

NEUROLINGUISTICS: SHAKESPEARE AND APHASIA

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Abstract

This paper proposes to discuss the basic aspects of language formation in the brain – its location, before proceeding to discuss aphasia. The paper draws upon the research carried out at University of Liverpool, where it was shown that reading Shakespeare increases intelligence. This research takes current findings further in the field of Neurolinguistics, by showing how the effects of reading Shakespeare can affect people suffering from various forms of aphasia. The research is based on the findings of the author in classroom context, and the subjects of the research are his students suffering from some form of language disorder. The paper does not only list the findings, but attempts an explanation of why and how reading Shakespeare can be medically beneficial, by revealing some of the basic features of neuroanatomy, certain chemicals which are at work at certain places, and they can affect language, memory and speech production.

Keywords: Shakespeare, Neurolinguistics, Aphasia, Neuroscience, Linguistics

Introduction – Language and the Brain

From the very first time a baby utters its cry, it indulges in something it is not yet aware of consciously – production of speech. To the baby – and to most of the people – the crying of the baby is simply a cry, and they do not associate it with language, much less with any speech. But in fact, that is *the* language for the baby – it has acquired the elementary blocks in its neonatal stage in the brain and is now producing sound. It will continue to do so every time it wants to express itself – till it is taught to modify its sounds in other recognizable patterns that the adult world calls languages.

So, what is language? When heard, it is nothing but a fusion of sounds arranged in a systematic manner, which is accepted by a group, a community (of any scale). When written, it is nothing but a systematic arrangement of scribbling's, once more accepted by a group, a community (of any scale). The last part is important – the part about acceptance – because that is why there are different languages. As an example, let us think of the sound /bɔɪ/. To any speaker of the English language, a figure of a young male should pop into mind. He would, in fact, relate the sound with the written word “boy” and then any image of what the writing and the sound denotes, as accepted by the speakers of the English language. However, that does not go to say that /bɔɪ/ is an English word. It's simply a combination of sounds, which, when related to the English language, denotes one meaning. In another language, for example, Bengali, it denotes something else. It denotes what the English equivalent is of “to flow” and also “to bear”. So, how can one know which meaning is alluded to when someone utters this combination of sounds? To someone who knows only one of these languages, this complexity would not arise. For someone who knows both the languages, the brain places it in context and comes up with the meaning as would be most appropriate.

That brings us to the topic of how language is formed in the brain, and where it resides. For the purpose of anatomical division, the human brain is divided into four imaginary regions, called *lobes*: the *frontal lobe*, the *parietal lobe*, the *occipital lobe* and the *temporal lobe*. (See figure below). Each of these lobes has their specific functions. Though these lobes are present in both the hemispheres of the brain, their functions are not necessarily the

same in both the hemispheres. The gyri (sing. gyrus, upward ridge-like structures) and the sulci (sing. sulcus, the gaps between the gyri, the hole-like structures) help in locating the areas of functioning of different features.

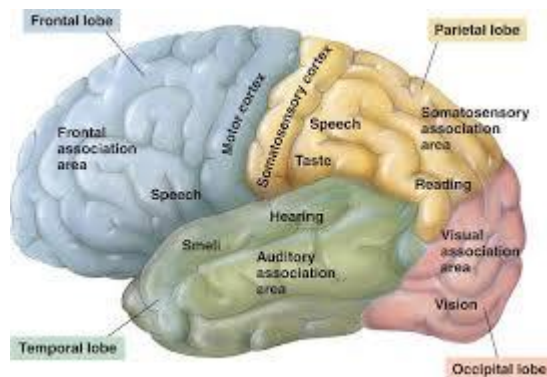


Figure 1. The Lobes of the Human Brain <http://bio1152.nicerweb.com/Locked/media/ch49/49_15CerebralCortex-L.jpg> 19/04/14, 7:26p.m. IST

Researches carried by Broca and Wernicke have thrown light on where language and speech resides in the brain (Akmajian, et al, 2010). In Figure 1, towards the inferior part of the frontal lobe, we see “speech” which is, to refer technically, Broca’s area. In the temporal lobe, towards the back, where we see the label “hearing” is the area of language comprehension, which is, to refer technically, Wernicke’s area. Any damage in Wernicke’s area or Broca’s area would result in aphasia (defect in language comprehension or production) (Akmajian, et al, 2010).

