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TEMAZEPAM AND THE PERCEPTUAL-MOTOR PERFORMANCE OF PROFESSIONAL FOOTBALLERS

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ABSTRACT

The use of benzodiazepines to overcome the possible debilitating effects of travel on football performance is a recent phenomenon and indicative of current usage of such drugs. Contemporary psychological theory is critical of many of the measures used to monitor such drugs. This study has created a battery of tests which include some measures which are deemed more ecologically valid and, for purposes of comparison, some traditional indices.

On a sample of First Division professional Association footballers temazepam (40 mg) was compared with placebo on these measures and testing occurred on the afternoon following night time medication. The findings suggest that on such a protocol, perceptual-motor performance is not impaired.

INTRODUCTION

Very little research carried out into the effects of psychoactive compounds has attempted either to create conditions which are representative of those which normally prevail, or utilise task specific performance measures. Although there has recently been a significant change of emphasis which has led to the acceptance of environmental determinates as being of equal importance to the organismic determinants of behaviour (Goldfried and Kent, 1972; Goodenough, 1949); doubts nevertheless exist as to the appropriateness of many of the measures used as the dependent variable in monitoring drug effects. A bewildering number of such measures have been outlined by Hindmarch (1980), yet Wilberg (1975) claims that many such measures only describe a fraction of total skilled performance. A more critical appraisal is required of the extent to which the results of many experiments can be generalised from the set of environmental conditions created by the researcher to the "real" world (Harré and Secord, 1972).

A suitable paradigm for the examination of the interaction between environment and performance is the modern game of Association Football. Football players often taken benzodiazepines in an attempt to overcome one problem which accompanies success, i.e. the debilitating effects of travel. Little formal examination of the effects of such compounds upon football performance have been carried out.

A series of tests have been devised, based on earlier tests by Golby (1982) which appear to have more ecological validity. This battery of tests includes measures which mimic the skills of Association football and, for purposes of comparison, some traditional laboratory measures. The purpose of this research was to examine the effects of temazepam on these tests of perceptual-motor performance using a sample of professional football players.

SUBJECTS AND METHODS

The study was carried out on twelve match-fit volunteer Nottingham Forest professional footballers. Performance levels were determined on the day prior to the administration, that same evening of 40 mgs temazepam (7-chloro-1, 3-dihydro-3 hydroxy-1-methyl-1-5-2M-1, 4-benzodiazepine-2-one), a compound of the 1, 4 benzodiazepine group of drugs (or placebo equivalent). Each group consisted of six players and re-testing took place early the following afternoon, at a time close

to kick-off time on match days.

Complex reaction time. This was measured by a portable apparatus consisting of six stimulus lights corresponding to six response buttons which were arranged in an arc about a central button. There was a uniform distance from the central button to each response button. Stimulus lights were illuminated in a random sequence and with a random period of time between each presentation. The subject was instructed to respond as quickly as possible by shifting his finger from the central button to the appropriate response button. Three response measures were recorded viz, recognition time, which is the time lapse between the presentation of the stimulus and the finger leaving the central button, movement time, which was the time taken to move the finger from the resting template to the correct response button, and lastly, the total response latency, which was the sum of the individual recognition and movement times.

Gross bodily complex reaction time. This test was based on a similar principle and methodology except subjects started on a central platform measuring 50 cms x 40 cms and were surrounded by six pressure pads located on the floor equidistantly on the circumference of a circle of 6 metres diameter. Each pad was colour coded. Upon the presentation of a coloured light the subject was instructed to move as fast as possible to the appropriate matching pad and cancel the signal by touching the pad with the foot. As with complex reaction time, measurements of recognition time, movement time and total response latency were recorded.

Critical Flicker Fusion (CFF) was used as an index of drug sedation and drowsiness. Subjects were seated a uniform distance from a presentation area in which was located a set of light emitting diodes. Subjects were asked to depress a button upon discriminating flicker in the diodes. Two sets of three trials were given on an ascending and descending scale and subjects indicated on three occasions when they saw the lights commence to flicker and on three occasions when they saw the lights appear to cease flickering. The mean time on the six trials gave an accurate threshold value for each subject.

Footballing Skill

a) **Trapping Test:** The time taken to bring a soccer ball under control was used as one indication of football skill. The ball was launched from a purpose-built machine (see Fig. 1) so that each ball was delivered to fall in an arc of 10° each side of the launching point and in an area between 6 metres and 12 metres from the machine. Reliability tests had revealed a mean time in transit of 1.53 seconds with a standard deviation of 0.045 seconds when launching on to a sample target. Each player was presented with the same number of trials in the same sequence of presentation and was asked to bring the ball under control as quickly as possible to a previously identified spot. The time from the release of the ball to the moment the ball was trapped under the sole of the foot on the correct spot was recorded. Adequate recovery was permitted between each trial and the mean time on all trials is given as the performance time.

