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Synopsis

Technological breakthroughs in modern day Pupillometry have increased knowledge of pupillary dynamics. Pupillometry has helped focus such applications as diagnosing Alzheimer's disease, human fatigue, and chemical/substance abuse and for other ophthalmologic diagnostic applications. For these and other applications, it is important to monitor the time response of the pupil as the eye is subjected to various lighting conditions. A Pupillometer flashes a beam of light on the subject's eyes and records their pupillary response.

Experts agree that the development of an accurate, cost-effective, portable Pupillometer would aid in detecting impairments caused by fatigue, alcohol/drug, bio-chemical and biological substances. To apply this body of knowledge outside of the laboratory has been difficult due to a lack of practical, cost-effective instrumentation that could be readily applied by Law Enforcement, Transportation, Military, and Rail and Heavy Vehicle operations. Specifically, the pupillometers have suffered from problems including alignment size/complexity, and cost. MCJ, Inc. has developed and initially demonstrated a technology that has overcome these problems.

The Pupillometer resembles a large pair of binoculars. The test subject raises the Pupillometer to his/her eyes and holds it there during the test. The Pupillometer will determine when proper alignment occurs with the test subject's eye and then initiates a flash of light originating from two green light emitting diodes (LED's). The duration of the flash is approximately 100 milliseconds. The flash will cause the test subject's pupils to contract rapidly and then begin to dilate. The Pupillometer will measure the contraction and dilation of the pupil over a 3-second period starting when the LED initiates its flash. The test will be repeated another 2 times and at the conclusion of the final test, the Pupillometer will determine an average of the 3 tests. Algorithms have been developed with a PASS/FAIL indicator.

This non-invasive Pupillometer is designed to give a strong indication that Bio-Chemical Inhalants, Biological Agents, Alcohol or Drugs impair the Test Subject. Second, the device is designed to give reliable indications of these impairments. The Pupillometer will reduce job related accidents caused by impairment increase highway safety, and decrease damage to property and lost productivity due to injury; almost every industry would benefit economically and socially.
San Diego County Probation
Pupillometer Pilot Study – Summary of Results

The EyeCheck™ pupillometer pilot was conducted during November 2001. The goal of the pilot program was to compare the findings of test results using both the EyeCheck™ pupillometer and urinalysis screening. Norchem Laboratories conducted the urine tests at a zero cut-off level at pre-screening.

The following people were not included in the study results.
- Juveniles
- Pregnant offenders
- Those offenders who have had RK or Lasek Surgery within two weeks of the test.
- Offenders over age 50
- Offenders that have suffered from an eye or head injury.

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Exams analyzed.................146

False positives (tests positive on the pupillometer and negative on urine) include samples that were positive on urine screens below NIDA threshold for “positive.”

The critical result for “false negatives” (tests negative on pupillometer and positive on urine) was 3 percent. Both false negatives and false positives, are expected to be even less as we gain experience using the device.
The Eye Check™ pupillometer system must be considered strictly a “screening device” to better utilize our urine testing resources. Where applied, EyeCheck™ pupillometer will reduce the number of urine tests needed by 56 percent. If used for all testing in probation, this would mean about $150,000 a year in savings.
"EyeCheck Comparison" by Champaign County, Illinois Probation and Court Services Department January 2003

EYECHECK COMPARISON

WHAT IS EyeCheck?

The MCJ EyeCheck Pupillometer website, describes the EyeCheck Pupillometer as "a lightweight, hand-held instrument that measures the absolute pupil dynamics to presumptively detect drugs and intoxicants….With immediate results." The instrument is used by law enforcement, corrections (including probation and parole) and the instrument is used as a tool in private employment testing.

WHAT PROMPTED A REVIEW OF THE EyeCheck INSTRUMENT?

