

Disorders of Arousal From Sleep and Violent Behavior: The Role of Physical Contact and Proximity

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Study Objectives: To review medical and legal case reports to determine how many appear to support the belief that violence against other individuals that occurs during Disorders of Arousal - sleepwalking, confusional arousal, and sleep terrors - is triggered by direct physical contact or close proximity to that individual and does not occur randomly or spontaneously.

Design: Historical review of case reports in the medical and legal literature.

Measurements and Results: A total of 32 cases drawn from medical and legal literature were reviewed. Each case contained a record of violence associated with Disorders of Arousal; in each, details of the violent behavior were available. Violent behaviors associated with provocations and/or close proximity were found to be present in 100% of confusional arousal patients and 81% of sleep terror patients. Violent behaviors were associated with provocation or close proximity in 40%-90% of sleepwalking cases, depending on whether the legal verdict and other factors were taken into account. Often the provocation was quite minor and the response greatly exaggerated. The specific manner in which the violence was triggered differed among sleepwalking, confusional arousals, and sleep terrors.

Conclusions: In the cases reviewed, violent behavior directed against other individuals associated with Disorders of Arousal most frequently

appeared to follow direct provocation by, or close proximity to, another individual. Sleepwalkers most often did not seek out victims, but rather the victims sought out or encountered the sleepwalker. These conclusions are tempered by several limitations: the selection of cases was not random and may not represent an accurate sample of violent behaviors associated with Disorders of Arousal. Also, final verdicts by juries in reported legal cases should not be confused with scientific proof of the presence or absence of sleepwalking. The pathophysiology of Disorders of Arousal with and without violent behavior could be associated with normally occurring deactivation of the frontal lobes during slow wave sleep (SWS) connected via atypically active thalamocortical pathways to the limbic areas. It is not known if the violent sleepwalker, confusional arousal patient, or sleep terror patient differs from other patients with these disorders. The conclusions of this case series await confirmation by the results of future sleep laboratory based studies.

Keywords: Sleep, disorders of arousal, sleepwalking, violence, neurophysiology, forensic science, expert testimony, parasomnias

Citation: Pressman MR. Disorders of arousal from sleep and violent behavior: the role of physical contact and proximity. *SLEEP* 2007;30(8):1039-1047.

INTRODUCTION

Sleepwalking, confusional arousals and sleep terrors - Disorders of Arousal¹ - have been reported to be associated with violent behaviors against other individuals for hundreds of years.² Murders, attempted murders, assaults and sexual assaults have been reported to occur during these disorders and have occasionally resulted in criminal charges.³⁻⁶ Some defendants using sleepwalking defenses have been acquitted, as sleepwalkers are not thought to have the required conscious awareness or criminal intent to be judged guilty. The violent act itself is most often described as the release of a primitive form of rage over which the sleepwalker has no control.^{7,8}

Disorders of arousal result from a partial or incomplete arousal from SWS.¹ It has been known since 1965 that these disorders do not represent acting out of dreams.⁹

Disorders of Arousal are thought to require predisposing, priming, and precipitating factors.^{10,11} Proximal trigger factors for Disorders of Arousal include external sounds such as snores or inter-

nal events such as apneas, hypopneas, or leg movements.¹¹ Cases of sleep related violence have often been discussed in relation to priming factors such as sleep deprivation and stress, but rarely in relation to the actual proximal trigger of the violent event. The rarity of violent behaviors during Disorders of Arousal suggests that some additional factor or trigger must be present.

According to clinical wisdom, the occurrence of violence against other individuals during Disorders of Arousal is associated with, or triggered by, proximity or direct contact with other individuals.

Families are frequently given advice not to touch or grab sleepwalkers during episodes as they may resist physically. The same advice is often given to sleep technologists performing sleep studies on suspected sleepwalkers. Guilleminault and colleagues report that sleep laboratory technicians performing studies intended to provoke sleepwalking episodes in the sleep laboratory were frequently hit when they grabbed sleepwalking research subjects or attempted to block the research subject's out-of-bed activities.¹²

This clinical wisdom has many supporters. Alexander Bonkalo, MD, a Canadian psychiatrist, was the first to seriously study sleepwalking violence in the modern sleep medicine era. In 1969 he wrote with regard to adult sleepwalkers:

"When interfered with, a person in a state of arousal tends to be negativistic, resistive and assaultive...." (P. 407)¹³

Mahowald and Schenck later noted:

"The victim is someone who merely happens to be present, and who may have been the stimulus for the arousal." (P. 734)¹⁴.

Disclosure Statement

This was not an industry supported study. Dr. Pressman has indicated no financial conflicts of interest.

