making task ($r = 0.48$, $n = 7145$), and the TMB Flanker task ($r = 0.35$, $n = 688$). The test is minimally associated with tasks that measure general cognitive ability but load minimally on short term memory and processing speed, such as vocabulary ($r = 0.03$, $n = 5248$). Performance on this task is correlated with depression symptoms, as measured by the Beck Depression Inventory ($r = 0.13$, $n = 294$, $p < 0.05$).

Appropriateness for Field Test Use

This task, being brief and well-tolerated by participants, is well-suited to field test use. To ensure that participants understand the task before they begin, the test includes three practice trials before the test trials begin.

Device Effects: The Digit Symbol Matching test is easy to administer across a wide variety of device types. However, since this test measures cognitive processing speed using reaction time, differences in device performance (such as device latency in registering input) are likely to impact measured scores. Our data showed that participants using desktop or laptop computers had slightly higher scores (and thus lower reaction times) than those using mobile devices (iPhone mean = 46.73, $SD = 9.09$, $N = 4615$; iPad mean = 45.95, $SD = 9.12$, $N = 2907$; Macintosh desktop/laptop mean = 49.85, $SD = 11.07$, $N = 10313$). Thus, it appears that device latency may play a role in participant scores, with a Cohen's $d = 0.4$ differences between scores on Macintosh and iPad scores. Part of this difference may be due to sociodemographic differences, but device related variability may also play a role.

Participant Burden: Digit Symbol Matching poses a low burden to participants and is generally well-tolerated. The average participant rating for batteries containing this task was 4.0 out of 5, compared to an average of 3.7 for all batteries hosted on Test My Brain. 93% of participants who began this test completed it.

Figure 1. Distribution of scores

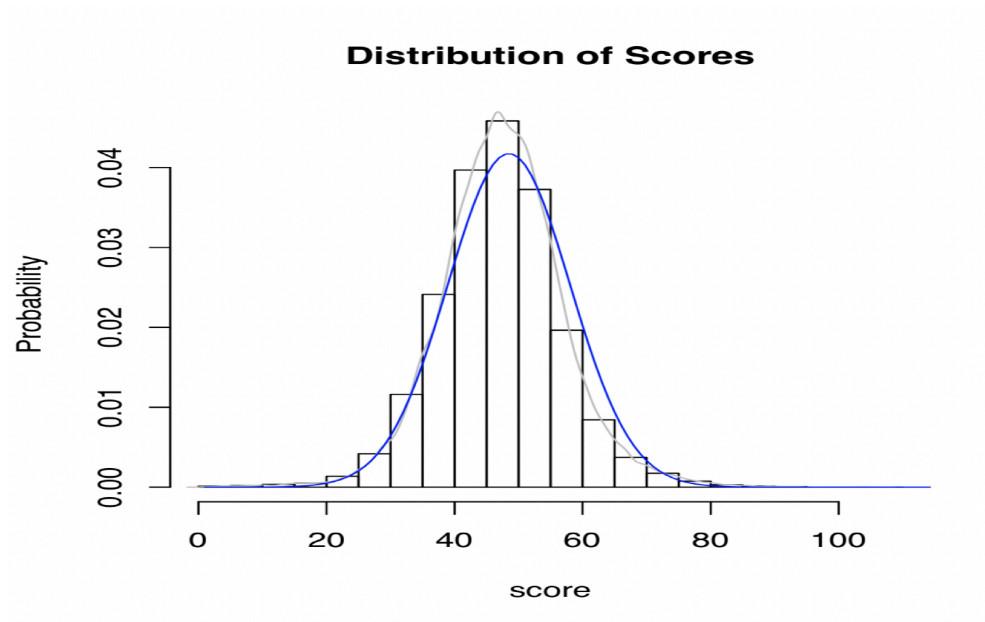


Figure 2. Age-related differences in performance

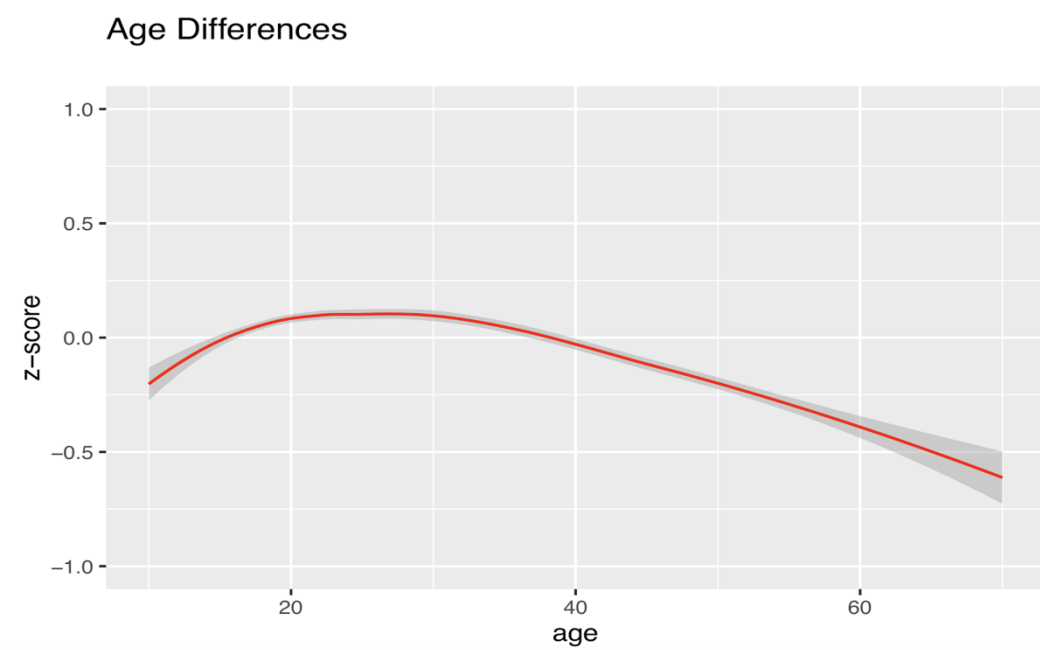


Figure 3. Sex differences in performance

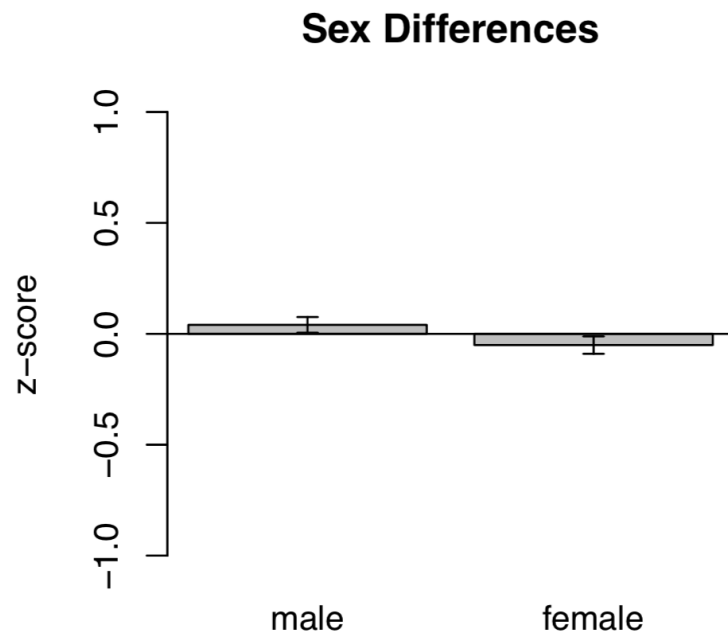


Figure 4. Education-related differences in performance

