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## The effect of mobile phone (GSM) use on Brain function

*NOTE: The effects reported here are still within normal limits and should NOT (yet) be interpreted as adverse health effects. they need replication and further study.*

### 'Slowed Brain-activity' in frequent mobile phone users.

Nijmegen - 11/9/2007 – According to a recently published study, frequent mobile phone users demonstrated slowed Brain function. This study is the first study investigating the long term effects of mobile phone use on brain function. It was also found that frequent mobile phone users showed better focused attention, which can be explained as a learning effect related to making more phone calls in distractive surroundings. No firm conclusions can be drawn as to whether these effects are to be considered an adverse health effect or not, but data have already been collected from more than 20.000 people to replicate this study and further investigate the adverse health effects.

In the September issue of the International Journal of Neuroscience a study will be published on the long term effects of Mobile Phone use on brain function. Earlier studies have mostly investigated the acute effects of mobile phone use on brain function. However, this study employed an epidemiological approach to investigate the long-term effects of mobile phone use on brain function. In this study data was used from 300 people of which 100 were 'frequent mobile phone users', 100 'non-mobile phone users' and an 'intermediate group' of 100 people. Differences in brain activity (measured using QEEG or quantitative EEG), Neuropsychological functions such as attention, memory and executive function and personality traits were assessed. The results show that frequent mobile phone users score higher on extraversion. Furthermore, frequent mobile phone users showed improved focused attention. This was explained by a learning effect due to making more phone calls in busy environments, whereby people learn to focus better on the phone call and filter out irrelevant environmental information. However, the brain activity from frequent mobile phone users shows more slow activity (increased Delta and Theta) and a slowing of the Alpha Peak Frequency. These effects could not be explained by the differences in personality and focused attention. "In Alzheimer's dementia you also find a severely slowing of brain activity. However, the slowing found in this study, with mobile phone users, can still be considered within 'normal' limits" according to Martijn Arns, the main investigator. "The frequent mobile phone user group used their mobile phone - at the time of data collection - only 2.4 years on average which can currently be considered as a short time. Therefore, it is to be expected that the observed effects in this study can be more severe with prolonged mobile phone use" according to Martijn Arns.

The 'Brain Resource International Brain Database' was employed for this study, which currently contains data more than 20.000 people, on the basis of which this study can be replicated in a cost-effective and time-efficient manner. Future studies should point out whether this effect can be replicated in larger groups, with prolonged mobile phone use and whether this slowed brain activity is to be considered as an adverse health effect or not.

This study was carried out by researchers from Brainclinics Diagnostics and the Radboud University department of Biological Psychology both from Nijmegen (the Netherlands), the Institute of Psychiatry (London) and the Brain Resource Company Ltd. (Sydney).

More information can be found on [www.brainclinics.com](http://www.brainclinics.com)

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### ELECTROENCEPHALOGRAPHIC, PERSONALITY AND EXECUTIVE FUNCTION MEASURES ASSOCIATED WITH FREQUENT MOBILE PHONE USE.

**Martijn Arns**, Gilles van Luitelaar, Alex Sumich, Rebecca Hamilton & Evian Gordon

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For a **reprint** of the full article please **contact us**.

#### **Abstract :**

The present study employs standardized data acquired from the Brain Resource International Database to study the relationship between mobile phone (GSM) usage, personality and brain function (N=300). Based on the frequency and duration of mobile phone usage, three groups were formed. The findings suggest a subtle slowing of brain activity related to mobile phone use which is not explained by differences in personality. These changes are still within normal physiological ranges. Better executive function in mobile phone users may reflect more focused attention, possibly associated with a cognitive training effect (i.e. frequently making phone calls in distracting places), rather than a direct effect of mobile phone use on cognition.

Keywords: QEEG, EEG slowing, neuropsychology, mobile phone, GSM, cell phone, personality, cognition, slowed alpha peak frequency.

#### **Acknowledgements**

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*All scientific decisions are made independent of Brain Resource Companies's commercial decisions via the independently operated*

scientific division, BRAINnet ([www.brainnet.org.au](http://www.brainnet.org.au)), which is overseen by the independently funded Brain Dynamics Centre and scientist members.