Fig. 1

- b) **Dribbling Test:** The ability to dribble a football was measured by asking players to tightly control a football around a slalom course made by traffic cones. The course was laid out as in Fig. 2. Players were asked to dribble to each of the first four cones in turn, returning between each one to the starting line. On returning from the fourth cone, the player would dribble to the fifth and then weave in and out of the remaining cones, around cone no. 10, in and out of nos. 9-5 and then return to the starting point. The total time taken to complete the course was recorded and performance time given as the mean time of the trials. Adequate rest was given between each trial.

Fig. 2: Layout of slalom course for test of dribbling skill.

- c) **Push Pass Test:** Football sensitivity was measured by the push pass test. Subjects were asked to pass a ball from a starting line, using the inside of the foot so that the ball came to rest as close to the middle of the circle marked on the playing area as possible. There was a distance of 20 metres from the starting line to the centre of the circle. The target consisted of circles of 0.5 metres wide scored from 100 in the middle to 25 in the outer circle. Three blocks of 12 trials were recorded. Performance was recorded as mean score for each trial.

Test item reliability

Several of the items in the battery of tests were subjected to scrutiny for reliability and validity during pilot testing and technician training sessions, prior to their utilisation in the main study. The use of Critical

Flicker Fusion (CFF) is, as Hindmarch (1982) states, a reliable and valid means of measurement of the effects of centrally acting drugs and the same author (Hindmarch, 1980) also shows reaction time to be a reliable and sensitive measure. Of the remaining three tests used, the soccer agility (slalom) test is an adaptation of the agility run represented in most published motor ability test batteries (see e.g. Campbell and Tucker, 1967 and Baumgartner and Jackson, 1975) and in the form used in this study is a part of the Warner test of soccer skills. Both reliability and validity were thus established. The push-pass and ball control measures were assessed for reliability by means of an intraclass correlation coefficient using ANOVA techniques (Winer, 1971). The calculated r values for these tests were $r = .88$ and $r = .81$ respectively. The face validity of the three tests of soccer are apparent and the construct validity of these measures was felt to be demonstrated by the fact that pilot studies showed performance had improved with age and that professional players performed better than good quality amateurs (see Johnson and Nelson, 1979 and Barrow and McGee, 1979).

Urine samples were collected the morning prior to testing to ensure compliance. One player failed to register the minimum level required for detection ($0.2 \mu\text{g/ml}$ on the "scaled up" level); his data was removed from the study.

RESULTS

The mean changes (together with standard deviations) produced by temazepam (40 mg) when compared to placebo are presented in Table I.

Table I Mean and standard deviation of scores on all tests of perceptual-motor skills.

	Placebo	S.D.	Temazepam	S.D.
Critical Flicker Fusion (CFF) (HZ)	32.66	1.36	32.084	2.91
Choice Reaction Time (MSec) (total response latency)	.524	.08	.517	.06
Choice Reaction Time (MSec) (Movement time)	.332	.053	.330	.045
Choice Reaction Time (MSec) (recognition time)	.204	.041	.188	.02
Gross Bodily Choice Reaction Time (MSec) (total response latency)	2.28	.271	2.192	2.45
Gross Bodily Choice Reaction Time (movement time)	1.541	.201	1.535	.127
Gross Bodily Choice Reaction Time (recognition time)	.657	.154	.838	.194
Ball Control (machine) (Secs)	3.241	.371	3.572	.171
Slalom (Secs)	38.770	2.797	40.63	.857
Push Pass (Pts)	290	85.73	330	39.28

The Hartley's test for homogeneity of variance and the SPSS subprogramme CONDESCRIPTIVE to check the normality of the distribution were used. This resulted in the failure to reject the hypothesis of no difference. Thus the assumptions of the analysis of variance were deemed to have been met even though N was small. A two-way ANOVA (groups $\times$ drug) revealed there was no difference among groups (1, 8). A statistical design which tested initial group differences had been utilised to ensure that both placebo and active drug groups were matched for skill level prior to testing. There was some evidence of a slight difference in pre-test skill level before testing commenced on two of the measures. This did not however achieve significance at the .01 level and, indeed, both groups are regarded as highly skilled performers at the peak of their profession.

There was no significant difference on any measures between the temazepam and control groups and no interaction effect, nor were any coherent trends demonstrable.

DISCUSSION

Drugs of the benzodiazepine group are commonly prescribed as night time sedatives and several studies (Maccagnani and Ambrosini, 1970) and Riccioni (1970) have shown that temazepam possesses an activity characteristic of such drugs,

in that it has an anxiety reducing effect as well as a tranquillising and sedative activity. The effects of drug administration, especially in repeated dose regimen have been known to persist for some time following the cessation of treatment, and many metabolites of the benzodiazepine have been detectable for several days afterwards (Garattini et al, 1973).

