



# EEG and eyeblink response to different acupuncture modalities: preliminary results from four pilot studies



© David Mayor (University of Hertfordshire) and Tony Steffert (Open University)

## A. Why EEG & EBR?

- **Encephalography (EEG)** records electrical activity on the scalp, and is useful for investigating rapidly changing cortical brain states
- **Eyeblink rate (EBR)** is a marker for central dopamine function, and is also inversely correlated with parasympathetic activity

EBR correlations from the literature

Increased EBR	Decreased EBR
Conjunctal dryness	ST36
Drowsiness, sleep deprivation	Downward gaze
Higher baseline arousal	Visual attention
	Following stress
	TEAS
Anxiety	Convergent thinking
Cognitive flexibility	Neuroticism, introversion?
	PATHOLOGY
Panic disorder	Schizophrenia (positive symptoms)
Schizophrenia (positive symptoms)	Schizophrenia (negative symptoms)
Other psychiatric disorders	
Hamilton's disease	Repetitive behaviour disorder
Social dyslexia	Peritonsillar
Autism, Tourette & syndromes	
	Medication
Dialysis	Enzyme dependence

"I think you'll find it's the actual point that's causing me to blink – every time it fires off in Colon 4"

"I felt the blinking started when the electrical stimulation started"

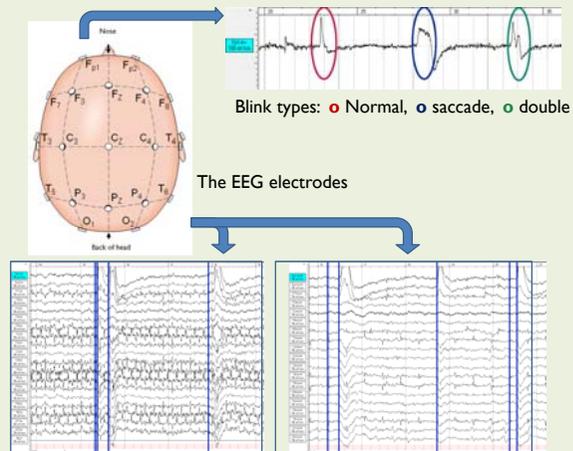
(Study participants)

"I shut my eyes and all the world drops dead;  
I lift my lids and all is born again."

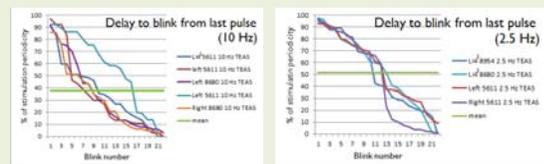
Sylvia Plath (Mad Girl's Love Song, 1951)

## B. OUR RESEARCH QUESTIONS

1. How do the EEG & EBR respond to stimulation at different acupoints?
2. How do the EEG & EBR respond to different modalities of acupuncture?
3. How do the EEG & EBR respond to electrical stimulation at different frequencies?
4. In particular, does stimulation 'drive' the EEG or blinking at 10 Hz more than 2.5 Hz?



EEG traces showing TEAS pulse artefacts (10 Hz left, 2.5 Hz right). Vertical blue lines indicate pulse-to-blink delays.



Pulse-to-blink delays for 22 pulses. Mean delay (normalised) is significantly less for 10 Hz TEAS.

## E. OUR CONCLUSIONS

- EEG and EBR respond differently to MA, EA and TEAS at different acupoints
- EEG and EBR changes are sometimes parallel, sometimes opposite
- 'Dosage'/order effects suggest that EA has a greater effect on dopaminergic function or arousal than MA
- Blink may be facilitated more by 10 Hz than by 2.5 Hz TEAS

## D. OUR RESULTS

### EEG (Pilot 1, N=7)

- Stimulation on the **Right** resulted in **greater** relative spectral power than on the **Left** \*
- Stimulation of **ST36<sup>2</sup>** resulted in **greater** relative spectral power than at **LI4<sup>2</sup>** \*

