Flash VEP-based Brain Computer Interface (BCI)

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The Brain Computer Interface Using Flash Visual Evoked Potential and Independent Component Analysis

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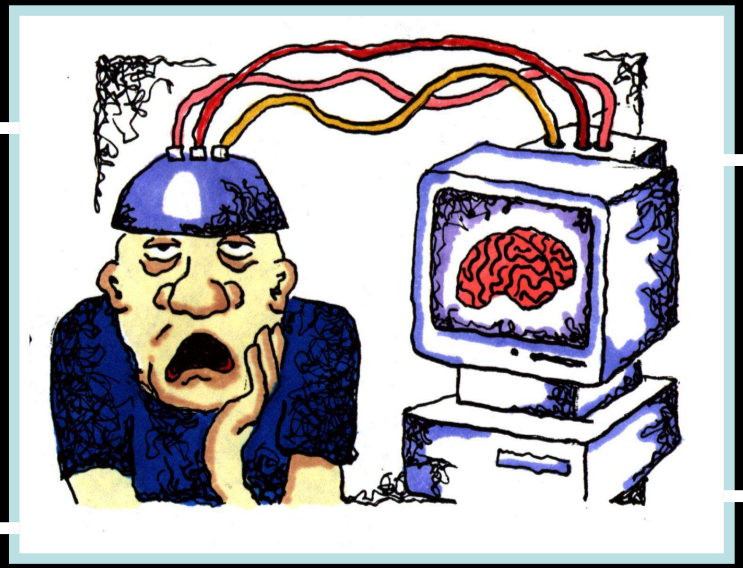
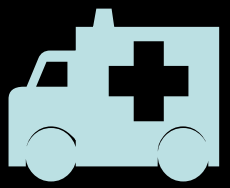
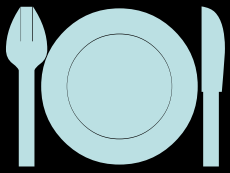
Brain Computer Interface
大腦操控人機界面

