

The Effects of Amphetamines on Driving and Sobriety Test Performance

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Background

As the number of drug related road fatalities is increasing (Drummer, 1994; Drummer 1998; Drummer & Gerostamoulos, 1999), considerable research is being conducted to reduce mortality and morbidity caused by driving under the influence of drugs other than alcohol. The Standardised Field Sobriety Tests (SFSTs) have demonstrated to be a sensitive measure of impairment associated with a Blood Alcohol Concentration (BAC) of up to 0.08% (Burns and Moskowitz, 1977; Burns, 1987). A number of studies have shown that performance on the SFSTs provides an accurate indicator of driving impairment associated with alcohol consumption (Burns and Moskowitz, 1981; Compton, 1985; Stuster and Burns, 1998).

The SFSTs have also been implemented in several drug impaired driver detection programs for the identification of drugs other than alcohol. One such program is the Drug Evaluation and Classification Program (DECP), a twelve-step procedure that includes the administration of the SFSTs in addition to physiological tests that are related to drug intoxication. The John Hopkins Study (Bigelow *et al.*, 1984) and the 173 Case Study (Compton, 1986) are the two most renowned studies investigating the efficiency of the DECP. The John Hopkins Study was a controlled clinical trial that found the DECP to be over 90% accurate in identifying drug impairment and the class of drug associated with the impairment. The 173 Case Study was a field study, which involved drivers who were arrested for suspicion of driving under the influence of drugs. Results of the blood analyses were compared with Drug Recognition Experts (DREs) evaluations. The findings indicated that in 94% of cases where a drug other than alcohol was identified, the DREs also reported it, whereas, when specific classes of drugs were classified, the DREs were correct only 49% of the time. A limitation of Compton's 1986 field study was that it did not include an accurate representation of the CNS stimulant class of drugs, as the only stimulant detected in blood samples was cocaine.

A recent validation study of sobriety testing was conducted by Heishman *et al.*, (1996), who reported that the DECP has an optimal ability to predict the use of cannabis when 17-28 variables are assessed. It was noted that the DREs evaluation of drug impairment was consistent with toxicology reports in only 44% of the cases.

This enormous variation in success rates, 44% to 94%, clearly manifests the critical need for further research. The SFSTs have not been rigorously assessed in both validity and reliability of efficiently detecting driving impairment caused by drugs other than alcohol. Thus, assessing driving ability in conjunction with performance on sobriety tests, following the administration of a drug, would enable a more reliable assessment of the efficiency of SFSTs in detecting driving impairment associated with drugs other than alcohol.

Peck *et al.* (1986) examined the efficacy of sobriety tests to predict driving performance following the administration of alcohol and cannabis. The authors reported impairment on two sobriety tests, and found this impairment correlated with impaired driving performance. More recently, Papafotiou *et al.* (2001) found that the SFSTs correctly identified driving impairment associated with cannabis in 76.3% of cases. Furthermore, a new sign, HMJ (head movement/jerks), was noted to significantly improve the accuracy of SFSTs to predict driving impairment.

Stimulants are increasingly recognised as potentially important causes of driving fatalities, with the most recent report indicating that drivers tested positive for stimulants in 4.1% of Australian road accidents (Drummer, *et al.*, 2003).

As the number of amphetamine related road fatalities is not decreasing (Drummer, 1994; Drummer 1998; Drummer & Gerostamoulos, 1999), and there is some evidence to suggest that amphetamines might be related to reckless driving, which may in turn contribute to drug-related driving fatalities, it is essential that a means for detecting amphetamine use in drivers be implemented. Hitherto, no such reliable instrument exists which can be administered on the roadside and that accurately identifies amphetamine consumption.

For this reason, in December 2000, the Victorian Government passed legislation authorizing Victoria Police officers to administer the SFSTs to drivers suspected of being impaired by a drug/s other than alcohol. The legislation requires the administration of the SFSTs if a driver with a BAC below .05% is suspected of being impaired by a drug other than alcohol. Police officers, thus, require substantial information on the effects of drugs, and low alcohol levels combined with drugs on the SFSTs, so that SFSTs classifications can be supported in court proceedings. Not surprisingly, the reliability and validity of the SFSTs for detecting non-alcohol related impairment is questionable and subsequently have important legal implications as these tests have only been validated in relation to alcohol.

