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PAPER

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Mark R. Pressman,[1,2,3] *Ph.D. and David S. Caudill,*[1] *J.D., Ph.D.*

Alcohol-Induced Blackout as a Criminal Defense or Mitigating Factor: An Evidence-Based Review and Admissibility as Scientific Evidence

ABSTRACT: Alcohol-related amnesia—alcohol blackout—is a common claim of criminal defendants. The generally held belief is that during an alcohol blackout, other cognitive functioning is severely impaired or absent. The presentation of alcohol blackout as scientific evidence in court requires that the science meets legal reliability standards (*Frye*, FRE702/*Daubert*). To determine whether "alcohol blackout" meets these standards, an evidence-based analysis of published scientific studies was conducted. A total of 26 empirical studies were identified including nine in which an alcohol blackout was induced and directly observed. No objective or scientific method to verify the presence of an alcoholic blackout while it is occurring or to confirm its presence retrospectively was identified. Only short-term memory is impaired and other cognitive functions—planning, attention, and social skills—are not impaired. Alcoholic blackouts would not appear to meet standards for scientific evidence and should not be admissible.

KEYWORDS: forensic science, alcohol blackout, scientific evidence, *Frye*, *Daubert*, evidence-based review, admissibility, amnesia, cognitive function, automatism

Amnesia is a common claim of criminal defendants, and alcohol-related amnesia is reported by 19–80% of criminal defendants (1–5). Alcohol-related amnesia is commonly referred to as an "alcohol blackout" by the lay public as well as in the scientific/medico-legal fields, although definitions vary. The scientific/medico-legal definition of "alcohol blackout" refers to loss of memory for significant events that occurred during a drinking episode (6).

Alcoholic blackouts are usually classified as fragmentary or complete (en bloc) depending on the severity of the memory loss (7). Additionally, alcoholic blackout may be classified by the presence or absence of signs and symptoms of severe intoxication. The behavior of bingers, heavy drinkers, alcohol-dependent drinkers, or alcohol abusers during a blackout may not appear as expected. Often, these individuals are not "fall down drunk" during blackout episodes and may demonstrate none of the behaviors typically associated with severe intoxication (8). Individuals may carry on conversations and engage in other complex activities that require higher cognitive functions with no subsequent memory (9). These activities may include abnormal or criminal behaviors.

The incidence of alcohol blackouts is unknown. Large survey studies of college-age subjects suggest that more than 80% may have experienced at least one episode of what the students describe as a blackout. These episodes are usually associated with signs of intoxication. However, the data collected on each student are quite limited, and the source of the data is often other intoxicated friends or companions. It is likely these college students would not meet diagnostic criteria for alcoholism (10). The incidence of alcohol-related amnesia in the absence of common signs and symptoms of intoxication is unknown.

Some of the confusion as to what cognitive processes are active during an alcohol "blackout," and what role a blackout should have in court proceedings, is due to the common public usage of the term. The medico-legal usage of this term should be carefully distinguished from the generic/public/slang usage suggesting a profound loss of cognitive functioning along with motor functions. The generic use of the term "blackout" reflects its meaning in describing an electrical power failure or pilots suffering from a lack of oxygen at high altitude. "Blackout" suggests, to the lay public, not just loss of memory but unconsciousness or severely diminished cognitive function.

In court, a generic understanding and use of the phrase "alcoholic blackout" are not sufficient, but must follow rules of scientific evidence. In the United States, these rules vary at the federal and state levels. Thus, in states relying on the *Frye* standard of scientific evidence (*Frye v. U.S.,* 293 F. 1013 (D.C. Cir. 1923)), use of "alcoholic blackout" as a defense would require minimally that the concept and the methods related to its evaluation be "generally accepted" by the relevant scientific community. In federal courts and in many state courts (11), scientific evidence must meet the standards of Federal Rule of Evidence (FRE) 702 and be consistent with the *Daubert* ruling of the U.S. Supreme Court (which also considers general acceptance as a

[1]Villanova University School of Law, 299 N Spring Mill Rd, Villanova, PA 19085.
[2]Sleep Medicine Services, Department of Medicine, Lankenau Medical Center, Lankenau Institute for Medical Research, 100 Lancaster Ave, Wynnewood, PA 19096.
[3]Department of Medicine, Jefferson Medical College, 1025 Walnut St, Philadelphia, PA 19107.

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nonexclusive factor alongside testability, peer-reviewed publications, and error rate). Introduction of an alcohol blackout defense may also be limited or excluded by laws related to voluntary intoxication depending on the jurisdiction (12).

