



## Journal of Neurotherapy: Investigations in Neuromodulation, Neurofeedback and Applied Neuroscience

### Historical Archives: The Beginning...

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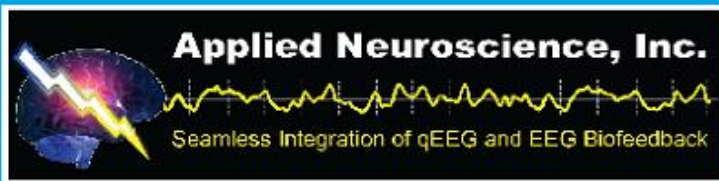
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## *HISTORICAL ARCHIVES*

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### Historical Archives: The Beginning . . .

#### *PART I*

In this issue of the *Journal of Neurotherapy* we introduce a new feature of our journal, the Historical Archives. In any profession it is important to be aware of the historical origins of the field. The field of neurofeedback was conceptualized a long time ago, and in this section we want to share some of the first works so the interested reader can get an idea of where our field came from and how it all started. As with most psychiatric treatments, the field of neurofeedback started as serendipity . . .

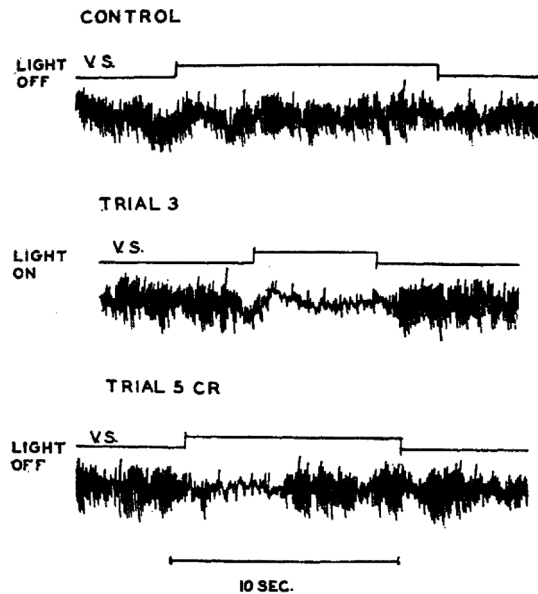
In the early 1940s several studies already demonstrated that the human EEG could be classically conditioned (Jasper & Shagass, 1941a; Knott & Henry, 1941). These studies investigated in great detail the occipital alpha-blocking response and whether alpha blocking with visual stimulation could be conditioned to an auditory stimulus. In addition a range of classical conditioning principles have been successfully applied, and all of the Pavlovian types of conditioned responses could be demonstrated (Jasper & Shagass, 1941a). In a follow-up study, Jasper and Shagass (1941b) investigated further whether participants could also exert voluntary control over this alpha-blocking response. In this study they had participants press a button, which would turn the lights on and off, and use subvocal verbal commands when pressing the button (e.g.,

“Block” when pressing the button and “Stop” when releasing the button). See Figure 1 demonstrating these effects. In the bottom tracing one can see that after five sessions the participant was able to voluntarily suppress the alpha rhythm when the light was off. This is the first study that demonstrated “voluntary control” of the EEG activity and was investigated almost 70 years ago! In 1943 Shagass and Johnson replicated this finding demonstrating that participants also could achieve voluntary control over the alpha-blocking response by clenching their fist. Even though these studies demonstrated “voluntary control” they still relied on classical conditioning principles, and it would take another 20 years before operant conditioning of the EEG would be demonstrated.

In 1962 classical conditioning of brain activity was taken one step further when Wyrwicka, Serman, and Clemente published their study in *Science*. It demonstrated that pairing a neutral auditory stimulus with electrical stimulation of the basal forebrain resulted in this auditory stimulus inducing sleep preparatory behavior. Not much later, in 1968, Wyrwicka and Serman laid the foundation of neurofeedback as we know it today: operant conditioning of EEG activity.

Most of us are aware of what happened after this initial report on conditioning of SMR activity in the cat. However, the original report describing “Serman’s cats,”

FIGURE 1. This figure shows the voluntary control of the alpha blocking response over sessions. The alpha blocking is classically conditioned to pressing or releasing a button. The bottom trace shows the voluntary control with lights off (alpha is present). Note the short blocking of alpha under voluntary control. Also note that in the top graph that the voluntary signal initially has no effect on the alpha activity. This is the first report of voluntary control of EEG activity based on classical conditioning principles. Graph from Jasper and Shagass (1941b).



Voluntary conditioning of the alpha rhythm. First line shows lack of effect of voluntary signal (V.S.) before conditioning. Second line is the conditioning trial with light. Third line shows conditioned voluntary response with no light stimulus. Note short duration of alpha block in voluntary CR relative to duration in UCR.

which were resistant to monomethylhydrazine (rocket fuel), was never published publicly given it was part of an assignment with the Aerospace Medical Research Laboratory

and deemed confidential for the past 40 years. Therefore, we are hereby now publishing the original study for the public. We hope that in this way interested readers can gain firsthand knowledge of the original findings that laid the foundation of the clinical use of operant conditioning of the EEG. This is an excellent reference of the foundation of operant conditioning of the EEG and the beginning of neurofeedback.

Martijn Arns, MSc  
Senior Editor

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