In The Horizontal Gaze Nystagmus Test: Fraudulent Science in the American Courts, 44 SCI. & JUST. 133 (2004), J.L. Booker argues that the HGN test is “fundamentally flawed” and that the United States Department of Transportation “indulged in deliberate fraud in order to mislead the law enforcement and legal communities into believing the test was scientifically meritorious and overvaluing its worth in the context of criminal evidence.” The article is replete with hyperbole and flawed reasoning, factually and legally. Because of space limitations, this review addresses only the most important claims and errors.

BACKGROUND: THE HGN TEST

Examination of a suspect’s eyes for HGN is a widely-used and effective standardized field sobriety test. Officers use the test to identify the presence of alcohol or certain other impairing substances. When administering the test, officers examine each of the test subject’s eyes for distinct jerkiness at maximum deviation, lack of smooth pursuit and an angle of onset prior to 45 degrees. The criterion for a positive test is four or more “cues” or “clues.”

A POINT-COUNTERPOINT REVIEW

Preamble

The Horizontal Gaze Nystagmus (HGN) test was conceived, developed and promulgated as a simple procedure for the determination of the blood alcohol concentration of drivers suspected of driving while intoxicated (DWI)

The preamble misrepresents law enforcement’s use of the HGN test. Officers are taught that neither the HGN test, nor any of the other field sobriety tests, proves intoxication beyond a reasonable doubt; they are taught about alternative causes of impairment. Officers do not make a decision or reach an opinion on one piece of evidence or a single test. Rather, they assess the “totality of the circumstances.”

Introduction

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For ease of understanding, this review follows the structure of the original article.
The Horizontal Gaze Nystagmus (HGN) test is the most widely applied toxicological procedure in the United States of America. Developed between 1974 and 1983 in a federally-funded program sponsored by the National Highway Transportation Safety Administration.

NHTSA stands for National Highway Traffic Safety Administration. Further, the HGN test is not a “toxicological procedure” as that phrase is normally applied.

... the HGN test flew directly in the face of established medical and toxicological opinion that simple clinical tests were inadequate for the task of establishing intoxication.

This statement is not accurate. As noted above, officers are taught to rely on the totality of the circumstances, their common sense and investigative skills.

Although its merit as a scientific test might have been disputed, its value as a political matter is not in doubt: important voting constituencies that supported the American president elected in 1980 were the ‘religious right’, a fundamentalist coalition of religious groups that eschew the use of alcohol, the ‘moral majority’, a political group that also espoused prohibition, and the soon-to-be-important Mothers Against Drunk Driving (MADD) which still advocates similar views.

MADD does not advocate prohibition. Rather, MADD has a policy for “the Responsible Use of Alcohol: “MADD urges that those Americans of drinking age who choose to drink do so in a responsible manner, avoiding any driving after drinking.” See http://www.madd.org/activism/1,1056,1621,00.html#use (last verified February 8, 2005).

In 1996 the fundamental competence of the scientific basis of the standardized battery of field sobriety tests was challenged with the exposure of an internal paradox that implied the work was poorly researched and inadequately reviewed prior to its adoption by the National Highway Transportation Safety Administration.

Booker cites only one source to support his claim: an article he wrote entitled “The Field Test Paradox,” published by the Texas Criminal Defense Lawyer Association (TCDLA) in its newsletter, Voice for the Defense, in 1996.

In 1998 the integrity of the statistical evaluation of the original research upon which the validity of the tests rested was unfavorably reviewed.

Booker cites only one source to support his claim; an article he wrote entitled, “The Application of the ‘Known and Potential Rate of Error’ Criterion to the Standardized Battery of Field Sobriety Tests,” published by the TCDLA in Voice for the Defense in 1998.

In 2001 new research indicated that the Horizontal Gaze Nystagmus (HGN), the cornerstone of the test battery [sic] was fundamentally flawed and that the HGN test was
improperly conducted by more than 95% of the police officers who used it to examine drivers suspected of driving while intoxicated.