The propositions that (i) alcohol blackouts do occur, (ii) alcohol consumption affects memory, and (iii) there is no evidence to suggest that cognition is severely disturbed during a blackout all find support in the literature. Cunnien (13, p. 74), noting that amnesia "does not infer defects of attention, awareness, or consciousness during the drinking episode itself," also argues against the defense on another basis—that alcohol consumption is voluntary. Van Oorsouw et al. (14) acknowledge the view that "it is highly unlikely that a person can experience a blackout during complex behavior such as robbery, murder, or rape" (p. 365) and conclude their own study with skepticism concerning blackout claims—"blackouts during events requiring fine motor skills…are unlikely" (p. 370). Responding to van Oorsouw et al., Merikangas (15) notes that the authors

> did not address the essential questions: does a blackout remove mens rea? Or does amnesia prove that the understanding of right and wrong was impaired? Also, unanswered is the question of how one might validate a claim of amnesia without corroboration. (p. 376)

Merikangas (15) seems to conclude that alcohol blackouts are automatisms—absences of mind—that should be recognized as exculpatory unless they are feigned. Granacher's (16) response, on the other hand, is that "many elements of cognition are not affected among persons who report blackouts, while other areas seem preferentially affected" (p. 372); moreover, "most of the evidence of a blackout is provided by subjective recall from the accused and so may be of questionable veracity" (p. 374). And while the evidence mounts concerning the effects of alcohol on hippocampal functions, compelling

> evidence indicates that acute alcohol use impairs the performance of a variety of frontal lobe-mediated tasks, like those requiring planning, decision-making, and impulse control, but the underlying mechanisms are not known. (17)

But in response lawyer Francisco Duarte opines, cited in Harrell (18),

> just because [defendants] don't recall [a crime], it doesn't mean that at the time they weren't aware. Obviously, they were experiencing the moment, cognizant of the moment.

And according to Zorumski, cited in Dryden (19)

> even at…high levels [of alcohol], we don't see any changes in how the brain cells communicate. You still process information. You're not anesthetized. You haven't passed out. But you're not forming new memories. (p. 194)

A controversy persists, however, based on (i) the fact that alcohol diminishes self-control and (ii) the sense that contemporary neuroscience is challenging our legal notions of responsibility and control over our actions—both of which lead some to conclude that

> voluntariness and consciousness are not…either on or off. Rather they are continuums, ranging from unconscious, involuntary to semi-conscious, semi-voluntary to fully conscious, fully voluntary. (20, p. 603)

This view lends support to Sweeney's (21) popular, albeit sensationalistic, thesis that

> a person in a blackout…is in an unconscious state. He has no idea of what he is doing. He is out of control, [but is able] to walk, talk, drive, get into arguments, pick fights and become violent while unconscious….[And] the law does not recognize the diminished capacities stemming from the interruption of working memory during an alcohol blackout….Can a person be held responsible for his actions while in an unconscious state? (p. 190)

An Example

A recent trial of an individual for quadruple murder and arson in the northwest United States presents an example of how "alcohol blackout" has been used as a criminal defense or mitigating factor. The defendant claimed to have no memory of the murders because of an "alcoholic blackout." He later admitted committing the arson. The defendant, a 24-year-old man, was described at trial as a former alcoholic who had recently returned to drinking after 19 months of abstinence. He initially claimed not to have been drinking, but subsequently told law enforcement and others that he had consumed three fifths of vodka starting in the afternoon and continuing into the early morning hours—a period of 6–10 h. Police later recovered three empty bottles of vodka at his home. However, the police were unable to determine when the bottles had been purchased and when the alcohol had been consumed. The defendant stated he had been drinking surreptitiously, putting vodka in orange juice, so his friends would not know he had resumed drinking alcohol. Friends who were present that evening playing video games with the defendant stated they were not aware he was drinking alcohol. They did not describe any typical intoxicated behavior. Instead, they described him as slightly "friendlier" than usual. He did not slur his speech and walked in a coordinated manner. The murders occurred the next morning after he left his home and crossed the street to the victims' home with two knives and a hatchet. After entering this home, he stabbed to death two young women and their children aged 3 and 5 years. The defendant stated he later "awakened" in the victim's house covered in blood and had no memory of his violent actions. Only then did he become aware of murdered women and children. Although he claimed to have no memory of his actions, he assumed he must have killed the women and children. He moved the bodies of the victims and then went to the bathroom of the victim's home, took a shower, changed out of his bloody clothing, put on clothing he found in a bedroom, and then returned home. He then went to a local store, bought two containers and filled them with gasoline, and returned to the home of the victims. He entered the home, spread the gasoline throughout, and started a fire. He then returned to his home. The fire department responded at 11:40 AM. Fire marshals testified there were multiple locations throughout the house where fires were started. Investigation eventually led to the defendant, who initially denied any memory not only of the murders but of buying gasoline and setting the fires. He claimed that the injuries to his person had been caused when he was attacked. However, he eventually changed his story,

