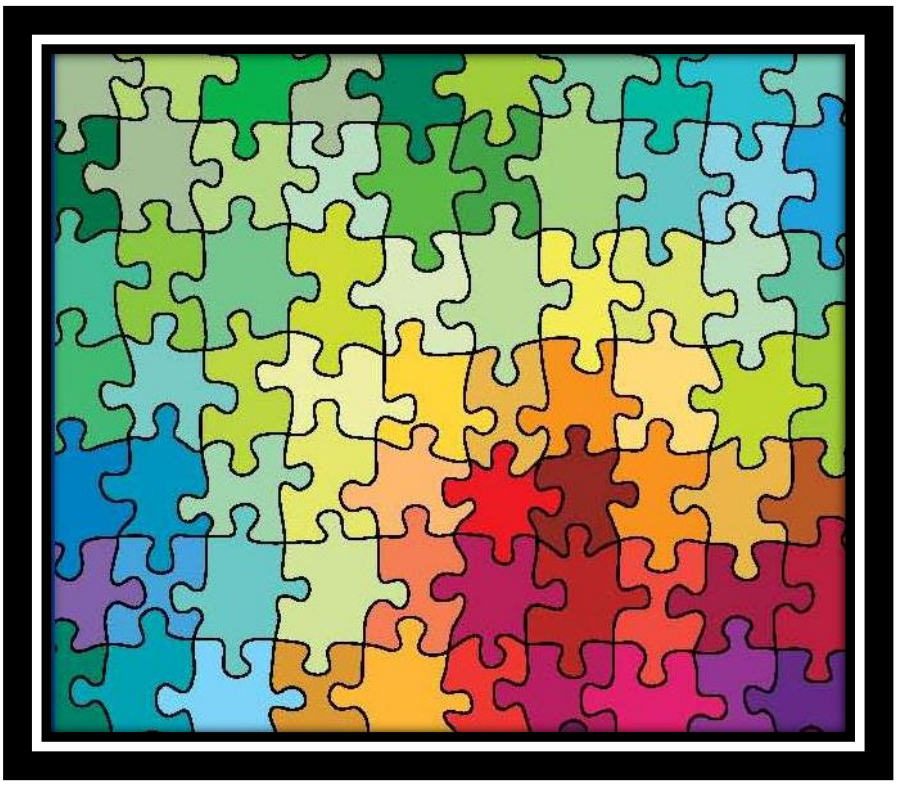
Austin Maze



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Description of the Austin Maze

The Austin maze is a spatial learning task that is based upon Milner's earlier work examining maze learning following brain lesions (Milner, 1965). You can download a free trial of our current maze from http://www.workforhumankind.com/AustinMaze/Download.

The Austin maze comprises a 10 x 10 array of identical blocks within which is embedded a secret pathway that leads from the "start" (bottom left hand corner) to the "finish" (top right hand corner). The respondent's task is to learn the pathway, initially via trial and error but eventually by learning the maze and avoiding touching blocks off the path. Feedback is provided after each block is touched to indicate whether the response was correct or incorrect. Typically the criterion for success is judged as 3 consecutive error-free trials.

One of the earlier versions of the Austin Maze comprised a stand alone box with battery operated, electronically connected, push buttons with green and red lights (the latter with audio feedback) for correct and incorrect choices. The current version is developed as a program that can be shown on a computer screen while the respondent uses arrow computer keys to negotiate through the maze. One study conducted with healthy adult undergraduates comparing push button and computer based versions of the maze (Morrison & Gates, 1988) found a high correlation between various measures of maze performance (r = 0.74 - 0.82) and no significant within group differences on the two versions, suggesting that a computerised version is a reasonable substitute for the more traditional version.

Because the Austin Maze represents a complex learning task it is a useful adjunct to simpler spatial learning tasks available in standard neuropsychological tests. The provision of a computer based task that provides feedback via red and green lights gives the task additional novelty value that can also be useful for motivating respondents.

What the Austin Maze measures

The Austin Maze was originally promoted as a measure of planning, error utilisation and regulation based on the finding that patients with frontal lobe lesions do poorly (Milner, 1965; Walsh & Darby, 1994). Walsh, in particular, argued that patients with frontal lobe damage have difficulty eradicating errors from their performance, thus even if one error-free trial is attained, this performance is unlikely to be maintained.