### EBR (Acupoint results)

#### Pilot 2 (N=12)

- Mean EBR was **higher** during stimulation on the **Left** than on the **Right**, but only after 10 minutes of stimulation
  - Mean EBR was **higher** during **ST36<sup>2</sup>** than **LI4<sup>2</sup>** stimulation (for MA and EA)
- [See top row of upper right Figure]

#### Pilot 3 (N=4)

- Mean EBR was **higher** during stimulation on the **Left** than on the **Right** during **first** MA and EA treatments in each session, but **lower** during **second** MA and EA (and both TEAS) treatments
  - Mean EBR was **higher** during **LI4<sup>2</sup>** than **ST36<sup>2</sup>** stimulation during **first** treatments in each session, but **lower** during **second** treatments (MA, EA, TEAS)
- [See bottom row of upper right Figure]

#### Pilot 4 (N=1)

- Mean EBR was **higher** during TEAS on the **Left** than on the **Right** ear

### EBR (Modality results)

#### Pilot 2

- EBR increased **more** with **EA** than **MA** \*
- EBR increased **more** with **20 minutes** than **5 minutes** of EA \*

#### Pilot 3

- EBR during **EA** usually **increased** compared to during prior **MA** \*
- EBR **decreased** again **after EA** \*
- EBR is usually **greater** for **TEAS** than **MA** [See lower right Figure]

- Blinks occurred with **less delay** following pulses during **10 Hz** than **2.5 Hz** TEAS (timescales normalised) \* [See Figures on left]

## C. OUR PROTOCOL

(All interventions in balanced order)

### Pilots 1-3

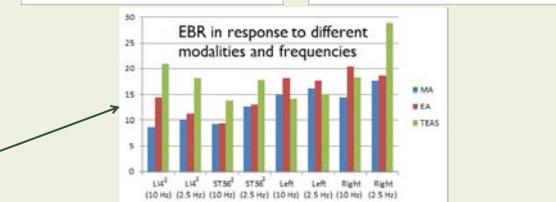
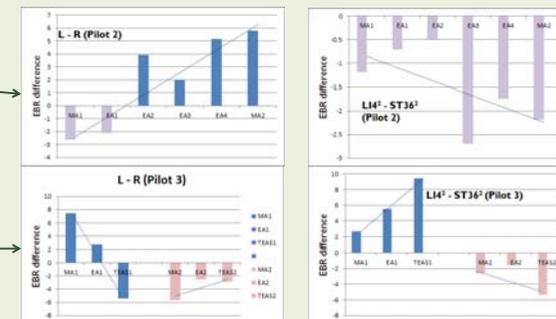
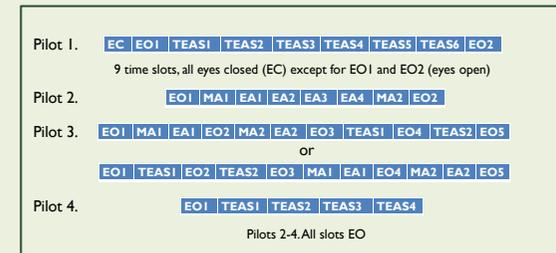
Points: LI4 to LI4 (**LI4<sup>2</sup>**), **ST36<sup>2</sup>**. **Left** or **Right** LI4 to ST36

Parameters: 2.5 Hz or 10 Hz (256 µs)

Modalities: manual (**MA**), electro (**EA**), transcutaneous (**TEAS**)

### Pilot 4

**Left** or **Right** ear (*shenmen, concha*), 2.5 Hz or 10 Hz, TEAS



## F. WHERE NEXT?

These findings need to be replicated and extended:

- Are results similar at other acupoints?
- What are the effects of interventions such as laser acupuncture?
- Does the *yinyang* model help to explain our results?
- Does baseline EBR indicate responsiveness to acupuncture?
- Does acupuncture have a 'balancing' effect on EBR?