Again, Booker cites only one source for this claim; an article he wrote named “End-Point Nystagmus as an Indicator of Ethanol Intoxication.” See 41 SCI. & JUST. 113 (2001). In that article, Booker presented research he conducted on end point nystagmus. The article are of questionable value.²

Booker conducted two experiments. In the first experiment, Booker purported to study “the validity of the HGN test” under laboratory conditions using volunteer test subjects. However, Booker only assessed end point nystagmus; thereby failing to assess two-thirds of the HGN test! Booker’s decision to limit his experiment to end point nystagmus is particularly curious given his recognition that “[t]he signature element of the HGN test is the criterion of discernible nystagmus appearing before the eyes are deviated 45 degrees laterally.” See 44 SCI. & JUST. at 145. Further, he provided results in terms of whether a subject exhibited nystagmus in “one or both eyes.” Because a subject with nystagmus in one eye can only score a maximum of three clues, no officer would identify a subject with nystagmus in one eye as impaired using the HGN test.

In the first experiment, Booker split the volunteers into two groups and did a two-part evaluation. During the first part, he assessed the effects of fatigue on end point nystagmus; in the second, he assessed the effects of alcohol on end point nystagmus. All of the examinations were reportedly conducted in accordance with the student and instructor manuals used to train police officers. However, no information was provided about the person(s) who administered the tests and what training, if any, they had. Therefore, it is impossible to discern whether the test administrator(s) and evaluator(s) were qualified to assess the subjects’ nystagmus.

During the first part of the first experiment, Booker reported that the effects of fatigue on nystagmus were assessed in 66 volunteers. The article did not indicate whether any of the subjects had nystagmus naturally. The subjects were examined after being awake for a between 9.0 and 14.5 hours. They were then re-examined after 13 to 14 hours of continuous mental and physical activity. Booker reported that “subjects had distinct nystagmus in one or both eyes after being awake for an average of 11.2 hours,” but did not indicate how many subjects he was referring to. He further indicated that “[d]istinct end position nystagmus was observed in one or both eyes of 55% of the group examined after being awake for an average of 24.5 hours.”

² Even the introduction to that article contained multiple mistakes. Notably, Booker claimed that the HGN test was “accepted for stand-alone use only for the purpose of evaluating the chemical concentration of alcohol in the blood…” This is not true. See infra. Booker also claimed that test proponents believed that the HGN test “qualitatively [identified] ethanol as the intoxicant by correlating the lateral angle of nystagmus onset with BAC.” This also is erroneous. It is universally accepted that HGN is not specific to ethanol. See infra. Police officers are taught that there are multiple causes of nystagmus and that all depressants, inhalants and phencyclidine (PCP) cause HGN. A person’s BAC correlates with the angle of onset of nystagmus only when that person is not also under the influence of one of these drug classes and the person has no interfering medical conditions.
Stephen K. Talpins

April 2005

Booker noted that “about 70 percent of DWI arrests are made between 11:00 p.m. and 5:00 a.m.” and concluded that “the HGN test has routinely been applied in situations where a high incidence of false positives is to be expected.” No arrest data is cited to support the notion that innocent people could be or were being falsely arrested for DUI. Further, the fact that so many arrests are made during those hours may not be significant because there is no data on how long the arrestees were awake prior to their arrests. If, for example, someone sleeps during the day, then late night-early morning arrests may not evidence that fatigue was present.

During the second part of the first “experiment,” Booker assessed the effects of alcohol on nystagmus in 89 volunteers. Nineteen percent (19%) of the subjects exhibited nystagmus in one or both eyes prior to being dosed, but it is unclear whether any of these subjects were excluded from the remainder of the study. To measure the subjects’ breath alcohol concentrations, Booker used an Intoxilyzer 5000, an instrument he previously claimed is “unworkable.”\(^3\) Booker found that a number of the subjects displayed nystagmus at various BACs below 0.100%. Booker also found that more of the subjects displayed nystagmus during the elimination phase than the absorption phase.

In the second experiment, Booker viewed 52 DUI arrest videotapes and evaluated “overall officer performance… simply on the time he took to conduct the HGN test and the number of times he stopped the motion of his stylus for at least four seconds.” Booker found that only one officer administered the test in exact compliance with the prescribed method. This experiment is flawed because, as Booker conceded, the tapes were of poor quality and the deviations from protocol may have been insubstantial. Regardless, Booker failed to identify a single instance where an officer’s assessment was contradicted by blood or breath testing.