人腦具有許許多多的訊號，是否可以利用這些訊號來控制一些儀器，幫助病人改善生活品質？



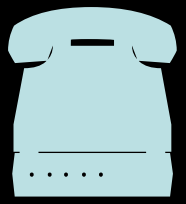


緊急救護



飲食

洗手間



聯絡

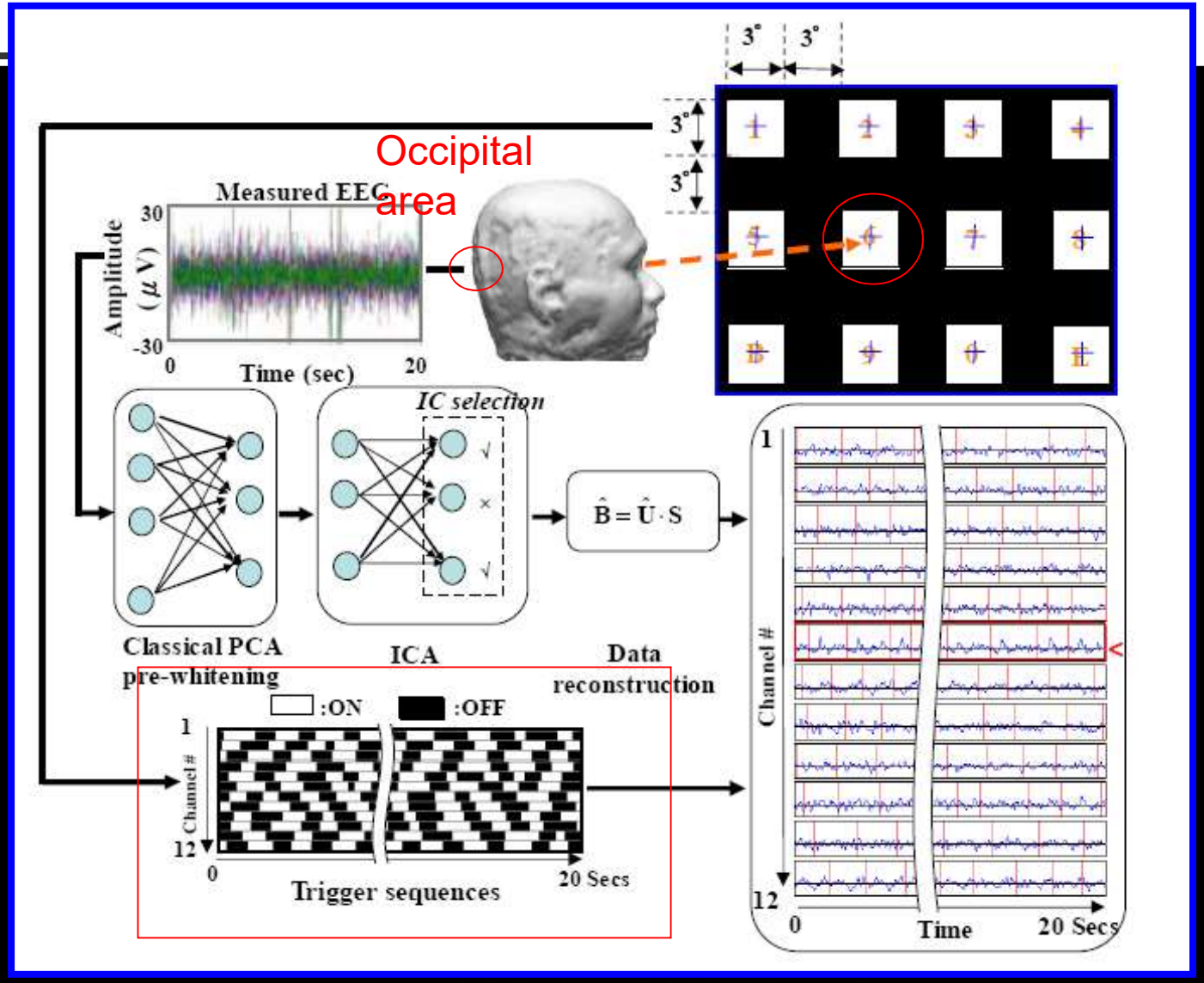
飲水

Brain Computer Interface

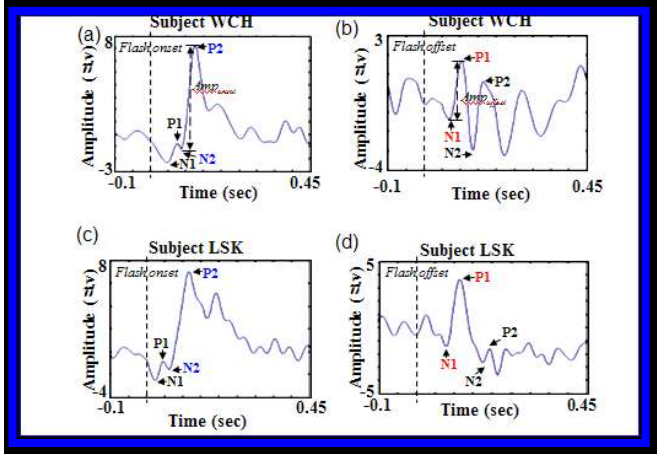
大腦操控人機界面

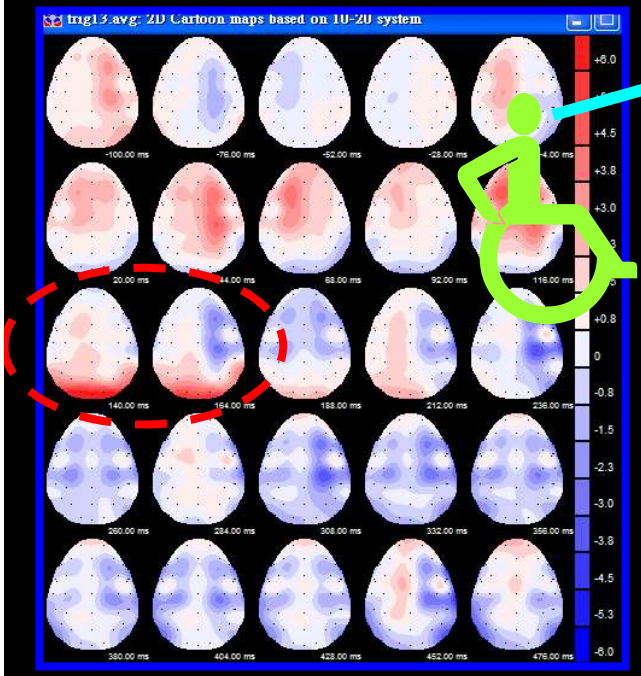
Brain signal controlled wireless mouse

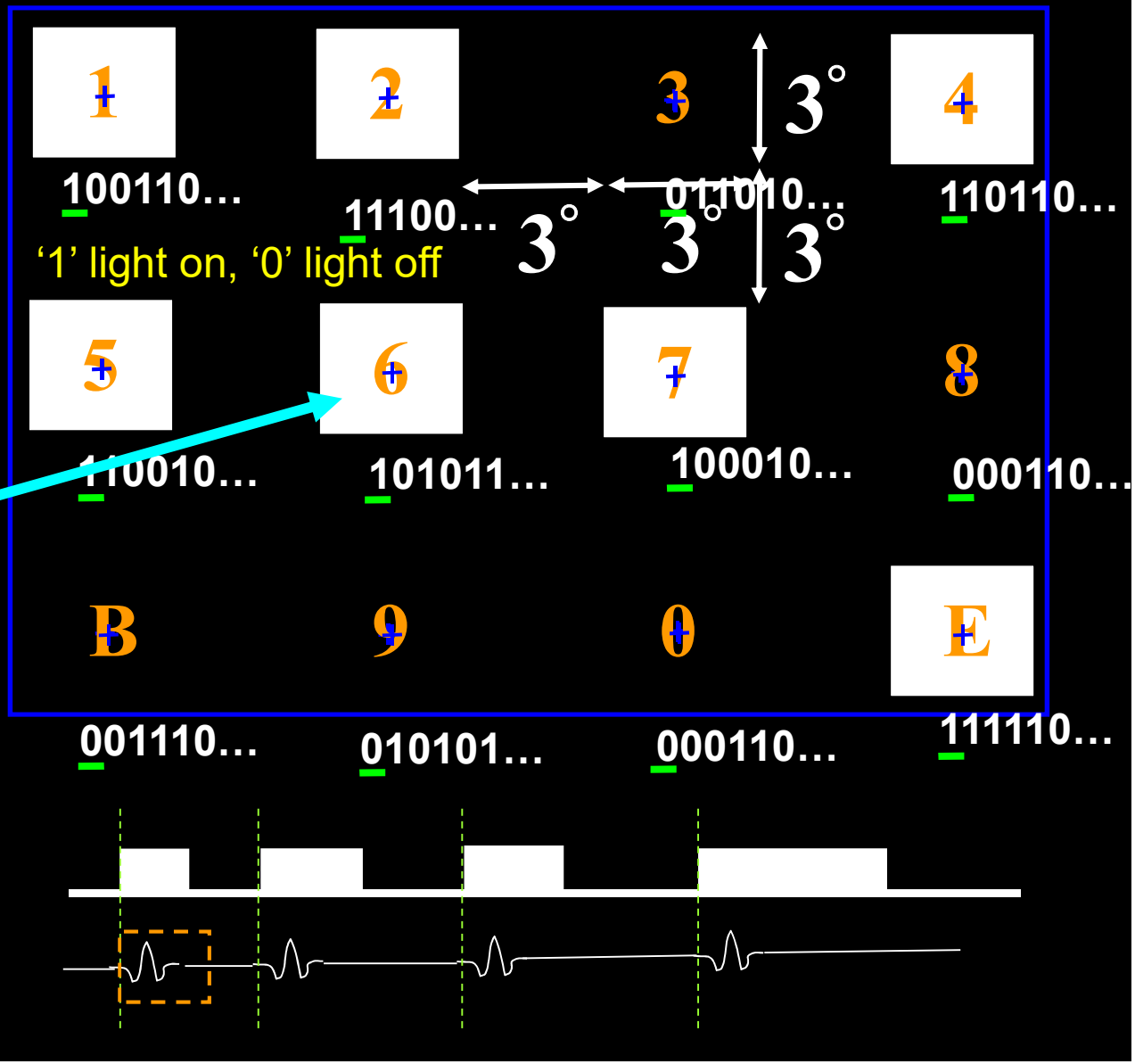
Flash VEP-based BCI



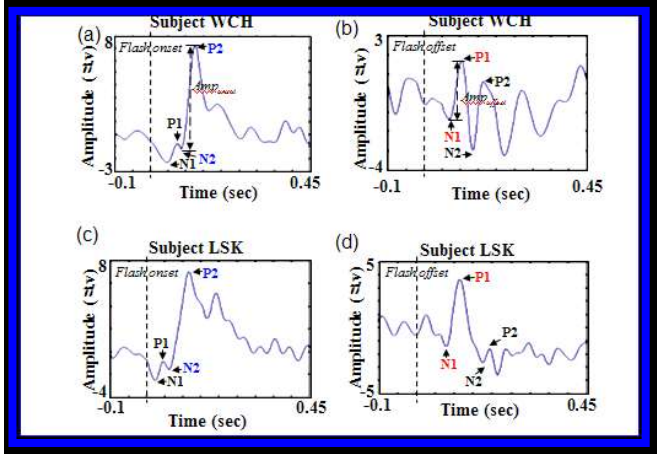
Visual Stimuli and Visual Evoked Potential (VEP)

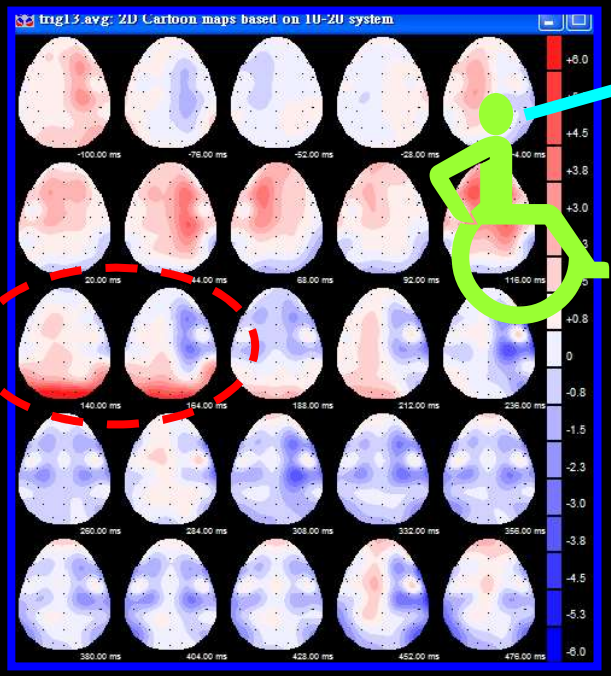


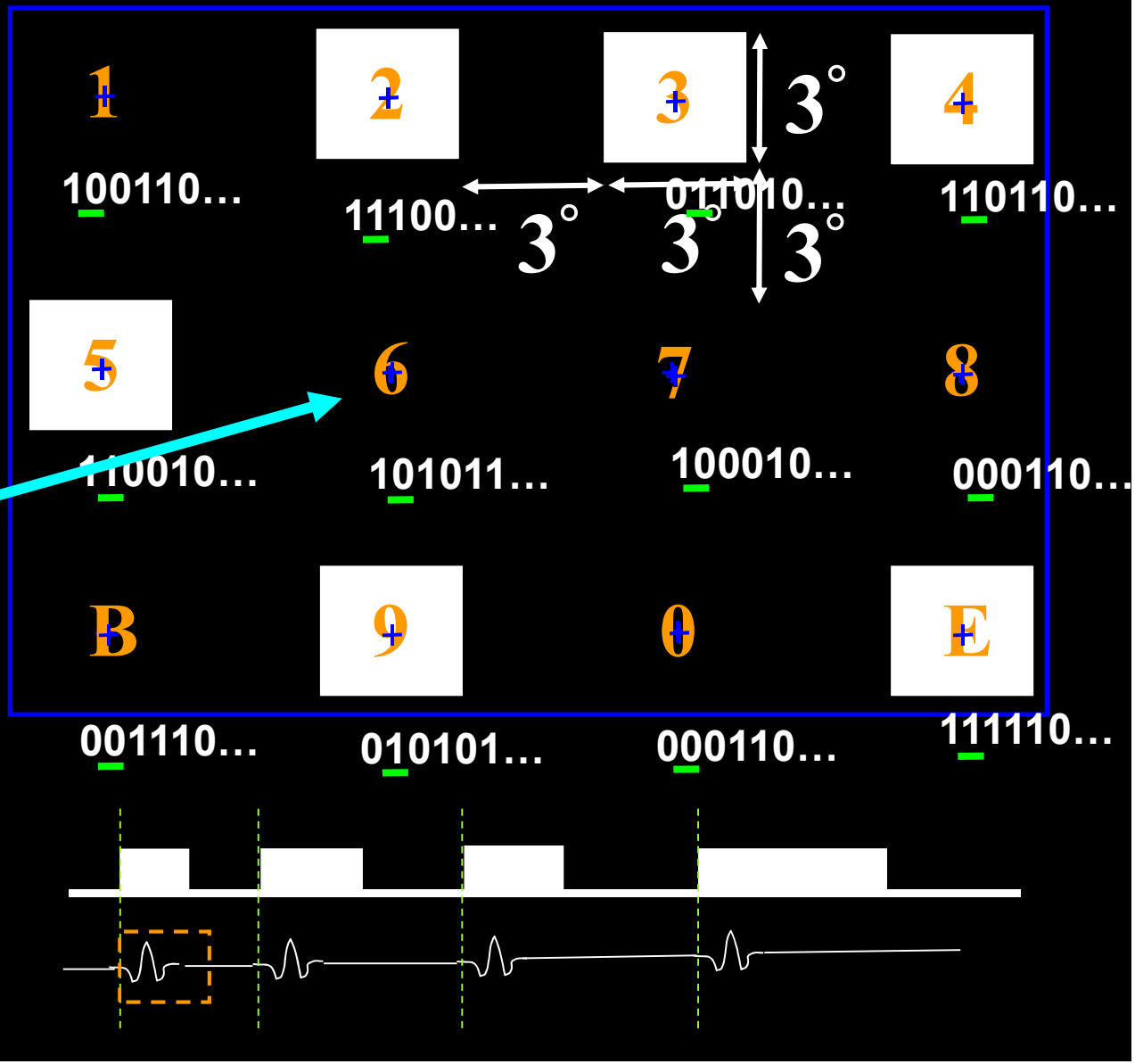




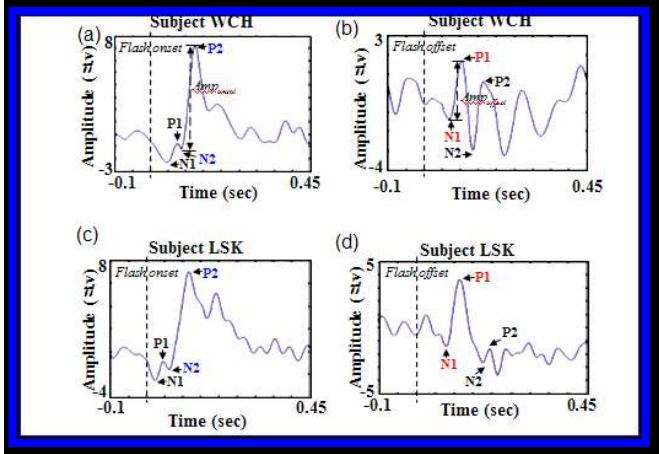
Visual Stimuli and Visual Evoked Potential (VEP)