It is, thus, imperative that rigorous research be conducted to assess the efficiency of SFSTs across a diverse range of licit and illicit drugs. As stimulants are increasingly recognised as potentially important causes of driving impairment (Drummer, *et al.* 2003), the present study examined the efficiency of the SFSTs to identify driving impairment associated with dexamphetamine consumption.

Methodology

Twenty healthy participants (10 males; 10 females) aged between 21 and 32 years (\bar{M} = 25.4 years, \underline{SD} = 3.3 years) with a valid, full drivers license, completed two treatment conditions: placebo and 0.42mg/kg Dexamphetamine tablet. Dexamphetamine sulphate (5mg Dexamphetamine tablets, Sigma Pharmaceuticals Pty Ltd, Victoria, Australia) was prepared by mixing 0.42mg/kg dose of Dexamphetamine tablets with flour, which was encapsulated in three soft gelatine capsules, to render them visually indistinguishable from the placebo capsules. A repeated measures counter-balanced, double blind, placebo controlled design was employed.

During each session participants completed a driving simulator task and sobriety tests. The driving test consisted of four tasks, 'freeway traffic driving' and 'city traffic driving' in both day and night conditions. The SFSTs comprised of three tests: Horizontal Gaze Nystagmus (HGN), Walk and Turn Test (WAT), One Leg Stand Test (OLS). These tests allow for the objective identification of impairment equivalent to a BAC of 0.08% or above

(Burns, 1987). Each test must be administered in the same manner to all individuals and specific signs must be observed within each test for a person to be identified as impaired (Page, 1995). Throughout the administration of the HGN test a 'new' sign known as Head Movements/Jerks (HMJ) was scored. Papafotiou *et al.* (2001) reported that head movements were observed in the highest percentage of participants in both the low and high THC condition compared to any other HGN sign recorded. For this reason, this sign will be recorded in the present study to investigate its pertinency in amphetamine intoxication.

Analyses and results

For overall SFSTs performance, a test of difference in proportions based on paired data was performed to establish whether the sobriety tests could successfully detect the presence of dexamphetamine. The second set of analyses was a series of Wilcoxon signed-rank tests. These explored the effects of dexamphetamine on each specific signs/errors observed in the SFSTs.

Dexamphetamine did not affect overall SFSTs performance. SFSTs successfully identified the presence of dexamphetamine in only 5% of cases. The inclusion of HMJ as a sign of impairment did not change the percentage of participants classified as impaired on overall SFSTs performance.

Dexamphetamine did not affect overall HGN performance. HMJ (Papafotiou *et al.*, 2001) was observed more frequently in the dexamphetamine condition than any other HGN sign. Furthermore, HMJ was the only sign which approached significance, $T = 10$, $p = .096$.

No significant differences were found between dexamphetamine and placebo for overall WAT. It should be noted that Improper Turn (IT) occurred more often in the placebo condition compared to the dexamphetamine condition.

Dexamphetamine did not impair OLS performance. However, it should be noted that errors were observed more often in the placebo condition compared to the dexamphetamine condition.

The SFSTs were 10% successful in predicting driving ability as 'impaired' or 'not impaired' following dexamphetamine consumption. Separately, the best test of driving impairment related to dexamphetamine was the WAT test, although the percentage of individuals correctly identified as impaired or not impaired was only 15%. Including HMJ, as a sign in overall SFSTs performance did not increase the accuracy of the SFSTs to correctly identify driving impairment associated with the presence of dexamphetamine.

Discussion

The present study found that 0.42mg/kg dexamphetamine did not affect overall SFSTs performance. The sobriety tests successfully identified the presence of dexamphetamine in only 5% of drivers, and were 10% accurate in predicting driving ability following dexamphetamine consumption. As the driving simulator task and the SFSTs were completed within the 2-3 hour post-drug administration period, and as dexamphetamine blood levels are relatively constant during this period (Kupietz *et al.*, 1985; Brauer *et al.*, 1996), it is reasonable to conclude that the observed impairments corresponded to blood and saliva dexamphetamine concentration levels of approximately 90 ng/ml and 80 ng/ml respectively.

The present study yielded no significant findings for any of the signs in the HGN test. Generally, the signs were not observed, suggesting that these errors may not be typically induced with dexamphetamine. These results are consistent with the DRE instructor's manual (1993), which indicates that stimulants do not affect performance on the HGN, LSM, VGN, and Lack of Convergence tests (Kosnoski, *et al.*, 1998). However, as a result of the sympathetic nervous system effects associated with the drug, the classic ocular sign of stimulant use is dilated pupils that react slowly to light. This is further supported by other research which has noted that eye signs are less useful for observing impairment associated with stimulant use (Adler and Burns, 1994), however, dilated pupil size and slowed reaction to light is frequently observed (Page, 1998; Shinar, *et al.*, 2000).

