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# A simple measure of handwriting as an index of stress

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**The use of the length of ticks written as questionnaire responses is suggested as a quick and easy method for recording the effect of stresses on human perceptual-motor performance. A validation of the measure is provided by the results of a field experiment on the effect of alcohol drunk in a social setting.**

In studies of stress on human performance, it is often undesirable to take measurements under laboratory conditions because of difficulties in reproducing the practical situation in the laboratory. On the other hand, there is a lack of sensitive performance tests that can be carried out under field conditions where sophisticated equipment would be impracticable. Ideally, a test should draw on existing skills in order to minimize the possibility of confounding practice effects. But, in addition, the equipment should not be obtrusive, partly for logistic reasons, but, more important, to minimize disruption of the normal activities of those taking part. In the present paper, we describe an index of human motor performance that we feel meets these criteria. As validation, we summarize the results of a field experiment that documents the effects of alcohol on the index.

In order to avoid the use of special equipment, many human performance tests for use in the field are designed around tasks that require subjects to make written responses. Where the test format is of the forced-choice variety, the written responses will typically involve no more than ticks (check marks) and crosses if the answers are "yes" and "no." If there are more than two alternative responses to be selected from, ticks only may be used, one being made in a box chosen from an array alongside each question.

Others (Baddeley, de Figueredo, Hawkswell Curtis, & Williams, 1968; Legge, Summerfield, & Steinberg, 1964) have demonstrated that measures based on the dimensions of letters or digits provide a sensitive index of stress. However, it has not previously been shown whether the dimensions of handwritten responses as simple as ticks may be similarly used. A tick is one of the simplest handwriting movements, and can apparently be made with very little attention to its construction. Thus, ticks may not require visual monitoring in the course of their production and for this reason may be particularly susceptible to stresses affecting the production of movements in general. Moreover, a large number of ticks can be collected in a short period of time, providing a large sample of easily measured responses.

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Before describing a field experiment to look for effects of alcohol on the dimension of ticks, it is worth noting that effects of alcohol on handwriting have been previously reported. For example, Hilton (1969), as well as describing a general deterioration in quality of writing following alcohol consumption, noted that writing becomes "somewhat larger, more spread out." What we want to know, then, is whether such increase in size of handwriting is statistically reliable and whether it applies to ticks.

## METHOD

### Procedure

A series of tests including memory and semantic reasoning tests was administered to 14 right-handed subjects on two evenings. All subjects were tested on the first evening and were randomly assigned to one of two equal groups. Group 1 was then tested on a second occasion following an evening of social drinking. Group 2 was tested at a similar time after an evening with no alcohol intake. Although it was not possible to obtain accurate measures of blood alcohol level in the alcohol group, the amount of alcohol consumed was on the order of 4-5 pints of beer. (Rough estimates based on alcometer readings indicated a level of .06%). Further details of the procedure are given by Baddeley (Note 1).

### Measures

Responses were handwritten with ball-point pen. Tick responses were made in response to a semantic processing test that required subjects to indicate by a tick (or cross) the truth (or falsity) of statements about the world (e.g., canaries have wings; canaries have gills). Subjects completed as many questions as possible in 3 min. Samples of handwriting were based on the written free recall of two lists of 16 words/session. After testing was complete, certain features of the writing were scored in the laboratory with computer-aided measurement based on a Computek GT50 graphic tablet with a spatial resolution of .3 mm. The height (vertical extent) of the first 10 occurrences of the letter o (written in lowercase, but regardless of context) in the free recall lists was determined and the average and standard deviation (SD) was calculated for each of the two testing sessions. Corresponding estimates of mean and SD of the length of tick ascenders[1] were based on averages of estimates made for the first 10 ticks on each of the semantic reasoning test sheets filled out by each subject (the average number of sheets was 2.54, range: 1-4).

## RESULTS AND DISCUSSION

The average over the subjects of the mean and SD of the vertical extent of the letter o as a function of group for test and retest is shown in Table 1. The difference for the means between Group 1 (alcohol intake prior to retest) and Group 2 was significant [$t(12) = 2.076$, $p < .05$, one-tailed], but there was no effect on SD. Table 2 summarizes the effect of alcohol on the length of the tick. The difference between groups was significant both for the mean [$t(12) = 2.025$, $p < .05$, one-tailed] and for the SD [$t(12) = 5.246$, $p < .025$, one-tailed].

