

## A scientific single case study on speech, auditory processing and attentional strengthening with Forbrain®

### SUMMARY REPORT

by Carles Escera, PhD, Professor  
Institute for Brain, Cognition and Behavior (IR3C) and Department of Psychiatry and Clinical  
Psychobiology University of Barcelona

#### Introduction

Forbrain® is a user-friendly device that uses bone conduction and a series of dynamic filters to give the user feedback of his/her own voice in a way that is proposed to optimize all components of the audio-vocal loop thus improving auditory perception. It has been suggested that the device can enhance speech, fluency, memory, focus, coordination and many other sensory functions, resulting in several improvements in the psychological (cognitive) / emotional domain.

The present single-case study is the first attempt to test the hypothesis that Forbrain® indeed induces plastic changes in the brain by at least two independent but related neural mechanisms:

- 1) by challenging the audio-vocal loop through the modified speech signal leading to a enriched acoustic environment resulting in auditory plasticity, and
- 2) by forcing the executive mechanisms of attention control to cope with the involuntary attention signals triggered by the mismatching speech inputs.

The final outcome of all these processes may be the reinforcement of the executive mechanisms of attentional control, resulting in better concentration, stronger resistance to distracters, improvements in working memory capacity and the feeling of being more focused.

#### Protocol

In this proof-of-concept research an individual case study (a 21-year old healthy female) was conducted to determine what mechanisms and changes could be detected following five fifteen minute sessions of Forbrain® use on consecutive days plus a follow-up day three days later. Specifically, the research was designed to look at the purported neural mechanism that challenged the audio-vocal loop through the modified speech signal leading to an enriched acoustic environment resulting in auditory plasticity. In addition, it researched whether focus could be improved by forcing the executive mechanisms of attentional control to cope with involuntary attention signals triggered by mismatching speech inputs.

Measurements were taken prior to use, during use and after use and included metrics on voice quality, emotional arousal as measured by skin conductance and heart rate, and attention which looked,

among other things, the neurological response to distraction (ATT test).

The auditory discrimination of speech (AUD test) was measured by a test that looked at the acoustic (fundamental frequency and intensity) and phonological (vowel identity and duration) changes.

### **Procedure of evaluation**

The procedure was as follows.

1. Baseline measurements were taken on four consecutive, alternating runs of the AUD and ATT tests, lasting a total of 80 minutes.
2. Baseline measurements of voice quality and emotional arousal parameters were obtained during reading for 7 minutes while wearing Forbrain® in off mode.
3. During a 15-minutes long session, voice quality and emotional arousal parameters were recording during reading with Forbrain® in on mode.
4. After using Forbrain®, new measurements of voice quality and emotional arousal parameters were obtained during reading for 7 additional minutes while wearing Forbrain® in off mode.
5. A full post-treatment (post-Forbrain® use) measurement session including four consecutive, alternating runs of the AUD and ATT tests lasting for 80 minutes was finally performed.

This very same schedule was repeated on five consecutive days, featuring a total of 75 minutes of Forbrain® use.

### **Conclusions**

The present single-case study was designed to scientifically test whether the use of Forbrain® had any cognitive enhancement effects. To test for such effects, a sophisticated design was implemented that recorded behavioral, psychophysiological and brain responses before, during and after Forbrain® was used for 15 minutes on five consecutive days, plus a follow-up day. The data was analyzed by means of quantitative statistical methods suited for single-case studies (Manolov et al., 2014; Shadish et al., 2014a; Shadish et al., 2014b), and the results obtained revealed significant effects on all three levels of analysis: behavioral (voice quality), psychophysiological (emotional arousal), and neuronal (activation of the cerebral network of attention control). Specifically the results can be summarized as follows:

1. After using Forbrain® for 15 minutes, the activation of the cerebral network of involuntary attention was dampened. This is supported by the attenuated amplitudes of all components of the distraction potential (N1-enhancement, novelty-P3, reorienting negativity) and indicates that Forbrain® can reinforce the mechanisms of executive control of attention and protect from distraction, resulting in better concentration, at least during the subsequent 80 minutes when the post-Forbrain® use measurements were taken.
2. During the use of Forbrain® there is an enhancement in ongoing emotional arousal. This is supported by the statistically significant differences in heart rate and skin conductance between

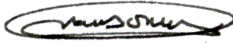
measurements taken during reading without Forbrain compared to measurements taken during reading while using Forbrain®. Because there were no differences between measurements during reading while using Forbrain® and post-use ones, these effects, at least regarding the skin conductance response, remain for the short period of seven minutes of the post-use measurement.

3. During the use of Forbrain®, and at least during the seven-minute period afterwards, voice quality improves as a consequence of Forbrain® use.

The research is, of course, subject to all the limitations of a single case design and has limited generalizability. However, as a first step in researching the effects of a limited use of Forbrain, the results suggest that there is a real basis for the claims that Forbrain can improve voice quality and the executive attentional mechanisms and memory.

The results suggest that Forbrain® could be helpful in improving focus in those who have attention disorders such as ADHD, and those who have difficulties with speech production and auditory processing. Moreover, any improvement in attention, such as was demonstrated in this study, could have benefits to everyone on memory, focus and fluency.

Further research should be undertaken to fully understand the scope and the pervasiveness of Forbrain® effects.



Carles Escera  
Barcelona, June 24th, 2015