Several months ago, a sales representative from MCJ EyeCheck contacted the department and asked if we were interested in previewing a pre-screening drug-testing tool. In a subsequent conversation, the department agreed to test the instrument for 30 days in an attempt to determine the accuracy of the instrument. At that time, we knew very little about the instrument capabilities; however, the offer was very appealing. Accordingly, on 11/22/02, the Champaign County Probation and Court Services Department agreed to conduct testing on the EyeCheck instrument. After a brief training period conducted by the EyeCheck representative, three officers from the department were assigned to conduct testing. The training was not intended to be in-depth, but was sufficient to provide officers with a general understanding of how to use and interpret results. Department protocol for the drug testing process was established. In essence, if an adult offender was tested on EyeCheck, he/she was also to be tested on our AXSYM. Each test result on EyeCheck was later compared to the results obtained on the AXSYM. A review of test results, using two separate instruments (EyeCheck and AXSYM) was then evaluated following the term of the testing period.
Initially, the intent was to compare results on approximately 100 samples. Since the department was afforded a longer period to test the instrument, 169 samples were actually compared.

By comparing the results of the EyeCheck against results of FPIA testing via the AXSYM drug-testing instrument of Abbott Labs, we hoped to get an idea as to the feasibility of using the apparatus for the department. The drug-testing instrument we presently use is the AXSYM. It is a proven and an accepted instrument-based testing mechanism; commonly used by hospitals and clinics. The AXSYM instrument provides an exact numerical result in nanograms per milliliter NG/ML.

WHAT ARE THE ADVANTAGES TO USING THE EyeCheck INSTRUMENT?

In addition to the information previously noted, the instrument is lightweight and portable. Consequently, the instrument could be used at a number of locations. In addition to the viewing instrument and the EyeCheck software, the only other component of the system is the computer (we used a laptop during the testing period). The testing process in non-evasive (eliminating the need for officers to handle hazardous body fluid, or view the collection of urine) and very little amount of time is necessary for training on the instrument. Upon being trained, EyeCheck is easy to use and provides almost immediate results. All data is collected, recorded and stored. The results are displayed on the computer screen with data noting either a pass or fail test result. Another major advantage to the apparatus is cost effectiveness. The cost of the viewing instrument and software is $7800; with no recurring costs.

WHY CONSIDER USING EyeCheck?

During the last fiscal year, officers of the Champaign County Probation and Court Services conducted 2344 drug tests. Each test generally consisted of a 3 or 4 drug panel test. Of the 2344 test completed, 58% of the tests were determined to be negative (1360 negative test results). If the EyeCheck is a reliable pre-screening instrument, then Champaign County could realize a substantial savings by doing fewer tests on the AXYSM.
WHAT ARE THE DISADVANTAGES ASSOCIATED WITH THE USE OF THE EyeCheck INSTRUMENT?

As noted by the sales representative, the EyeCheck is not intended to be a pre-screening drug-testing tool for everyone. Certain situations/conditions may affect the results of the testing. For instance, a person who has experienced a serious head/eye injury may prompt a positive test result even though the person may not have any altering substance in his/her system. Some other examples of situations/conditions that may have a bearing on test results include the following:

" Not recommended for individuals under the age of 16
" Not recommended for individuals over the age 50
" Not considered to be a reliable testing instrument for pregnant women

It should be noted that EyeCheck is a pre-screening instrument to determine possible impairment and not a replacement for urinalysis. A positive result on EyeCheck alone should not be used as a basis for issuing a sanction. A confirmation by urinalysis testing, or by some other accepted testing procedure is a necessary component for this pre-screening drug testing apparatus.

IMPRESSIONS

During our testing period, 169 individuals participated in the review of the EyeCheck apparatus. Following each EyeCheck test, the participant was also required to provide a urine sample later tested on the AXSYM. The results indicate that during the testing period, 71 individuals tested positive on EyeCheck and 4 individuals obtained yellow indications (a yellow result means the test result was so close to the dividing parameters that the test could either be positive or negative). With that thought in mind, a total 75 (71 plus the 4 tests previously noted) individuals were considered to have positive test results. Approximately half of the 75 (38) tested positive in at least one or more of the panels conducted on the AXSYM (either a 3 or 4 panel test). This does not mean 37 people tested negative and had no altering substance in
their system. It only means that since we only tested for three or four drugs, these individuals could have been positive for other drugs not tested; such as alcohol, barbiturates, benzodiazepines, inhalants or some other substance.