Submitted for publication December, 2006

Accepted for publication April, 2007

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SLEEP, Vol. 30, No. 8, 2007

Broughton notes that:¹⁰

“During a sleepwalking episode, the subject shows reduced responsiveness to environmental stimuli, including calling of the person’s name. Vigorous attempts to waken subjects often do not lead to full arousal and may induce resistance and even violence. Violence without such resistance to the behaviors appears to be relatively rare” (P. 701)

Finally, Cartwright explains the violent behavior of two men she believes to have been sleepwalking when they killed a close relative:

“Without the ability to recognize the person who stood in his way and while higher cognitive areas controlling judgment were partially blocked, the primitive impulse to attack took over.” (P. 1155)⁷

The purpose of this review is to examine published medical and legal cases of sleep related violence against other individuals to determine if they are consistent with the clinical wisdom and generally held beliefs described above.

METHODS

A computer search for any clinical case report of sleep related violence directed at another individual during a disorder of arousal was conducted in the National Library of Medicine database. An additional search for any legal cases during which sleep related behaviors were used as a defense was conducted without regard to the final verdict. Cases were limited to those during which murder, attempted murder, or assault occurred, and in which information regarding the circumstances of the violent attack was available.

Cases were divided among those related to confusional arousals, sleepwalking, or sleep terrors followed by sleepwalking. When available, the circumstances of the sleep violence were reported along with any relevant sleep history.

The case reports presented in Tables 1-3 should be evaluated with a number of important limitations in mind. First, there is no way to determine if the cases presented here are representative of all such cases. These case reports were identified by a computer search of medical and legal literature databases, resulting in identification of only those cases submitted for publication. Case reports could have been limited to those that were of particular interest to the reporter or had an unusual aspect. In searching legal databases, legal cases may be found as published or unpublished cases. Published cases indicate that a summary of the case has been printed in an official legal publication or website. This occurs most often when the initial verdict is appealed to a higher court, but may occur for other reasons depending on the jurisdiction. Unpublished cases may find their way into public consciousness in a number of ways. Those who participated in the case may write subsequent articles or books. Media reports of sleepwalking violence cases are common due to the often dramatic nature of the crime. As with cases retrieved from medical databases, there is no way to determine if these cases are typical of sleepwalking violence cases. The best that can be said is that data and conclusions are based on the cases that were available for review. It is possible that future cases or past cases that come to notice may contradict these conclusions.

Second, the amount of detail available for each case varied significantly. The description of some of the unpublished legal cases is limited to only a few sentences, while published legal cases – especially those appealed to the highest court in a jurisdiction – can run for hundreds of pages. Thus, diagnostic criteria and de-

tails of the defendant’s behavior that would be highly desirable in evaluating cases is often not available.

Third, legal cases may involve a false claim of sleepwalking (malingering) by the defendant, testimony by unqualified expert witnesses, or misbehavior by expert witnesses or lawyers. There is no way in a review of this type to determine if the claim of alleged sleepwalking related violence was scientifically valid.

Fourth, in many of the cases reviewed, a jury verdict is available. For the purposes of this review, the reader should not assume that because the jury reached a guilty verdict that the defendant was not a sleepwalker, or that the defendant who was acquitted was a sleepwalker. In most jurisdictions, reasonable doubt is the standard and the jury may rely on numerous types of evidence before reaching a verdict, especially in jurisdictions where the trial system is adversarial. The jury may ignore evidence that a sleep specialist thinks is powerful and focus entirely on evidence that a sleep specialist may judge irrelevant. If the opposing attorney makes a highly qualified sleep specialist look foolish on the witness stand, what is the jury to think? If the defendant is not personable or confuses dates and facts, what is the jury to think? If the sleep expert is unable to speak in a simple and easily understood manner or speaks in a condescending tone to the court, the expected verdict based on the scientific evidence may not occur.

Fifth, there is no way to evaluate this case data using standard statistical methods. Due to the reasons noted above, there is no way to rank each case by the likelihood it fits the general theory; rather, only basic summary statistics can be provided. A review of these cases is not the same as hypothesis testing.

Sixth, a direct test of this generally held belief of provocation and proximity is essentially impossible at this time. However, recent advances in sleepwalking research suggests that empirical testing might be possible in the future.¹⁵ Thus, these cases form the backdrop on which future studies may be designed and carried out.

Seventh, in the majority of case reports reviewed, no differential diagnosis was done or reported. There are many potential sources of violent behavior in sleep.¹⁰ Many of the cases discussed here occurred before the first description of REM behavior disorder. It is possible that some of these cases actually represent other neurological or psychological syndromes or the effects of alcohol or drugs.

Thus, this review was limited to the history and data available. In the meantime, the review of these cases is a good starting point in attempts to understand how and why sleepwalking violence is triggered.