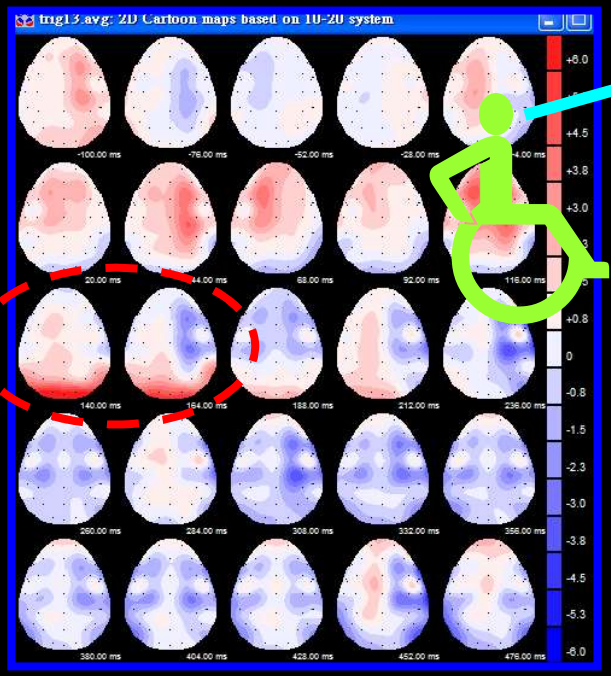


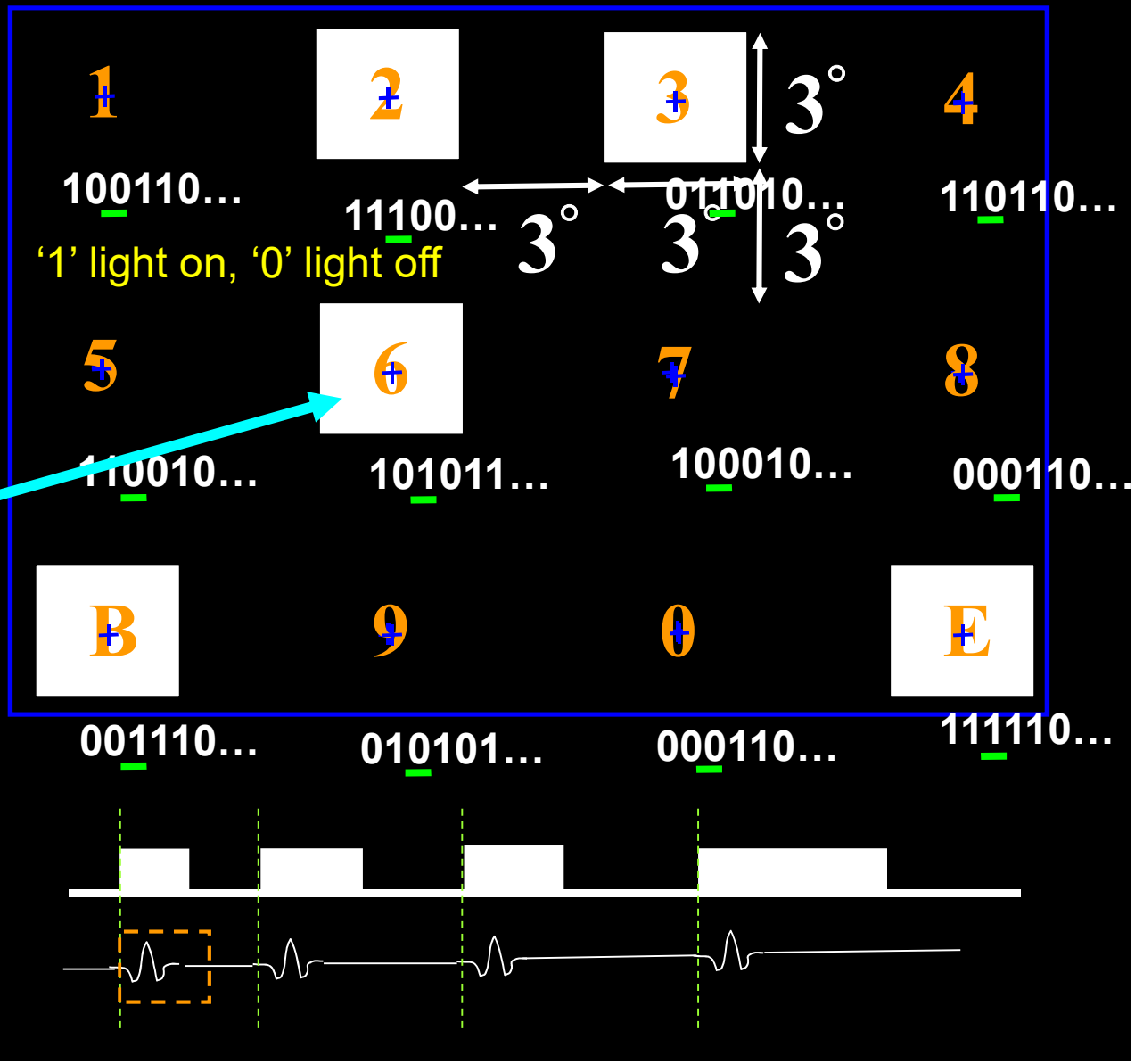




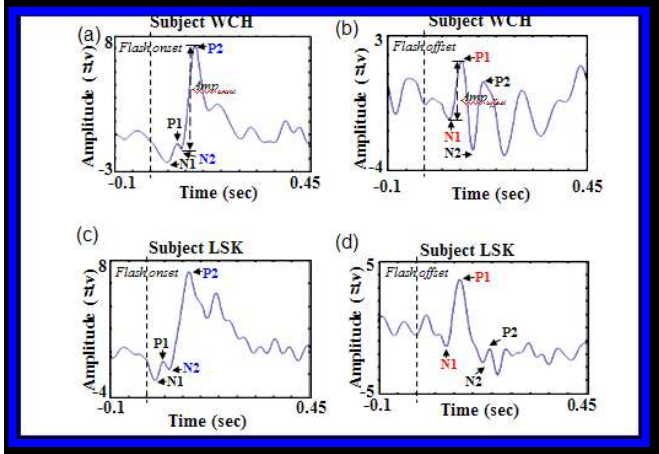
Visual Stimuli and Visual Evoked Potential (VEP)

