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Reply to the letter of M. Backonja and W. Howland

In the comment stated by M. Backonja and W. Howland, our finding on the relation between EEG and pain has been totally misrepresented. Nowhere in our paper (Chen et al. 1989) did we indicate "a lack of significant EEG findings". Our results provided otherwise. The main findings of our paper are: (a) under the noxious stress of the cold-pressor test, the pain-sensitive (PS) and pain-tolerant (PT) groups exhibited markedly heightened delta and beta cortical power densities; (b) PS subjects showed significantly higher delta, but not beta, power than the PT subjects; (c) significant topographic differences were observed, i.e., different cortical loci showed different reactivity to pain; and (d) overall cortical participation and a differential anterior-posterior gradient, but less hemisphere lateralization, of brain activation in the pain state. The minor finding was reduction of alpha activities in the parietal and occipital loci from baseline to pain state. We commented that such alpha-desynchronization might not be specific to pain activation since many external stimuli and internal states in a subject can often result in the alpha-desynchronization.

However, the work by Backonja and Howland (1991) can be complimented in the differentiation of high and low alpha activities during the temporal course of pain processing. What remains to be studied is whether such differential alpha activation is a specific and reliable indication of human pain processing or is often associated with non-specific aspect of arousal, stress and cortical workload in brain.

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Response to M. Backonja and W. Howland

Electroencephalography has been used to determine whether the acquired data demonstrate temporal (time and frequency domain) and/or spatial (topographic) specificity of pain. Three studies have examined the encephalogram during painful tonic stimulation produced by the immersion of an arm in ice-cold water (Chen et al. 1989; Backonja et al. 1991), or the infusion of an algesic substance into muscle (Veerasarn and Stohler 1992).

The reported effects of tonic experimental pain on cortical power densities of various frequency bands can be summarized as follows:

There is agreement among all 3 studies with respect to the observed significant increase in cortical *beta* power density in pain which was explained to a large part by muscular effects according to our work. These effects are likely due to specific pain-related expressions produced by facial and scalp muscles in the close vicinity of the recording electrodes. Interestingly, these reactions are not limited to pain. In fact, remembering a previous painful episode causes similar effects in the cortical *beta* power density and the electromyogram. The particular spatial arrangement of the involved facial and scalp muscles, located directly under the recording electrodes favors the contamination of the electroencephalographic record.

The exciting findings of our colleagues of increased cortical *delta*, particularly in pain-sensitive subjects (Chen et al. 1989), or *alpha* power (Backonja et al. 1991) density during the immersion of a hand in ice-cold water could not be replicated in our study. How about a re-analysis to consolidate these findings?

Given our repeated-measures design, we estimated the required sample size for (a) a given significance level ($P = 0.01$), (b) power of the test (90%), (c) magnitude of the effect of pain (20%, 2-tailed) with (d) the measurement parameter having an either average (coefficient of variation: 0.23) or large variability (0.32) to be 13 or 19 subjects, respectively. Because we did not observe any significant increase in the *delta* power in pain in our total group of 19 subjects, we did not examine whether the subjects which needed higher infusion rates differed from the others. In addition, we considered the comparison of the outcome of the cold pressor test with the result of a given subject's required infusion rate to maintain pain at a level of greater than 5 on a 10-point scale as questionable. For this very reason, we did not investigate the response in a subgroup of pain-sensitive or pain-tolerant subjects.

Pooling of the *theta* and *alpha* bands raises a valid point. In our experiment, it was necessitated by the equipment/software constraints of the topographic brain mapping system, CADWELL S32 (Cadwell Laboratories, Kennewick, WA 99336). Because our main focus was to examine the extent to which the *beta* power density is

	Chen et al. (1989)	Backonja et al. (1991)	Veerasarn and Stohler (1992)
Stimulus	Cold pressor test (upper extremity)	Cold pressor test (upper extremity)	Muscle pain and sham pain (face)
EEG delta power	Significant increase, particularly in pain-sensitive subjects	Not significant	Not significant
EEG theta power	Not significant	Significant increase in ipsilateral frontal electrodes	Not significant with alpha and theta bands (3.5–13 Hz) pooled
EEG alpha power	Not significant	Specific temporal low (8–10 Hz) and high (10–12 Hz) alpha response to pain	Not significant with alpha and theta bands (3.5–13 Hz) pooled
EEG beta power	Significant increase bilaterally in frontal and parietal regions	Significant increase bilaterally in frontal and parietal regions	Significant increase bilaterally in frontal and parietal regions
EMG		Response in high beta (26–30 Hz) band suggested contamination	Significant relationship between beta (13–35 Hz) and EMG signals (35–100 Hz) demonstrated by Pearson's product moment correlation

dependent of the contamination of muscle effects, pooling of the *alpha* and *theta* bands was needed and regarded as the most acceptable compromise. Instead, we added the frequency band of 35–100 Hz to our data collection protocol.

Because uneven pain intensity scores might affect the variables under examination, we chose to maintain pain by means of the continuous infusion of saline into muscle (Stohler et al. 1992). Artifact-free epochs were selected during times when the subject rated the pain intensity greater than 5 on the 10-point scale, starting 90–150 sec following the onset of stimulus delivery and as soon as a relatively steady-state condition was reached. As far as the work of the colleagues from Wisconsin-Madison is concerned, our sampling would favor the discovery of their finding of *alpha* augmentation because we did not consider the initial phase following pain initiation during which Backonja et al. (1991) reported *alpha*-blocking. However, we could not observe an increase in the combined cortical *alpha* and *theta* power density. Specifically, such an increase was not observed in the ipsilateral frontal leads for which both significant *alpha* and *theta* increases were reported (Backonja et al. 1991).

Finally, the cerebral representation of pain of the upper extremity and the face may account for possible differences between our studies as well.

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Comments on P.D. Wall, *PAIN*, 51 (1992) 1–3

Dr. Wall's recent editorial comments on the placebo effect (*Pain*, 51 (1992) 1–3) are to be praised for bringing further attention to this misunderstood and somewhat notorious topic. However, I wish to highlight some ways in which his comments may foster the undeservedly notorious reputation of this ubiquitous process.

The negative connotations associated with the placebo effect arise largely because the effect appears to contradict a fundamental tenet of the biomedical model of reality – namely that psychological events *cannot* cause physical and anatomical changes. As he implies in his 2nd and 3rd reasons (if I may overstate the case somewhat), the placebo effect seems implausible because it appears unrelated to the 'true' effects of any medical therapy. In other words, only objective, organic, material reality is 'real', and any subjective process is inherently less valid or worthy of our attention–placebo is a nuisance variable, and the whole realm of psychological processes creates only nuisance artefacts.

However, when we use a biopsychosocial model to understand medical phenomena, rather than a reductionistic biomedical model, then placebo response becomes not only more understandable, but also more *desirable*. In other words, all great medical healers possessed the ability to elicit, whether by conscious design or not, the