stating he did remember buying the gasoline and setting fires, but he continued to claim he had no memory of the murders. At trial, an alcoholism expert and researcher testified for the defense that in his professional opinion, the defendant had been in a state of alcohol "blackout" when he killed the two women and two children. This expert described the various factors in his opinion as a "perfect storm" leading to an alcoholic blackout. This perfect storm of factors included a past history of alcohol abuse and blackouts, as well as a family history of alcohol abuse and blackouts. He further fit the general demographic of those reported to have blackouts more frequently—young and male. The defense expert further testified that he accepted the defendant's self-report that he had consumed of a large quantity of alcohol in a short period of time. He believed the recovery of three empty bottles of vodka at the defendant's home was consistent with this claim. He made no attempt to corroborate the defendant's story, and indeed, he was not certain if it could be corroborated. He stated there was no way to know when the defendant had been drinking or how long the vodka bottles had been in the defendant's house. When pressed on this point, he stated he relied on his extensive clinical and research experience interviewing, evaluating, treating, and studying alcoholics in clinical and rehabilitation settings. Another expert estimated that if the defendant had consumed three bottles of vodka in the time period he reported, his blood alcohol level (BAL) would have been 0.35%, a level at the high end of that found in previously published reports of blackouts. This estimate of BAL was based only on the defendant's self-report. The quantity of alcohol as well the speed and duration of time the defendant was actively drinking could not be corroborated. This expert noted that after 19 months of sobriety, the defendant's reaction to alcohol would not have been the same as expected in an active alcoholic. The possible effect of an extremely high BAL on an alcohol naïve subject was not discussed. The primary defense expert in the quadruple murder, described above, relied on published data, the defendant's self-report, and his own extensive clinical and research experience with severely alcohol-intoxicated individuals. He was unable to cite established methods or standards for the retrospective diagnosis of "alcoholic blackout." The presence of a period of "alcoholic blackout" rested solely on the defendant's own testimony. There were no validated and reliable scientific methods for determining the presence of an alcoholic blackout while it was apparently occurring, much less retrospectively. However, he was able to provide indirect or circumstantial evidence to support his testimony regarding the epidemiology, genetics, and demographics of the "alcoholic blackout."

The use of "alcohol blackout" as a defense has a long history (22), but its scientific reliability and validity have rarely been tested using modern techniques of evidence-based research and medicine. Experimental data that might assist would include (i) results of studies of alcohol "blackout" performed with experimental methods and (ii) results of studies in which alcohol was administered to well-evaluated subjects in order to induce an episode of alcoholic "blackout" and objectively study it. Many studies of alcohol blackout depend on the subject's ability to recall previous episodes of blackout months or even years before. This type of study has numerous methodological limitations. Chief among them is the question of whether studies that require a research subject or patient to "remember not remembering" can supply reliable and valid data. Second, how much of the published data on alcoholic blackout would be admissible as scientific evidence under *Frye* or *Daubert*?

We attempted to answer these questions with a detailed search of the published scientific literature to identify all articles on alcohol blackouts in which data were collected either prospectively or retrospectively. These research articles were reviewed and categorized according the research methods and results. Finally, the results of this evidence-based study are applied to the question of what is an alcohol blackout, how is it diagnosed, and how and why it might be admitted in the courtroom as scientific evidence.

Methods

A computer-based search of PubMed (National Library of Medicine) was conducted for the terms "blackout" and "alcohol," and each in turn with "violence," "criminal behavior," "automatism," "memory," "cognitive function," and "amnesia." This produced 95 published articles. A review of these articles was performed to identify those in which empirical data were collected to elucidate the nature of alcohol blackouts.

Results

A total of 26 articles were identified and retrieved in which data were collected about alcohol blackouts. These articles were separated into four categories based on general methodology and goals of the research.

- In the first category (see Table 1), a total of 10 experimental studies were identified with a total of 91 subjects/patients. In nine of 10 of these studies, alcohol was administered to known alcoholic patients with the objective of significantly increasing BALs in order to affect short-term memory loss or induce a "blackout" under controlled circumstances. In a minority of these studies, subjects were currently admitted to inpatient units, with a history of alcoholism implied, but not specified. One study was in effect an "accidental" experiment when a past participant of a research project appeared in the emergency room (ER) severely intoxicated (26). Of these 10 studies, only one was placebo controlled, but there is some doubt whether the subjects were truly blind to alcohol versus no alcohol condition. All other studies used a within-subject design, testing patients while sober and while severely intoxicated. However, they all employed open-label designs where patients/subjects were informed in advance of the methods, and no control conditions were present. Methods and results for each of the 10 studies can be seen individually in Table 1. A summary of the main findings for all 10 studies can be found in Table 2. These studies suggested that alcohol "blackouts" could be most easily induced experimentally in known alcoholics with past histories of blackouts. The ability to induce a blackout was also found to be related to the rate at which patients consumed alcohol and BAL increased. When patients drank at a slower rate and BAL increased at a slower rate, fewer blackouts occurred, even when the BAL eventually was >0.300%. On the other hand, some patients demonstrated blackouts with BAL levels as low as 0.14. These studies uniformly reported that experimenters were unable to determine when a blackout was present based on patient behavior even as the patients were directly and continuously observed. A number of studies—while noting patients for the most part maintained self-control—also noted there was a change in affect, often around 2 h after drinking began. On rare occasions, a sudden outburst of violent behavior was reported.