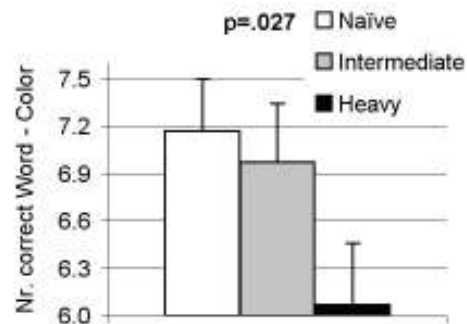
### Background

In previous studies the direct – or acute effects - of Mobile Phone (GSM) use on brain function have been investigated using neuropsychological and neurophysiological techniques. Previous studies suggests an association between acute GSM use and enhanced scores on cognitive tests. These results have been mostly interpreted as being due to small increases in brain temperature which lead to increased metabolic activity and thus faster reaction times. Electroencephalographic (EEG) studies show an increase in alpha EEG power, mainly in the parietal and occipital areas during exposure to a GSM-'like' field; during wakefulness (Croft et al., 2002; Schulze et al.; Mann & Röschke, 1996; Krause et al., 2000b) and sleep (Lebedeva et al., 2001; Borbely et al., 1999; Huber et al., 2000; 2002a; 2002b). Furthermore, increases in theta power (Lebedeva et al., 2001) and modulation of high frequency induced brain activity (Eulitz et al. 1998) have been reported during MP exposure. In contrast, other studies find no significant effects of MP exposure on spectral measures of the wake and sleep EEG (Röschke & Mann 1997; Wagner et al. 2000; Eulitz et al. 1998). In more controlled studies, Krause et al (2004) and Haarala et al (2003) failed to replicate previous findings. Thus, the acute effects of GSM-use on EEG, memory or reaction time may be small, variable and not easily replicable. Thus, results of the acute effects of an MP 'like' field on brain function are inconclusive and reasons for the above inconsistencies are unclear.

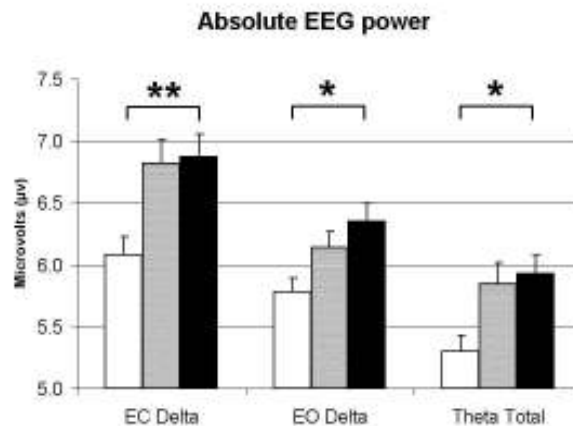
The relationship between the cumulative long-term and/or frequent use of GSM use on brain function and information processing has not been investigated yet. Therefore, this epidemiological study was designed to gather data and explore the association between long term and/or frequent GSM-use, brain function and personality. The Brain Resource International Database (also see [www.brainnet.org.au](http://www.brainnet.org.au)) was used to investigate personality, neuropsychological performance and brain function as a function of self-reported mobile phone use in a large group of healthy subjects.

### Results

The results of our study show that Frequent mobile phone users showed improved performance on the Stroop test and showed a lower interference score, as can be seen in the figure below.



Furthermore, there was increased slow activity in the EEG (delta and theta) related to the frequency of mobile phone use as can be seen below.



The alpha peak frequency was also lower for mobile phone users, and there was a significant correlation between mobile phone use and Eyes Open alpha peak frequency at central and right temporal sites.

These results cannot be explained by the pre-existing differences in Personality and Stroop performance.

### Conclusion

The results showed that frequent mobile phone (GSM) users were more extraverted and less open-minded (openness). Furthermore, frequent mobile phone users showed improved focused attention (less interference on the Stroop). This was explained by a learning effect due to making more often phone calls in busy environments, whereby people learn to better focus on the phone call and filtering out irrelevant environmental information. However, the brain activity from frequent mobile phone users showed more slow activity (increased Delta and Theta) and a slowed Alpha Peak Frequency. These effects could not be explained by the differences in personality and focused attention. Severely slowed brain activity has also been found in patients with Alzheimer's dementia. However, the slowing found in this study can still be considered within 'normal' limits. The frequent mobile phone user group used their mobile phone at the

time of data collection on average only 2.4 years, which can currently be considered short. Therefore, it could be expected that the observed effects in this study could be exaggerated with longer mobile phone use.

For this study the 'Brain Resource Company International Brain Database' was employed, which currently contains data from more than 17.000 people, on the basis of which this study could be replicated in a cost-effective and time-efficient manner. Future studies should point out whether this effect can be replicated in larger groups, with longer mobile phone use and whether this slowed brain activity should be considered adverse health effects or not.

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