Neural transmission – sensation, perception and interpretation

The brain processes information and sends instructions through an extremely complex system of nerve-cells, known as neurons. The travelling of information from one neuron to the other is a process called synapse, and the synapses can be chemical (indirect synapse, where messages are transferred through neurotransmitters) or electrical (direct synapse). Senses, when received, travel from the peripheral nervous system to the central nervous system (the brain and the spinal cord). The neurons which do this are called afferent neurons (as they are affected by the electrical impulses). There are zones of specialisation in the human brain, and some of them have been roughly labelled in the diagram. The occipital lobe is concerned with vision. For each of the senses travelling to the respective zones, there is processing in different layers. The impulses first go to the primary visual cortex (for vision), or to the primary auditory cortex (for hearing) and so on. From there, they are sent to what is known as the association areas of the regions. So, from primary visual cortex, the signals go to the visual association area, which is close by (refer to figure 1). The same thing happens with auditory senses. It was told earlier that the location of language comprehension lies in these regions. So, Wernicke’s area is close to visual association area and auditory association area. In the association area, the signals are interpreted, and this is where language comes in. In hearing the sound /bɔɪ/, the signal would go to the primary auditory cortex, from which it will move to the auditory association area, where it will be interpreted, which means that the sound will be identified as a word previously known, “boy”. If the impulses are strong enough, a person might then visualise a figure of a boy, as there is a good probability that the impulses would go to visual association area as well. Then, previously stored memories would be retrieved by the brain, where the meaning of the word “boy” would be generated and it would make sense. The brain attaches meaning to everything and without it, nothing would make sense. In the generation of meaning, the brain would dig up memories of all that was recorded via neural transmission when the word was first heard. Researches have shown language resides primarily in the left-hemisphere, and the left-thalamus is important for language and memory (Ojemann and Ward, 1971). O’Shea writes,

“This close association between...memory and language is reinforced by brain imaging studies indicating that language-associated working memory is located in the frontal and parietal lobes of the cerebral cortex on the same side of the brain required for speech” (2005).

In the making of memory, something more comes up, which is emotions. They would bring out the “feelings” towards what is seen, felt, heard or tasted or smelled. So, in interpreting a signal, language comes into play, and everything we know has a word for it, and we assign meaning to everything, which the brain digs up, and in so doing, re-lives the emotions once again. Then, if actions need to be taken, the brain does that through the efferent neurons (which bring about the effect/result). It is the presence of the emotions that makes each experience unique. In fact, two persons hearing the same thing may not experience the same effect, as their emotions may be different. A person may develop trepidation each time he hears a particular ringtone on the mobile phone simply because his boss happens to have the same ringtone, and the employee has grown to fear the boss and the ringtone is associated with his memory of the fearful boss! Another person might have amorous feelings hearing the same ringtone, as it might be the one his loyal girlfriend uses!

Shakespeare and Intelligence

Damage to Broca’s or Wernicke’s areas might result in some sort of language impairment, but it does not mean every bit of language function would be hampered. It has been observed that specific regions result in different types of aphasia. The focus of this paper is not to discuss location of the lesions/damage and resulting aphasia, but its treatment using Shakespeare. In 2006, researchers at University of Liverpool found that reading Shakespeare increases brain activity (news.liv.ac.uk). The explanation was that the complex images that are found in Shakespeare makes the brain work a lot in finding out the meanings. It has to go back and forth to find the application of words, which becomes all the more complex with something called *functional shift* which is a shift in the function of a word (‘The Reader’ issue 23. pp. 39-43). Often, nouns are used to serve as verbs.