Although, the inclusion of HMJ in the scoring procedure did not increase the percentage of correct classifications, it was observed more frequently in the dexamphetamine condition than any other sign, and was the only sign to approach statistical significance. Although the findings suggest that including HMJ as a sign of impairment does not increase the efficiency of the SFSTs, the absence of an improvement in accuracy appears to be associated to the standard signs of the HGN test not effectively detecting the presence of dexamphetamine.

No significant findings for any of the signs in the WAT test were observed, suggesting that this test may not be appropriate for identifying the presence of dexamphetamine. It should be noted that Improper Turn (IT) occurred frequently across both the placebo and the dexamphetamine condition, which is consistent with research examining the effects of cannabis on SFSTs performance (Papafotiou, *et al.*, 2001), where IT was observed similarly across placebo and cannabis conditions. This sign is, therefore, likely to be observed irrespective of drug consumption and, thus, administrators should be cautious when evaluating an individual as impaired based on the observation of IT.

Consistent with previous research, dexamphetamine did not affect the OLS test, where more errors were observed during the placebo condition. Heishman *et al.* (1998) performed a stepwise discriminant analysis on 76 variables recorded in a controlled trial, and found that a decrease in errors on the OLS test was the third best predictor for the presence or absence of dexamphetamine (the first two were vital signs). These results are in accordance with reports of amphetamines enhancing human performance (Cami, *et al.*, 2000; Shenberger *et al.*, 1998; Weiss and Laties, 1962), and thus indicate, that the OLS is not an appropriate measure for detecting dexamphetamine-induced impairment.

The percentage of cases correctly classified as impaired on the SFSTs (5%) was extremely low following that of previous research, which has reported sobriety testing to be successful in detecting impairment caused by drugs other than alcohol in 44%-94% of cases (Heishman *et al.*, 1996; Compton, 1986 respectively). However, previous research does indicate that the stimulant drug class are notably more difficult to detect. Heishman, *et al.* (1998) reported that the majority of subjects dosed with dexamphetamine were classified as 'not impaired' by the Drug Recognition Examiners (DREs). The authors noted that only 2% of cases where dexamphetamine was administered the classification was correct. Furthermore, the DREs classified subjects as dosed with other drugs more frequently than with the amphetamine dose administered. Shinar, *et al.* (2000) also found stimulants, specifically dexamphetamine, the most difficult to identify, with only 7.8% of cases correctly classified. The authors concluded that in the case of amphetamine impairment, identifying subjects as stimulant-impaired was no better than chance.

Furthermore, the SFSTs are only a subtest of the DECP, therefore, it is difficult to assume that the SFSTs, comprising of only three tests, are likely to successfully predict the presence of dexamphetamine when the DECP, a 12-step program, has difficulty in correctly identifying and classifying stimulant-impairment. Previous research has demonstrated that the DECP has an optimal ability to predict impairment associated with cannabis when 17-28 variables are used (Heishman *et al.*, 1996). The SFSTs observe only 16 variables. Although cannabis is a different class of drug, it is reasonable to assume that including more signs in the SFSTs assessment may increase the percentage of correct classifications.

The SFSTs were 10% accurate in predicting driving performance as 'impaired' or 'not impaired' (day time driving conditions only) following dexamphetamine administration. Although extremely low, the most efficient predictor of driving performance associated with the presence of dexamphetamine was the WAT test, where it was found to be 15% accurate.

Including the new sign HMJ, did not increase the accuracy of the SFSTs to successfully identify driving impairment associated with the presence of dexamphetamine. However, it was the sign that was most related to dexamphetamine as it was observed more frequently in the dexamphetamine condition than any other SFST sign.

Conclusion

The results of the present study suggest that dexamphetamine does not impair performance on the SFSTs. The SFSTs identified the presence of dexamphetamine in only 5% of cases, and were 10% accurate in predicting driving ability. These findings indicate that the SFSTs are not efficient in detecting driving impairment associated with the presence of dexamphetamine, and support Papafotiou *et al.* (2001) recommendations that the SFSTs need to be validated for the various drug classes, as impairment related to drugs differs to that of alcohol.