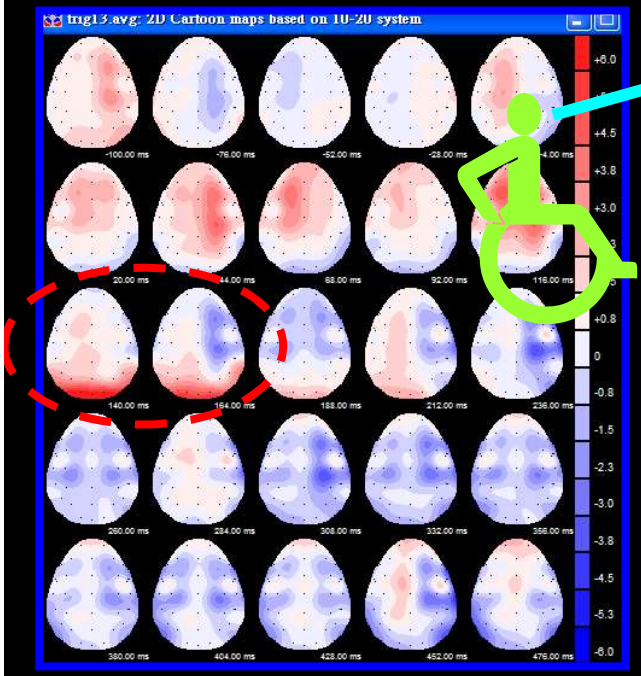


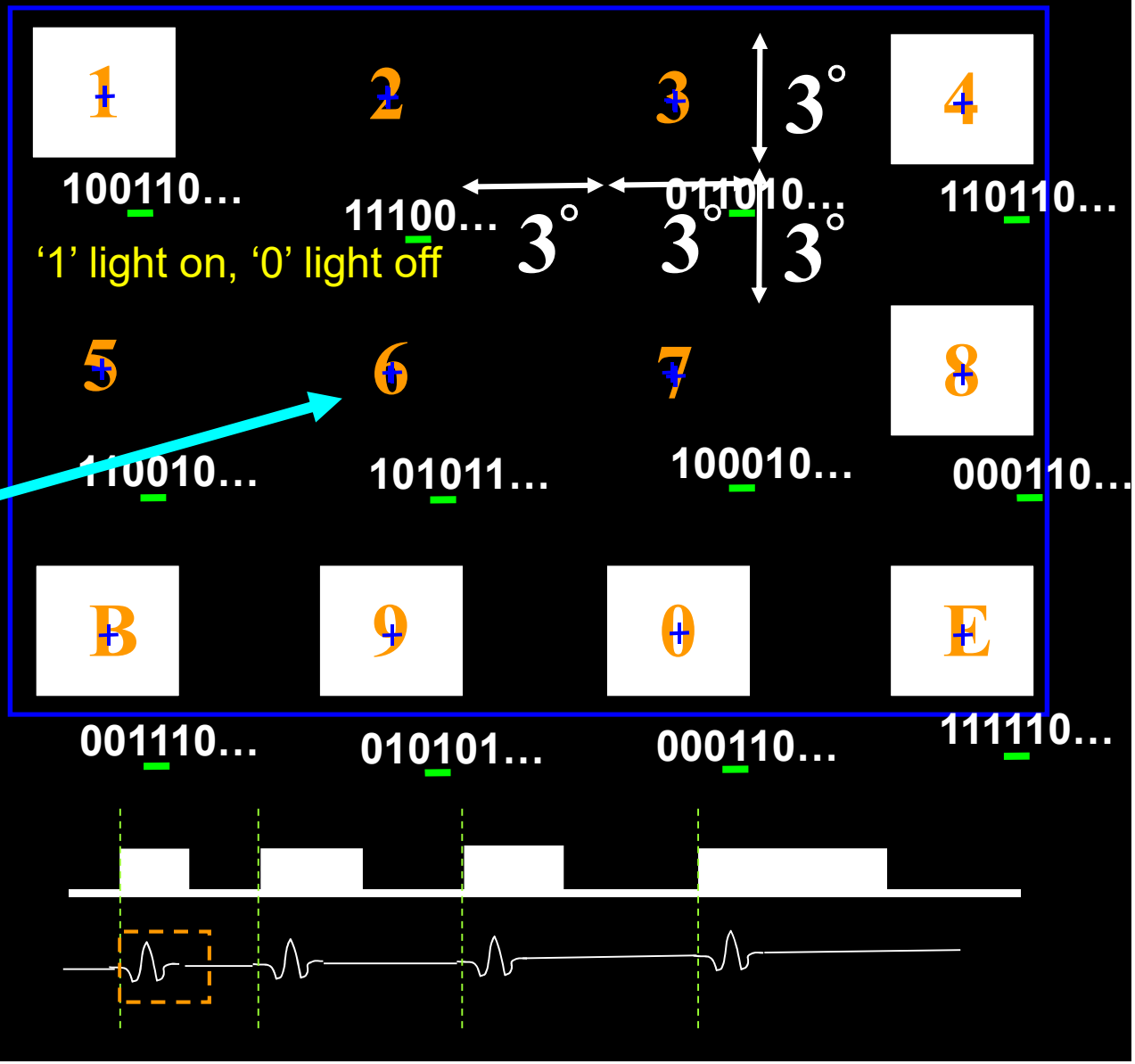




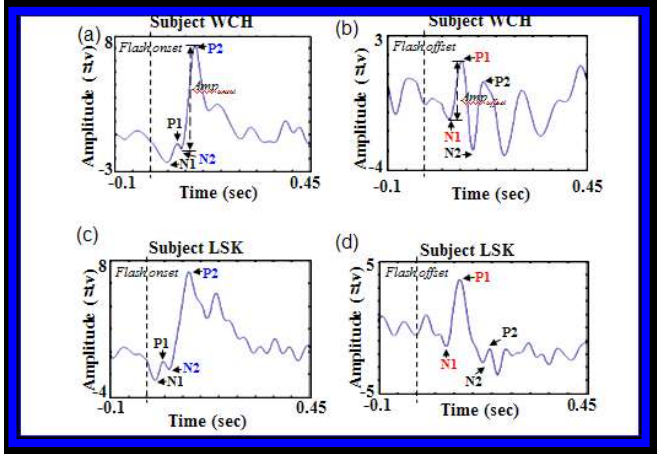
Visual Stimuli and Visual Evoked Potential (VEP)

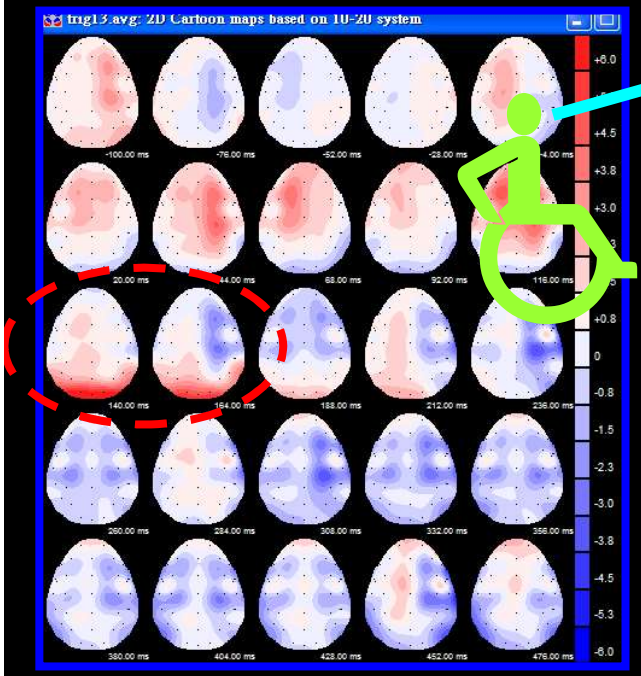


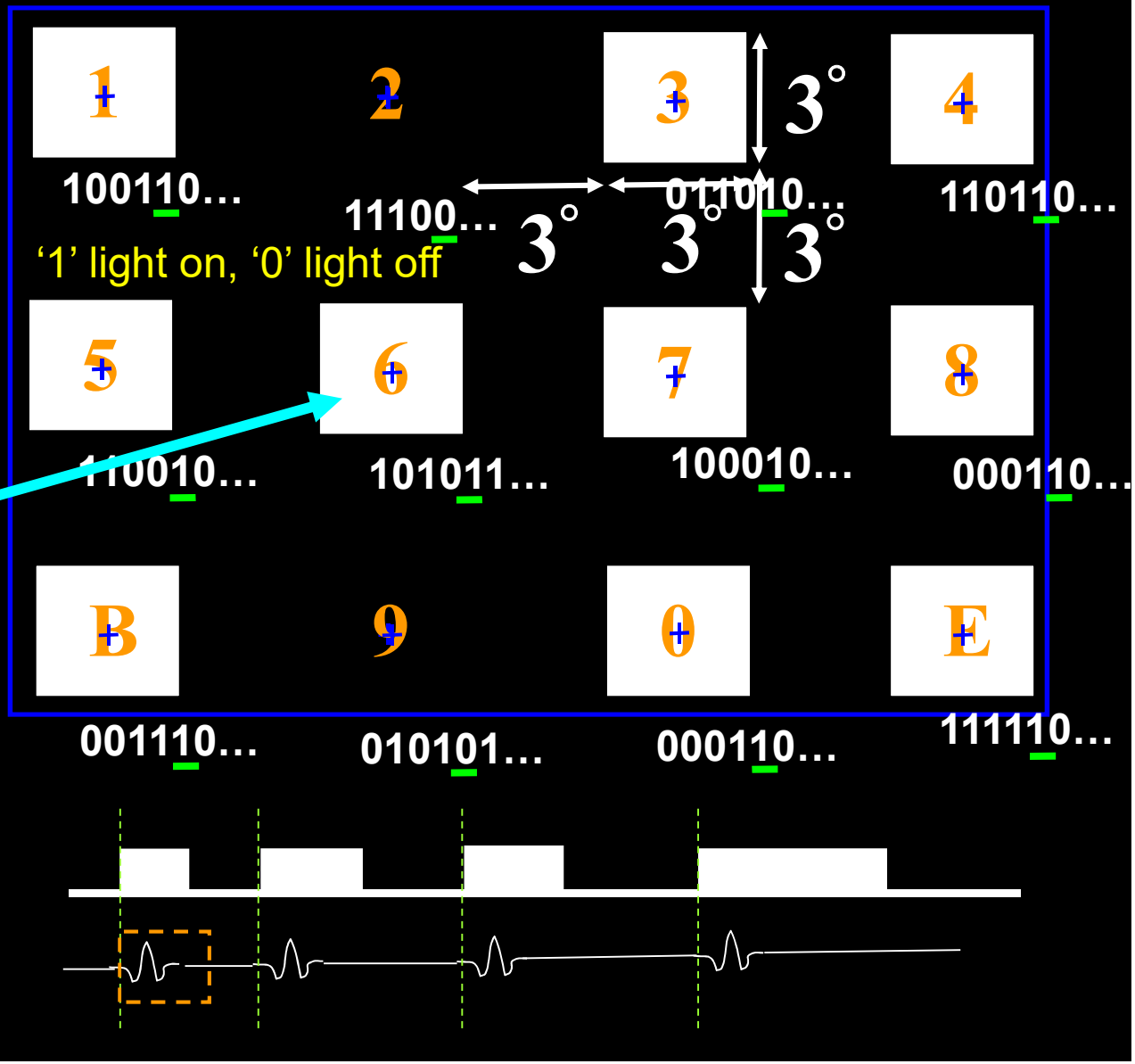




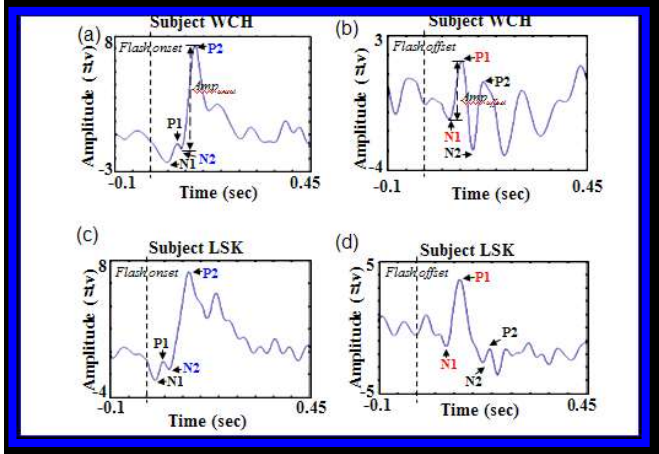
Visual Stimuli and Visual Evoked Potential (VEP)

