



## Slow Wave Activity Is Reliably Low in Sleepwalkers: Response to Pressman et al. Letter to the Editor

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We thank the editor for the opportunity to respond to the letter by Pressman et al.<sup>1</sup> This is a critique of the article by Cartwright and Guilleminault<sup>2</sup> recently published in the *Journal of Clinical Sleep Medicine*. We address the salient points their letter raised:

### 1. The aim of our article

This was clearly stated in the abstract: “*To test whether laboratory-based research differentiating sleepwalkers (SW) from controls (C) can be applied in an uncontrolled forensic case as evidence the alleged crime was committed during an arousal from sleep in which the mind is not fully conscious due to a SW disorder.*” This aim was restated in more specific terms: “*The objective of this study is to test the SWA in a forensic case to determine if it was significantly low in the first NREM cycle and if that indicated the presence of a predisposing condition and possibly a sleep problem which could be treated.*”<sup>2</sup> (p.723). Thus the aim was to test if this lab-based finding could be replicated in an uncontrolled setting and not to use “*spectral analysis... to support a defense of sleep walking in criminal cases*” in general.

Pressman et al. quote a cautionary statement from Gaudreau et al.<sup>3</sup> that a significantly low slow wave activity (SWA) in the first NREM cycle “*does not conclusively establish or refute a tendency toward sleepwalking.*” We agree that this is not in itself sufficient evidence to support a SW diagnosis nor would it establish that it was the cause of an event which took place at an earlier date. However the Pressman et al. letter did not include the two sentences prior to the one quoted which puts the Gaudreau et al. admonition in a significantly different light. “*Our results suggest that spectral analysis of SWA across NREM cycles can contribute to our understanding of the disorders of arousal. Delineating patterns of SWA associated with various parasomnias could help clarify their underlying pathophysiology.*” Our article aimed to encourage just this—enhancing the understanding of the pathophysiology of NREM sleep arousal disorders.

### 2. Was the method appropriate?

We based the method for our study on the hypotheses proposed by Espa et al.<sup>4</sup> as the conditions necessary to precipitate an occurrence of a SWS parasomnia. “*The occurrence of SWS parasomnia requires not only a SWS pressure increase but also SWS arousal enhancement.*” This is the push/pull model that Pressman argued was a theory that only Cartwright held in the debate he refers the reader to review.<sup>5-8</sup> He argued forcefully and repeatedly that SW only occurred with an increase of SWS and that this was the accepted wisdom. In fact the two variable model was stated earlier by Broughton et al.<sup>9</sup> in describing the Ken Parks case. “*These typical polysomnographic features of sleepwalkers suggest the coexistence of both pressure for deep sleep (SWS) and of heightened arousal causing inability to sustain such sleep.*” This opposite pressure model was used in the Pilon et al.<sup>10</sup> study which succeeded in eliciting sleepwalking events in the laboratory by combining increasing pressure for SWS by a prior period of sleep deprivation and increasing arousals from sleep by delivering auditory tones during the recovery sleep. Neither of these manipulations was successful when applied singly. It was this opposite pressure model that we tested in the case study reported in our recent paper.

The evidence presented in court supported both pressures were present in the defendant on the night of the event (he had a period of prior sleep deprivation and excessive caffeine intake during the day before the event). Thus the conditions for a SW event were present. Furthermore we pointed out that “*the additional history of snoring and a mild breathing disorder validated in the PSG may be a contributing cause of his low SWA, high CAP rate and arousal into non-conscious acts when sleep deprived and over-caffeinated.*”