The HGN test ... is accepted by the courts as evidence equal in merit to chemical testing and protected from review and criticism by judicial notice... (emphasis added).

This contention is so erroneous that it is absurd. A person is guilty of DUI if he or she drives with an unlawful blood or breath alcohol concentration (BAC). Virtually every state has Implied Consent laws requiring motorists to provide breath samples and/or blood samples upon request by a law enforcement officer. No state has similar laws for HGN testing. Courts permit prosecutors to prove that a defendant drove with an unlawful BAC by introducing blood or breath alcohol test results. There is not a single judge in the country that permits prosecutors to prove unlawful BAC by providing HGN test results alone. In fact, only a handful of courts permit prosecutors to introduce an officer’s estimation of a defendant’s BAC. All of these courts, with one exception, limit the admissibility of the officer’s opinion to probable cause hearings. In Florida, officers are allowed to testify to their estimations during trial, but only if the prosecutors also


Finally, the First Amendment of the United States Constitution prevents the courts or anyone else from shielding anything from criticism.

The HGN test “avoided... review because the bulk of the publications describing and reviewing the procedures are found outside peer-reviewed literature and because the test is taught, certified and used as an enforcement function of police agencies, not as a scientific function.”

It is true that few commentators have published peer reviewed articles regarding the HGN test, but the implication that the HGN test escaped scientific scrutiny is unfair and inaccurate. Dr. Burns first examined the HGN test’s utility as a sobriety test in 1977. She and others have presented the test to members of various scientific communities many times. Additionally, defense attorneys and their experts have vigorously challenged the test’s reliability for years.

The contention that the test is used by law enforcement agencies and “not as a scientific function” also is misleading. Physicians have relied on nystagmus testing for decades.

NHTSA developed the specific HGN protocol to promote objectivity among law enforcement officers. There is nothing new or novel about the test or the procedures.

4 Prosecutors in Florida do not rely on urine test results to establish BAC. However, the court opinion allows them to do so.

5 See e.g. M. Burns, An Overview of Field Sobriety Test Research, 97 PERCEPTUAL & Mo. SKILLS, 1187-1199 (2003); K. Citke, B. Ball and D. Rutledge, Nystagmus testing in intoxicated individuals, 74 OPTOMETRY 695 (Nov. 2003); M. Burns, The Use of Horizontal Gaze Nystagmus as a Field Sobriety Test, presented at the 35th International Congress on Alcoholism and Drug Dependence, Oslo, Norway (July 31 to August 6, 1998); J. Richman and J. Jakobowski, The Competency and Accuracy of Police Academy Recruits in the Use of the Horizontal Gaze Nystagmus Test for Detecting Alcohol Impairment, 47 N. E. J. OPTOMETRY 5 (1994); F. Tennant, The rapid eye test to detect drug abuse, 84 POSTGRADUATE MED. 108 (July 1988); C.J. Forkiotis, Optometric Expertise: The Scientific Basis for Alcohol Gaze Nystagmus, 59 CURRICULUM II, 1, 3 (April 1987); H Yolton, Is the Driver Drunk?, 57 J. AM. OPTOMETRIC ASSN., 654 (1986); D. Tiffany, Optometric expert testimony: foundation for the horizontal gaze nystagmus test, 57 J. AM. OPTOMETRIC ASSN. 705 (1986); G. Goding and R. Dobie, Gaze Nystagmus and Blood Alcohol, 96 LARYNGOSCOPE 713 (July 1986)(also presented at the Meeting of the Western Section of the American Laryngological, Rhinological and Otological Society, Inc., San Francisco, California, January 11, 1986); G. Good and A. Augsburger, Use of Horizontal Gaze Nystagmus as a Part of Roadside Sobriety Testing, 63 AM. J. OPTOMETRY & PHYSIOLOGICAL OPTICS 467 (June 1986); V. Tharp, H. Moskowitz, and M. Burns, Abstract of 1981 Study, PSYCHOPHYSIOLOGY 193 (Mar. 1981).

