



Zig-zag tracking: A test of psychomotor speed and accuracy designed for repeated administration.

B. Tiplady, C. Barton, A. Dudman, G. Drummond, P. Wright
 Departments of Psychology and Anaesthetics, University of Edinburgh

Background

Performance in psychomotor tasks is measured in terms of both speed and accuracy. These can be traded off against each other, with fast performance being associated with low accuracy (or high error rates), while slower performance allows high accuracy. The particular speed-accuracy trade-off adopted depends on a number of factors, including individual style, the instructions given, and rewards or feedback that are contingent on performance on different aspects of the test (Wickelgren, 1977).

Drugs that impair performance can also have different effects on speed and accuracy. Benzodiazepines tend to slow performance on a number of psychomotor tasks with little effect on accuracy. Ethanol has a quite different effect, increasing errors, with less effect on speed (Tiplady et al., 2003). It is therefore important to measure both speed and accuracy of psychomotor performance.

Paper and pencil tracking tasks such as the Spiral Maze (Gibson, 1978) have proved particularly useful. The Spiral Maze, however, exists in only a single version, and it is desirable to have multiple equivalent versions for use in human behavioural pharmacology. The recently developed Zig-zag Tracking Test (ZZTR) has been designed to facilitate version generation by using a repetitive shape.

Methods.

The total time to complete the ZZTR was recorded, and an error score was calculated by adding one point each time the pen touched the side of the track or an obstacle, two points if it crossed or penetrated the boundary.

The test was evaluated in a study in which 30 female and 27 male volunteers aged 18-25 were randomized to receive a single dose of either ethanol or placebo. Performance on ZZTR and other tests including the Gibson Spiral Maze (GSM) was assessed before ethanol and at 30, 75 and 105 minutes post dose. Tests were practiced twice before baseline assessment. Blood alcohol concentrations were measured using a breathalyzer.

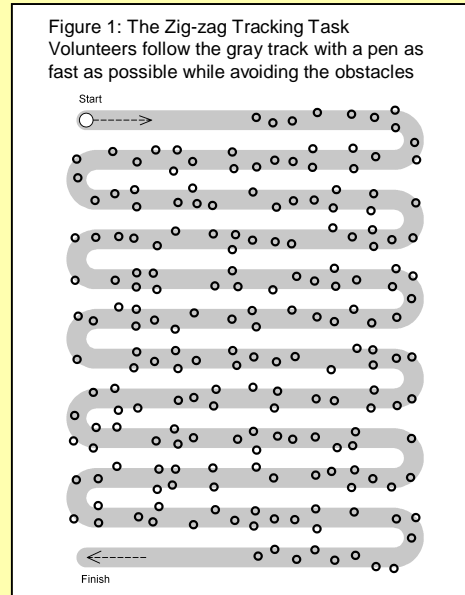
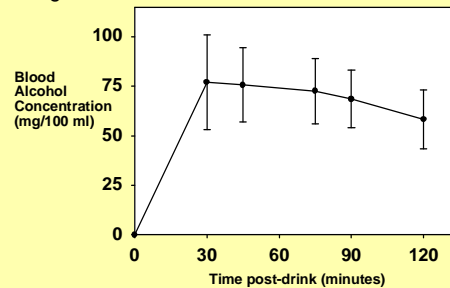


Figure 1: The Zig-zag Tracking Task
 Volunteers follow the gray track with a pen as fast as possible while avoiding the obstacles

Results

Figure2: Blood alcohol concentrations.



Maximum blood alcohol concentrations were obtained at 30 minutes post-drink (mean 77.1 mg/100ml, S.D. 24.0).

Table 1. Effects of ethanol on speed and accuracy of the two tracking tasks.

| Task, Measure | 30 minute Time-Point | | | Area Under Response/Time Curve | | |
|-------------------------|----------------------|---------------|-----------|--------------------------------|--------------|-----------|
| | Placebo | Ethanol | t, sig | Placebo | Ethanol | t, sig |
| Spiral Maze | | | | | | |
| Time (s) | 35.0 (8.9) | 34.1 (9.4) | 0.38 n.s. | 35.1 (9.1) | 33.1 (8.6) | 0.86 n.s. |
| Error Score | 6.18 (6.64) | 11.66 (10.34) | 2.39* | 6.19 (5.93) | 10.66 (8.77) | 2.26* |
| Zig-Zag Tracking | | | | | | |
| Time (s) | 53.2 (12.4) | 55.4 (13.0) | 0.66 n.s. | 53.9 (12.5) | 54.0 (11.7) | 0.05 n.s. |
| Error Score | 16.5 (11.6) | 25.6 (16.4) | 2.41* | 16.0 (11.8) | 24.2 (15.1) | 2.29* |

Means are shown, with standard deviation in brackets. Area under the curve was calculated using the trapezoid rule. Values were then normalized so that they could be compared directly to the original values. Statistical significance was determined using student's t test. * p<0.05; n.s. not significant

Figure3: Zig-zag Tracking Performance.

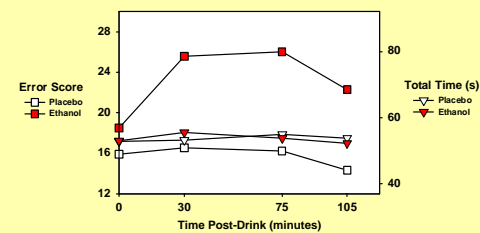
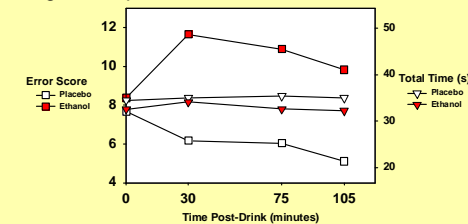


Figure4: Spiral Maze Performance.



Both ZZTR and GSM showed increased error scores with ethanol at all time points, with no significant effect on speed. GSM but not ZZTR showed a marked practice effect, with error score decreasing from 8.4 (baseline) to 5.1 (105 minutes) in the placebo group.

Discussion

These data confirm results from previous studies showing that ethanol impairs accuracy but not speed of performance in this type of tracking task. Error scores on both tracking tasks showed similar sensitivity to the effects of ethanol, but the lack of a practice effect with ZZTR indicates potential advantages for this test. The regular structure of the ZZTR allows the standardized generation of multiple versions of equivalent difficulty, particularly important in psychopharmacology, where a test may be performed many times by a particular volunteer.

Further development of the test will involve the use of a digital pen/paper system. This will allow automation of scoring of both speed and accuracy in the task, and will also make it possible to obtain more detailed information about performance on the task.

References

- Gibson, H. B. 1978, Manual to the Gibson Spiral Maze, 2 edn, Hodder and Stoughton Educational, Sevenoaks, Kent.
- Tiplady, B., Hiroz, J., Holmes, L., & Drummond, G. (2003) Errors in performance testing: a comparison of ethanol and temazepam. *J. Psychopharmacol.*, 17:41-49.
- Wickelgren, W. A. (1977) Speed-accuracy tradeoff and information processing dynamics. *Acta psychologica*, 41:67-85.

Copies of the Zig-zag Tracking Test may be obtained from Brian Tiplady, brian@penscreen.com, www.penscreen.com.