Mesoscopic Neural Activity Alignment During Shared Intentionality Experiments

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Background

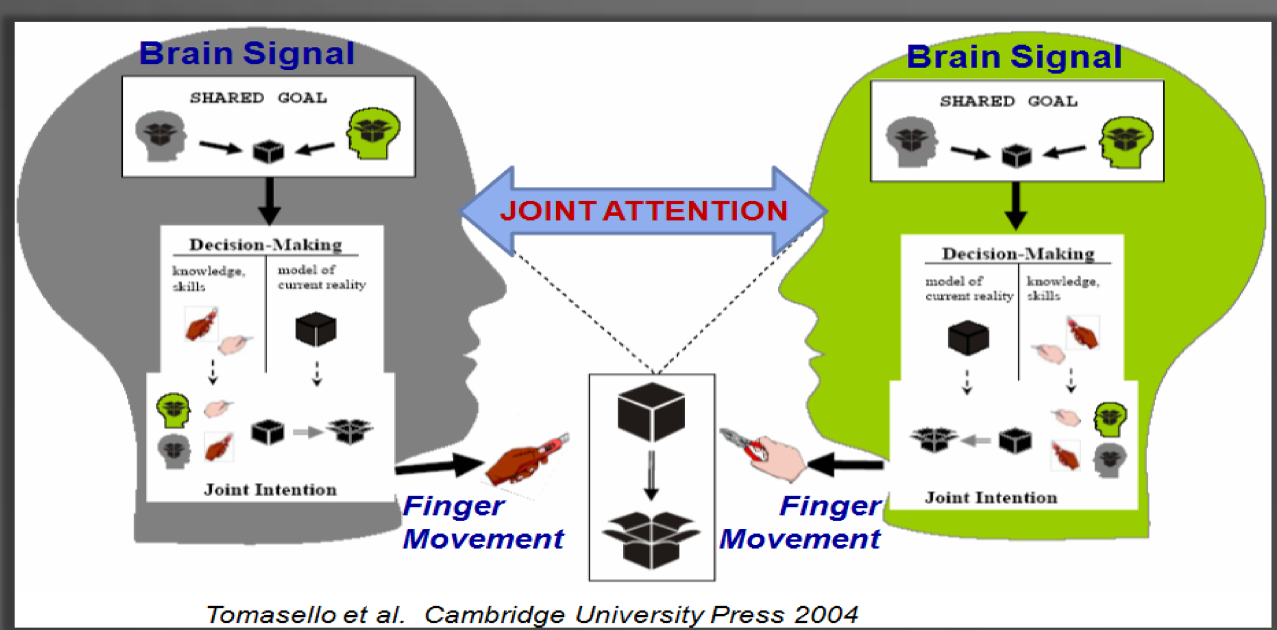
Abstract

- Studies in EEG analysis from human subjects have demonstrated that perceptual information can be captured while subjects were engaged in task oriented activities.
- Perceptual patterns were found in the beta-gamma range (25–30 Hz).
- Our results suggest that the scalp EEG can yield information about the timing of episodically synchronized brain activity in higher cognitive function, so as to support mechanisms of brain–computer interfacing.

Shared Intention

We intend to J iff

1. (a)I intend to we *J* and (b) You intend that we *J*
2. I intended that "we *J*" in accordance with and because of 1a, and *meshing subplans* of 1a and 1b; You intend that "we *J*" in accordance with and because of 1(a), 1(b), and *meshing subplans* of 1(a) and 1(b)
3. Step 1 and step 2 are common knowledge between us.



Joint Attention and Social Coordination

- In terms of inter personal coordination we consider human actions in social context. Synchrony coordination dynamics is adopted from bimanual rhythmic coordination - dynamical process, the HKB model (Haken, Kelso, & Bunz, 1985).
- Thus far there is some experimental evidence that supports the idea that the sequence formation of frames begins with the abrupt resetting of phase values on every channel, followed by re-synchronization and temporal/spatial pattern stabilization within the frame.