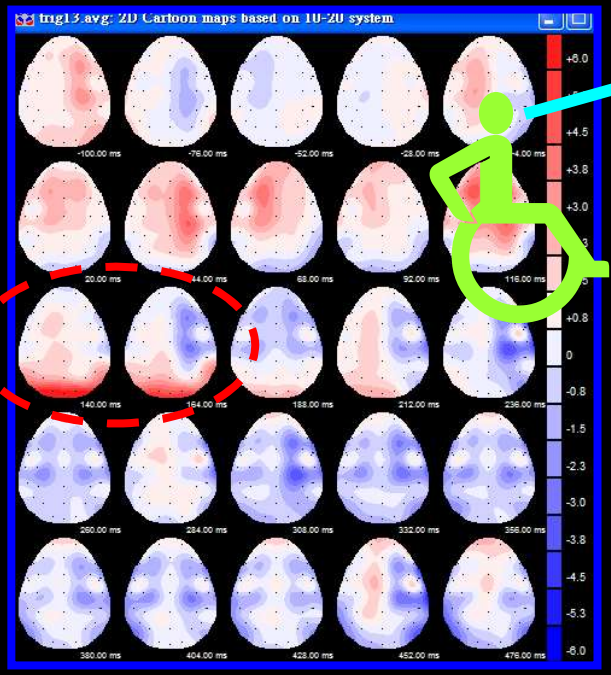


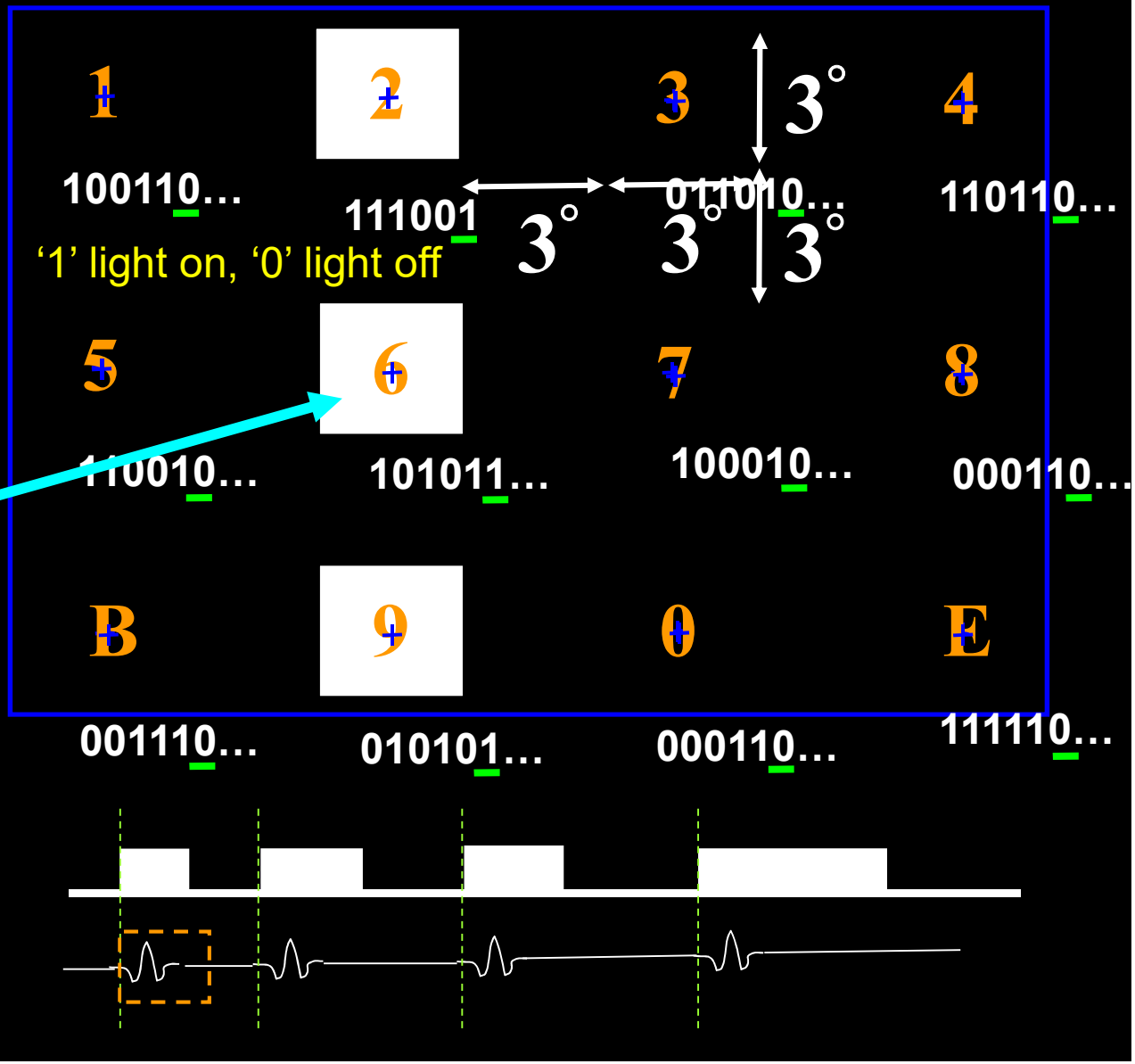




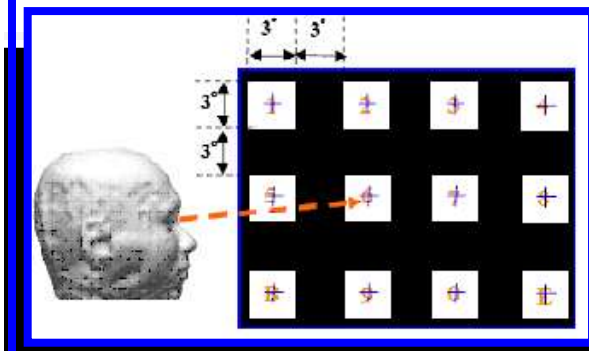
Visual Stimuli and Visual Evoked Potential (VEP)