Of all the individuals tested, 18 offenders blinked and could not complete the test on the EyeCheck instrument. For a test to be successful, the participant must keep his/her eyes open for approximately 6 seconds, when instructed to do so. Generally, it is our impression that only on rare occasions would a person not be able to successfully complete the test. The officers further expressed the opinion that the blinkers did so in an attempt to spoil the test results. Of the 18 individuals who blinked, 11 of the 18 were determined to have an illegal substance in their system following the AXSYM test. At the end of the testing period, it became evident to the officers completing the tests that the blinking was intentional (by reviewing the straight lines on the graphs indicating it was not a blink, but an intentional closure of the eyes).

There were 76 EyeCheck tests resulting in negative indications. Of this number, six turned out positive on urinalysis. Though this was certainly a problem and a cause for concern, the most recent software was not available for this test and the new software, reportedly, is more sensitive to blinks. The software will prompt the officer conducting the test that the person had blinked. In one instance, the individual was on a prescribed pain medication for a period of time that could have resulted in a negative indication on the EyeCheck.

The most significant aspect of the five negative indications is that they all occurred between 11/26/02 and 12/10/02. All negative results on EyeCheck taken between 12/10/02 and 12/31/02 were later determined to be negative through urinalysis testing. One can speculate that toward the end of the testing period, officers conducting the tests were more familiar with the instrument. Consequently, better results were noticed as officers became more familiar with the instrument.
Based on other surveys conducted on the EyeCheck, we expected a 3% false negative result; which is considered acceptable percentage. The 5 false negatives out of 169 tests is a 2.9% false negative result. If you only use the three unexplained results, then the false negative result would be 1.7%. Both results (2.9% or 1.7%) were within the expected variance for a pre-screening drug-testing tool.

ADDITIONAL POINTS WORTH NOTING:

- Blinkers were positive 61% of the time.
- False negatives were within the acceptable range of 3%.
- The testers accuracy improved after approximately 2 weeks of regular use of the device
- Since a urine sample is not needed, EyeCheck is not affected by dilution or substitution
- It takes 3-5 minutes to administer the EyeCheck
- THC may not be detectable beyond current impairment. Although THC may stay in your system for 30 days or more, Eyecheck may not detect this extended time.
- If an individual falls into that 3% (passes the EyeCheck and is positive on urinalysis) this would not be acceptable. However, since we will use this test more frequently than urinalysis, this individual would be subject to more tests and eventually determined to be positive on subsequent tests.

Champaign County Probation and Court Services was searching for a way to reduce the cost of drug testing without lowering the number of test needed to adequately monitor compliance and not compromise the accuracy of the test. Although EyeCheck is not 100% accurate (no test is), officers conducting the test found it to be acceptable pre-screen drug testing device.

IT SHOULD BE NOTED THAT THIS WAS NOT A SCIENTIFIC STUDY AND THE DEPARTMENT MAKES NO SPECIFIC CLAIM BASED ON DATA PROVIDED. INFORMATION CONTAINED IN THIS DOCUMENT NOTES THE IMPRESSIONS OF THE OFFICERS INVOLVED IN THE TESTING
PROCESS. FINALLY, THE AFOREMENTIONED INFORMATION IS NOT INTENDED TO BE AN ENDORSEMENT OF THE EYECHECK INSTRUMENT.

Joseph J. Gordon, Director
Champaign County Probation and Court Services Department
Illinois State Police
Study of Pupillometry used in Law Enforcement

In 1996, the Illinois State Police (ISP) began measuring pupillary response with the EyeCheck™ instrument. The EyeCheck™ instrument was developed by MCJ, Inc. Rockford, Illinois. MCJ Inc. is a research and development company which investigates non-invasive technologies for determining impairment with biometrics. EyeCheck™ is a non-invasive instrument, which introduces a light stimulus to a subject's pupil, and measure the subsequent pupillary reaction or pupillary dynamic. Pupillary movement provides indications of activity within the body's central nervous system. Interpretation of pupillary reaction has assisted in determining possible impairment caused by alcohol, drugs, or fatigue.