Pressman et al.<sup>1</sup> raise the question whether a low SWA in the first NREM cycle, measured after the fact (not months or years) but specifically in this case eight months after the incident, can be a reliable marker of a predisposition to SW. The authors of the critique point out that the studies showing high reliability within subjects of the profile of the

spectral analysis sleep EEG wave forms, were not conducted on SW subjects and have not been shown to be stable over the extended period that usually occurs between an event that results in a criminal charge and a subsequent sleep study. However the several studies showing night-to-night reliability of delta power within normal individuals<sup>11-14</sup> even under sleep deprivation conditions, along with the several studies showing the significantly lower SWA in SW groups than in C **even when no SW events occurred**,<sup>3,4,15</sup> makes a low SWA a strong candidate to be a manifestation of the genetic vulnerability to abnormal delta arousals<sup>16-19</sup> and therefore likely to be a stable characteristic of sleep. Our article was one small step to encourage research needed to test stability of this within SW subjects over time.

### 3. Should sleep experts testify in forensic cases?

Pressman et al. deny that Mahowald et al.<sup>20</sup> discourage sleep experts from acting in forensic cases or from conducting research. The reference cited for this statement includes these quotes: “*the expert witness can inform all parties there is absolutely no after-the-fact polysomnographic evidence that could possibly have any relevance as to whether the accused was sleepwalking at the time of the event.*” And later “*attempts to ‘stimulate’ sleepwalking in the sleep laboratory (by sleep deprivation, medication administration, or alcohol ingestion) are completely worthless and totally inappropriate.*” However these authors add “*there may be a future role for utilizing PSG evaluations in forensic sleepwalking cases for ruling out, or greatly minimizing the probability, that the accused is in fact a sleepwalker.*” Sleep science should inform both sides in an adversarial trial.

### 4. Other mistaken implications re: Cartwright and Guilleminault

The data presented in support of this case did not rely on the visual scoring of SWS% and made no mention hypersynchronous delta (HSDWA) which Pressman et al.<sup>1</sup> note have not contributed to diagnosis of SW.

Another mistaken implication is that a sleep study conducted after a defendant has spent many months in prison would not reflect their prior sleep. Our case did not serve any time before his sleep study was run. This was carried out while awaiting his trial, during which time he lived at home.

### 5. Conclusion

Finally, we disagree with the last sentence of the Pressman et al. letter<sup>1</sup>: “*Tests of any sort performed months or years after the index crime can tell us nothing about whether or not the criminal defendant was sleepwalking during commission of the crime act.*” For someone who puts such emphasis on science, the first author sells short the promise of new technology to advance our ability to do appropriate testing; for example the use of home video monitoring. Mwendig et al.<sup>19</sup> conducted a long term study of a SW comparing two nights of lab based video-polysomnography to thirty-six nights of home video monitoring over three months in three different locations. They found no significant difference in the frequency or duration of the SW events captured in the lab and at home. The one difference that was highly significant was that under home video monitoring

conditions the events were significantly more complex than those in the laboratory. If home polysomnography were added to the video monitoring, we would be able to test whether low SWA was stable over extended time.

Having reviewed this critique carefully we remain in support of our concluding statement: “*There is, for example, a strong need for research involving larger samples to clarify disparate findings between studies with small samples.*”

Properly credentialed sleep medicine professionals who are approached to serve as experts in forensic cases need to view this as an opportunity for a “field study” to collect new observations and evaluate these against whether or not they are supported by the state-of-the-art sleep research and whether further sleep testing would be useful in clarifying the question of guilt. That is the role of the expert. It also requires judgment as is reflected in the wording of the oath concerning “reasonable doubt.” Science is our method to test beliefs. It is constantly evolving and on occasion enough evidence accumulates to require a “paradigm shift.” We may be at that point where dogma about the type of study needed in forensic cases and role of the sleep expert must give way to a new approach.

### CITATION

Cartwright R; Guilleminault C. Slow wave activity is reliably low in sleepwalkers: response to Pressman et al. letter to the editor. *J Clin Sleep Med* 2014;10(1):113-115.

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## SUBMISSION & CORRESPONDENCE INFORMATION

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## DISCLOSURE STATEMENT

The authors have indicated no financial conflicts of interest.