“Shakespeare uses a linguistic technique known as functional shift that involves, for example using a noun to serve as a verb. Researchers found that this technique allows the brain to understand what a word means before it understands the function of the word within a sentence. This process causes a sudden peak in brain activity and forces the brain to work backwards in order to fully understand what Shakespeare is trying to say.” (news.liv.ac.uk)

We find famous lines like these “Some squeaking Cleopatra boy my greatness” where “boy” is used as a verb. The brain is surprised by the occurrence of the word, as the application seems different from what is stored in its memory (which is discussed in the preceding section). It therefore, has to work out the meaning and in doing so, it enriches the person’s understanding of the use of the word. Furthermore, in the person’s head, there would be the image of a “boy”, fused with the meaning of the sound “squeaking” and that would tend to be associated with Queen Cleopatra. The word “greatness” would of course, have no specific image, and each person would resort to his emotions to feel the effect of the word “greatness”. All together, the line would give a colourful fusion of a boy in the shape of Cleopatra (or Cleopatra in the shape of a boy) making movements which bring out “squeaking” sounds. Brain activity would peak at the new experience, and this is something which will be frequently encountered. This would enhance the intelligence of the person, as it is through language that the brain processes meaning, and humans are considered most superior because of their ability to comprehend and form complex sound patterns into the many resulting languages.

Shakespeare and Aphasia

Having formed some basic idea about the structural features of the brain and how language is related to them, and having understood how Shakespeare can influence the brain in a positive way, let us now focus on the research, which is the treatment of aphasia. Aphasia results from brain damage/injury due to some form or the other, as the neural network is hampered. Shakespeare increases brain activity. In other words, it excites a lot of neurons which would not have been excited otherwise. The importance of the associational cortices has been noted earlier. So, if there is excitement of a lot of neurons, resulting in a lot of action potentials being generated so that a lot of the

association cortices are affected in the reading/hearing of a line/part from Shakespeare, it would reduce the chance of the effect of the aphasia, as other parts of the brain would be able to help in the processing of information, because a regional aphasia results in regional impairment, not overall impairment.

The first subject of the study was a student suffering from defect in language production. Of course, without the use of MRI and fMRI machines at hand, it was not possible to determine where exactly the problem lay, but with the understanding of Neurolinguistics, it was not difficult to determine the cause, either. Knowing that speech production defects relate to Broca's aphasia, it was evident that the problem lay in that region. The subject, Tuhin Sarkar, a boy in his final year of school, had problems in speaking fluently. He did not have difficulty in comprehending meaning, so, there was no problem with Wernicke's area. The problem in speech heightened when he was speaking over the phone, although it was not so prominent in speaking face-to-face (it does not go to say there was no problem if he saw the person; it was there, but the effects were more if the person spoken to was not present in person). This helped in making the inference that the visual stimulus was important for the boy and that it was probably the lack of sight which somehow resulted in a lack of confidence, which gave impetus to the problem. In talking to the student, I further came to know that he suffers from phobia, and fears being alone. In fact, there were times when I had left him in my room by himself to attend to some situation. On coming back, I found him standing up, ready to pace the room. On asking the reason, he told that he was afraid of being left alone. There were obviously childhood memories which made him afraid of these situations. Needless to say, he also had fear of spirits at such times. Knowing these further confirmed the conviction that the lack of sight triggers a sense of fear (the amygdala is responsible for such impulses, commonly summarised as "fight, fright or flight" impulses). So, not seeing the person in front of him while speaking triggers the negative impulses, as his subconscious nervousness creates difficulty in speaking, as the synapses are not strong.

Before we come to how Shakespeare can possibly help this student, Broca's area needs to be discussed a little bit. Right next to it is the primary motor cortex, which is responsible for the basic movements. Broca's area falls in close proximity to the association area of the motor cortex. That explains why Broca's area is concerned with production (utterance) of sounds, as that involves movement, which is taken up by the motor cortices. So, a person suffering from Broca's aphasia experiences difficulty in speaking, which requires motor function, after all. Both of them lie in the frontal lobe, and the frontal lobe is primarily known for one's sense of personality. It decides what to do with all that is processed in the rest of the brain (O'Shea, 2005). It, therefore, is the seat of our judgement. It is also the seat of our reward centre. Sense of pleasure/reward is experienced here, and that is done by the release of dopamine from the limbic region. (Cooper, 2014). The brain produces this naturally, but they can be stimulated by drugs too, which forms the basis of addiction. As this paper does not concern with that, let it suffice to say that the release of dopamine generates the feeling of satisfaction and goodness; a sense of reward and achievement, which has its effects in decision-making.