However, controlled examination of the relation between cognitive ability and Austin Maze performance suggest that the test is not specific to executive disorders, in fact quite the

reverse. Based upon the performance of healthy undergraduate students and adults from the community, it appears that the Austin Maze is more clearly a test of spatial ability, visuospatial learning and, to some extent, working memory (Crowe et al., 1999). Studies have found a significant association between maze performance and WAIS-R PIQ (Tucker, Kinsella, Gawith, & Harrison, 1987); specifically WAIS-R subtest Block Design (Bowden, Dumendzic, Clifford, Hopper, & et al., 1992; Crowe et al., 1999) and also the Visuospatial Learning Test (authors: Malec, Ivnik & Hinkeldey, 1991) (Crowe et al, 1991). In contrast, no association between conventional measures of executive function (such as the Wisconsin Card Sort Test or the Tower of London) was found (Crowe et al, 1991).

Crowe and colleagues have suggested that earlier trails of the Austin Maze may be more dependent upon spatial ability – in terms of orientation to the task, while later trials may be more reliant upon visuospatial learning in order to consolidate memory for path details. Working memory also contributed to performance although not uniquely (i.e. working memory also contributes to visuospatial abilities). There is a paucity of research that provides an examination of the role of different kinds of cognitive impairment following neurological damage in Austin Maze performance.

Scores and Norms

There are typically three kinds of scores used to evaluate performance on the Austin Maze

- ***trials to criterion (i.e. 3 error-free trials),***
- ***cumulative errors to criterion***
- ***cumulative errors in the first 10 trials.***

In the tables below are some data from published studies that provide normative data for each of these scores including an estimate of the value that represent the outer 95th percentile of normative performance, i.e. the value, beyond which, performance should be considered abnormal. It should be noted that Bowden et al, 1992 and Tucker et al, 1987 provide more detailed norms that are stratified according to WAIS-R Block Design and Full Scale IQ respectively.

There is debate concerning which measure is the most sensitive to impairment. Walsh (1994) argued that frontal lobe disorders, characterised by poor error utilisation, make it well nigh impossible for the test-taker with frontal damage to achieve 3 errorless runs in a row.

Thus, he advocated "trails to criterion" as the most sensitive measure especially for those with frontal pathology.

On the other hand, Bowden (1992), using a statistical evaluation of the data, has argued that cumulative errors to criterion are highly correlated to cumulative errors on the first 10 trials, and therefore the latter measure, more briefly attained, is adequate for indexing impairment. Finally, Crowe (1999) on the basis of evaluating various approaches, has suggested that cumulative errors to criterion, may indeed be the most sensitive.

TABLE 1: TRIALS TO CRITERION

Reference	Type of maze	Type of group	N	Age Range or Mean (SD)	Mean score (SD)	95%
Tucker er al, 1987[1]	Push Button	Community and various university and trade students	109	16-30	14.2 (7.8)	27
Morrison & Gates, 1988	Push button	University students	32	18.8	13.17 (4.98)	21
	Computer	University students	32	18.8	14.12 (5.89)	22
Bowden & McCarter, 1993	Push button	Normal healthy (hospital staff)	20	39.7 (11.3)	*10.2*[2] *(2.3)*	*14*
	Push button	Chronic alcoholic dependent	21	40.9 (11.6)	14.4 [1] (6.4)	25
Crowe et al., 1999 [1]	Push button	University students	108	22.9 (6.1)	12.65 (4.99)	21
Grieve & Viljoen, 2000	Computer	Socially disadvantaged African students	30	19-29	19 (8.43)	33

[1] *Criterion was TWO errorless trials*

[2] *Mean score=mean of 8 maze trials learned to criterion each using different mirror image paths.*

TABLE 2: CUMULATIVE ERRORS TO CRITERION

Reference	Type of Maze	Type of Group	N	Mean age (SD)	Mean score (SD)	95%
Tucker et al, 1987 [1]	Push Button	Community and various university and trade students	109	16-30	69.6 (65.2)	177
Morrison & Gates, 1988	Push button	University students	32	18.8	39.03 (20.74)	73
	Computer	University students	32	18.8	33.45 (16.42)	61
Crowe et al., 1999 [1]	Push button	University students	108	22.9 (6.1)	49.43 (25.35)	91
Grieve & Vijoen, 2000	Computer	Socially disadvantaged African students	30	19-29	366.56 (472.23)	1146