RESULTS

A total of 32 cases were identified. They have been divided into 3 categories.

1. Confusional Arousal

Confusional arousals are defined in the International Classification of Sleep Disorders-2 (ICSD-2) as sudden partial arousals from SWS resulting in complex behaviors, but in which the sleeper does not leave the bed.¹⁶ Confusional arousals share an identical pathophysiology with sleepwalking. Confusional arousals are associated with severe cognitive impairments and followed by amnesia (Table 1). A total of 10 cases were identified. In 6 cases,

Table 1—Confusional Arousals and Violent Behavior

Case Name or Reference	Violent Behavior	Circumstances	Evaluation	Verdict of Court
Fain v. Commonwealth ⁵ (1879) (Kentucky, USA)	Shot hotel porter 3 times.	Porter entered darkened hotel room unannounced and attempted to awaken defendant	Provoked by porter	Convicted and reversed on appeal
Raschka ⁴⁶ (1984)	Assaulted 2 police officers	Police officers found intoxicated defendant asleep in car, attempted to wake up	Provoked by police officers	Not reported
Bradely v. State ⁴⁷ (1925) Texas	Shot girlfriend	Disturbed by noise while asleep, jumped up with gun and started firing. Found girl friend dead on bed	Provoked by noise?	Acquitted
Tibbs v. Commonwealth (1910) Kentucky	Beat victim with fists, stabbed to death with knife.	Victim attempted to arouse defendant from sleep.	Provoked by victim	Convicted and reversed on appeal.
Oswald and Evans ⁴⁸ (1985) Tarsch, 1986	Stabbed husband 3 times, back, chest, thigh	Suffering from cough, shared bed with husband. Awakened by cough? Where did knife come from?	Possibly provoked by cough.	Not reported
As reported in Bonkalo ¹³ #1 (1600)	Knight stabbed friend to death	Was asleep when friend attempted to awaken him	Provoked	Not reported
As reported by Bonkalo # 3	Killed wife with axe	Defendant was awakened by noise around midnight. Grabbed axe and attacked "stranger" in room.	Provoked	Not Reported
Podolsky ⁴⁹ R. v. Borshears (1960) England	Strangled prostitute while intoxicated	Awakened to find hands around neck of woman he had slept with. Involvement of alcohol.	Provoked??	Acquitted
Bonkalo #4	Killed employee entering office with gun	Night shift supervisor fell asleep in office. Approximately 30 minutes later, employee entered office and awakened him. Pulled gun in confusion and fired	Provoked	Not Reported
Bonkalo #6	Stabbed boy to death.	Boy shared room with defendant along with 13 others. He tried to pick up something next to the sleeping defendant. Defendant was aroused by disturbance and grabbed knife and stabbed him	Provoked	Not Reported

the victim touched the sleeping individual or attempted to arouse them. In 4 cases, a noise woke the sleeping individual with the victim close by. Thus, 100% of these cases conform to the generally held belief of provocation and/or proximity triggering sleep related violence.

2. Sleepwalking

Sleepwalking, or somnambulism, is initiated in a similar fashion to confusional arousals, or it may follow sleep terrors. Once the individual's foot touches the floor and walking begins, the behavior is considered to be sleepwalking, no matter how the episode started. Sleepwalking may take the form of slow wandering, or it may be more agitated with running or other motor behaviors. As with confusional arousal, the sleepwalker's higher cognitive processes are profoundly impaired. A total of 10 cases were identified based on claims of violent behavior during an alleged episode of sleepwalking as part of a defense to criminal charges (Table 2). In this group of cases, there exists the possibility that some of the claims of sleepwalking lack a basis in sleep science. Additionally, the possibility that in some cases sleepwalkers may have been convicted and non-sleepwalkers acquitted cannot be ruled out. In 5 of these cases,

direct provocation or close proximity was not noted. In one case a verdict is not reported. In the remaining 4 cases the defendant was convicted, suggesting the jury was convinced on the balance of the evidence that these defendants were not in a sleepwalking state at the time of the violent act. However, the significance of provocation or proximity as evidence is not clear in the majority of these 5 cases. The use of the final jury verdict in order to determine the weight of the scientific evidence or diagnosis is fraught with danger. It cannot be determined if the jury understood the scientific sleep evidence or gave it significant weight in their deliberations. Perhaps one attorney was simply superior to the other. In *Mass. V. Tirrel*, the defendant was represented by one of the leading lawyers of the time (1847) who was noted for his excellent oratory. Mr. Tirrel was acquitted of murder despite the fact that after killing the victim, he set fire to her apartment with her in it, escaped, and went into hiding for several months. His concealment of evidence and escape from the legal authorities might well be interpreted differently by a modern court. It is possible that a jury will ignore scientific evidence for evidence that is more accessible or understandable to them. A jury may find the defendant unbelievable or unlikable or be influenced by evidence of good or bad moral character. In *California v. Reitz*, 2004, the defendant was reported to