Hilbert Transformations

Provide the 'analytic' amplitude of the EEG signal. The real (v(t)) and imaginary (v'(t)) parts of the signal are used to for the following calculation:

$$AA(t) = [\ v^2(t) + v'^2(t)\ ]^{.5}$$

Procedure

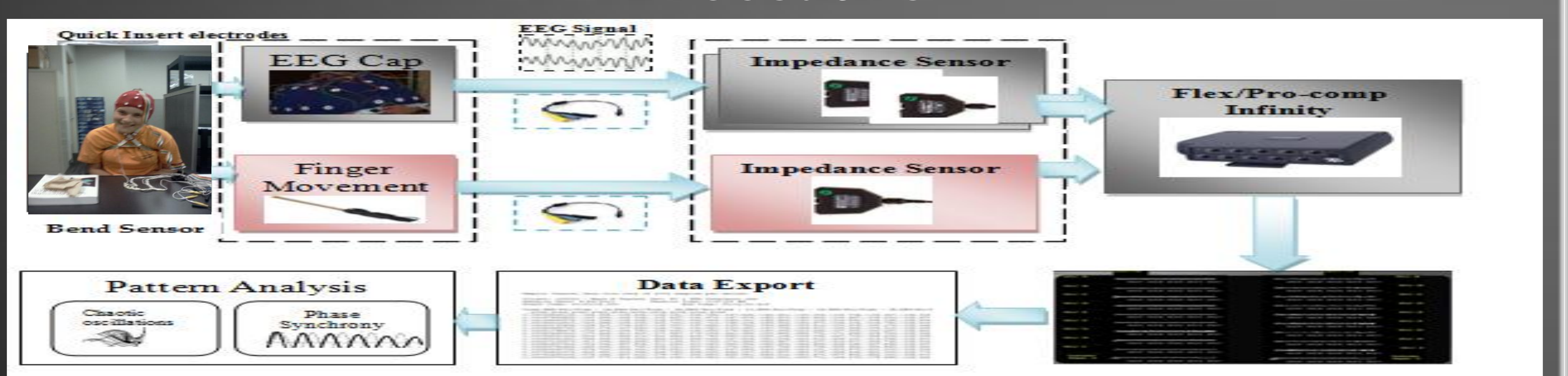
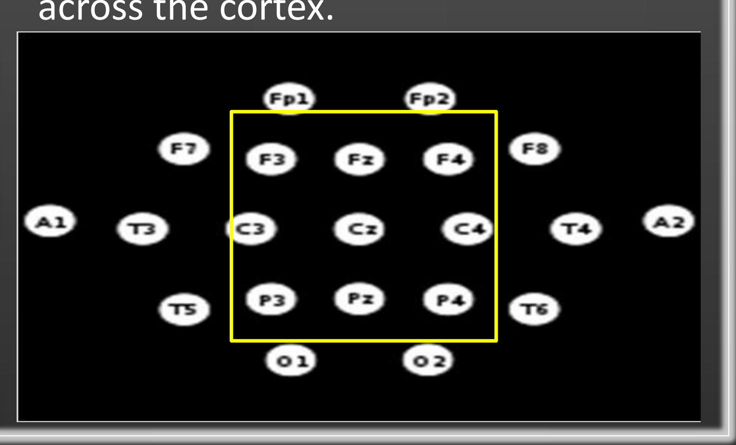


Fig. 1. Evoked-related potentials (ERP) were captured via an EEG cap using nine electrodes. Additional sensors were utilized to capture finger movement via a bend sensor. Grounding and negative connections were facilitated via ear lobe connections. Positive, negative and grounding connections were inserted into an impedance sensor which connected to the Flex/Pro-comp Infinity™ amplifier. EEG data capture was accomplished through BioInfinity™ where data was exported in order to enable EEG analysis of cognitive states.

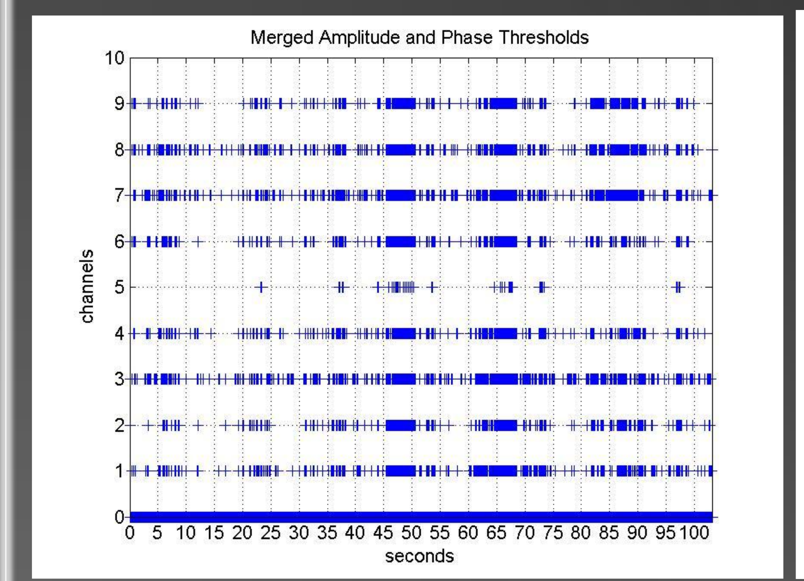
Continuous records were taken, with the times of various sorts of visual stimuli via a protocol consisting of the following:

1-40s: Rest period
40-50s: Eyes open+ finger movement
50-60s: Rest period
60-70s: Eyes wandering+ finger movement
70-80s: Rest period
80-90s: Eyes closed + finger movement

The 10-20 EEG system is utilized in this experiment. We utilized the three by three matrix outlined in the yellow box to illustrate phase movement across the cortex.