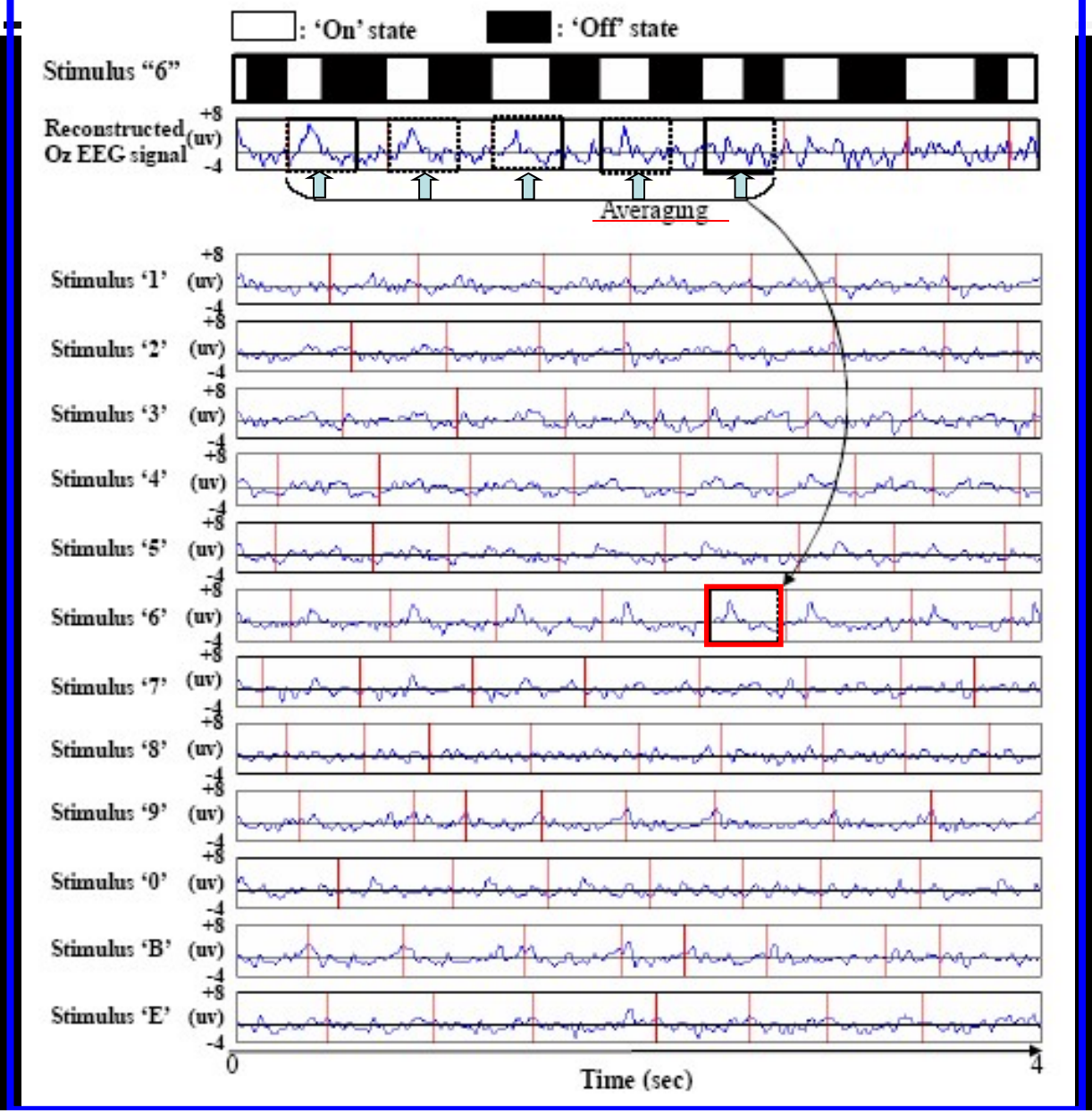




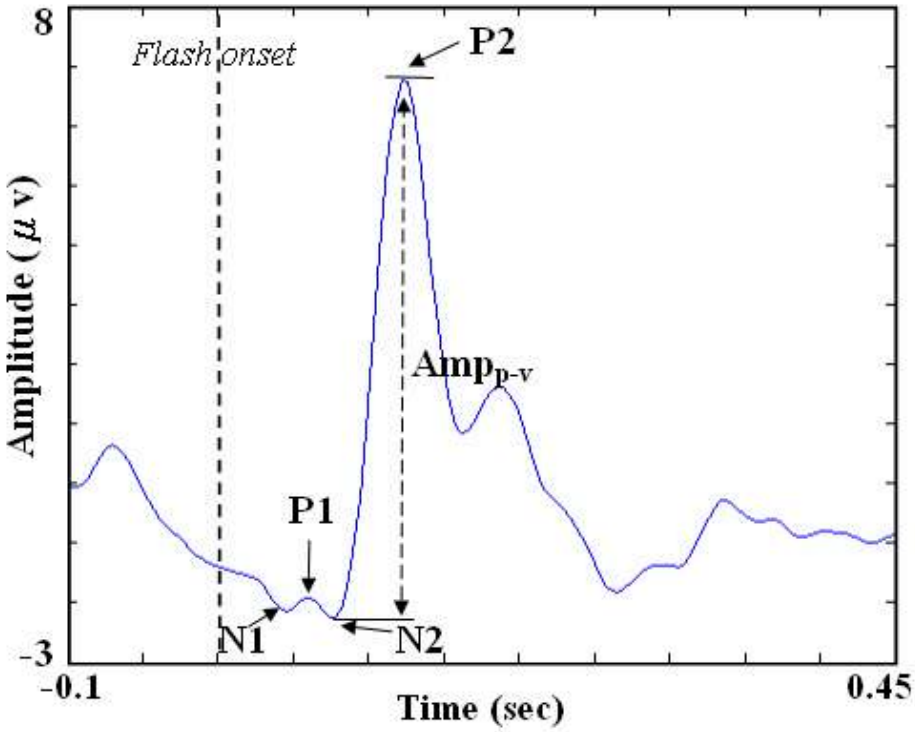


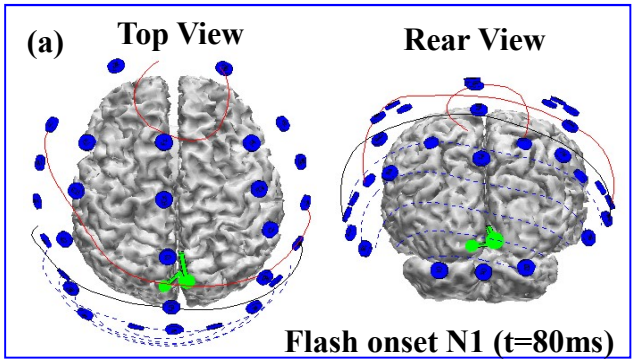
Suppression of responses from peripheral visual fields using simple cross-trial averaging

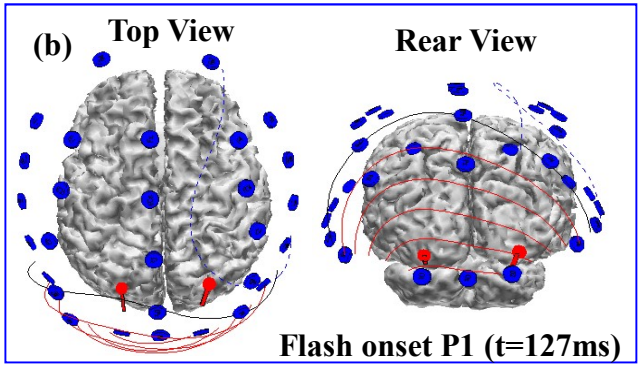




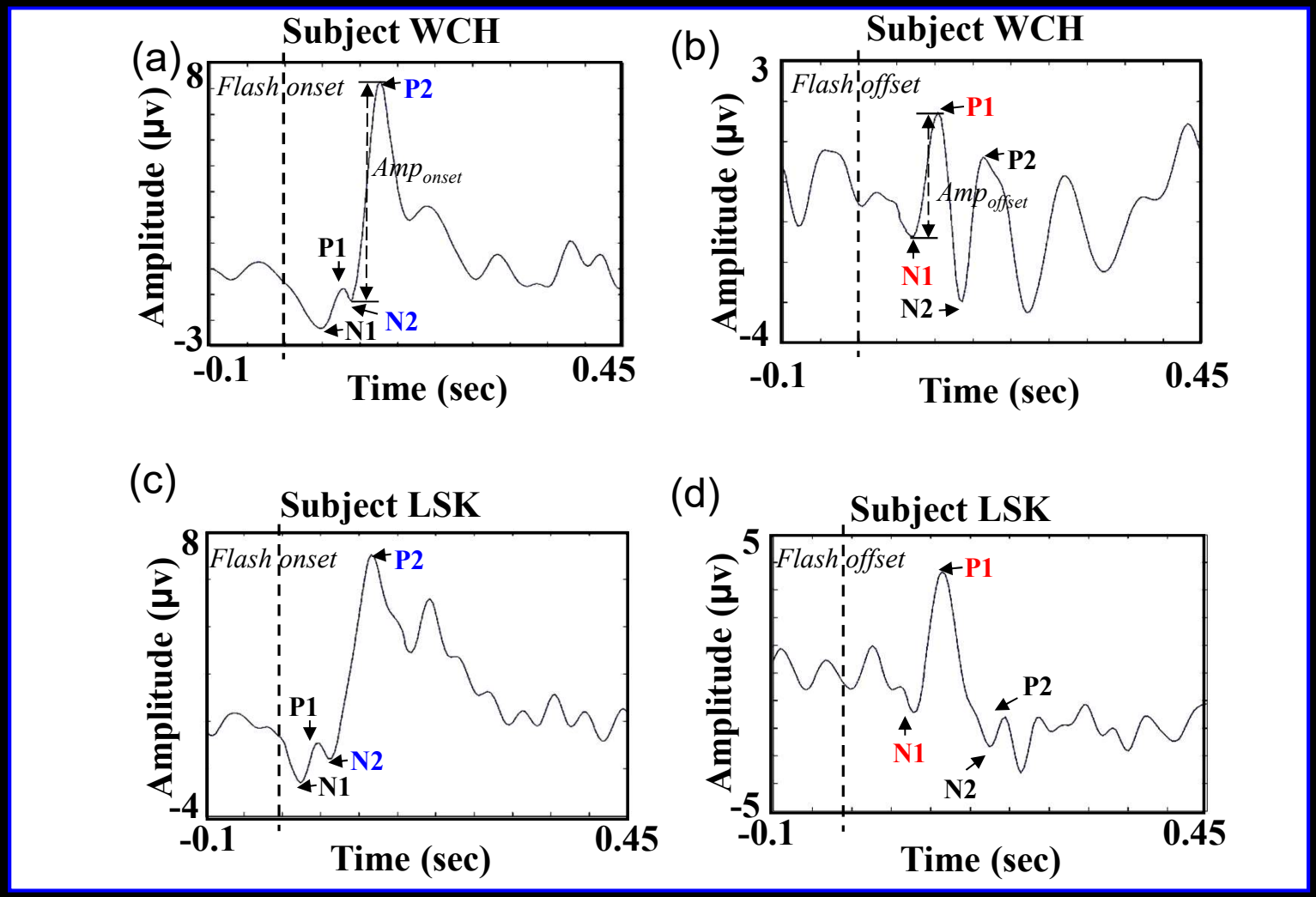
Features of VEP





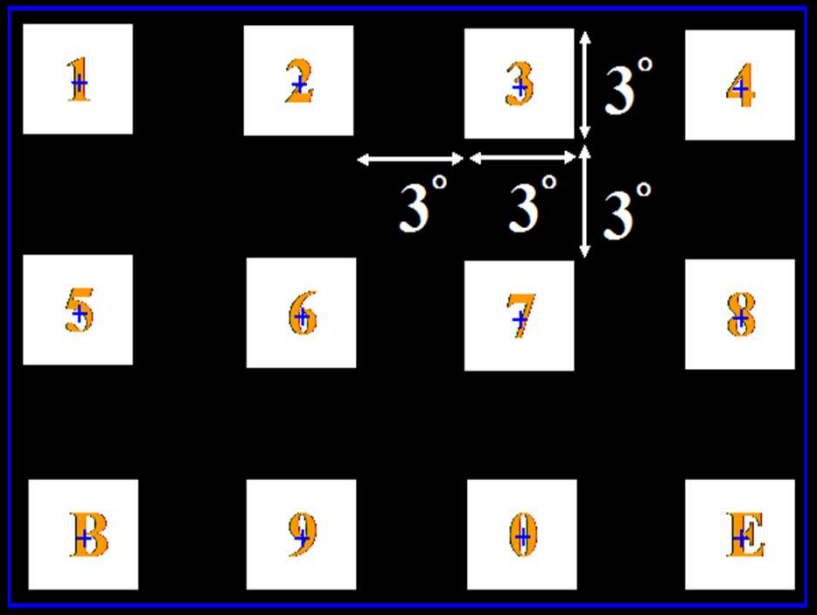


Inter-individual difference



$N2_{onset}$-$P2_{onset}$ and $N1_{offset}$-$P1_{offset}$ are taken as features for the detection of gazed communication channel (CC)

Input a phone number



Flash onset mode

Subject	Input results (wrong underlined)	Total time (sec)	Total/ Wrong	Transfer rate (sec/command)
WCH	0287513694E	57	11/0 (100%)	5.18
LSK	02875103694E	71	12/1 (91.7%)	5.91
DMN	03280752139694E	93	15/4 (73.3%)	6.20
SSC	0287513765 9E4E	91	14/3 (78.5%)	6.50
CCC	02E8751436B984E	104	15/4 (73.3%)	6.93
Average		83.2	83.36%	6.14