Table 2—Sleepwalking and Violent Behavior

Case Name or Reference	Violent Behavior	Circumstances	Evaluation	Verdict of Court
Arizona v. Falater ¹ (1999)	Two attacks on victim 1. Stabbed wife 44 times 2. 45 minutes later found her apparently alive, dragged her to swimming pool and held head underwater	1. First attack not witnessed. Defense suggested sleepwalking defendant had exited house to fix pool pump. Victim followed him out and attempted to stop him resulting in attack 2. Witnessed by neighbor. While victim lay motionless on patio in back yard, defendant stood over her, left scene, retrieved work gloves from garage, returned to body and moved her in several planned stages to pool, pushed her in and held head underwater. Victim did not resist.	1. Not witnessed, if defense theory correct, could have been provoked by victim 2. Unprovoked, victim was near death and could not resist.	Convicted
R v. Parks ^{8 4} (1985) Canada	Stabbed mother-in-law to death, stabbed father-in-law who survived.	Defense experts report they believe defendant was found wandering in house by his in-laws, who attempted to restrain him.	Probably provoked attack due to in-laws physical contact	Acquitted
Bonkalo #5	Killed night watchman with gun	Awakened early in night by wife who was shouting incorrectly there were burglars in house. Grabbed gun, went to window and shot night watchman on street.	Provoked	Not Reported
Mass. V. Tirrel (1841) Boston	Cut throat of lover, set fire to room.	Approximately 4 AM loud bang heard, followed by someone running from home and fire breaking out. Defendant left city and went into hiding. Eventually captured in New Orleans several months later.	Defense included extensive testimony by family members and other regarding defendant's prior sleepwalking, but his behavior at scene is incompatible with current knowledge. Setting fire to room to cover up crime, fleeing scene and going into hiding are inconsistent behaviors.	Acquitted
Indiana v. McLain (1993)	Assaulted police officers, resisted arrest	Severely jet lagged. Only 15 hours of sleep in previous 4 days. 1.5 beers and marijuana. While a passenger in a car, stopped. Police officer approached. Stated incorrectly that he knew officer, got out of car and sat down in police car. Officer drove him over to where friends were. Both exited police car. Defendant assaulted officer. Was subdued by several officers.	Proximal cause of attack not clear. Potentiating factors sleep deprivation and alcohol present. Amnesia for event. Was in close proximity to victim	Convicted.
US v. Clayton (2000) ²	Hit victim in head with hammer several times. Chased victim down street with hammer.	Requested to borrow hammer from fellow officer. Then requested screwdriver. When victim turned around, attacked him with hammer	Unprovoked	Convicted
California v. Reitz (2004)	Smashed flowerpot against girlfriend's head, dislocated elbow and wrist, stabbed repeatedly in back of neck with his pocketknife resulting in her death.	Defendant stated he awoke after dreaming about intruder. Stated type of wounds to neck similar to those he used to kill sharks.	Close proximity. Significant history of sleepwalking behaviors acknowledged by prosecution. However, his violent behavior was not thought to be out of character as he had history of domestic violence while awake.	Convicted
R. v. Lowe (2005) Manchester England	Beat father to death with repeated attacks in 3 locations of his father's home, resulting in 90 separate injuries	Both defendant and victim were severely intoxicated. Defendant apparently went to sleep in a separate room from victim. Beating continued on at least 3 occasions on different floors of the house and ended on the front walk of house.	Were apparently not sleeping in close proximity. Repeated nature of beatings in different locations not consistent with typical sleepwalking violence.	Acquitted.
R. v. Catling ³ (2005) Dorset, England	Stabbed girlfriend 9 times and cut throat.	Victim attacked while asleep and lying motionless in bedroom. Defendant in living room. Defendant severely intoxicated along with at least 6 tablets of zopiclone - a sleeping pill. Had argued with victim. Victim had threatened to prevent him from seeing daughter.	Unprovoked attack.	Eventually withdrew sleepwalking defense and pleaded guilty
Pennsylvania v. Ricks-gers ⁵⁰ (1993)	Shot wife in hip. Bullet deflected upward resulting in her death.	Approximately 1 hour after reported bedtime defendant awakened by sound of gunshot. He had retrieved gun from hiding place under mattress and shot wife in hip. Called police.	Pt. Found to have severe obstructive sleep apnea based on clinical history and polysomnography. Coroner stated this was not a homicide because of manner in which gun was fired. Provocation unknown-	Convicted