On July 1, 2000, Public Act 91-881 was passed and amended 625ILCS 5/11-501/5 by adding paragraph (b) to the section. The added paragraph states, "The Department of the State Police shall create a pilot program to establish the effectiveness of the pupillometer technology..." The bill mandated an 18-month pilot program utilizing 15 instruments. The purpose of the project was to determine if pupillometer technology could detect motor vehicle drivers' impairment caused by alcohol and or drugs. In addition, the amendment specified the measurement of fatigue levels in commercial motor vehicle drivers. A training curriculum was developed by the ISP Academy staff and MCJ Inc. to accomplish the mandate set by Public Act 91-881.

The pilot involved collecting data for 18-months and on November 15, 2001, data was forwarded to the New England College of Optometry for analysis. Upon analysis, it was concluded Pupillometry can be used as an objective measure to screen and identify reduced alertness as a result of sleepiness or fatigue. It was also determined pupillometry can be used to screen and identify subjects potentially under the influence of drugs.

Pupillometry has proven, through empirical testing, to be an effective tool which can assist in the detection, confirmation, and ultimate prosecution of impaired drivers. Impairment not involving alcohol can be difficult to identify and even more difficult to confirm and prove. The use of the pupillometer as a screening instrument would aid in identifying impairment and expedite roadside evaluation of a suspected impaired driver.
**West Virginia Division of Corrections, Toxicology data match and EyeCheck™ Pupillometry, on inmates, parole, probations, work release and personnel, August-September 1999**

February 18, 1998
Report to the Commissioner,
West Virginia Division of Corrections

**EyeCheck vs. Urine Toxicology**
Utilizing parole, probation, work release and corrections inmates at Mount Olive, Prunytown, Huntington, and Charleston West Virginia, under a cooperative agreement with the State of Illinois and West Virginia, 116 clients were tested using the following procedures:

All urine collection, instant checking using Gene Cup, Accusign, Med Tox, and iris scanning using the EyeCheck was conducted at the respective facilities. Emit was also used for screening at the West Virginia Laboratory in the Anthony Correctional facility. Once this was completed the urine was frozen and sent to the Illinois State Police Crime Lab in Chicago for additional EMIT testing and final GC/MS confirmatory testing. **The match of the urine was for only the positive presence of drugs and not for the identification of drug types.** The data was then match against the EyCheck for Pass/Fail indicators. The collection, testing and analysis were conducted under the supervision of the Institutional Review Board of the University of Illinois. The Illinois State Police in West Virginia conducted collection of all data, to include urine and iris scanning.

All instant checks were confirmed by GC/MS, additionally GC/MS identified more than the instant checks. Although drug classification was not match in this study, it is clear that the instant five panel screens are far less accurate than EyeCheck or GC/MS. Which indicates that more illicit drugs are being used than previously thought, to include inhalants.

Of the 20 EyeCheck identified, 17 were match with GCMS, which indicates a 90% accuracy for the EyeCheck when compare to GCMS. When compared to EMIT from West Virginia and the Chicago Crime Lab, EyeCheck had matched and exceeded this testing when confirmed by GC/MS. The question of the additional 3, which EyeCheck identified as having drugs, was identified as inhalants, which EMIT or GCMS could not have identified.

In conclusion, the EyeCheck could be a useful instrument for the screening of drugs to eliminate unneeded urine test.
USE OF THE EYECHECK™ PUPILLOMETER FOR THE DETECTION OF FATIGUE DO TO SLEEP DEPRIVATION.

This document was prepared by Dr. Jack E. Richman of the New England College of Optometry, Boston MA. Through a contract with the Illinois State Police and is submitted to the General Assembly of the State of Illinois pursuant to Public Act 91-0881 to amend the Illinois State Motor Vehicle Code by changing Section 11-501.5

1. FATIGUE

Goal:

To determine the capability of the EyeCheck™ pupillometer to discriminate and identify fatigue and sleep deprived impaired subjects from normal (non impaired).

