Trails-X Trail-Level Performance Using the Profile Variability Index

Jennifer Greene, PhD, Melissa Messer, MHS, David Hartman, PhD, and Cecil Reynolds, PhD

Background

Trail-making tasks—rapidly connecting objects on a page according to a certain plan—are some of the most widely used neuropsychological tests. The Trails-X improves on other trail-making tasks by:

- Removing literacy and numeracy requirements.
- Increasing executive function demands by eliminating the predetermined trail sequence common to trail-making tasks.
- Requiring examinees to connect circles of alternating colors without a predetermined start or end point.
- Producing several scores.

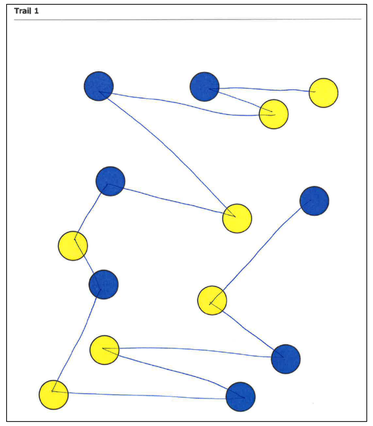


Table 1. Trails-X Scores

Time to Discontinue	Time to Discontinue is the time (max 75 seconds) spent on each trail. The Time to Discontinue for each trail is summed to obtain the Total Time to Discontinue, or the total time the examinee spent on the Trails-X.
Connected Circles	Connected Circles refers to the number of correctly connected circles on each trail (range 0-22). The Connected Circles scores for all trails are summed to obtain the Total Connected Circles score.
Matrix	A Matrix score for each trail (range 1-12) is derived from a matrix of raw Time to Discontinue and Connected Circles scores. Each trail's Matrix score is summed for the Total Matrix raw score, which is converted to a *T* score. It scales the intersection between time on task and number of circles the examinee could connect correctly in that time.

Objective: To examine performance variability across trails.

Method

Participants included the Trails-X standardization sample (n = 732), individuals with traumatic brain injury (TBI; n = 20), learning disabilities (LD; n = 24), intellectual disabilities (ID; n = 25), attention-deficit hyperactivity disorder (ADHD; n = 27), and dementia (n = 23).

Trail-level performance was assessed via the mean Time to Discontinue, Connected Circles, and Matrix scores across trails.

The Profile Variability Index (PVI) was calculated for the Matrix scores (Plake, Reynolds, & Gutkin, 1981; McLean, Reynolds, & Kaufman, 1990), with higher PVIs indicating more variability across trails.
The formula for calculating PVI is:

$$\mathrm{PVI_i} = \frac{\sum_{j=1}^{k}(X_{ij}\text{-}M_i)^2}{k-1}$$

Where i is the individual, X_{ij} is the score for individual i on subtest j, k is the number of subtests in the battery, and M_i is the mean score on all subtests.

The clinical groups and standardization samples were compared via a one-way ANOVA.

This study was conducted by PAR, the publisher of the Trails-X.

Results

Overall, the mean Matrix score was 6.47 for the standardization sample and as low as 3.02 for the dementia and ID samples.

The mean Connected Circles score was 15.78 for the standardization sample and as low as 11.63 for the dementia sample.

The mean Time to Discontinue score was 39.40 seconds for the standardization sample and as high as 54.55 seconds for the dementia sample.

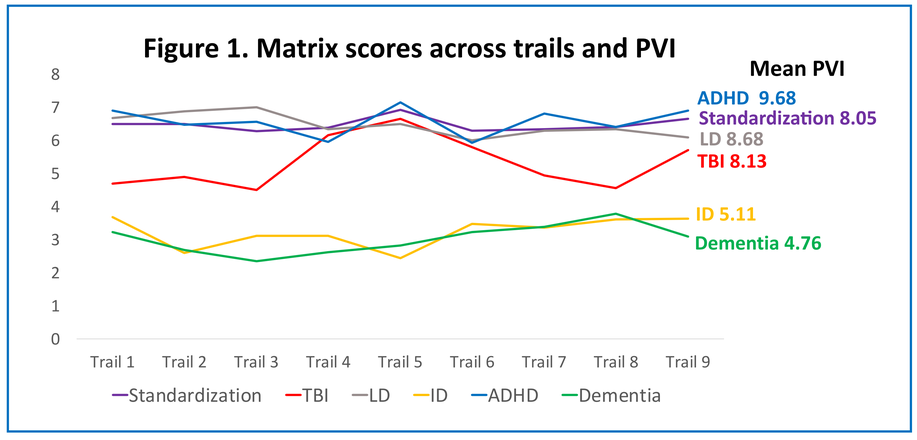
The mean PVI ranged from 4.76 in the dementia sample to 9.68 in the ADHD sample.

There was a statistically significant difference on the PVI score ($F[5,845] = 6.921$, $p = .000$)

The dementia (M = 4.76) and ID (M = 5.11) samples had significantly lower ($p < .05$) PVI scores than the other samples, which were not significantly different from each other.

Table 2. Mean Performance and PVI

Sample	Matrix score *M*	Connected Circles score *M*	Time to Discontinue score *M*	PVI *M*
Standardization	6.47	15.78	39.40	8.05
ADHD	6.56	15.79	44.39	9.68
LD	6.45	15.38	34.67	8.68
TBI	5.32	14.87	54.32	8.13
ID	3.23	12.22	36.08	5.11
Dementia	3.02	11.63	54.55	4.76



Conclusions

The dementia and ID samples were characterized by consistently low performance.

The standardization and other clinical samples were characterized by moderate amounts of variability, indicating that some variability across trails should be expected within less impaired individuals.