TABLE 1—Experimental studies: under controlled conditions, known alcoholics with a history of "blackouts" were given alcohol with the intent of inducing a "blackout," so it could be studied in real time.

References	Subjects/Patients	Protocol/Methods	Results
Ryback (23)	7 men, known alcoholics age 33–41 years	Two studies: 7 days and 12 days of free drinking. Within-subject placebo design. Observers took detailed notes on subjects behavior	First study: 3 of 4 had blackouts. Great variability in BAC. One subject had blackout with a BAC of 0.140%. Another subject did not have a blackout with a BAC of 0.305%. In study 2, a subject reached a maximum BAC of 0.330% without a blackout. Subjects did appear intoxicated to the researcher. Blackouts occurred as early as 36 h or as long as 60 h after the start of drinking
Miller et al. (24)	10 subjects who were heavy drinkers with a history of experiencing blackouts recruited via newspaper ads	Day 1 drinking alcohol; day 2 placebo (water); day 3 water with subjects knowledge; day 4 recall testing	8 subjects reported blackouts during testing on day 1, but not day 2. BAC values ranged from 0.128 to 0.228%. Two subjects not experiencing blackouts had two lowest BACs: 0.128 and 0.156
Tamerin et al. (25)	13 known outpatient alcoholics with hx of repeated blackouts	10 days sober followed by 12–14 days free-choice drinking maximum 1 quart of 100 proof alcohol per day	6 of 13 subjects experienced blackouts
Berglund et al. (26)*	Single case report 61-year-old man with BAL of 0.38%	Cerebral blood flow measurement	12 h later, amnesia for 2–3 h in E.R. rCBF compared to others in this patient while sober showed 30–60% increases in flow. Appeared intoxicated, but no slurred speech and cooperative
Goodwin et al. (8)†	10 subjects recruited from employment office able to drink a pint of whiskey in a few hours. 8 met criteria for alcoholism and 5 had a hx of blackouts	4-h testing period. Every 30 min shown toy for 1 min. Every 30 min shown 1 min scene from an "erotic" movie. Next morning shown 24 toys and entire movie and asked to identify toys and scenes presented earlier	5 of 10 subjects had no recall at 30 min. Same group had no memory 24 h later. Blackout group differed from nonblackout group by history, speed with which BAL increased and high BAL level. Blackouts—279/100 mL vs. nonblackouts 181 mg/100 mL
Goodwin et al. (29)	12 community volunteer subjects, all heavy drinkers, 10 met criteria for alcoholism. All gave history of frequent blackouts	All subjects tested while sober on 3 memory tasks and then 8 memorable events were performed. 1 min after event and 30 min after event were asked to recall. If they failed, subject was "cued" by presenting a small part of event. Repeat testing 24 h later	All subjects had difficulty recall memorable events 30 min later, but only 1 of 12 subjects had a blackout 24 h later. All subjects received a "cue" at 30 min to "jog" their memories
Freemon et al. (30)	10 volunteers "able to drink over a pint of whiskey in a few hours"	4-h testing period. Every 30 min shown toy for 1 min. Every 30 min shown 1 min scene from an "erotic" movie. Next morning shown 24 toys and entire movie and asked to identify toys and scenes presented earlier	All subjects showed some change in personality. Four of 10 subjects experienced memory loss during the experimental procedure between 2nd and 3rd hours and one subject near the end of testing. All 5 had complete memory loss the next day
Wolf (31)	5 alcoholic Alaskan men awaiting trial for homicide who had amnesia for their crimes	4 oz whiskey or 8 oz beer every 45 min. EEG and Wechsler measured	All subjects experienced blackouts lasting 2–7 h. High BACs were 0.325, 0.237, 0.193, 0.180, and 0.152. Observers reported a change in affect with more anger expressed after 1.5–2.5 h of drinking. On the second day of drinking, one subject became violent
Diethelm and Barr (32)	15 inpatient alcoholics. All but one experienced blackouts at home	IV administration of ethanol to a high of 0.240%. Statistics not provided for entire group	Patients during blackout felt "intoxicated" but had "well coordinated thinking and speech." Patients exercised good self-control
Hutchison et al. (33)	8 male inpatients in Forensic Unit of Psychiatric Unit. Nonalcoholics	Within-subject design. Various memory tests give before and after drinking. Detailed interviewing by one investigator 2 fluid oz. whiskey initially and then free drinking	2 of 8 experienced blackouts: One at BAC of 0.15–2 and the other between 0.12 and 0.15

BAC, blood alcohol content; BAL, blood alcohol level; rCBF, regional cerebral blood flow; hx, history.

*Not an experimental study per se. Patient brought to emergency room severely intoxicated. He had been part of a prior study on alcohol abstinence which included rCBF testing.

†Identical data also reported in Goodwin (27) and Goodwin and Hill (28).

TABLE 2—Summary of findings for first set of experimental studies.