1.1 Subjects

To establish the effect of lack of sleep and related fatigue on behavior of the pupil, forty eight volunteer subjects were recruited from Illinois State Police Academy. Each was screened for any medical conditions, eye abnormalities, had reportedly not been awake greater than ten hours, and were reportedly free of any pharmacological agents. This was confirmed with urinalysis employing a comprehensive drug screen, which complies with Federal (SAMHSA) regulations.

There were 83% males and 17% females ranging in age from 21-40 years of age with a mean and median age of 28 years of age. Consent to participate in pupillometry was obtained from each subject after the nature of the procedure had been explained fully.

1.2 Method

All the subjects were instructed to sleep at home for the entire night. Upon awakening they were instructed to avoid alcohol, caffeine and strenuous physical activity, which are known to alter papillary activity.
Each subject agreed to remain wake for a twenty-four hour period in which their pupils would be assessed five times every six hours. This provided a baseline (alert, non sleep deprived) pupil activity profile, then one at six hours, twelve hours, eighteen hours, and finally twenty-four of wakefulness.

Subjects were seated with the pupillometer in a relatively quiet darkened room. Since previous studies have shown that when alert subjects sit in a darkened environment, their pupils remain dilated and relatively stable in size and fluctuation. Drifts toward smaller pupil diameter (miosis) occurs more in fatigued versus alert persons. Fluctuations and change in pupil size is also consistently reported. When these changes are monitored, changes in alertness can be measured. Based on this approach, the examiner followed the instructions for administration of the EyeCheck™. The subjects were allowed to dark adapt for 90 seconds before pupil diameter was continuously measured for a period of eight minutes. The pupil size was sampled continuously each tenth of a second and measured to a hundredth of a millimeter in size. Once this data was collected on the subject, an analysis was performed on the data by the EyeCheck™ pupillometer and the accompanying laptop computer and software. If pupil size decreases while variability increases, then we may be able to identify pupillary criterion that can identify sleepiness and reduced alertness. These oscillations had a tendency to increase during the 10-minute duration of the test, while the subject was sitting in the dark quiet examination room.

1.3 Results: Cumulative Miosis. In this investigation, the CM value for all subjects was compared in the alert stage (Normative value) with the CM value after 18 hours of sleep deprivation. A paired t-test indicated that there was a significant difference between the alert and sleep deprived conditions (p<.01). The sensitivity was 81.82% and the specificity was 94.29%. The positive predictive value, i.e., does a randomly selected subject from the population actually have the problem, was 93.10%. The negative predictive value, i.e., does a randomly selected subject from the population not exhibit problem, was 84.62%. This indicates that the EyeCheck™ pupillometer, using this parameter as a physiological objective measure, evaluation identified reduced alertness as a product of sleepiness and fatigue.

Our results, like those of other investigators, demonstrated that pupillary parameters such as changes in pupil size and fluctuations can identify sleepiness and reduced alertness.
The Sensitivity and specificity of infrared Pupillometry measurements in identifying drug impairment in a county probation program

Presented December 12-15, 2002 San Diego CA

Scientific Program American Academy of Optometry

Author: Jack Richman Affiliation: The New England College of Optometry
Co-author(s) Roberto S. Noriega , San Diego County Dept. of Probations

Introduction:

In California, there are approximately 600,000 probationers within the criminal justice system. Drug testing is an important tool to reduce health and workplace costs and to monitor criminal offenders. Unlawful drug use is a violation of the conditions of probation and periodic drug testing is an effective method to deter and to detect drug use. Unlike most forms of misconduct, it leaves a chemical trace that can be detected reliably by relatively inexpensive tests. San Diego and Los Angeles have fairly elaborate testing programs, but neither tests more than a small proportion of its clients. 1

Frequent testing is essential to reducing the rate of drug use. Once-a-week testing produces about a 35% chance of detecting any given incident of drug use. Industry and law enforcement, e.g., probation departments, employ drug screening to check for drug free compliance. Drug testing (urinalysis) itself is relatively low-cost, between $5 and $10 per test. However, when such testing is performed thousands of times per month, the cost may be quite costly and possibly prohibitive for an effective compliance program.

