

Cognitive Task Workflow Overview: TestMyBrain Digit Symbol Matching

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TMB Test Name: TestMyBrain Digit Symbol Matching

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The Many Brains Project

The Many Brains Project is a US-based 501(c)3 non-profit focused on the development of digital cognitive testing tools. We currently support many different types of research studies through our infrastructure for cognitive assessment - these range in size from small lab-based pilot studies to large longitudinal, multisite clinical research studies with tens of thousands of participants. As TestMyBrain.org has been continuously in operation since 2008, we provide a stable and secure platform for hosting and delivering mobile and web-based cognitive assessment protocols. Through TestMyBrain.org, data have been collected from over 2.5 million participants in a *citizen science* framework that includes structured return of research results toward the development, validation, and normative characterization of cognitive measures. We currently support research and education at over 400 sites worldwide as well as support for over 1200 clinicians or clinical sites engaged in remote digital neuropsychological assessment. For more information contact info@manybrains.net.

CITATION

Please credit The Many Brains Project and TestMyBrain in any papers, posters, or publications related to the TMB tests or data collected by TMB tests.

- Example:
 - All tasks were selected from and hosted on The Many Brains Project's web-based cognitive testing platform, TestMyBrain (Germine et al., 2012; The Many Brains Project).
 - Germine, L., Nakayama, K., Duchaine, B. C., Chabris, C. F., Chatterjee, G., & Wilmer, J. B. (2012). Is the Web as good as the lab? Comparable performance from Web and lab in cognitive/perceptual experiments. *Psychonomic Bulletin & Review*, 19(5), 847-857.
 - The Many Brains Project. *TestMyBrain Cognitive Tests*. URL: www.manybrains.net

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General Test Overview

Background:

TMB Digit Symbol Matching (Chaytor et al., 2021; D'Ardenne et al., 2020; Pozo et al., 2022; Hartshorne & Germine, 2015; Singh et al., 2021) is a processing speed test adapted from the WAIS-III (Wechsler, 1997) for remote, digital administration.

Task Parameters:

Participants are presented with six symbols, each of which is paired with a single digit between 1-3 (i.e., two symbols are paired with each digit). These digit-symbol pairings remain visible throughout the duration of the test. Individual probe symbols are sequentially presented above the digit-symbol pairings, to which participants respond by selecting the corresponding digit as quickly as possible for 90 seconds; each probe symbol remains visible until participants make a response, or until 90 seconds have elapsed from the beginning of the test trials. Participants complete three practice probes before beginning the 90 seconds of test probes.

Primary Outcome:

The suggested primary outcome of the test is median reaction time of correct responses to test probes (medianRTc), a measure of processing speed. Researchers may also consider incorporating response accuracy (proportion of probes correctly matched).

Input Device:

Participants using touch devices make their responses by touching the digit that corresponds with each symbol probe, whereas participants using devices without touch capability must answer by pressing the corresponding digit on their keyboard.

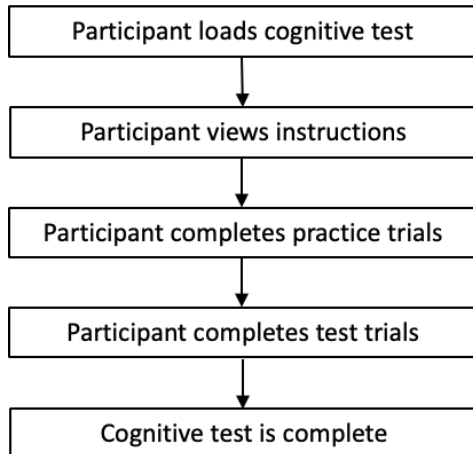
References:

- Chaytor, N. S., Barbosa-Leiker, C., Germine, L. T., Fonseca, L. M., McPherson, S. M., & Tuttle, K. R. (2021). Construct validity, ecological validity and acceptance of self-administered online neuropsychological assessment in adults. *The Clinical Neuropsychologist*, 35(1), 148-164.
- D'Ardenne, K., Savage, C. R., Small, D., Vainik, U., & Stoeckel, L. E. (2020). Core neuropsychological measures for obesity and diabetes trials: Initial report. *Frontiers in Psychology*, 11, 554127.
- Hartshorne, J., & Germine, L. (2015) When does cognitive functioning peak? The asynchronous rise and fall of different cognitive abilities across the lifespan. *Psychological Science*, 26(4), 433-443.
- Pozo, E., T. Germine, L., Scheuer, L., & Strong, R. W. (2022). Evaluating the Reliability and Validity of the Famous Faces Doppelgangers Test, a Novel Measure of Familiar Face Recognition. *Assessment*.
- Singh, S., Strong, R. W., Jung, L., Li, F. H., Grinspoon, L., Scheuer, L. S., Passell, E. J., Martini, P., Chaytor, N., Soble, J. R., & Germine, L. (2021). The TestMyBrain Digital Neuropsychology Toolkit: Development and Psychometric Characteristics. *Journal of Clinical and Experimental Neuropsychology*, 43(8), 786-795.