- Short-term memories not stored or retained
- Archival memories unaffected
- Social interaction intact
- Capacity for planning intact
- Physical symptoms of severe intoxication not present
- No slurring of words
- Able to walk, etc., without apparent impairment
- No external signs of blackout
- Blackout could not be determined by expert observers while it was in progress
- Individual variability in occurrence of blackouts
- Not all severe alcoholics had blackout when tested
- The timing, duration, and BAC varied and can occur after "moderate" drinking

BAC, blood alcohol content.

- In the second category were two studies (see Table 3). Methodologically, they were similar to those in the first category except that the goal of the research was to induce mild or moderate levels of intoxication in subjects who were documented alcoholics with past histories of blackouts. No blackouts were induced in these studies, but partial memory losses were noted.
- In the third category (see Table 4) were 10 studies that involved 703 subjects whose past alcoholism, blackouts, or DUIs could be corroborated by medical or criminal histories. The majority of subjects/patients in these studies were previously diagnosed alcoholics who had reported blackouts in the past, but were now abstinent. Subjects/patients in these categories were most often asked to describe previous blackout episodes or were tested in the present to determine current cognitive deficits. No attempts were made to administer alcohol to them in the present or to induce a state of blackout. These studies had widely varying goals and methods.
- In the fourth category (see Table 5) were four studies with a total of 15,338 subjects, the majority of whom were of college age. Three of the four studies were large survey studies that depended on subjects' self-report of their own past blackouts or those of others. There was no corroboration of their reports. Although subjects in this category often reported "blackouts," questioning was most often limited to responses to general questions. Table 6 provides a list of general findings unrelated to the direct observation of subjects during an alcoholic blackout or a lesser form of amnesia.

Discussion

The term "alcohol blackout" is most often incorrectly used as a generic, nonscientific term suggesting that all higher cognitive function was absent during a drinking episode. A report of amnesia is often construed as proof that the individual was not consciously aware during the episode. That generic use of the term is pervasive, but inconsistent with the existing scientific literature. Whether a particular jurisdiction relies upon *Frye* or *Daubert*, claims of "alcoholic blackout" should not be admissible, based on the existing scientific literature and the inability to confirm its existence in the present or in the past. Further, even if an alcoholic blackout were assumed to have been present, existing scientific literature strongly suggests this state may interfere with memory but does not negate mens rea during the episode.

At the outset, it must be acknowledged that admissibility standards for scientific evidence vary among jurisdictions (and even among courts within a particular jurisdiction). Conventionally, we have distinguished between *Frye* (or "general acceptance") jurisdictions (15 states and the District of Columbia) and *Daubert* jurisdictions (federal courts and half the states), but there are also states that keep *Frye* and supplement it with *Daubert* reliability factors, as well as a few states where each adopts a standard different from each other and from either *Frye* or *Daubert* (45). Therefore, generalities concerning the admissibility of alcohol blackout evidence prove difficult. Complicating matters, courts within a jurisdiction are often in conflict—for example, in a *Frye* jurisdiction such as Pennsylvania, controversies arise over when and how the "general acceptance" test is to be applied, and some judges use terminology from *Daubert* even as they acknowledge that its framework has been rejected (Blum v. Merrell Dow Pharmaceuticals, Inc. (564 PLA 3, 5-8 2000)).

Nevertheless, it is possible to make some preliminary observations. First, in *Frye* jurisdictions, a party proffering expert scientific testimony must show that the methodology used, and

TABLE 3—Experimental studies: under controlled conditions, known alcoholics were given mild-to-moderate quantities of alcohol with the intent of inducing short-term memory loss.

References	Subjects/Patients	Protocol/Methods	Results
Goodwin et al. (34)	32 hospitalized male alcoholics. History of blackouts	Divided into experimental and placebo groups. Experimental group administered alcohol sufficient to produce mild or moderate intoxication. No BAC reported. Recall test based WAIS Vocabulary scale. Tested on immediate recall, at 30 min and at 24 h	None of the blackout prone alcoholics experienced blackouts or any deficits in short-term memory. Supports a "threshold" concept of blackouts not graded
Lisman (6)	4 male alcoholics who had not responded to treatment. History of blackouts	5 days sober 5 days drinking 5 days sober 5 days drinking 5 days sober Goal was that each day of drinking would result in BAL of 0.140–0.170 in early afternoon. Memory tested and % memory loss determined	Administration of ETOH at levels lower than usually thought to produce blackouts resulted in an average 60% memory loss. One subject had an 80% loss. No complete blackouts were noted. Consistent with fragmentary short-term and 24-h memory deficits related to BAL during initial acquisition and later recall. Not related to state-dependent learning

BAC, blood alcohol content; BAL, blood alcohol level.

TABLE 4—Experimental studies: under controlled conditions known alcoholics with a history of "blackouts" were tested while sober and/or abstinent. Includes interview and surveys. Alcohol was not administered.