¹The author appeared as an expert witness for the prosecution in this case in Maricopa County, Arizona. ²The author appeared as an expert witness for the prosecution in this U. S. Army General Court Martial case. ³The author acted as a scientific consultant for the Crown Prosecution Service in this case. The sleepwalking defense was eventually withdrawn and defendant sentenced to life in prison.

have a significant history of sleepwalking and a well-known sleep specialist gave testimony for the defense on his behalf. Yet, he was convicted because evidence was presented that he had a history of violent domestic abuse while awake. Thus, evidence of bad moral character trumped the scientific evidence of sleepwalking. The absence of detailed clinical histories for the defendants in these cases as well as the absence of transcripts of expert testimony or reports submitted by the experts makes it impossible in this sample to determine which defendants were bona fide sleepwalkers and were likely to have been sleepwalking during the violent criminal act. Thus, in the absence of other data and evidence, the presence of proximity and/or provocation can only be said to range from 40%-90% in this group.

3. Sleep Terrors Followed by Sleepwalking

Sleep terrors differ from confusional arousals in that they are often initiated by a frightening image associated with significant sympathetic nervous system activation. The patient experiencing sleep terrors may act in an agitated, anxious, or panicky manner. The presence of an image makes the differential diagnosis of sleep terrors in this group more difficult than for sleepwalking or confusional arousals. A frightening image could be consistent with a nightmare. The visual imagery of sleep terror patients is occasionally described using terms such as “dream-like” or “dream fragment.” However, other sources have noted that the visual imagery of sleep terror is distinctly different from that of an anxiety dream or nightmare.¹⁷ Broughton^{18,10} notes that patients with nightmares report a detailed succession of images and that nightmares do not progress into sleepwalking. Broughton also notes the visual imagery reported in sleep terrors tends to be less complex than in a typical nightmare. The differential diagnosis of sleep terrors and nightmare can also be made on other factors, such as sudden sitting up in bed, initial scream, and by time of night. Unfortunately, these other behaviors are not described in the majority of cases in this section. Additionally, there is no established manner for analyzing the content of nightmares versus the content of sleep terror images. Thus, it cannot be ruled out that in one or more of these cases the violent behavior occurred secondary to a sudden awakening out of a nightmare with violent imagery (Table 3). A total of 11 cases involving probable sleep terrors were identified. All of the individuals in this group described a vivid and frightening image, usually of being attacked or assaulted. In response to this frightening image, all of the individuals left their beds and showed agitated, complex behaviors. However, in 2 of the cases neither direct provocation nor close proximity was reported. In one case, the defendant navigated to her daughter’s room and killed her while believing she was defending her. The court acquitted her of murder. Thus, 9 of the 11 (81%) cases included descriptions of either close proximity or direct provocation.

DISCUSSION

Literature and popular media often portray the sleepwalker, arms extended, sometimes with knife in hand, wandering in search of a victim. The cases reviewed here appear to support the basic principle that the sleepwalker does not seek out a victim. Rather the victim most often comes to the sleepwalker, or they may encounter each other by accident. This review supports the commonly held belief that violence by a sleepwalker or individual

during a confusional arousal or sleep terror does not occur with prior intent.

The majority of cases reviewed demonstrated that either close proximity or direct physical contact was associated with and perhaps required for the triggering of violent behavior against others in sleepwalking and related disorders. Among those cases in which close proximity or direct contact was not demonstrated, it must be remembered that claims of sleepwalking may represent a legal strategy when no others are available. Juries may convict or acquit for reasons unrelated to the behaviors discussed here. The limitations discussed earlier must be kept in mind. The jury’s decision is not based on a $P < 0.05$, but on reasonable doubt. The combination of science and law may not always produce results that make sense to scientists.

Violent behavior, as noted in this review, occurs in slightly different ways in sleepwalking, confusional arousals, and sleep terrors. In the case of sleepwalking, the violence occurs only after the sleepwalking episode has been triggered and is underway. During the sleepwalking episode, while moving about the environment, the sleepwalking individual encounters someone else – most likely a family member. This person may approach, block, touch, or grab the sleepwalker, triggering a violent reaction. In the case of confusional arousals, violence may be precipitated in one of two ways. An individual may have a confusional arousal associated with complex behaviors but never leave the bed. The bed partner or parent may try to “calm” or restrain the individual by grabbing or holding them. Just as with the sleepwalker, this may trigger a violent reaction. More often, a confusional arousal occurs when someone attempts to awaken a sleeping individual in bed. In these cases the violent reaction follows the confusional arousal by seconds. In some case reports, the violent reaction appears to occur almost simultaneously with the awakening from sleep. Sleep terrors differ from sleepwalking and confusional arousals in that the individual appears to react to some type of frightening image. The individual may act in an improper or agitated manner without regard to reality. If another individual is encountered or is in close proximity, violent behavior may occur.

