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PROPOSAL TO STUDY BIOPHYSICAL EFFECTS OF A 60 HZ MAGNETIC FIELD: FROM NEUROPHYSIOLOGY TO MOTOR BEHAVIORS

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0.1. Introduction.

Effects of human exposure to extremely low frequency (ELF) magnetic fields (MF) have been reported [1-7]. It has been shown that ELF MF can modulate EEG or evoked potentials [1, 2]. Heart rate and heart rate variability seem to be affected by exposure to 50 or 60 Hz MF [3, 4], which indicates that electrophysiological rhythms can also be modified at the peripheral level. However, effects of ELF MF on subtle human behaviors remain controversial and involved mechanisms are unknown.

Another way to investigate MF effects on the whole human body is to evaluate human motor functions. For example, human anteroposterior postural oscillations can be affected using a pulsed MF at 200 μT [5]. Moreover, the exposure to a 50 Hz, 1000 μT MF seems to have a relaxing effect on human postural tremor [6, 7]. Interestingly, Cook et al. [1] emphasized the link between resting posterior alpha activity and the state of relaxed wakefulness.

Therefore, links begin to appear between human physiological, neurophysiological, and motor modulations induced by MF exposure, which make the concomitant investigation of these parameters essential to provide reliable information concerning the mechanisms involved. Thus, the present project will study the effects of exposure to a 60 Hz MF (North American power grid frequencies) up to 1800 μT on human physiological, neurophysiological, and motor functions. This exposure corresponds to the highest level of induced currents allowed by the International Commission on Non-Ionizing Radiation Protection at the level of the head [8].

0.2. Objective.

The main purpose of this project is to determine sub-clinical (subtle) effects in humans during and following acute exposure to power-line frequency MF. We will investigate: 1) Peripheral blood perfusion (with a Doppler probe); 2) Heart rate (frequency and variability); 3) Brain electrical activity (EEG); 4) Posturo-kinetic activity (postural sway); 5) Voluntary motor functions (rapid alternating movements); and 6) Involuntary movements (postural tremor).

This research will be funded in part by Hydro-Quebec, Electricite de France, Ontario Research and Development Challenge Fund (ORDCF), Canadian Institutes of Health Research (CIHR) and Lawson Health Research Institute.

0.3. Methods.

ELF MF exposure will be assessed on 120 subjects during two counterbalanced exposure sessions (active/real and control/sham) on two separate days. A double-blind procedure will be used such that neither the participant nor the experimenter will know when the real or sham condition occurs.

Subjects will be exposed to a 60 minutes homogenous (continuous or intermittent) 60 Hz MF up to 1800 μT centred at the level of the head. During a session, subjects will have to complete 4 blocs of testing (each 14 minutes) as follows: 15 minutes before the beginning of the exposure period, 15 and 45 minutes after the beginning of the exposure, and 15 minutes after the end of the exposure.

During each bloc, ECG and blood flow will be recorded continuously. The other parameters to be recorded include: a) Resting EEG - eyes open and eyes closed (2 min each), b) Postural oscillations - eyes open and eyes closed (30 s each), c) Performance in slow and rapid alternating hand movements (6 conditions of 10 s each), and d) Index finger postural tremor with and without visual feedback (1 min each). Recordings will be realized in a sitting position, except for postural oscillations.

0.4. Expected results.

For each computed characteristic, a within subject ANOVA 2 (real sham) x 4 (moments of recording) will be run. According to results of the literature, we hypothesize that 1) MF will not affect peripheral blood flow, 2) Reduce heart rate, 3) Increase EEG power in alpha band activity, especially in the posterior regions of the brain, 4) Postural oscillations will provide a decrease of the quantity and variability of anteroposterior displacements, 5) Rapid alternating hand movements maximum frequency will increase and 6) Postural tremor amplitude will decrease. Effects should appear after several minutes of exposure.

0.5. Discussion/Conclusion.

The data collection should begin in April 2006 and finish in April 2007. This ambitious project (approved by the University of Western Ontario Research Ethics Board # 11956E) should provide reliable information concerning human exposure to power-line frequency MF..

0.6. References.

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