References	Subjects/Patients	Protocol/Methods	Results
O'Mahony (35)	39 alcohol abusing inpatients at psychiatric w/hx of blackouts and 28 patients with no hx of blackouts	Intelligence testing with subtests of WAIS-R	58% reported blackouts. Blackouts not related to duration of alcoholism. Waking cognitive function and hx of blackouts not related
Zucker et al. (36)	74 patients in a VA inpatient alcohol treatment center	Compared those with blackouts with those without	75% experienced blackouts. No significant difference between groups with hx of blackouts and without on drinking variables. Blackout group has other symptoms known to associated with alcoholism
Branchey et al. (37)	37 male alcoholic patients with blackouts and 11 without blackouts on an inpatient alcohol rehabilitation unit. All abstinent	Psychiatric evaluation and plasma tryptophan measurement	Lower tryptophan levels in patients who experienced blackouts. Tryptophan levels and symptoms of blackouts highly correlated
Tarter and Schneider (38)	50 male alcoholic inpatients	Wechsler memory scales	No difference in memory capacity between patients with high-frequency blackouts and those with low-frequency blackouts. High-frequency blackouts associated with greater frequency of drinking and higher tolerance for alcohol
Curlee (39)	100 alcoholic inpatients	Structured interview	Compared results to Goodwin et al. (42). 64% reported blackouts. Slightly younger onset, higher rate of blackouts, more binge drinking
Morrison and Pendery (40)	2 case reports of suicide attempts in alcoholics	Case reports	2 patients attempted suicide during "blackout." Neither reported suicidal behavior before blackout
Perry et al. (41)	65 subjects who had DUI arrest with BAC of 0.08% or >	Interview and questionnaire within 6 months of arrest	Strong linear relationship between BAC and probability of memory loss in patients with history of blackouts. Less quantities and slower rate associated with gray outs
van Oorsouw et al. (14)	Study 3: 100 suspected DUI	Study 3: retrospective analysis of blood and psychiatric interview. Drivers claiming blackout compared to those who did not claim blackout	14% claimed blackout. Overall BAC 0.19±0.53 (range 0.066–0.350). The BAC of those claiming blackouts was not different from those offenders not claiming blackouts
Goodwin et al. (42)	100 hospitalized alcoholics: 64 w/history of blackouts, 36 w/no history of blackouts	Structured interview	One-third had never experienced a blackout. Blackouts occurred later in alcoholism. Blackouts associated with (i) severity and duration of alcoholism, (ii) capacity for drinking large amounts of alcohol, (iii) loss of control, (iv) neglect of meals, (v) gulping drinks, (vi) hx head trauma. Blackouts did not always occur in same individual under apparently identical circumstances
Hartzler and Fromme (7)	136 young "heavy drinkers" recruited from community	Retrospective survey of history of blackouts using Timeline-follow-back assessment tool. BAC computed via algorithms available on Internet using specified quantities and time intervals accounting for gender and weight. No direct measurement of blood alcohol or estimation of tolerance or metabolic rates	En bloc blackouts = 1.5% Fragmentary blackouts = 5.4% Fragmentary blackouts reported 3 times more often. However, both types of blackouts occurred at similar estimated BACs

BAC, blood alcohol content; hx, history.

perhaps even the conclusion reached, would be accepted in the relevant scientific field. Critics have pointed out that this is a conservative standard that (i) may not only eliminate credible, but novel, science, but also (ii) may maintain discredited science that courts have traditionally relied upon (46). Moreover, in many fields of scientific expertise, controversies persist that require identifying a majority and minority opinion, both of which have some support in the field. Thus for a court to rely upon "published scientific studies" to discern general acceptance can be misleading when studies offer conflicting conclusions (see, e.g., *Pennsylvania v. Middleton,* 550 A.2d 561, 565-66 (Pa. Super. Ct. 1988)). Alcohol blackout evidence is just such an example, yet on the basis of our evidence-based review, including the lack of recent studies, we conclude that there is no general consensus supporting alcohol blackout as an automatism or state of unconsciousness (to support a claim of no responsibility for a crime).

Second, in those jurisdictions adopting a *Daubert* standard, general acceptance is just one reliability factor among many, including the *testability* of the expert's theory, evidence of a *low error rate*, and peer-reviewed *publications* supporting the testimony. As to *testability*, there is no generally accepted scientific method to detect an alcoholic blackout while it is occurring or afterward. The study of alcoholic blackout using double-blind,

TABLE 5—Retrospective survey studies of nonalcoholics.

References	Subjects/Patients	Protocol/Methods	Results
Nelson et al. (43)	2324 twins, nonalcoholics	Filled out questionnaires; genetic analysis of stored samples	52% of men had lifetime hx of blackouts. 20.9% of men reported 3 or more blackouts in a year did not distinguish between blackouts associated with other signs of severe intoxication and blackouts associated with short-term memory loss only
van Oorsouw et al. (14)	Study 1: 178 nonalcoholics. Mean age 25 ± 11 years. Study 2: 100 nonalcoholics mean age 21 years	Study 1: asked about own experiences Study 2: asked whether they had witnessed blackouts in others	Study 1: 76% reported at least one blackout lifetime. Mean of 15 drinks within 4 h. Estimated BAC was 0.26. 15% reported associated criminal relevant behavior. 46% indicated memories returned. Study 2: 76% witnessed blackouts in others. 28% associated with criminally relevant behavior. 55% of individuals recovered complete memory
White et al. (17)	50 undergraduates recruited by campus flyer	Questionnaires	88% reported at least 1 blackout lifetime. 34% experienced one or more blackouts in the 2 weeks before testing. 83% relied on other intoxicated individuals to provide detail of events during blackouts. 78% had some memory of events that occurred during blackouts (fragmentary)
Jennison and Johnson (44)	12,686 young adults	Surveys when aged 19–26 years and 23–30 years	Alcohol associated with amnesia in 18.9% of men and 10.4% of women during first measurement period. Amnesia associated with quantity of alcohol, age of drinking onset, no. of alcoholic family members, capacity to control drinking behavior