[1] *Criterion was TWO errorless trials*

TABLE 3: CUMULATIVE ERRORS TO TRIAL 10

Reference	Type of Maze	Type of Group	N	Age range	Mean Score (SD)	95%
Bowden et al., 1992	Push button	Mix of community, undergraduates and NH&MRC twin registry (one twin only)	86	16-19	61.1 (49.9)	160[3]
			53	20-24	46.5 (21.6)	93
			42	25-29	44.2 (34.6)	133
			49	30-39	47.4 (24.5)	103
			52	40-49	55.7 (26.1)	109
			53	50-59	62.5 (27.1)	126
			31	60-70	88.8 (38.1)	161
Crowe et al., 1999	Push Button	Undergraduates	108	(M: 22.9 (SD: 6.1)	45.55 (20.11)	78.73
Grieve & Vijoen 2000	Computer	Socially disadvantaged African students	30	19-29	331.27 (446.96)	1068

[3] *Corresponds to 5th centile as reported by Bowden et al (1992)*

Practice effects and test-rest correlation

Tucker at al, 1987 examined performance on the Austin Maze when re-administered one month (28 days) later. Overall, they reported that repeated administration lead to a saving of 41 % (SD= 35%). This translated to a reduction in trials from 14.2 (SD = 7.8) to 8.1 (SD = 6.9) or a reduction in cumulative errors from 69.6 (SD= 65.2) to 17.0 (SD = 27.3). Bowden & McCarter (1993) were not explicitly examining practice effects. However, it can be seen in TABLE 1 that the mean number of trials over the 8 trials for the normal adult group appears lower than other estimates from different studies, again suggesting that practice leads to significant savings.

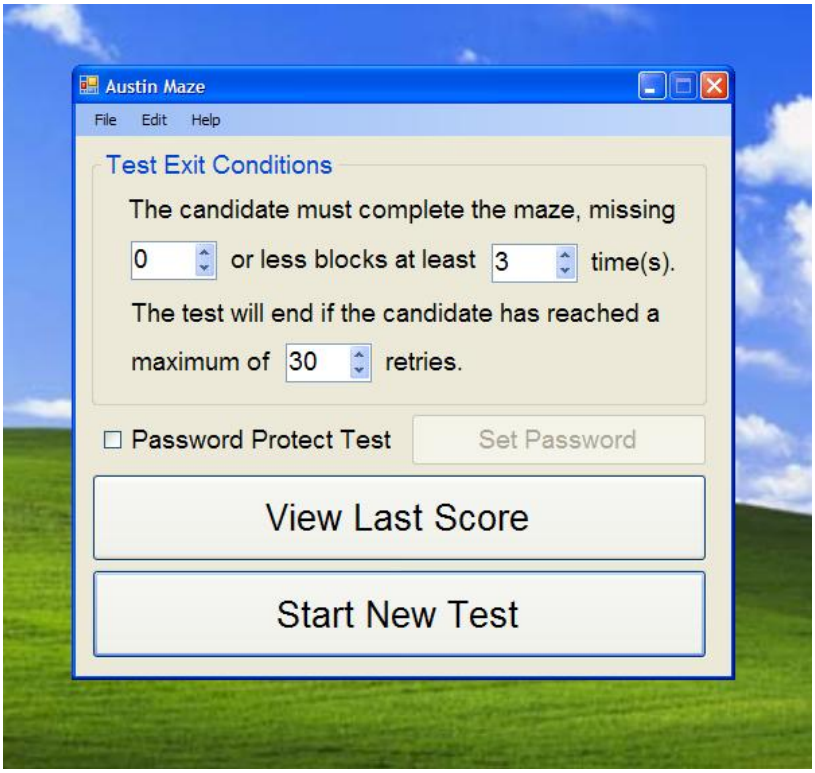
Importantly, Tucker et al, 1987, found that practice effects increased incrementally with IQ, i.e. higher intellectual ability lead to greater savings. Conversely, the apparent similarity between the alcohol dependent adults' mean score over 8 trials with the mean observed for single trials in other studies (Bowden, et al, 1992) (TABLE 1) suggests that pathology – in this case alcohol related brain changes - may interfere with the benefit of practice. Overall, Tucker at al, 1987 reported a test-retest correlation of $r = 0.56$ for trials to criterion (2 error free trials) and $r = 0.79$, for cumulative errors to criterion.