... HGN test results may be introduced through a police officer who has a certificate showing completion of a short course of instruction taught by non-degreed instructional personnel

This assertion is misleading and inaccurate. It suggests that officers who complete a “short course” are given a certificate and carte blanche to testify. In fact, as Booker subsequently notes, officers are permitted to testify in many courts “because they have produced documented correlations of actual arrests and chemical concentration tests.” Additionally, many officers receive training from degreed professionals including research scientists, toxicologists, and optometrists.

**The Elements of Fraudulent Science**

Booker identifies three elements that should be demonstrated before a scientific work can be declared to be deliberately fraudulent.

**Incompetence**

In the matter of the field sobriety tests, particularly the HGN test, lack of fundamental competence can be illustrated by the procedure used for the measurement of the 45 degree angle of deviation of vision; redaction of unfavorable data during its development is demonstrated by development of the vertical gaze nystagmus (VGN) test.

This statement falsely implies that NHTSA attempted to mislead the public by hiding unfavorable information. There is no evidence to support this claim.

**Measuring an Angle of 45 Degrees**

Booker notes that 17% of Texas arrestees between 1998 and 2002 had BACs between 0.00 and 0.09. Presumably, he believes that these data supports his position that the “fraudulent” use of the field sobriety test occurs “always at the expense of the citizen accused.” This is not the case. First, DUI arrestees typically are not tested for an hour or more after they are found driving. A normal person eliminates between 0.015 and 0.020 alcohol by body weight each hour. Therefore, many of the individuals who provided samples below the 0.08 may have been above 0.08 when they were driving. Second, the “legal limit” is 0.08. Booker provides no data on the number of people between 0.08 and 0.10. Third, the phrase “legal limit” is a misnomer. A person is guilty of DUI if the person drives with an unlawful blood or breath alcohol level or while impaired. Studies demonstrate that impairment begins at the lowest recordable levels; there is no truly

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7 See e.g. G. C. Drew, W. P. Colquhoun, H. A. Long, Effect of Small Doses of Alcohol on a Skill Resembling Driving, 1958 BRIT. MED. J. 993 (Oct. 25, 1958)(researchers finding that “there is a measurable increase in mean error [on a driving simulator] as soon as there is a measurable quantity of alcohol in the blood”); H. Moskowitz and M. Burns, Effects of Alcohol on Driving Performance, 14 ALC., HEALTH & RES. WORLD 12 (1990)(“[c]ertain skills important for driving are impaired at 0.01 and 0.02 percent BAC or, in other words, at the lowest levels that can be measured reliably”). See also M. Valask, A Safe-Driver Level of Blood Alcohol, 39 PATHOLOGIST 36 (Mar. 1985)(advocating a zero tolerance DUI law)
“safe” BAC at which people can drive. Indeed, the American Medical Association’s (AMA) Council on Scientific Affairs recognizes that “significant alcohol involvement in injury-causing road crashes begins at a driver BAC of 0.05%.” Thus, the AMA and the American College of Emergency Physicians (ACEP) advocate a legal limit of 0.05. Fourth, many of the people below 0.10 may have been under the influence of drugs as well as alcohol.

The Vertical Gaze Nystagmus Test

The only reference to any PCP literature found in the NHTSA research documents is a paper by Liden et al. that unambiguously shows vertical nystagmus to have been present in only four of the nine case of PCP poisoning discussed, explaining the reason for the phrase, “selected sections” in the NHTSA citation of that work.

Booker’s implication that NHTSA essentially made up the test and that there is no significant relationship between VGN and drugs like PCP is incorrect. Medical doctors and researchers have produced numerous books and articles recognizing the relationship. The fact that “only four of the nine cases of PCP” poisoned people had VGN is of no consequence; VGN is a less sensitive indicator that only appears in cases of intoxication that are extreme for those particular individuals tested.

Attempts to Hide Flawed Research

Fantastic theories contrary to experience are suggested

The HGN test is based upon the assumption that any physical or mental impairments that serve to produce ‘clues’ from which intoxication may be inferred are caused by alcohol. There is no requirement that any evidence, much less substantive evidence, of [sic] the presence of alcohol is a predicate condition for advancing to a conclusion regarding the amount of alcohol that is present.

