The behaviour of split brain patients

Split-brain patient is a denomination used for people who had the corpus callosum severed by surgery to minimise the seizures of a medicine intractable (Freberg, 2010) and multifocal epilepsy (Kalat, 2013), commissurotomy is the name of this operation and it is a very rare technique and some patients only had partial split (Breedlove, Watson, & Rosenzweig, 2010). The corpus callosum is a Latin word means thickened skin, described by Galen in the second century; it is the largest white bundle of axons in the human brain that communicates the two hemispheres, the term commissures was introduced by Felix Vicq d'Azyr to indicate the fibre pathways as he understood that the corpus callosum was constituted of nerves. The American Walter Dandy who cut the corpus callosum in the 1930 to have better access to brain tumours led to a new start on an investigation of the corpus callosum as the patients did not show any mental, motor or intellectual anomalies. (Wickens, 2009) However, most of the split-brain case studies were performed by Joseph Bogen in the 1960s. (Freberg, 2010)

The early studies of split-brain patients were started in the 1960s by the winner of the Nobel Prize in 1981 Roger Sperry and his student Michel Gazzaniga. Roger Sperry first study was in cats that had the corpus callosum and the optic chiasm sectioned, and he discovered that each hemisphere was unaware of what the other learned. (Sperry, Stamm, & Miner, 1956) He used the behaviour techniques of the split-brain cats to research split-brain humans. The outcome of these studies reveals that the brain functions are lateralised

The major discoveries of the split-brain patients were the lateralisation of function, cross-cueing; and the concept of the interpreter; leading to the theory of a modularized brain.

The lateralisation theory which means cerebral hemispheric specialisation in cognitive, perceptual, emotional and motor activities began with the early studies of split-brain patients, the results showed that the left hemisphere is superior on speech and language and the right hemisphere is superior on visualmotor skills, for instance being able to draw three-dimensional objects. One of the case studies, D. R., a split-brain patient, was instructed to look at a dot in the middle of the screen, to prevent the eyes to move. On the left side of the dot appears a word and on the right side appears another word, when the participant was asked what she saw, she responded that she saw the word on the right side of the visual field, however when they were asked to point at the word with their left hand they pointed at the left side word of the visual field. The results prove that the hemisphere were incapable to communicate with each other , the visual and tactile information did not travel between the hemispheres and it showed that the language is superior in the left hemisphere in most of the people, and that the left hand is controlled by the right hemisphere. (Gazzaniga M. S., The split brain in man, 1967) D. R. was also tested her motor control, the starting position was to her hold out her two hand fist closed, he asked her to do a hitchhiker gesture with her right hand and then with her left hand, she accomplished the task quickly, on the other hand, when Gazzaniga asked her to do the same with her left hand first, she was unable to do it. It showed that the patient had cross-cueing information outside the disconnection of the corpus callosum.

Thus, the experiment continued and she was asked to close her eyes and make the same gesture with her right hand which she did easily, then she was asked to do the same with her left hand, which she was unable to do. Since the patient had her eyes closed, the right hemisphere was unable to cue the gesture and unable to understand the spoken instruction, the left hand was left inactive. This experiment revels not only the disconnection of each hemisphere but also how the brain can reach a unique result from a modular brain with several decision centres. (Gazzaniga 1985, 2011 cited in Gazzaniga M. S., 2013)

Cross-cueing suggests the communication between the two hemispheres via nonneural route. N. G. was another case study of split-brain patient that collaborate with the understanding of the cognitive and emotional cueing. In this test colour light was shown and she needed to say the right colour of the light. When the light green appears on her right visual field which is projected to the left hemisphere, she namely the colour quickly, when the light appears on the left visual field, which is projected on the right hemisphere, she said for instance green and the light was green, then nothing changed. Although, after a few errors on the left visual field, the patient started to use another approach, if the red light was shown and she started saying “ green”, she stopped and said red. In this case, very quickly the right hemisphere knows the right colour and heard the wrong one, it gave a cue to the left hemisphere to not say the wrong word by stopped the speech process, or it has shaken the head, shrugged the shoulders or another cue. (Gazzaniga M. S., 2013) Another case was that the patient need to say numbers instead of coloured lights, the same principle was used, and

it was expected that the patient respond quicklforonumberer of the right visual field, which happened, however the numbers showed on the left visual field was correct as well, the reaction time wadifferently as was not about the same, 1 was quicker than 2, which was quicker than 3 and so on until 9. It was discovered another cross-cueing technique, the right hemisphere was counting using a head bob when it stop it is the number that appeared and the left hemisphere spoke. (Gazzaniga & Hillyard, Language and speech capacity of the right hemisphere., 1971)

The concept of interpreter perhaps was the most imperative discovery of all of split-brain research, which shows that we create a story to explain our behaviours and feelings to ourselves. (Gazzaniga M. S., 2013) After 25 years of research, Michael Gazzaniga and Joseph LeDoux decide to change the question that they asked to a split-brain patient, instead of asking what they see, they asked why they choose that picture. P. S. was a patient with all lateralise phenomena which had been discovered on early studies, the experiment comprised in a multiple-choice option for each hand, to choose a picture that matched to the stimulus presented in the left visual field for the right hand; and the right visual field for the left hand. His left hemisphere saw a picture of a chicken claw and his right hand chose a picture of a chicken; his right hemisphere saw a picture of a snow scene and his left hand chose a picture of a shovel. When he was asked why he chose all this picture he said: “ The chicken claw goes with the chicken, and you need a shovel to clean out the chicken shed”, which showed the interpreter.

Gazzaniga stated that our brain function in a modular way, and we can achieve a desired behaviour or a goal somehow from “ a highly modularized

brain with multiple decision centers, not just one” (Gazzaniga M. , 1985, 2011) The case of P. S. which was cited above is a dramatic evidence of brain modularity. She showed that the right hemisphere was able to speak as the left hemisphere after two years of her surgery, which had been started simple and have been increased over the time. Despite being segregated and independent modules, they create a unitary speech behaviour by self-cuing to appear coherent, which provide evidence how the entire system works. (Gazzaniga M. S., 2013)

In conclusion, the experiments on split-brain patients still result in new discoveries of the brain functions. In the past 50 years split-brain patients have been tested and observed adding to science a new perspective of the brain. The lateralisation theory was one of the first discoveries before the technology of PET scan, fMRI and etc. arrived. The cross-cueing was another great discovery as not only shows the role of the corpus callosum, as well how the brain can communicate without it, and creating new pathway via nonneural route. Howsoever, the concept of the interpreter, as Gazzaniga stated is perhaps one of the most important findings of the split-brain research, showing us that our brain had a capacity to create motives to our everyday behaviours and feelings, excusing us for doing things that it is not logical. Gazzaniga (1985, 2011) stated about the modularity brain as: “ the human brain is not an all-purpose, centralized computing device but rather is organized in a modular fashion, consisting of distributed, specialized circuits that have been sculpted by evolution and development to perform specific subfunctions while preserving substantial plasticity.” , which lead to another hypothesis about our brain functions, needing more research.