Response Inhibition in Everyday Life. Validating a Mobile Version of the Stop-Signal Task set up on an Android Smartphone

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Response Inhibition

Impaired response inhibition may be a factor in alcohol abuse,and this has been investigated in a number of laboratory studies using assessments such as the cued Go/NoGo and Stop-Signal tasks (Logan et al., 1997; Field et al., 2010; Courtney et al., 2013).

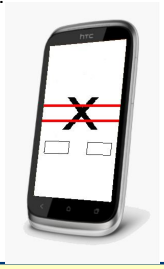
Laboratory studies provide a cross-sectional view in a controlled setting, and allow detailed studies of physiological function to be carried out. However it is seldom possible to follow individuals over long periods, and thus fluctuations in inhibitory control are difficult to assess. Such fluctuations in the ability to inhibit actions may be a factor in subsequent alcohol problems. To investigate this, methods that can be used in an everyday life setting are needed.

Ecological Momentary Assessment (EMA) – Assessment in Everyday Life

EMA was originally developed to collect self-report data, such as symptoms, thoughts and feelings, or behavioural events such as cigarette smoking. Entries could be made at random times of day, or whenever a specific event occurred. Early EMA studies used paper, sometimes with ancillary timing devices, but electronic devices such as smartphones or PDAs are now generally used as they allow both for timing and data capture (Shiffman 2008; Cohn et al., 2011).

EMA can also be used for objective assessments such as physical activity and cognitive function. Cognitive tests set up on mobile phones and other portable devices have been in use for a number of years (Tiplady, 1994; Shiffman et al., 1995; Tiplady et al. 2009).

The use of portable devices allows a profile of performance over time to be built up in an everyday setting, and performance to be correlated with other events and influences in a person's life. We describe here the initial validation of a stop-signal task (SST) on an Android ® smartphone, with a 3.5 inch touchscreen.



The Study

Data were analysed for a subset of 20 volunteers taking part in an ongoing study examining the effects of state fluctuations in response inhibition on alcohol consumption, in heavy drinkers motivated to 'cut down'. They were instructed to completed the SST at least twice a day for 14 days. They comprised 7 males and 13 females, and were aged 25 – 45 years (mean 28.85, SD 4.97).

Compliance was high, with an average of 1.93 entries per day, and 98% of days having at least one entry. Practice effects were seen over the first 3 – 6 days of the study. Mean scores for test variables were calculated for two periods of the study, days 7 – 10 and 11 – 14, in order to allow test-retest comparison. Reliabilities were evaluated using the intraclass correlation coefficient (form (2,1) in the classification of Shrout and Fleiss (1979)).

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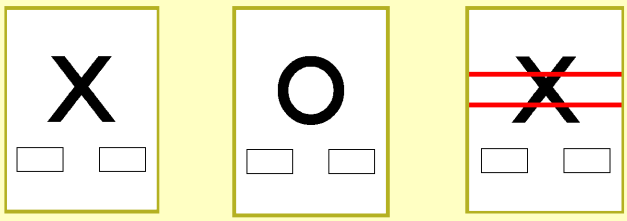
The Stop-Signal Task

Each stimulus consisted of a black letter X or O, to which the response was a tap on a left or right screen button respectively. In 25% of trials two red horizontal bars appeared superimposed on the letter after a variable delay. In such Stop Signal trials the user was instructed not to respond. In other trials the response was to be made as fast and as accurately as possible. Here are examples of stimulus displays.



The shorter the delay between the appearance of the stimulus letter and the appearance of then Stop-Signal, the harder it is for the user to inhibit the response. The program used an adaptive algorithm, in which a correct response was followed by a reduction in the Stop-Signal delay, while an incorrect response was followed by an increase in the delay.

The response times for correct responses (RTC) and number of errors (NI) made in non-SS trials was recorded and the stop-signal reaction time (SSRT) was computed from the stop-signal delays.

Table 1. Reliabilities for SST variables. ICCs were calculated for test (mean of days 7-10) and retest (mean of days 11-14

RTC	NI	SSRT
0.83	0.90	0.87

Table 2. Correlations (Pearson's r) among SST variables.

	Days 7 - 10		Days 11 - 14	
	NI	SSRT	NI	SSRT
RTC	-0.34	0.92	-0.29	0.87
NI		-0.56		-0.56

Results

Table 1 shows that there was good rest-retest reliability for all three variables. ICCs of 0.7 and above are generally considered to indicate good agreement for group comparisons (Streiner and Norman, 1985)

Table 2 shows a high positive correlation between the two reaction time measures. Correlations between reaction time and number of incorrect responses were negative, suggesting that a speed-accuracy-trade-off is occurring

Summary and Conclusions

These results suggest that the EMA implementation of the Stop-Signal Task is a reliable measure of performance in an everyday setting.

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