This case series has been limited to violent behavior of sleepwalkers directed against other individuals. There are also numerous cases of apparently accidental injury while sleepwalking and occasional reports of sleepwalking violence directed against inanimate objects.

Accidental injury while sleepwalking and related disorders most often appears to result from clumsy motor behavior or due to sudden and inappropriate responses to frightening images. Clumsy motor behavior is quite common in sleepwalkers and can result in injuries including tripping over objects, falling down stairs, cutting oneself with a knife, or burning one’s hand while sleep eating. Descriptions of these accidental behaviors do not include reports of rage, anger, or aggression. Thus, they would not be considered episodes of sleepwalking violence.

Other accidental injuries may occur directly as a consequence of an inappropriate response to a frightening image. There are numerous reports of sleep terror/agitated sleepwalking episodes in which individuals try to “escape” from frightening images by breaking through or jumping from windows.¹⁹⁻²² There are reports of severe injury and even death. Suicides and suicide attempts may instead be sleep terror/sleepwalking episodes. There is no evidence in these cases that the individual was angry or in a rage.

Table 3—Sleep Terrors Followed by Sleepwalking and Violent Behavior

Case Name or Reference	Violent Behavior	Circumstances	Evaluation	Verdict of Court
R v. Cogden ⁵¹ (1950) Australia	Killed daughter in next room with axe.	Previous night had entered daughter's room in apparent somnambulistic state and made brushing motions on face. Reported to physician who prescribed sedative. Next night had vivid image of soldiers attacking daughter. Left house, grabbed axe, entered daughter's room and "defended her" by hitting twice with axe.	No provocation. Inappropriate response to frightening imagery.	Acquittal
Howard and D'Orban ⁵² (1987)	Strangled wife to death	One hour after falling asleep had frightening image of 2 Japanese soldiers chasing him and wife through jungle. He strangled one soldier and kicked at the other.	Close proximity to victim. No provocation. Inappropriate response to frightening imagery	Acquittal
Podolsky ^{49, 51} (1957)	Shot to death father and brother, wounded mother	16 yr. old girl "dreamed" that burglars had entered home and were killing family. Grabbed 2 guns and fired 10 shots total.	No real provocation. Inappropriate response to frightening imagery.	Acquittal
R v. Griggs (1859)	Threw baby out window	Reported vivid "dream" that someone was shouting fire. Tried to save child by tossing out window.	No provocation. Inappropriate response to frightening imagery. Close proximity to victim.	Acquittal
R v. Nhete (1941) S. Africa	Killed man with axe	While sleeping around a camp fire "dreamt" he was being burnt. Jumped up and grabbed axe.	No provocation. Inappropriate response to frightening imagery. Close proximity to victim	Not reported
R. v. Dhalami (1955)	Stabbed man to death	Dreamt he was being attacked by several men. He defended self.	No provocation. Inappropriate response to frightening imagery. Close proximity to victim	Not reported
R. v. Ngang (1960)	Stabbed man	Image of being attacked by evil spirit. Defended self	No provocation. Inappropriate response to frightening imagery. Close proximity to victim	Convicted, but reversed on appeal
R. v. Price (1961) mentioned in Williams, G. ⁵³	Marine attacked corporal with bayonet	Reported awakening from dream	? Close proximity to victim	Not reported
Howard and D,'Orban ⁵² (1987)	Stabbed and beat friend with club	Fell asleep in sleeping bag next to victim's bed. Awakened about 2 hours after sleep onset. Had frightening image of 3 figures trying to attack him. Has memory of hitting and punching attacker. Awoke to find friend severely injured.	No provocation. Inappropriate response to frightening imagery. Close proximity to victim	Acquitted
Ohio v. Hines (1993) Ohio	Aggravated burglary and assault on elderly residents of home with rolling pin and knife	Had been awake for 22 hrs. After consuming 2-3 bottles of wine, fell asleep and awakened with a feeling of panic and sense someone was chasing him. Started running through woods and came upon house. Entered house picking up rolling pin and butcher knife. Walked up stairs where he encountered elderly resident walking to bathroom. Scuffle broke out between them.	Victim came to sleepwalker. Defendant had an extensive history of sleep terrors and sleepwalking documented in medical records prior to this incident. Alternate dx would be severely intoxicated behavior.	Acquitted
HMS Advocate v. Fraser ⁵⁴ (1878) Scotland	Smashed baby against wall.	Reported vivid image of wild animal rising from floor and attacking child. Tried to defend child from beast, grabbed child instead, threw against wall killing him	No provocation. Close proximity to victim. Inappropriate response to frightening imagery	Acquittal