An alternative or adjunct approach may utilize newer non-invasive physiological methods that measure impairment. These may be more efficient and less costly than urinalysis. One such method is pupillometry. Alterations in pupillary reactions have been shown to be related to the presence of drugs. 2,3,4. The use of photographic, videographic, and/or infra-red pupillometry
has been employed experimentally and commercially for the detection of physiological impairment. 5-10
If an alternative or adjunct approach, e.g., infrared pupillometry, to measure impairment can be demonstrated to be effective, then more effective compliance in monitoring probationers may be achieved.

Purpose: The objective of this pilot program was to determine the sensitivity and specificity of a commercially available pupillometer to detect possible impairment due to drugs when compared with urinalysis.

**Methods:**

**Subjects:**
The subjects were defendants on probation with the San Diego County Dept. of Probation in San Diego County, California. Participating were one hundred forty six subjects, aged 18-50 years (Mean 34.3(10.2) years) with 72% male and 18% females. These subjects were on a frequent drug testing schedule ranging from weekly to monthly. They were tested on a random basis. Each one was given instructions to call a recorded message each night and to listen for a color, assigned to them by staff. When their color came up, they were instructed to report to the probation office for testing the next day. Each subject was tested at least once.

**Method**

When tested, each subject received two procedures for possible drug impairment: (1) the standard urinalysis, using the Gas Chromatography Mass Spectrum (GCMS) method to determine the presence of drugs, and (2) measurement of pupillary responses by a trained probation staff member using the MCJ Inc. Eye Check™ infrared pupillometer.

Pupillometer Procedure:
At the beginning of each test, a verbal survey was conducted. Subjects were asked several screening questions: (1) Informed consent and permission to participate in the study, (2) Had they ever suffered a serious head or eye injury, and (3) their age. Before a subject was deemed suitable for screening,
personal and historical information was entered into the Eye Check™ computer program. Information entered included; identification number, probation officer’s name, age, nationality and any other pertinent information, such as medications taken. When all of the information was entered, the subject was instructed to pickup the Eye Check™ Pupillometer instrument. The instrument weighs approximately 2 lbs. and is held similar to a pair of binoculars with peripheral eye shields to exclude light. They are instructed to look into it, and focus on a red crosshair with the eye being tested.

At the start of each test, subjects were told not to remove the instrument from their eyes until instructed to do so at the end of the test. During a thirty second adaptation to the dark, the participants were told that they would see a series of three green flashing lights with five second intervals, between each flash. The subjects were told that they could blink as needed during the dark adapt time period and between flashes. To further clarify the instructions, subjects were told that they would be instructed when to blink and not to blink. Other instructions given were; do not chew gum, do not speak and remain as still as possible during the test. The instrument and software tracks the pupil’s reaction response to a light stimuli. The pupillary dynamics are collected, recorded, and stored.

Based on the proprietary algorithms in the Eye Check™ software which is measuring the initial pupil diameter, a controlled flash of light, the light reflex reaction including the time to initiate the pupil constriction, the length of time to full constriction, the final pupil diameter, and the change in pupil size from the dark to light condition, a determination of possible drug impairment vs. normal is made. The data is then processed and the results are displayed on your computer screen. The displayed data indicates a PASS/FAIL results.

Results: The objective of this investigation was to determine the sensitivity and specificity of a commercially available pupillometer to detect possible impairment due to drugs when compared with urinalysis. In this study, the sensitivity and specificity of the Eye Check™ pupillometer in detecting potential presence of drugs was determined. The presence or absence of a pharmacological agent was confirmed with urinalysis employing a
comprehensive drug screen (GMSA). The drugs identified by toxicological evaluation included marijuana, stimulants, including amphetamine, cocaine, tranquilizers, and opiates, including heroin.