Wechsler, D. (1997). WAIS-III, WMS-III Technical Manual. San Antonio, TX: The Psychological Corporation

Detailed Test Activities

Flow Diagram

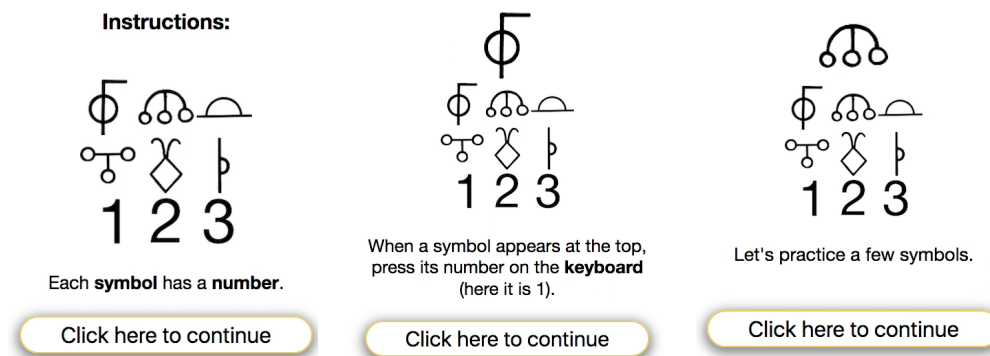


1) Instructions

Description

The participant views brief instructions for the test and clicks a button when ready to start the practice trials. No data is generated during the instructions phase.

Screenshots



Instructions:

Each **symbol** has a **number**.

Click here to continue

When a symbol appears at the top, press its number on the **keyboard** (here it is 1).

Click here to continue

Let's practice a few symbols.

Click here to continue

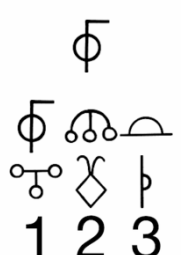
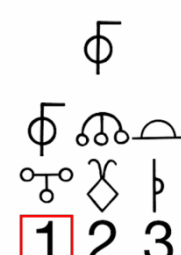
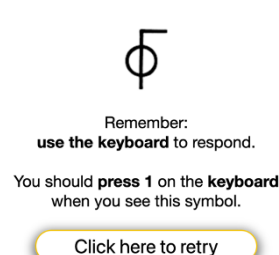
2) Practice Trials

Description

The participant completes three practice trials/probes. Each probe symbol is presented above the digit/symbol pairings until a response is made, or until 5 seconds have elapsed. When a response is made, the selected digit is highlighted in red for 300 ms. When the correct answer is selected, the next symbol probe is then presented, and the highlighting of the selected digit is removed. If the participant selects the incorrect digit during any of the practice trials, they are told the correct answer and required to repeat the practice trial until they answer it correctly. If a response is not made within 5 seconds, the participant views the same message as when they answer incorrectly, and must repeat the trial. Practice trials are recorded in the trial level data for the test, but do not contribute to full test outcomes.

Screenshots

- Practice Trial Structure:

Probe visible until response or timeout (5000 ms)	Response highlighted 300 ms	If incorrect response or timeout
		

3) Test Trials

Description

Before starting the test trials, the participant views brief instructions, then clicks a button to begin the test trials. During test trials, the participant matches probe symbols with their corresponding digits for 90 seconds. No feedback on accuracy is provided. The participant has unlimited time to answer each probe, until the test ends when 90 seconds have elapsed since the beginning of the test trials. When a response is made, the selected digit is highlighted in red for 300 ms, after which the highlighting is removed and the next probe is displayed. Test trials are recorded in the trial level data for the test, and also contribute to full test outcomes. All participants see the same sequence of probes, although the number of probes each participant gets through will vary depending on their response speed.

Screenshots

- Instructions:

Excellent!
You have completed the practice.
Now let's do more.

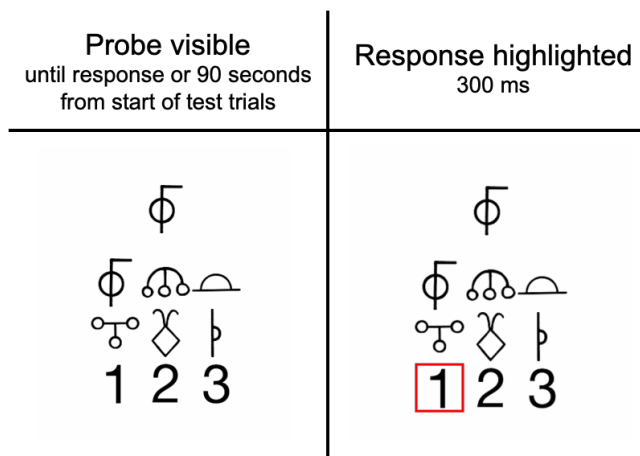
Click here to continue

Your score will be
how many correct responses
you make in 90 seconds,
so try to be **ACCURATE** and **QUICK!**

Click here to continue

...

- Test trial structure:



Trial Level Data

Variable	Description
type	Trial type ['practice', 'test']
symbol	probe symbol index [1-6]
digit	digit corresponding to probe symbol [1-3]
response	reported digit [1-3]
correct	response correctness, boolean [0,1]
rt	reaction time (ms)
timestamp	response timestamp from test start (ms)
state	event triggered by the response: timeout => no response until timeout keyup => keyboard keypress touchend, pointerup.touch => touchscreen touch

Full Test Outcome Data

Variable	Description
num_correct	Number of correct responses for 'test' trials
num_responses	Total number of responses for 'test' trials
meanRTc	Average reaction time of correct responses to 'test' trials (ms)
medianRTc	Median reaction time of correct responses to 'test' trials (ms). Recommended primary test outcome.
sdRTc	Standard deviation of reaction times of correct responses to 'test' trials (ms)
score	score = num_correct

responseDevice	User's response device: keyboard touch mouse pen
testVersion	Test's script version