Results



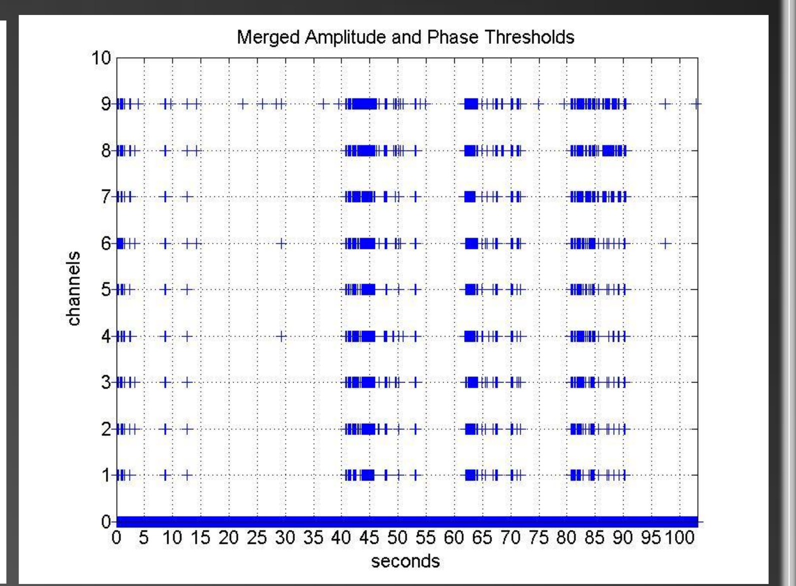


Fig. 2. Relationship between analytic amplitude and visual stimulation captured via EEG measurements between two participants . The two participants AA figures displayed above demonstrate synchronized activity across all channels. Synchronized AA activity occurs when both participants are engaged in (a) participants eyes focused on each others finger movement (40-50s)(b) participants eyes wandering during finger movement (60-70s), and (c) participants eyes closed during finger movement (80-90s).

	1 (5-10)	2 (10-15)	3 (15-20)	4 (20-25)	5 (25-30)	6 (30-35)	7 (35-40)	8 (15-30)
A_B_1	c	b	b					b
A_B_3		bc	ac		ac	c	c	ac
A_B_4	abc	abc	abc	bc		ab	bc	abc
A_B_5	b	bc	c					
A_B_6	c	c						
A_B_7	c	c	b					
A_B_8	b	b	b					
C_D_1	a	a	a	a	a	a	a	a
C_D_2	ac	abc	abc	abc		bc	abc	bc
C_D_3	c	c		b		a	b	c
C_D_4	bc	ac						abc
C_D_5	c							bc
C_D_6	c	b						bc
C_D_7		c						bc
C_D_8		b	b	b	b	b	b	b
C_D_9	c	bc						bc
C_D_10	bc	abc	b				b	bc
E_F_1	bc	b						bc
E_F_2		bc						abc
E_F_4	ac	ac	a	a				a
E_F_5	c							c
E_F_6	c							c
E_F_7		b	b					c
E_F_8	b		c		b			bc
E_F_9	bc							c
E_F_10	ac	c	c	c	c	c	c	c
G_H_9	c	c	c					c
I_D_1	bc	bc	bc	bc	bc	bc	b	
I_D_2	b	b	b					b
I_D_3	bc	bc	bc	bc	b	bc	bc	bc
I_D_4	b	b	b	b	c			c
I_D_5	abc	ab	ab	ab	b	b	ab	ab
I_D_6		a	a	a			a	a
I_D_7	c	c	c					
I_D_8	b	b	b	b	b	b	b	b
I_D_10		a	ab	a	a	a	a	ab
A_G_1								bc
A_G_2								b
A_G_5								c

Results

Results of quantitative EEG measurement of analytic amplitude have shown synchronized activity occurring more often during (c) participants eyes closed during finger movement (80-90s). Most synchronized activity also occurred during band pass frequency range (15-30 Hz). For each set of participants, ten recordings were performed. It has been observed that that there is more instances of synchronized activity between participants at the beginning of the recordings vs. at the last set of recordings. Six out of eight recordings demonstrated synchronized activity between participants.

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IRB protocol : 2220, University of Memphis

Acknowledgments

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