Applying the positive vs. negative for impairment criteria and scores as part of the analysis software by the manufacturer, the sensitivity and specificity of the Eye Check™ pupillometer was assessed. The results were based on a total 126 subjects since approximately fourteen percent of the tests conducted on the original 146 subjects were inconclusive on the Eye Check™ due to various reasons, e.g., defendant's history of drug abuse, prescribed medications, medical conditions, and operator training. Of these, sixty-five percent were negative for drugs or impairment on the Eye Check™ Pupillometer and urine screen. Fifteen percent of the tests conducted were positive on both the Eye Check™ Pupillometer and urine screen for a variety of drugs. Seventeen percent were considered false positives on the Eye Check™ and three percent were considered false negative.

Based on this, The Eye Check™ appears to differentiate subjects who were potentially drug impaired from normal in the majority of cases. The sensitivity was 86.2% and the specificity was 78.85%.

Discussion:

It should be noted that many subjects tested were under the care of physicians and were occasionally prescribed pain and or psychototropic medications. These prescribed drugs may have impacted the results of the pupil tests. The Eye Check™ system rated these tests as positive where urine screening was designed to ruled out the presence of higher dosage level street drugs.

What was the economic and drug free compliance outcome in this study? Based upon the first five months of this fiscal year it is projected that the San Diego County Probation Department will have conducted over 48,000 urine tests. The cost of a five panel urine toxicological screening test is $6.55. The estimated total cost for five panel drug screens a year is over $300,000. In
this study, it was found that 65% of the probation subjects were identified with the Eye Check™ Pupillometer as non drug impaired and confirmed with urine drug tests. Using the pupillometer solely, the Probation Department could have saved more than half of the drug test expenditure. These funds could have been applied to more frequent testing and drug free compliance which is essential to reducing the rate of drug use.

Why is there a potential difference between the presence of measurable impairment, e.g., pupils, and the presence of a chemical substance, e.g., urinalysis. Drugs create impairment in various central nervous system functions. It may be exhibited in various ways in an impaired individual e.g., slurred speech, bloodshot eyes, difficulty balancing and walking. Many drugs, e.g., cocaine, opiates, alcohol, and marijuana, have short duration of their effects. It is during that period of the activity where the impairment is apparent. When the drug has worn off, the signs of the impairment are gone or have diminished significantly. However, the presence of a drug or drugs in urine does not provide information as to whether the individual is actually under the influence of the particular drug at that time unless impairment is measured concurrently. Likewise, no determination can be made from urine as to the amount of or the time of the dose. For example, when smoked, the effects of cannabis begin almost immediately. The effects of smoked cannabis peak after about 20 minutes and last for 1-2 hours, however, the presence of cannabis metabolites may be present in the urine for 24 to 72 hours from a single use.

Consequently, the presence of the drug in the urine does not necessarily indicate impairment. It is fully possible to have a positive toxicological result without any sign of impairment. This was evident in several subjects in this study. As long as this discrepancy is recognized, the use of physiological based tests of impairment when compared with toxicological results will have appropriate meaning to the examiner.

**Conclusions:** The Eye Check™ pupillometer appears to effectively differentiate drug impaired subjects from normals in this study. The fifty-six
percent identified as non drug impaired represents the number of subjects that could have been tested using the pupillometer alone yielding significant economic savings and probation staff time. Pupillometry has demonstrated its value as a tool in screening for drugs. Overall, it appears to be a valid and cost effective tool for its intended purpose. It requires minimal training to operate, is portable, and is adaptable to a variety of drug testing and screening programs. Further familiarization with the instrument, improved differential algorithms, and improved training in its use will most likely increase its sensitivity and specificity.

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EFFECTS OF ANTIDEPRESSANTS ON THE HUMAN PUPIL
E. Szabadi and C.M. Bradshaw 24th Pupil Colloquium
http://www.jiscmail.ac.uk/files/PUPIL/ca.htm
http://www.jiscmail.ac.uk/files/PUPIL/col22abs.htm
http://www.jiscmail.ac.uk/files/PUPIL/absbook.htm23rd Pupil Colloquium, held in Nottingham, U.K. in August 1999


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