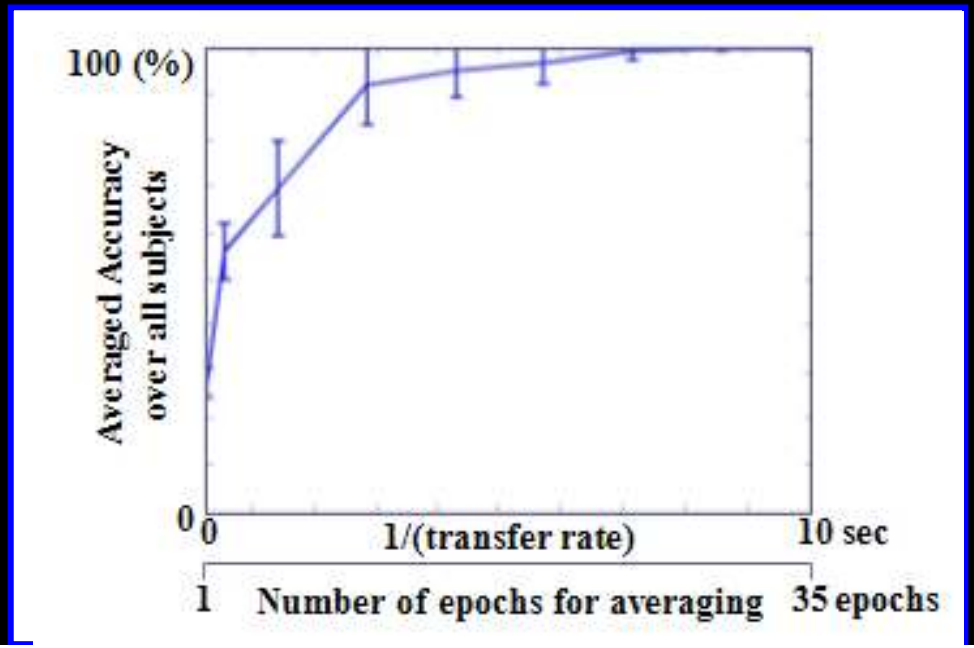
Flash onset-offset mode

Subject	Input results (wrong underlined)	Total time (sec)	Total/ Wrong	Transfer rate (sec/command)
WCH	0287513694E	48	11/0 (100%)	4.36
LSK	0287513694E	56	11/0 (100%)	5.09
DMN	028751236794E	81	13/2 (84.6%)	6.23
SSC	02875137694E	70	12/1 (91.7%)	5.83
CCC	027875136934E	79	13/2 (84.6%)	6.07
Average		66.8	92.2%	5.52

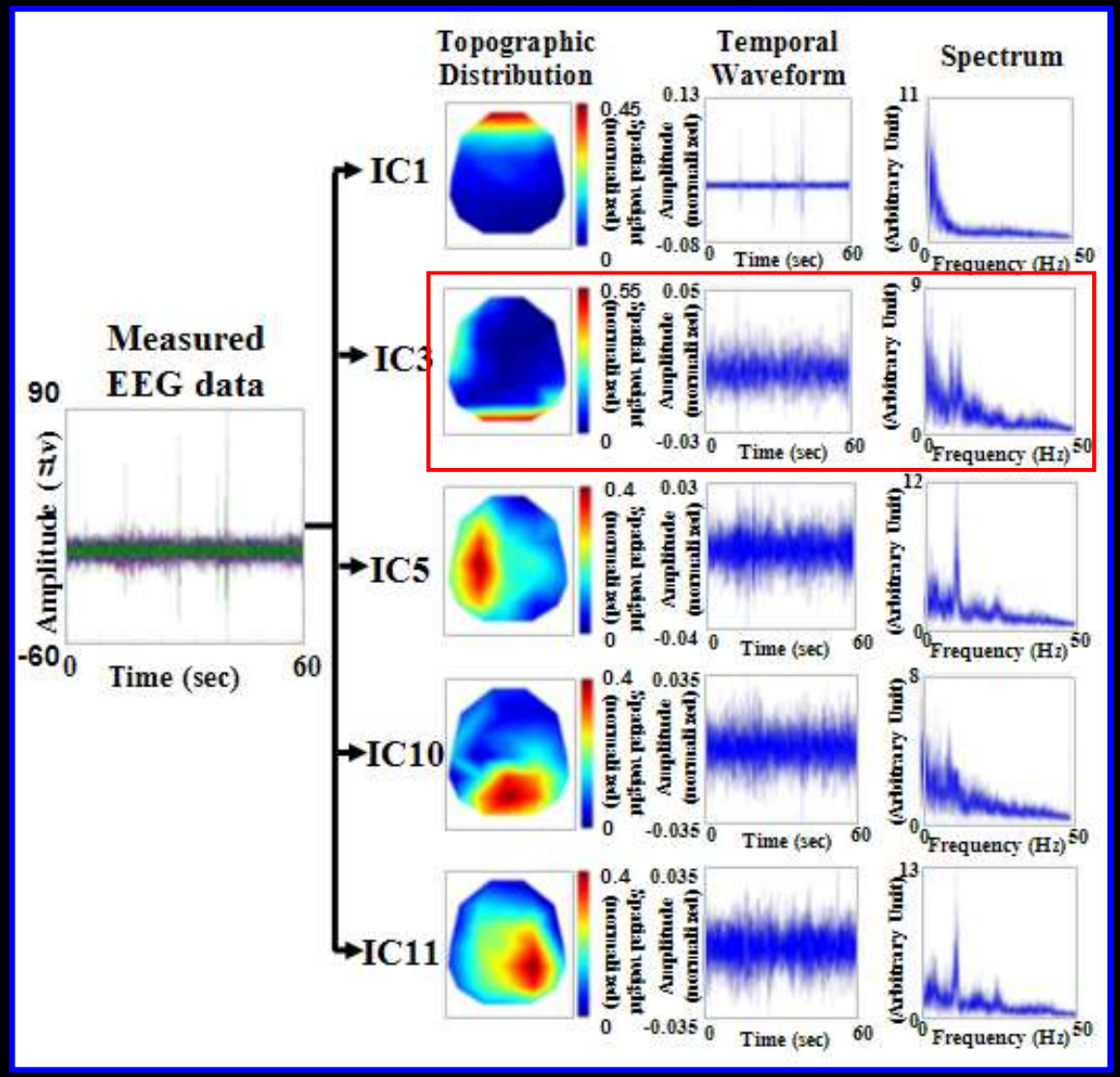
Input sequence: 0287513694E

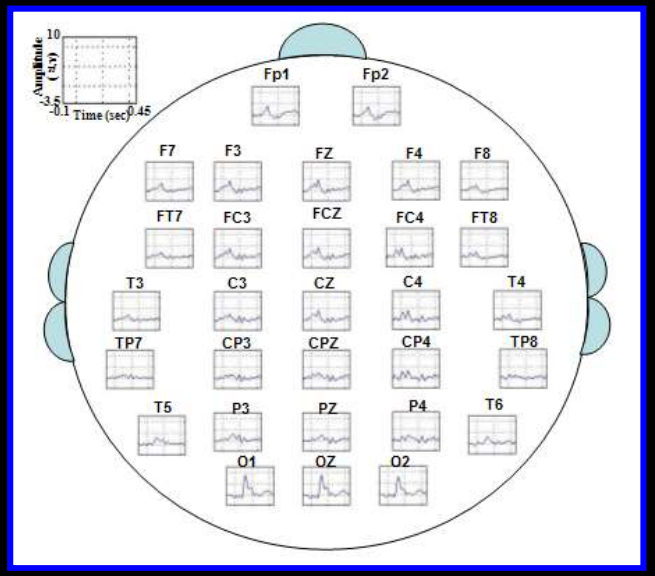
Results

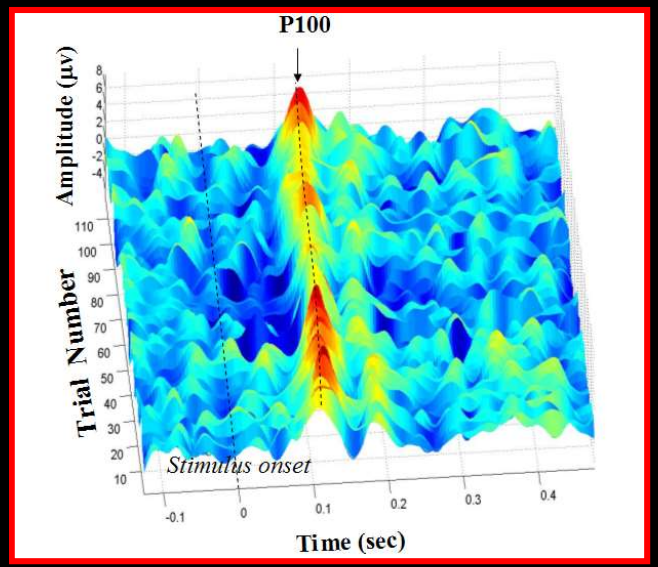
	Number of epochs for averaging							
Subject	1	5	10	15	20	25	30	35
WCH	0.33	0.76	0.91	0.97	0.98	0.99	1	1
TSC	0.24	0.63	0.84	0.903	0.91	0.97	0.985	0.995
LSK	0.32	0.74	0.94	0.96	0.975	1	1	1
LCC	0.25	0.65	0.93	0.965	0.971	1	1	1
CYA	0.25	0.57	0.93	0.952	0.961	0.99	0.995	1
Average	*0.278*	*0.67*	*0.91*	*0.95*	*0.96*	*0.99*	*0.995*	*0.999*