Studies have frequently demonstrated a tendency for subjects to feel a slight drowsiness the morning following night time medication (Gaillard et al, 1973; Hindmarch, 1975). The half life of temazepam, between four and ten hours (Breimer, 1979) indicates that this drug falls potentially into such a category. Research has shown that 30 mg temazepam, administered orally, induced feelings of drowsiness following overnight administration, such feelings disappearing within four to eight hours of awakening (Hindmarch, 1975).

Morning-after effects such as these, have been attributed to the muscle relaxant properties of these drugs and appear to be a phenomenon which is associated more with higher dose levels. Van der Klein, Vree and Guelen (1977) have demonstrated that the influence of the benzodiazepine on muscle tonus appears to last longer than the behavioural effects. In order to monitor any after-effects in the present study, subjects had been forbidden alcohol on the evening prior to re-testing. None of the players involved gave subjective reports of any drug "hangover" effects or felt any impairment when reporting for re-testing. There was no evidence of any improvement in the performance on measures tested, since practice on the afternoon of day one had ensured the elimination of learning effects.

Hindmarch (1976) in a previous study on temazepam using 10 mg, 20 mg, 30 mg and matching placebo in a repeated dose design had shown little effect on measures of arousal and performance, following night time medication, particularly in the low doses. Statistical significance was, however, reached at 30 mg on measures of choice reaction time. In the present study, choice reaction time was not affected by 40 mg when re-testing took place the following afternoon. Fergus and Hindmarch (1974) demonstrated no significant effect on performance on a driving simulator following administration of 20 mg, 30 mg and placebo. Re-testing took place between 8.30 a.m. and 10.30 a.m., the morning following administration.

In spite of the frequent demonstrations of the morning-after debilitating effects of benzodiazepine (particularly in the higher doses levels and when taken repeatedly), the use of benzodiazepines has become increasingly prevalent in contemporary life. In a recent article Gillie (1983) has shown that temazepam has been used to adjust sleep patterns in fighter pilots during demanding battle conditions. The officer in charge of the administration of the drug felt that such a use could only work on highly trained people. It should be borne in mind when considering the results of this study that the subjects were all extremely well-conditioned professional athletes who were in a state of match fitness. Such subjects may well be able to withstand or overcome any "hangover" effects more readily than less well-conditioned people.

Hindmarch (1982) has illustrated the susceptibility of Critical Flicker Fusion Frequency to the effects of psychotropic compounds in general, and specifically to temazepam. Subjects in this study demonstrated no significant change in cortical integrative activity. In addition, the three tests of Association football (which in these subjects are well-learned skills) registered little change in performance levels on the afternoon of the day following night time medication.

One interesting feature of the research was the poor relationship between the scores of subjects on the conventionally used laboratory analogue for perceptual-motor skill i.e. choice reaction time (CRT), and their scores on gross bodily choice reaction time (GBCRT) which has much greater face validity.

Since neither CRT nor GBCRT showed any significant differences between drug and placebo, and correlation coefficients between each set of three measures (.185 for total response latency, .426 for recognition time and .08 for motor time) did not achieve significance, an additional measure, the coefficient of determination, was computed as this is a useful method of measuring the "generality" between skills. These were .034, .181, .006 for total response latency, recognition time and motor time respectively. Such low figures suggest the two tests are measuring fairly discrete skills. This may well indicate that it is dangerous to claim that choice reaction time is an analogue for movements involving greater muscular groups or movements which require the subject to co-ordinate the movement of the whole body in time and space. Gross bodily choice reaction time would seem to present a more realistic measure and dissatisfaction with traditional indices seem to have been justified.

Table II Summary of ANOVA analysis of performance changes.

	Source of Variation		Interaction Subjects x Dose
	Main Effects Subjects	Dose	
Push Pass	.496	.719	.799
Slalom	6.593	1.47	2.26
Ball Control (machine)	6.442	1.50	.137
CFF	1.465	.379	4.64
GBCRT (TRL)	.402	.496	.842
(RT)	3.033	.617	0.18
(MT)	.618	.160	2.34
CRT (TRL)	.190	.050	.988
(RT)	.007	.164	.382
(MT)	.023	.540	1.35

* $P < .01$

This study, whilst attempting to replicate the types of skill encountered in Association football and to adopt the sort of regimen a club medical officer would follow when using an anxiolytic/hypnotic drug, did not include such variables as travel across time zones and the consequent disruption of sleep patterns nor changes in diet. These factors may well interact with the administration of psychoactive compounds to alter normal levels of performance and offer a fruitful avenue for further exploration.

Little research has been carried out using a time schedule similar to the one adopted in this study and utilising an acute dose, yet many people need to control patterns of sleep in order to ensure optimal levels of performance on some cognitive or perceptual-motor task. Indeed little research has been structured to monitor drug effects on measures which so closely resemble real tasks in an environment created to resemble that in which the task is performed. Nevertheless, within the limitations of this study, no deterioration in performance was detected under medication with temazepam on skills closely matching those required by professional footballers on the day following night time administration. Furthermore no trends were observed which might have indicated that temazepam did affect performance adversely.

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