BAC, blood alcohol content.

TABLE 6—Generally accepted findings associated with the occurrence of blackouts.

- Prior history of alcoholism
- More often during an advanced stage of alcoholism
- Family history of alcoholism
- Prior history of blackouts
- Family history of blackouts
- Capacity/tolerance for high quantities of alcohol
- Ingests high quantity of alcohol—most often >0.2
- Rapid drinking—"gulping," "bingeing"
- Head trauma
- Loss of control
- Failure to eat properly

placebo-controlled methods does not appear to be feasible. The patients/subjects—typically alcoholics—would almost certainly know whether they had received alcohol and not the placebo. "Normal" controls—nondrinkers or social drinkers—would also certainly be able to detect alcohol at low levels. Thus, *error rates* cannot be determined. Additionally, there would be a considerable medical risk if the normal subjects were expected to "binge" and increase their BAL's to levels consistent with blackouts. It seems unlikely that modern Internal Review Boards could be convinced of the safety of such protocols and permit their performance. Thus, we are left with existing experimental research published 20–40 years ago.

There is a single patient study in 1989, the result of luck rather than planning (26). A subject (patient) appeared severely intoxicated at an E.R. of a hospital, where he had previously participated in a cerebral blood flow study of the first 7 weeks of abstinence. In the E.R., he was recognized and taken for a cerebral blow flow test with a BAL of 0.38%. However, this study was the result of serendipity, not experimental science, and is certainly not a model for future scientific studies. No other studies of alcohol blackout using modern imaging studies have been performed. Thus, there are no biological markers of an "alcohol blackout" before, during, or after it happens—only the methodologically unreliable subjective report of the severely intoxicated alcoholic patient is available. As noted, the studies in Table 1 failed to detect alcohol blackout in subjects under constant and direct observation. Only nine studies were identified that administered alcohol experimentally to produce a "blackout" state. All but one study was conducted before 1980. More recent studies have administered alcohol at lower BAL levels to study its effects on memory and other cognitive functions, but BAL levels typically associated with "blackouts" were not reached and blackouts were not reported.

Retrospective surveys have confirmed some findings of the experimental studies, including how the speed with which the BAL increases is positively associated with retrospective reports of blackouts. The direct experimental studies of alcohol blackout do indeed note an especially strong effect on memory. However, other cognitive processes may not be affected. The behavior of patients/research subjects in whom an alcoholic blackout was induced was generally not consistent with the typical picture of severe intoxication. There were rare outbursts of uncontrolled behavior in a very small minority of patient/research subjects, on a background of otherwise normal behavior. However, almost all of the experimental subjects who reported blackouts were well-diagnosed alcoholics. This suggests the possibility that this group has developed a special tolerance or resistance to high levels of alcohol on most cognitive processes except for memory. The studies of Goodwin (9) and Ryback (23) remain the gold standard and are the only studies to directly observe a large group of patients during an alcoholic blackout episode. However, the subjects of Goodwin (9) studies were all alcoholics. Goodwin et al. (8) were unable to control for factors such as the duration of the patient/subject alcohol abuse or their tolerance to alcohol.

Consideration of the possibility of an alcohol blackout as a defense to criminal behavior should also take into account the very high frequency of alcohol intoxication in criminal behavior. Alcohol has been reported to be involved in an average of 50% of all violent crimes and sexual assaults each year in a large number of studies conducted worldwide. In the United States the Department of Justice estimates that three million alcohol-related violent crimes are committed each year (47). The 2005/2006

British Crime Survey (22) reported 1,029,000 alcohol-related violent crimes in England and Wales alone. The "alcohol blackout" has been described as fulfilling the requirements for a legal automatism (48). Automatisms are behaviors performed without conscious awareness or intent. In the absence of intent or awareness—mens rea—an automatism could provide a complete defense for criminal acts. As noted above, however, experimental studies of alcohol blackout show the only deficit is anterograde amnesia. Planning, social interaction, long-term memory, and other higher cognitive functions are reported to be present during the blackout, strongly suggesting mens rea is present. In light of these findings, an alcohol blackout would not seem to fulfill the requirements of an automatism. It is not clear, however, even if an alcoholic blackout were to be considered an automatism, how this would balance with the requirements of laws concerning voluntary intoxication (12). While automatism could be a complete defense to a crime, it