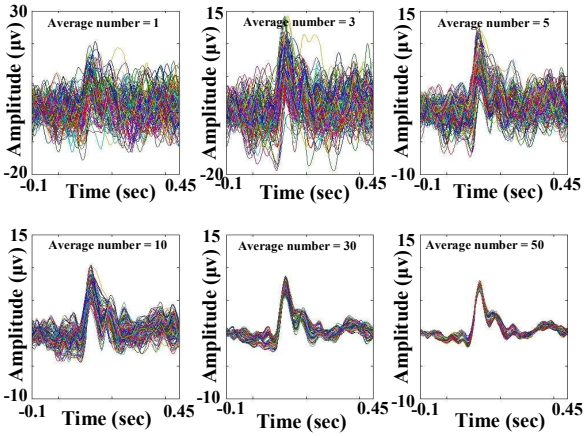
Remove occipital alpha rhythm using independent component analysis (ICA)

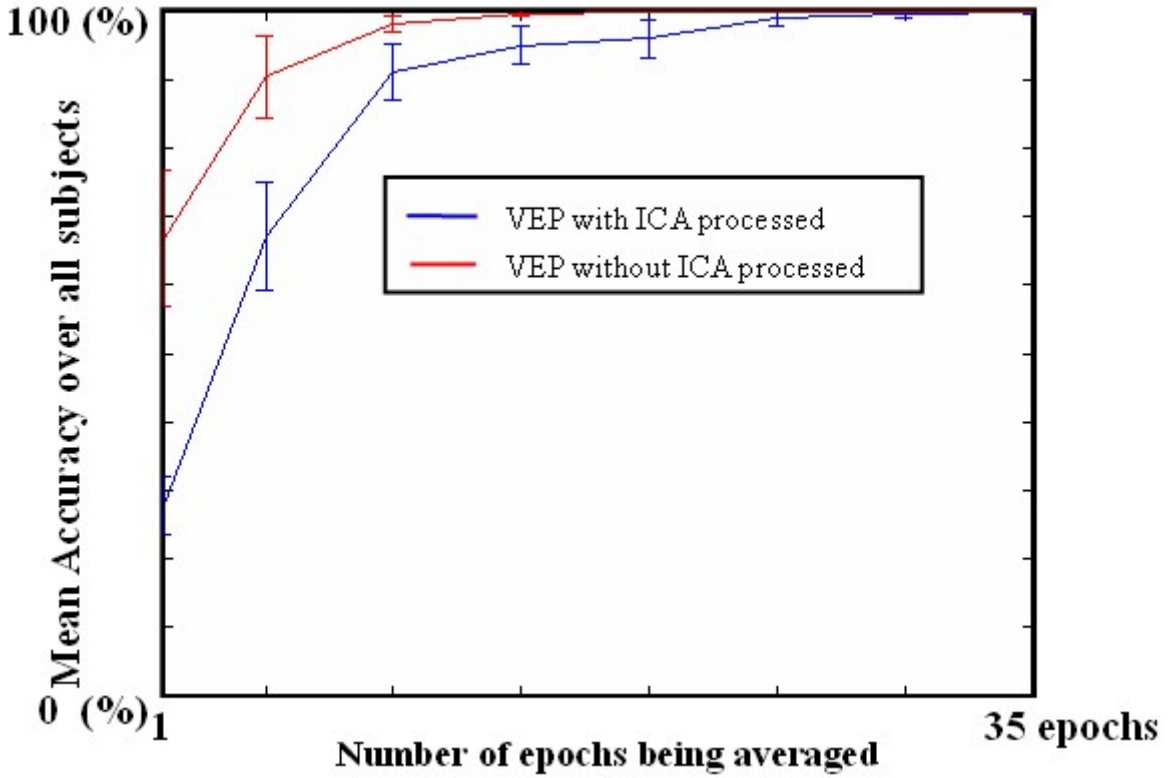






Results (with and without ICA)





Epoch number for average	Without ICA	With ICA
5 epochs (transfer rate: 1.5 seconds/command)	67.1%	92.2%
10 epochs (transfer rate: 3 seconds/command)	91.3%	98.9%

Flash VEP typewriter

EEG-based English typewriter

A	B	C	D	E
F	G	H	I	J	K
L	M	N	O	P
Q	R	S	T	U
V	W	X	Y	Z

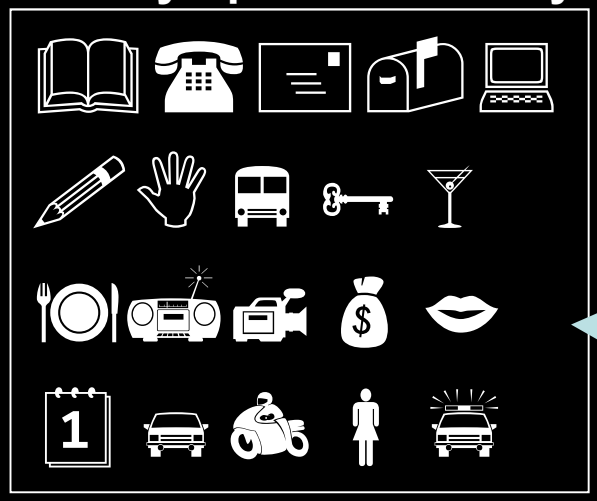
EEG-based Chinese typewriter

ㄅ	ㄆ	ㄇ	ㄈ
ㄉ	ㄊ	ㄋ	ㄌ
ㄍ	ㄎ	ㄏ	ㄐ
ㄑ	ㄒ	ㄧ	ㄕ
ㄖ	ㄗ	ㄘ	ㄙ...

Telephone virtual key-pad

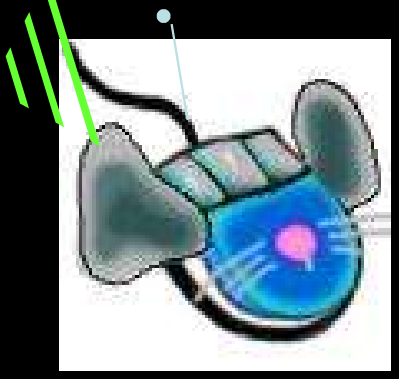
1	2	3	4
5	6	7	8
9	0	*	#

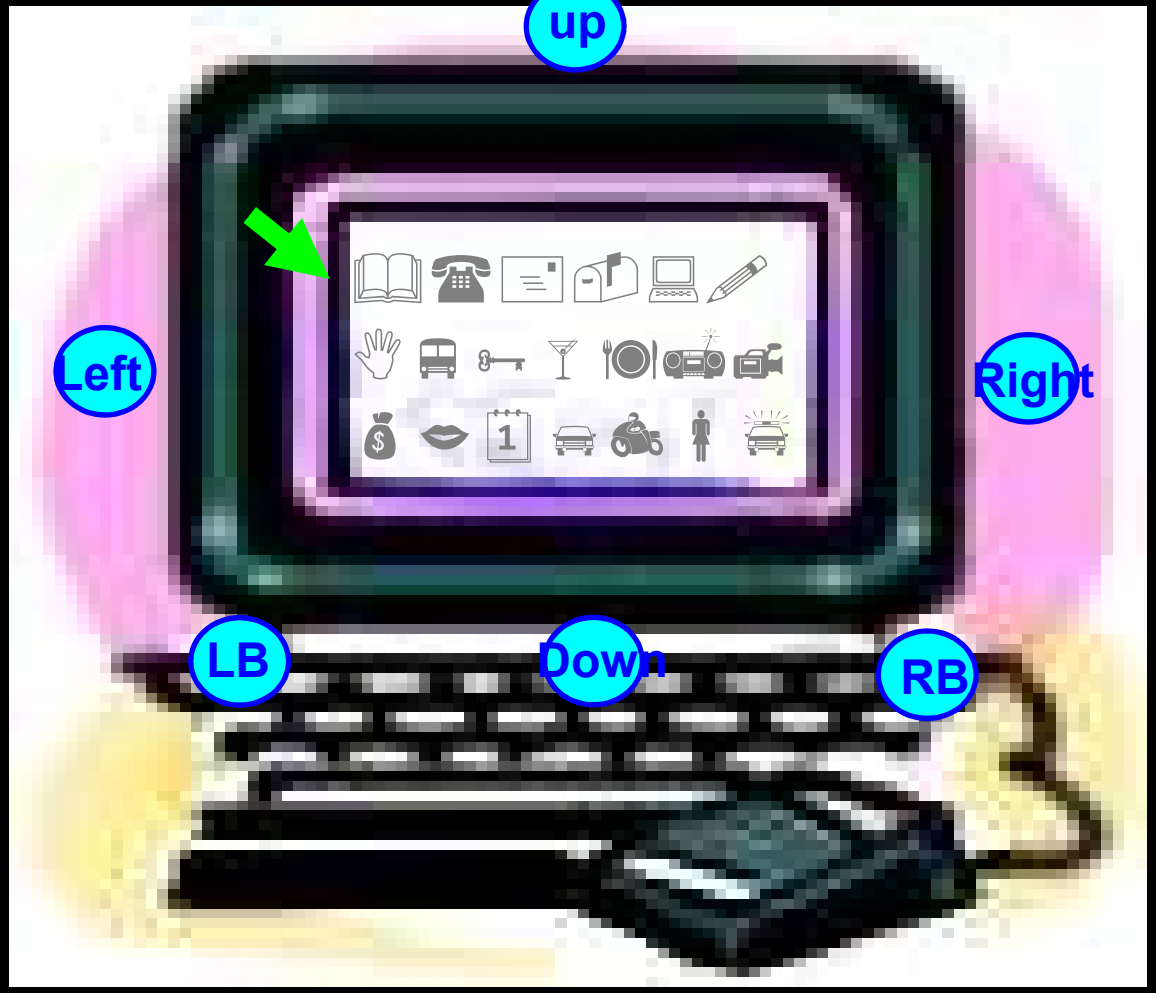
Necessary options for Daily life



Demo

Flash VEP-controlled mouse





Brain signal controlled wireless mouse

Thank you for your attention !