

# Influences of TETRA Fields Emitted by Handsets on Cognitive Function and Psychological Basic Activity

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## Background and motivation

The wireless TETRA (Terrestrial Trunked Radio) communication system developed for authorities and organisations with security-related tasks is used in several European countries or is currently under construction like in Germany. Current guidelines and exposure limit values for radio frequency radiation base on well established thermal effects. The study was an exploratory study, there are no scientifically based mechanisms for non-thermal effects. To examine concerns about non-thermals effects several international studies on possible effects of electromagnetic fields generated by mobile phones on cognitive performance were carried out. However the frequency band of TETRA (about 400 MHz) has been investigated less than the higher frequency bands of public communication systems. On the one hand there are only a few investigations on effects of fields of TETRA cellular phones on cognitive function and well-being of humans - on the other hand reliability of concentration and attention performances for the certainty of behavioural decisions and the correct evaluation of obtained information are very important during the use of Wdssets for example in police and security organisations..

## Aim of the investigations

The aim of this project consisting of two studies was to assess a potential health risk during the professional use of the TETRA mobile radio system by investigating volunteers in a shielded laboratory. To verify the results obtained in the first study using two generic antennas the second study with modified commercial TETRA 25 handsets (fig. 1) was performed.



**Fig. 1**  
Generic antenna  
and TETRA 25  
handset

## Material and methods

Two studies in a (3 x 4)m-Faraday room (fig. 2) were conducted, each with 24 young healthy male volunteers 20 to 30 years old. To complete the intended comparable conditions we selected two homogeneous groups of participants by means of preliminary aptitude tests.

During the first study the test persons were exposed to a TETRA 25 field of two generic antennas, fitted on the right and the left side of the head at a helmet in "intended use position" (CENELEC, 1996).

For the used maximum transmission power of 2 Watt, the specific absorption rate (SAR) measured with a head phantom was found to be below the exposure limit values (head) recommended by ICNIRP for occupational exposure (10 W/kg) and for general public (2 W/kg).

The test persons were exposed alternately to one of the two TETRA fields at both sides of the head or to a sham exposure (no field), fig. 3.



**Fig. 3** Volunteer with helmet  
and TETRA handset

While the TETRA device was either switched on or off according to a cross-over design each test person had to fulfil different visual demands for four periods of 30 minutes (sinistral, dexter and non-field exposure). The reaction behaviour of the volunteers was analysed in a double-blind-test.

The first test period was devised as an exercise and has not been evaluated. The computer-based cognitive tasks were aimed at different cognitive performances using the Vienna Test System: visual attention (test vigilance), identification of signals (test signal detection), quick response to a certain light stimulus (reaction test). Furthermore, we investigated aspects of psychological basic activity using a perception effect in a rest situation known as the "autokinetic illusion" (fig. 4). The test "vigilance" replaced the "numbers show test" performed in the first study (numbers in a quadratic pattern should be found in sequence). After each test period we carried out a survey about subjective parameters and possible perception of the TETRA field. The total time of each single experiment was three hours (time of test periods see tab. 1).

**Tab. 1** Procedure of the main experiment

	Activity	Duration (min)
Before the experiment	Medical check-up and questionnaire (health, well-being)	20
Test period 1 to 4 (repetitions)	Tests: numbers show test/vigilance	10
	reaction test	1.5
	signal detection	7.5
	autokinetic illusion	10
	Rating (subjective parameters)	1
	Questionnaire (field perceptible?)	1
After the experiment	Questionnaire (well-being)	5

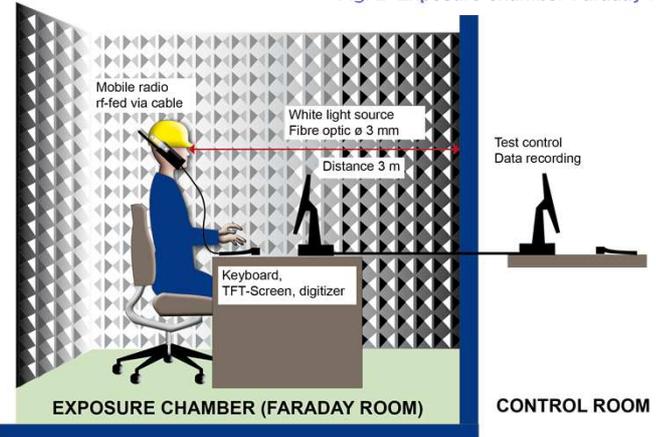
## Results and conclusion

The results of the second study verified the results of the first study. In both studies the participants did not perceive the presence of the electromagnetic field. Changes in well-being were not correlated with the particular mode of exposure but with the high cognitive requirements in performing the tasks.

Two studies with different homogenous groups of volunteers were carried out under comparable conditions and both studies did not show any influence on the visual information processing or the subjective experience as a result of the short exposure to an electromagnetic field of a TETRA handset.

With respect to the increased professional use of the TETRA mobile radio system the results of this project contribute to the safe and reliable use of handsets for users.

**Fig. 2** Exposure chamber Faraday room



In order to compare the results of both studies they were performed under the same conditions:

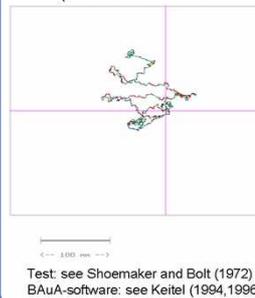
Frequency of RF-signal 380.25 MHz, frame repetition rate 17.65 Hz, RF power 2 W peak, maximum value of SAR 1.35 W/kg.

**Fig. 4** Test autokinetic illusion

### Task:

Observation of a small fixed light point (3 mm diameter) in the dark faraday room

→ The small light point seems to move (because orientation is not possible). → **Task:** To draw a pattern of the illusion of point movement



### Parameters:

- Latency period (s)
- Overall length in the track (mm)
- Max. span of the track (mm)
- Max. distance from starting point (mm)
- Number of changes of direction
- Number of stops
- Speed of drawing (mm/s)

## Statistical analysis of data

The analysis was performed using the statistical systems SPSS and SYSTAT by means of multifactorial analysis of variance, considering dependence on field exposure (field or non field) and dependence on application (TETRA field on the left or right side of the head). Both time and exposure effects on the dispersion about the mean of the sample have been evaluated by analysis of variance with regard to the response time values, the errors and the parameters of the autokinetic illusion.

With respect to each parameter none of the variances of the average values between the different exposure conditions showed any field influence. No statistically significant differences ( $P < 0.05$ ) between the two different TETRA exposures and the sham condition could be found.