However, there are reports in the medical literature of sleepwalkers acting in an apparently violent manner when alone in a room. Pressman and colleagues²³ describe a case that occurred during a continuous positive airway pressure treatment trial (CPAP) in a sleep laboratory. The patient who had been recently diagnosed with severe obstructive sleep apnea (OSA) had returned to the sleep laboratory for treatment. After lights out, the pressure was rapidly titrated upward with excellent effect, nearly eliminating the OSA. In the absence of the sleep fragmenting OSA there was a dramatic increase in slow wave sleep (SWS). After 12 minutes of SWS a short residual hypopnea occurred and caused a sudden arousal from SWS. The patient jumped out of bed and ripped off his CPAP mask and sensors. He screamed very loudly. He then turned to his left where a large picture was on the wall. With a powerful backhand slap he knocked the picture off the wall. After 10 minutes, his confusional state lifted and he returned to bed. When questioned by the technician he could only state that he thought someone was chasing him. He had no memory of screaming or knocking the picture off the wall.

Our assumption at the time was that while in a sleep terror related state, he misperceived the picture as “someone” who was chasing him. Thus, this patient did do violence to an inanimate object. However, this episode closely resembles the violence done to other persons described in Table 3 during sleep terror/sleepwalking. The violence occurred due to the misperception of a threat. It is certainly possible that in his confusional and frightened state he was unable to determine if the object was a person or not.

There are other anecdotal reports in which known sleepwalkers have “trashed” a room, or in which a sleep eater has left a kitchen in serious disarray. There is no way of determining if these behaviors involving inanimate objects occurred as a result of clumsiness, violent behavior, misperception of a threat, the result of a rage reaction, or for some other reason. The sleepwalker is in a profoundly unusual brain state. Other explanations for violent parasomnic behavior may yet be discovered.

The violent actions of sleepwalkers and related disorders against others have been most often ascribed to the “fight or flight reflex” first described by Canon in 1929.²⁴ However, recent research has suggested that the sequence of events described by Canon is not accurate.²⁵ Rather, the sequence of behaviors in response to a threat is actually 1) freeze, 2) attempt to flee, 3) attempt to fight, 4) fright or tonic immobility. This does not appear to describe the behaviors of violent sleepwalkers who are not reported to freeze before fighting. Additionally, this does not account for the violent behavior of someone awakened directly from sleep or in the midst of a sleep terror. The patient in the midst of a sleep terror is initially acting in response to frightening imagery, not to the threat of another person. Thus, the original concept of fight or flight or the updated freeze-flee-fight-fright concept does not appear to account for the violent behaviors.

Recent research finds numerous points of similarity between the neurophysiology and neuroanatomy of violence and that of SWS and sleepwalking. The frontal lobes and limbic system are the two major centers most often implicated in violent behavior²⁶ and are reported to have extensive interconnections.²⁷ The frontal lobes are well known to contain centers for executive functions such as alertness, attention, decision making, and exercise of judgment in social situations.²⁸ Damage to the frontal lobes may result in a variety of effects during wakefulness including 1) inability to control anger, 2) deficits in inhibitory control resulting

in exaggerated emotional responses, 3) deficits in planning, and 4) deficits in social skills.^{26, 28}

Neuroimaging studies have shown highly significant relationships between reduced prefrontal cortical size or prefrontal cortical activity with increased aggression and violence.^{29, 26} A large study of head injuries in combat veterans found damage to the frontal lobes was associated with an increased risk for violent behavior.³⁰ Frontal lobe dysfunction has also been reported to be associated with violent behaviors in schizophrenia as well as with chronic alcohol intoxication.³¹

Recent neuroimaging studies of humans during SWS sleep have noted a general deactivation of the frontal lobes. This deactivation is especially profound in the heteromodal association cortex of the prefrontal cortex.^{32, 33} Total sleep deprivation is also reported to result in a significant decrease in metabolism in the frontal lobe that is not reversed by a night of recovery sleep.³⁴ Additionally, a highly significant decrease in regional cerebral blood flow (rCBF) is reported to occur in the thalamus during SWS.³⁵ A highly negative covariation between rCBF in the thalamus and delta wave activity in SWS is reported to occur.³⁵ It has been suggested that the highly significant reduction in rCBF with increasing SWS activity is associated with direct inhibition of thalamocortical neurons and pathways. This closing off of afferent pathways to the cortex has been hypothesized to be one reason for the loss of consciousness and sensory awareness during SWS.

These studies have also shown that although the frontal lobe is deactivated during SWS, primary and secondary auditory and visual cortical areas are activated. This could underlie reports of NREM “dreaming,” or the vivid visual imagery reported in sleep terrors.³⁵

Bassetti and colleagues³⁷ are the only research group to capture an episode of sleepwalking from SWS with single photon emission computed tomography (SPECT). Compared to a group of 24 normal waking control subjects, an increase of 25% in regional cerebral blood flow was noted and found to be limited to the posterior cingulate cortex and anterior cerebellum. Additionally, compared to the awake normal controls, regional cerebral blood flow decreased in the frontal and parietal association cortices.