How to use this maze

1. Commencing a new test

When the test opens you will see the following screen. At this point you can edit the default settings for the number of trials to criterion (default setting is 3) and the maximum number of trials allowed for the trial (default setting is 30). You can also enter a password to protect the test from the respondent accidentally exiting etc. This is optional.

You can then commence a new test by pressing "Start New Test" and filling in the participant's name. The maze will come on screen ready to be used. The specific rules of the maze should be explained to the participant as follows:



"This maze requires you to work out how to get from the start to the finish by pressing blocks one by one. There is only one correct path. You must only press blocks in sequence and only go vertically (up and down) or horizontally (sideways). You must not skip blocks or go diagonally. When you press a block that is on the correct path, it will turn green briefly. If you press a block that is not on the path, it will turn red. When you have touched an incorrect block you MUST return to the last correct block before continuing. The first time you do this maze you will need to work out the correct path using trial and error. After this I would like to see whether you can learn the path without making any mistakes."

Each time the respondent presses a correct block (on the path) the block turns green briefly. Every time s/he presses an incorrect block, the square turns red briefly. Once the respondent reaches the end of the path and touched the "Finish" block, a message comes up:

"*Well done, you missed only… blocks*!"

Once OK is clicked, a new trial commences. The maze can be exited at any time by clicking the cross in the top right hand corner. When this is clicked you are returned to the menu screen (above).

Differences to previous versions

The following variants in the current maze compared to previous versions should be noted.

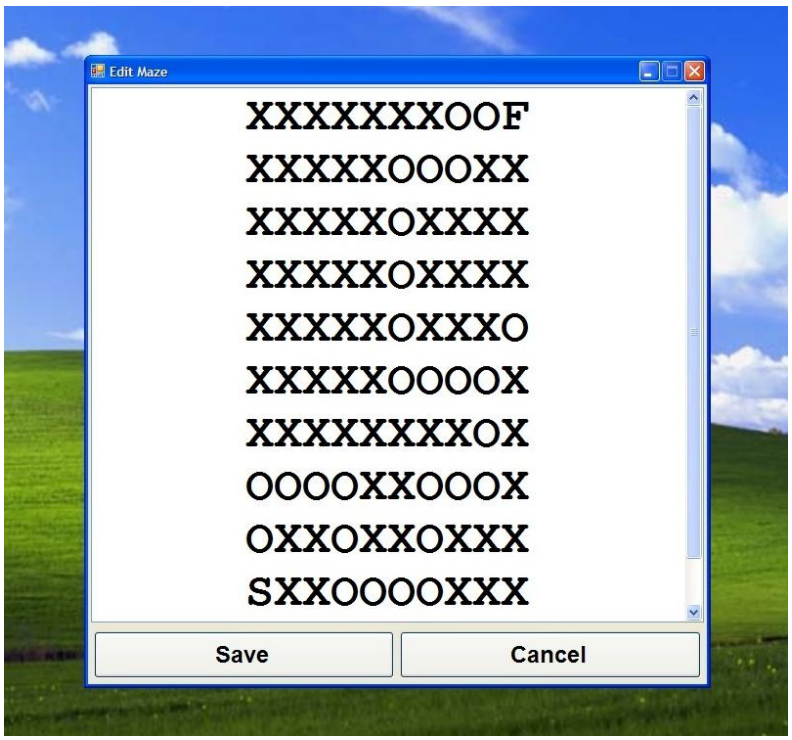
1. The last correct square to be touched turns grey until the next correct block has been contacted.
2. Backtracking on previously correct blocks will cause these to flash as red (incorrect)
3. Blocks are only correct if they are pressed in the correct order

2. Saving the data

Once a trial has been completed you can click to view "Last score" which is a summary of all trials of the test to that point. If you wish to save the data you need to press the save key. You will then be directed to choose a folder in which to save the data. Once the folder is selected, data will be exported to an excel sheet that will open on the screen. The excel sheet provides the participant's name, date and time of the test and a trial by trial tally of errors (missed blocks) and time taken to complete each trial.

3. Setting the path

When the maze opens it is set to the default standard maze path as originally described by Milner (1965). This can be easily altered by pressing the "Edit" tab. The path is then depicted by Os as represented as in the following screen shot. Simply type in a new path of Xs and Os and press save.



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