> is rarely, if ever, successfully raised in cases involving the voluntary ingestion of drugs or alcohol. It is, for all intents and purposes, reserved for instances of involuntary intoxication, pathological intoxication, or idiosyncratic reactions to a substance. (12, p. 202)

Some states do not allow evidence of voluntary intoxication to negate any element of an offense, but in most states, "voluntary intoxication" can be a mitigating factor or evidence of diminished capacity in criminal defenses (e.g. to negate specific intent) (12). In the state of Washington, for example, the relevant statute provides that an act committed "in a state of voluntary intoxication" is not thereby considered less criminal; but if a "particular mental state is a necessary element to constitute a particular species of degree of crime," then intoxication can be taken into account "in determining such mental state" (RCW 9A.16.090: Intoxication).

This review does not deal with assertions by certain researchers that as alcoholism is an addictive disease of the brain, which implicitly suggests that individuals who drink excessively and experience blackout are not truly in control of their actions or the consequences of their actions. Additionally, claims of "pathological intoxication," in which alcohol produces an unexpected and dramatic effect, do not appear to apply in these cases, as almost all experimental subjects were well-known alcoholics and most had reported previous blackouts. Many reviews do suggest that an alcohol blackout can occur in alcohol naïve individuals. However, this data appear to be derived from retrospective survey studies only. It is not clear whether these subjects experienced other symptoms of severe intoxication. Although blackouts have been reported to occur most often at blood alcohol content (BAC) levels >0.250, this is not a firm cutoff point. In the studies reviewed, blackouts occurred at BAC levels as low as 0.14 and did not occur at levels of 0.300. This is also true for other supposed circumstantial markers of blackouts such as prior or current history of alcoholism or even a prior history of blackouts (see Table 6).

There is significant interindividual variation that significantly weakens this data for diagnostic or evidentiary purposes. There are no specific biomarkers and test results that demonstrate that an individual has been experiencing blackouts, or more importantly, that the individual was in the midst of a blackout during the commission of a criminal act. Rather, the diagnosis of a blackout is completely dependent on the absence of a memory for a certain time period. The "alcohol blackout" appears to be a distinct form of severe alcohol intoxication in which short-term memory is selectively impaired, while other cognitive and motor skills are unaffected or only minimally affected. Blackout patients are not "fall down drunk" (see Table 7) (49). They do not appear to have obvious impairment in coordination, balance, social interaction, or speech. Rather, to all outward appearances, they are cognitively and physically intact. In the presence of these intact cognitive functions, alcohol "blackout" does not meet requirements for an automatism or even for diminished capacity. Goodwin (9) famously noted in a 1995 editorial that summarized his earlier work:

> Our findings had legal implications. Blackouts have rarely been held in extenuation for crimes; but lawyers continually try. I receive calls, when I tell lawyers what we found; they usually do not call back. What we found was that remote memory was intact but that people had trouble with short-term memory, which meant that, during a blackout a person would be able to recite the Ten Commandments and know the consequences of robbing a bank. It was simply that he would not remember these things 30 min later or the next day. *He knew right from wrong at the time of the act* [author's italics], and this appears to be the crucial factor where the law is concerned. (p. 316)

TABLE 7—Signs and symptoms of alcoholic blackout compared with severe alcohol intoxication.

Sign or Symptom	Alcoholic Blackout	Severe Intoxication*
Inappropriate sexual behavior	No	Yes
Inappropriate aggressive behavior	No†	Yes
Mood lability	Yes†	Yes
Impaired judgment	No	Yes
Impaired social functioning	No†	Yes
Impaired occupational functioning	Unknown	Unknown
Slurred speech	No	Yes
Lack of coordination	No	Yes
Unsteady gait	No	Yes
Nystagmus	Unknown	Yes
Impairment of attention	No	Yes
Impairment of memory	Yes	Yes
Stupor or coma	No	Yes

*Signs and symptoms from the American Psychiatric Association (49).
†Rare episodes have been reported, but are not characteristic of the group.

Conclusion

In summary, there is no objective or scientific method to verify the presence of an alcoholic blackout while it is occurring or to confirm its presence retrospectively. Even if such a method were available, valid, and reliable, an alcoholic blackout would not negate mens rea as the experimental studies reviewed here report that only short-term memory is impaired and other cognitive functions—planning, attention, long-term memory required to form criminal intent—are not impaired. This should disqualify a claim of alcohol blackout under *Daubert* and FRE 702. Its qualification under *Frye* is more difficult and depends on how "general acceptance" is defined, but there is no consensus in the field supporting a claim of automatism or unconsciousness. In light of these findings, expert scientific testimony on alcoholic blackouts would not appear to meet standards for scientific evidence set by *Frye* or *Daubert*.

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Additional information and reprint requests:
Mark R. Pressman, Ph.D.
Sleep Medicine Services
Lankenau Medical Center
100 Lancaster Ave
Wynnewood, PA 19096
E-mail: sleepwake@comcast.net