Booker again misapprehends law enforcement’s use of the HGN test. Law enforcement officers are taught that conditions and substances other than alcohol can cause nystagmus. They are taught that all depressants, inhalants and PCP (the so-called DIP

11 Interestingly, Booker chose to cite the AMA’s 1960 recommendation rather than the 1986 recommendation in the introduction.
drugs) cause nystagmus. Again, HGN is one piece of evidence, the totality of which must be weighed against a measured BAC.

**There are claims of great accuracy**

The promoters of the HGN test have recently encouraged prosecutors to believe that 'experienced law enforcement officers were correct ninety-six percent of the time in determining a .10 BAC or more using the HGN test, a finding that defies belief considering that under laboratory conditions using specially trained, experienced observers and a protractor to measure the angle the claimed accuracy of the HGN test was only 88%, and less than that (78%) when conducted without the appliance

Booker’s disbelief in roadside accuracy rates is unfounded. Officers are able to gather more information in the field than they can in the laboratory and they base their opinions on the totality of the circumstances. In the field, the HGN test is one tool of many. Also, many officers currently employing HGN in the field have become particularly skilled at using the test because they use in regularly. In contrast, the officers who participated in the research had been introduced to HGN with four hours of training during the week preceding their sessions in the laboratory and, consequently, lacked sufficient time to increase their skill, gain experience or develop confidence with the test.

In 1994, the Miami-Dade County State Attorney’s Office (SAO) collaborated with some local officers to conduct a large retrospective study of Miami-Dade County’s (Florida) Impaired Driving Program. The SAO reviewed Miami-Dade County’s three largest police departments’ arrest logs and DRE evaluations for 1991 through 1993. The SAO examined 25,129 total DUI arrests, including 1,181 DRE cases.

The SAO started by reviewing the 25,129 entries in the running logs. The SAO found that 88.5 percent of the arrestees who provided breath alcohol samples blew a 0.08 or above. 0.08 is the “legal limit” in Florida. 91 percent of the drivers blew 0.08 or above or refused to provide a breath sample. The refusals were significant because Florida law requires DUI arrestees to provide breath samples upon request. In the early 1990’s, a person who refused to provide a breath sample forfeited his or her driver’s licenses for one year for a first refusal or 18 months for a second or subsequent refusal. 95 percent of the arrestees blew 0.05 or above or refused to provide a breath sample.

Then, the SAO reviewed the 1,181 DRE cases. The SAO found that Miami-Dade County’s DREs correctly identified drug impairment 92.3 percent of the time. This figure likely underestimated the DREs’ ability to identify drug use and impairment because the Miami-Dade County’s Forensic Toxicology Laboratory was able to test for only a handful of the most commonly used drugs in the early 1990’s. Of the cases where the DREs correctly identified drug impairment, they correctly identified the impairing

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13 DREs utilize the HGN test to identify people under the influence of depressants (including alcohol), inhalants and PCP.

14 Recently, the Florida Legislature passed a bill making a second or subsequent refusal a crime.

15 In 2004, the SAO conducted an identical review of the three police departments’ DUI arrests from 1999-2001. The sample was much smaller; however, the results were remarkably similar to the earlier survey.
drug category 98 percent of the time. Excluding alcohol, they correctly identified the drug category in 93.9 percent of the cases.\textsuperscript{16}

Finally, the SAO reviewed two of the most experienced officers’ HGN logs, 568 cases. The SAO found that the officers correctly determined that arrestees were under the influence of alcohol and/or DIP drugs over 97 percent of the time.

The study was a central feature of the State’s evidence during a Drug Recognition Expert (DRE) Frye hearing. See Williams v. State, 710 So. 2d 24 (Fla. 3d DCA 1998), rehearing denied, 725 So. 2d 1111 (Fla. 1998). The data supporting the study was provided to defense counsel in the discovery process. The defense had months to review the data, but identified no errors.

Other jurisdictions and researchers have conducted field studies with similar results, including Arizona, California, Louisiana, and Texas.