The absence of deactivation of certain thalamocortical circuits along with the continued deactivation of others differs significantly from the usual finding in which these areas are overwhelmingly deactivated.³² Bassetti and colleagues suggest based on this single research subject that sleepwalking results from the specific activation of the thalamocingulate circuits while other thalamocortical arousal pathways remain inhibited.

The available data on the neurophysiology of SWS and violence allow for interesting points of comparison. The frontal lobes are deactivated in normal controls during SWS and in the one clinically diagnosed sleepwalker studied during SWS.^{37, 32} As noted above, sleep deprivation may result in deactivation of the frontal lobes that does not return to normal even after a full night of recovery sleep. Acute sleep deprivation is frequently associated with reports of sleepwalking. An increased degree of SWS deactivation, possibly exacerbated by prior acute sleep deprivation, could be part of the pathophysiology of sleepwalking. In a state of profound deactivation, the frontal lobes may have a reduced ability to inhibit limbic system activity. In the absence of frontal lobe inhibition, aggressive or violent impulses originating in the limbic system may be triggered or acted upon. Missing from this theory is a neurophysiological explanation of why

the sleepwalker is only partially aroused by external or internal stimuli and is able to remain in such a state. In other individuals, the sensory stimuli would result in a full awakening. However, partially aroused, the sleepwalker is able to remain in this state for minutes or longer, while the functionally deactivated frontal lobe release the limbic system to respond in an aggressive or violent manner to even minor provocative stimuli.

The violent response to minor provocations or to close proximity to others may have its roots in the concept of “defensive aggressiveness.”³⁸ Extensively studied in the rat, defensive aggressiveness can be elicited in response to perceived threats from an attacker or the experimenter even when no threat is actually present.³⁹ In humans, defensive aggression has been reported to be elicited by frustration, perceived threat, and interruption of an activity. Interruption of an activity – often by family members – is consistent with many reported episodes of sleepwalking violence.

The neurophysiology of sleepwalking violence may have certain elements in common with aggressive patients diagnosed with Severe Conduct Disorder, Anti-social Personality Disorder and Intermittent Explosive Disorder. Neurophysiological studies in these groups have noted frontal lobe dysfunctions of various types. The quantity of SWS in these groups is reported to be significantly elevated compared to normal controls.^{40-41, 42} In a group of violent male inpatients with the diagnosis of Antisocial Behavior Disorder, the percentage of stage 4 sleep was 17% compared to 6% in normal controls.⁴¹ Reduced frontal lobe size and/or activity could be associated with increased SWS as well as violence while awake due to reduced inhibition of limbic impulses.^{43, 44}

The overwhelming majority of sleepwalking, confusional arousal, and sleep terror episodes do not involve aggression or violence. There is no evidence that individuals with these disorders are inherently violent or predetermined to seek out victims. Episodes of sleepwalking related violence against other individuals almost never occur more than once.⁴⁵ At least among the cases reported here, the majority describe close proximity or direct provocation before violent behaviors. A review of neurophysiological literature suggests that the functional deactivation of the frontal lobes during SWS may be similar to changes in frontal lobe size and activity that are reported to be present in individuals prone to waking aggression or violence. Incomplete gating of afferent impulses by the thalamus in sleepwalkers may allow sleepwalking episodes to be triggered and sleepwalking violence to occur. However, it is not known if the violent sleepwalker differs from other sleepwalkers in some fundamental way. It is possible that the absence of physical contact or proximity to other individuals is the only factor that distinguishes violent sleepwalkers from nonviolent sleepwalkers. This suggests under the right circumstances that any sleepwalker might respond to a perceived threat or close proximity with violence.

This case series represents a first step in gathering together the available data on possible triggers for violence during sleepwalking, confusional arousals, and sleep terrors. Due to the limited number and nature of the case reports available, these conclusions should be considered preliminary findings only. Until recently, the idea that this commonly held belief might be testable in the sleep laboratory was quite farfetched. However, in just the last year, studies have shown that sleepwalking episodes can be triggered in the sleep laboratory with a very high success rate.¹⁵ This holds out the hope that sometime in the future a sleepwalker whose episode has been triggered in the sleep laboratory, might suddenly find

him or herself in close proximity to, or be touched by some research assistant. Alternatively, the research assistant might stand in a far corner, or inanimate objects might be placed in the sleepwalker’s path. This certainly will not be easy research to conduct, but might provide definitive evidence in favor or against the generally held beliefs reviewed and discussed here.

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