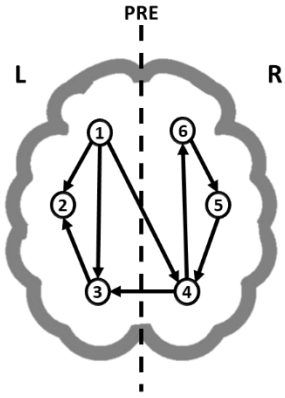
Neuroengineering 2022-2023

July 12th 2023

Part II

Solutions

A1.1-A1.4



g_{IN}

g_{OUT}	0	2	2	2	1	1	
3	0	1	1	1	0	0	1
0	0	0	0	0	0	0	1
1	0	1	0	0	0	0	1
2	0	0	1	0	0	1	2
1	0	0	0	1	0	0	2
1	0	0	0	0	1	0	2
	1	1	1	2	2	2	

A=

$N = 6$

$L = 8$

C=[1 1 1 2 2 2]

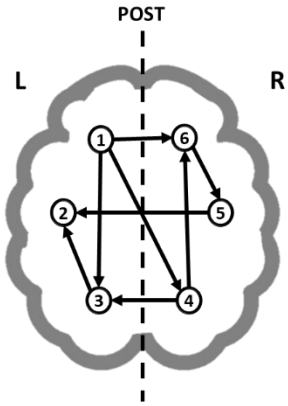
$$k = \frac{L}{N} = \frac{8}{30} = 0.27$$

$$D = \frac{L}{L + \sum_{i,j=1}^{N} a_{ij}\left[1 - \delta(C_i, C_j)\right]}$$

$$D = \frac{8}{8+2} = \mathbf{0.8} \qquad D \in [0.5, 1]$$

$$Q = \frac{1}{L}\sum_{i,j=1}^{N}(a_{ij} - \frac{g_i{}^{OUT} g_j{}^{IN}}{L})\delta(C_i, C_j)$$

$$Q = \frac{1}{8}\left[3 - \frac{(g_1{}^{OUT}+g_2{}^{OUT}+g_3{}^{OUT})(g_1{}^{IN}+g_2{}^{IN}+g_3{}^{IN})}{8} + 3 - \frac{(g_4{}^{OUT}g_5{}^{OUT}+g_6{}^{OUT})(g_4{}^{IN}g_5{}^{IN}+g_6{}^{IN})}{8}\right] =$$
$$= \frac{1}{8}\left[3 - \frac{(3+0+1)(0+2+2)}{8} + 3 - \frac{(2+1+1)(2+1+1)}{8}\right] = \frac{1}{8}[3 - 2 + 3 - 2] = \mathbf{0.25}$$



g_{IN}

g_{OUT}	0	2	2	1	1	2	
3	0	0	1	1	0	1	1
0	0	0	0	0	0	0	1
1	0	1	0	0	0	0	1
2	0	0	1	0	0	1	2
1	0	1	0	0	0	0	2
1	0	0	0	0	1	0	2
	1	1	1	2	2	2	

A=

$N = 6$

$L = 8$

C=[1 1 1 2 2 2]

$$k = \frac{L}{N} = \frac{8}{30} = 0.27$$

$$D = \frac{L}{L + \sum_{i,j=1}^{N} a_{ij}\left[1 - \delta(C_i, C_j)\right]}$$

$$D = \frac{8}{8+4} = \mathbf{0.67} \qquad D \in [0.5, 1]$$

$$Q = \frac{1}{L}\sum_{i,j=1}^{N}(a_{ij} - \frac{g_i{}^{OUT} g_j{}^{IN}}{L})\delta(C_i, C_j)$$

$$Q = \frac{1}{8}\left[2 - \frac{(g_1{}^{OUT}+g_2{}^{OUT}+g_3{}^{OUT})(g_1{}^{IN}+g_2{}^{IN}+g_3{}^{IN})}{8} + 2 - \frac{(g_4{}^{OUT}g_5{}^{OUT}+g_6{}^{OUT})(g_4{}^{IN}g_5{}^{IN}+g_6{}^{IN})}{8}\right] =$$
$$= \frac{1}{8}\left[2 - \frac{(3+0+1)(0+2+2)}{8} + 2 - \frac{(2+1+1)(1+1+2)}{8}\right] = \frac{1}{8}[2 - 2 + 2 - 2] = \mathbf{0}$$

A2. *Both Divisibility and Modularity computed considering the left and the right hemisphere as classes are decreased after the rehabilitative intervention. Since they are both measures of segregation, this means that the two hemispheres are less segregated (and therefore more integrated) as a result of the rehabilitation. As it is stated in the text that the integration between the hemispheres is a target of the intervention, we can conclude that the rehabilitation was successful.*

	Divisibility	**Modularity**	
PRE	0.8	0.25	Higher segregation/lower integration
POST	0.67	0	Lower segregation/higher integration