\textbf{The maximum effect that is observed is produced by a causative agent of barely detectable intensity, and the magnitude of the effects is substantially independent of the cause}

Given that half the population of sober adults exhibit end position nystagmus and that all the possible clues associated with the HGN test, especially the critical ‘onset prior to 45 degrees’ [sic] manifest at blood alcohol concentrations half (or less than half) that for which the test was developed, it is apparent that the HGN test is subject to a significant number of false positive results

Booker’s statement that a significant portion of the population exhibits end point nystagmus while sober is accurate. However, his use of the statistic is misleading.\textsuperscript{17} As Police officers look for “distinct” nystagmus. The distinction is significant. In Booker’s own study, for example, 19% of his subjects exhibited nystagmus in one or both eyes prior to the introduction of alcohol. See 41 SCI. & JUST. at 115.

The suggestion that the police are incorrectly identifying a “significant” number of sober people as impaired is wrong. Despite the fact that officers have relied on the HGN and other standardized field sobriety tests for over twenty years, no one has produced any reliable data showing that the police have arrested a significant number of innocent people.

\textbf{The effect is of a magnitude that remains close to the limit of detectability or, many measurements are necessary because of the very low statistical significance of the results}

\textit{Based on arrests and chemical test data, the field sobriety tests had an error rate of approximately 40% among people whose BACs were between 0.00% and 0.14%}

\textsuperscript{16} Note that in some of the cases, the DREs' opinions were corroborated by the subjects’ admissions.

\textsuperscript{17} NHTSA also reported that half the population exhibits end point nystagmus.
Booker attempts to establish a high error rate by restricting the field. This is inappropriate. Regardless, he fails to distinguish between the percentage of people incorrectly released and the percentage below the legal limit.

_Criticisms are met by ad hoc excuses thought up on the spur of the moment_

_HGN has never been proffered as an indicator of impairment, much less “an excellent indicator”_

This is inaccurate and conflicts with Booker’s prior recognition that the test’s “most common application is based on the belief that ‘… the HGN test is an excellent indicator of impairment.’” 41 SCI. & JUST. at 116. Regardless, HGN is an excellent indicator of impairment as all credible studies prove.

_If it is dependent on the presence or absence of glassy or blood-shot eyes, one must assume the quality of the HGN test as evidence changes seasonally with the air’s pollen and mold spore content, but this issue has never been addressed in any of the HGN literature_

The HGN test is not a vision test. The presence or absence of glassy or blood-shot eyes and the pollen or mold content of the air is irrelevant.

_The Intention to Deceive_

_Because of its gravity, the accusation of fraud must rest upon unambiguous, unimpeachable evidence. That evidence is ‘Appendix F’ in Horizontal Gaze Nystagmus: The Science and the Law, A Resource Guide for Judges, Prosecutors and Law Enforcement, a publication directed toward lay readers._

Appendix F contains a compilation of documents that a prosecutor may want to cite in support of the HGN test. As the document’s title indicates, it was not “directed toward lay readers.”

Booker claims that a number of the documents are not “favorable” to the HGN test because they do not specifically address the test itself. For example, he notes that some of the documents were written before the test’s development and use as a field sobriety test by law enforcement officers, while others do not reference the test or its components or NHTSA documents or studies. Booker misapprehends the purpose of the appendix. The appendix essentially is a resource guide and bibliography that lists articles that help establish the test’s utility. Some of the articles are listed because they support the test’s underlying theories and procedures. Regardless, the appendix provides full citations, providing for easy reference and verification.

_Discussion_
Considering that the student manual was originally considered to be a confidential state document and was only obtained through an “Open Records Act” request, silence from the scientific community cannot be considered an endorsement of the program.

NHTSA manuals are public record. The researchers who conducted the studies have presented the results in meetings throughout the world.

[The] numerous capricious, unexplainable changes from the original protocol suggest that the agencies sponsoring and enforcing the use of the tests failed to exercise due diligence in evaluating them.

NHTSA has modified the procedures several times to improve the test process. NHTSA’s open mindedness and continuing efforts evince the agency’s diligence and desire to obtain the most accurate results possible.

CONCLUSION

Despite all of Booker’s theories and arguments, one fact remains certain. Officers relying on the HGN and other field sobriety tests continue to arrest people who are impaired and release people who are not. The test works well.