

Study of Consciousness

The Brain

- The human brain is a powerful organ that controls most of the body.
- Researchers around the world have long tried to uncover how the brain operates, how memories are formed and stored.

Consciousness

- The human brain is arguably the most important organ in our body, yet many of its properties remain unknown.
- Defining, let alone studying complex concepts such as consciousness remains extremely difficult.
- We attempt to approach the problem of quantifying consciousness by assuming that it can be related to changes in intracranial pressure (ICP).

Model

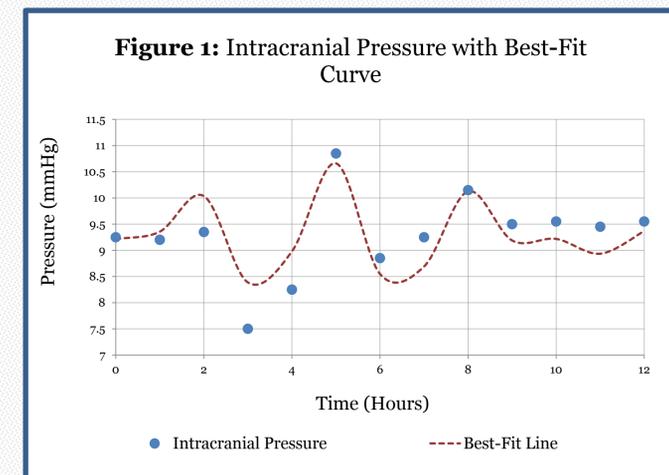
- After examining the data concerning intracranial pressure in rats (Lin & Liu, 2010), it became apparent that linear or exponential functions would not fit the data (see Figure 1).
- The functions of the form

$$P(t) = a \cos(bt + c) + d \sin(et + f) + g$$
 fitted the data best.

Fitting

- The actual fitting was performed using the least squares method (programmed in Excel)
- Obtained values of the constants $a, b, c, d, e, f,$ and g are displayed in Table 1. The obtained best-fit line is graphed in Figure 1.

t	y	$P(t)$	$(y-P(t))^2$	Constants	Calculated Values
0	9.25	9.21	0.001	a	0.669
1	9.20	9.35	0.024	b	8.589
2	9.35	10.03	0.470	c	1.220
3	7.50	8.38	0.785	d	0.721
4	8.25	8.97	0.529	e	4.588
5	10.85	10.66	0.035	f	-2.697
6	8.85	8.54	0.090	g	9.292
7	9.25	8.68	0.314	SS	2.759
8	10.15	10.12	0.001	Table 1: Summary of least squares data	
9	9.50	9.18	0.097		
10	9.55	9.21	0.110		
11	9.45	8.93	0.265		
12	9.55	9.36	0.033		



Results

- The scatter plot in Figure 1 demonstrates the periodic nature of intracranial pressure (ICP).
- An extrapolation could be made that as ICP changes, so does the memory function.
- Much of the pressure seem to fluctuate during the middle of the day, possibly due to increased or peak activity (Figure 1) and the pressure levels out toward the end of the day (Figure 1).
- This trend is not very clear on the scatter plot (Figure 1) alone, however the obtained equation helps to predict these features.
- Superimposing the function on the scatter plot (see Figure 1), one can see that the scatter points fit the function reasonably well.
- As a result, a typical consciousness function could be estimated the trigonometric function of the form $P(t) = a \cos(bt + c) + d \sin(et + f) + g$ under the assumption that the consciousness is proportional to the intracranial pressure.

Limitations!

- Can we use the data obtained for rats to make predictions about humans?
- Is it reasonable to assume that as ICP changes, so does the memory function.
- There is a study to support that a rat's brain operates and develops in a similar fashion to that of humans (Bayer et al., 1993).

Limitations! (cont)

- Rats make decisions in a very similar manner to humans; therefore, allowing for the crude comparison between rat ICP and human ICP (Raposo et al., 2012).

Conclusions

- The result of this project is a trigonometric function that models ICP changes and potentially could be used to study consciousness.
- While it is difficult to predict minimum and maximum values of HSP from our function, one can say that during the day after several hours of activity, ICP fluctuates the most and is relatively stable right after waking and before resting.

References

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