Thus, we have confirmed a statistically reliable effect of alcohol on the size of cursive handwriting as evidenced in the letter o. Of particular interest in the context of using the handwritten tick as an index of stress, we have shown an increase in the average size of ticks of the alcohol group over the control group and have also demonstrated a reliable increase in the variability of tick size. We would therefore suggest that where responses to questionnaire-type tests are collected in the form of ticks or check marks, the length of the tick ascender provides an easily scored and unobtrusive index of motor performance.

Finally, a word of caution in the application of this finding. Although a statistically reliable effect of alcohol on the tick size was found for the group of subjects as a whole, two points should be noted. First, the mean tick length of most of the subjects in the control group increased from test to retest (but not as much as the increases of Group 1 subjects). Thus, an increase in tick length should not be used without reference to a control group. Although we cannot be sure that the tick length increase in the control group was not simply a practice effect, it is worth noting that the retest was carried out at a different time of day from the first test, and time-of-day effects on the size of handwriting have been noted elsewhere (Glenville, Broughton, Wing, & Wilkinson, Note 2).

Second, even with a control group, there is considerable overlap in the scores of the two groups. Given such large individual differences, it is important to obtain a baseline level for each subject under control conditions before introducing the stressor. Such a design avoids the dangers of asymmetric transfer effects such as often occur in stress studies using a within-subjects counterbalanced design (Poulton & Freeman, 1966) without requiring the very large numbers of subjects typically required for a conventional separate-groups design.

**Table 1**
**Change in Mean and Standard Deviation of the Height of the Letter o for Group 1 (Alcohol taken prior to retest) and Group 2 (Control)**

| | | Test | Retest | Change |
|---|---|---|---|---|
| Mean | Group 1 | 2.30 | 2.51 | .21 (.46) |
| | Group 2 | 2.72 | 2.68 | −.04 (.32) |
| SD | Group 1 | .51 | .56 | .05 (.28) |
| | Group 2 | .61 | .64 | .03 (.19) |

*Note–N = 7. Standard deviations of change are given in parentheses. Means and SDs are expressed in millimeters.*

**Table 2**
**Change in Mean and Standard Deviation of Tick Length for Group 1 (Alcohol taken prior to retest) and Group 2 (Control)**

| | | Test | Retest | Change |
|---|---|---|---|---|
| Mean | Group 1 | 6.97 | 8.69 | 1.72 (1.93) |
| | Group 2 | 7.55 | 8.13 | .58 (1.74) |
| SD | Group 1 | .90 | 1.49 | .59 ( .71) |
| | Group 2 | 1.18 | .89 | −.29 ( .47) |

*Note–N = 7. Standard deviations of change are given in parentheses. Means and SDs are expressed in millimeters.*

## REFERENCE NOTES

1. Baddeley, A. D. *Information and alcohol: A field experiment.* Paper presented at the Uppsala meeting of the Scandinavian Society for the Study of Attention and Performance, 1976.

2. Glenville, M., Broughton, R., Wing, A. M., & Wilkinson, R. T. *Reliability of the Stanford Sleepiness Scale compared to short-duration performance tests and the Wilkinson auditory vigilance task.* Manuscript submitted for publication.

## REFERENCES

BADDELEY, A. D., DE FIGUEREDO, J. W., HAWKSWELL CURTIS, J. W., & WILLIAMS, A. N. Nitrogen narcosis and performance under water. *Ergonomics*, 1968, **11**, 157-164.

HILTON, O. A study of the influence of alcohol on handwriting. *Journal of Forensic Sciences*, 1969, **14**, 309-316.

LEGGE, D., SUMMERFIELD, A., & STEINBERG, S. Simple measures of handwriting as indices of drug effects. *Perceptual and Motor Skills*, 1964, **18**, 549-558.

POULTON, E. C., & FREEMAN, P. C. Unwanted asymmetrical transfer effects with balanced experimental designs. *Psychological Bulletin*, 1966, **66**, 1-8.

## NOTE

1. Casual observation shows that the ticks people make do not always have a measurable initial downstroke preceding the upstroke, which might be considered the body of the tick. Thus, our choice of the tick ascender as an index of motor performance is based purely on practical grounds.

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