Coming back to Shakespeare, it was noted how his lines results in a peak in brain activity. Knowing the power of his lines to evoke images, I chose some lines from *Hamlet* for him. It was the famous soliloquy, 'To be or not to be'. The passage is given below for ready reference.

To be, or not to be: that is the question:
Whether 'tis nobler in the mind to suffer
The slings and arrows of outrageous fortune,
Or to take arms against a sea of troubles,
And by opposing end them? To die: to sleep;
No more; and by a sleep to say we end
The heart-ache and the thousand natural shocks
That flesh is heir to, 'tis a consummation
Devoutly to be wish'd. To die, to sleep;
To sleep: perchance to dream: ay, there's the rub;
For in that sleep of death what dreams may come

When we have shuffled off this mortal coil,
 Must give us pause: there's the respect
 That makes calamity of so long life;
 For who would bear the whips and scorns of time,
 The oppressor's wrong, the proud man's contumely,
 The pangs of despised love, the law's delay,
 The insolence of office and the spurns
 That patient merit of the unworthy takes,
 When he himself might his quietus make
 With a bare bodkin? who would fardels bear,
 To grunt and sweat under a weary life,
 But that the dread of something after death,
 The undiscover'd country from whose bourn
 No traveller returns, puzzles the will
 And makes us rather bear those ills we have
 Than fly to others that we know not of?
 Thus conscience does make cowards of us all;
 And thus the native hue of resolution
 Is sicklied o'er with the pale cast of thought,
 And enterprises of great pith and moment
 With this regard their currents turn awry,
 And lose the name of action. (*Ham.* 3.1)

At first, the passage was read out to him, and he was asked to note all words which formed striking images in his head. Two days later, he was asked to recollect the images. After that, he was given a copy of the text and told to read from it a few times – reading in silence and was asked once more, to list some striking images. The next day, at night, he was asked to recollect the images based on his memory of the previous night. Each time, he mentioned seeing the image of jutting rocks and the roaring sea, with a crucifix at the far end of it. Another interesting image which he listed every time was the image of a skull (sometimes a full skeleton, sitting with one leg on top of another). It must be told that unlike people in the west, school students in India don't really have exposure to Shakespeare beyond some selections from Lamb's Tales from Shakespeare, so there was no way of his seeing pictures of Hamlet holding a skull, as is generally shown as cover picture of many books and film posters. So, it is quite curious that he visualised a skull! However, his turning it into a skeleton might have been because of the associative fear induced in him from childhood (his phobia to which I referred earlier). Nevertheless, he was instructed by me to read the soliloquy before going to bed and think of the images – and the words which resulted in the images. Table 1 lists the words and phrases and the resulting images.

Table 1. Lines and Images from Hamlet and Macbeth.

Subject's Name and Text Portion	Words and Phrases	Resulting Images
Tuhin Sarkar Hamlet's Soliloquy 'To be or not to be...'	Or to take arms against a sea of troubles, And by opposing end them?	"Sea-barrier" (to quote him); Crucifix

	But that the dread of something after death	Skull; Skeleton sitting with one leg on top of another
Macbeth “Tomorrow and tomorrow...”	Dusty death	Road dusty
	Brief candle	Small candle
	Walking shadow	Shadow walking; no figure

He was spoken to regularly over the phone to monitor the effects. He was not told anything about why he was being asked to read it, to avoid causing any placebo effect. What was most interesting is his problem in speaking was growing gradually before the test began, but from the time he was read the soliloquy and given the text of it and told to read it, not only was there a halt in the progress of the speech difficulty, but a remarkable reversal! From the fourth day, he began to speak over the phone without showing for the most parts, the difficulty that he had previously displayed all the time. It was not gone totally, but he showed 60% improvement.

Although it sounds incredulous, what happened was quite simple. Based on the research carried out at Liverpool about peak in brain activity in reading Shakespeare, the student was given a soliloquy which was serious and had lots of complex images. It was noted earlier that the speech problem increased when he was not able to see the person. Keeping this in mind, he was told to read the lines before going to bed, so that it remains on his mind when he is about to fall asleep. With the process of repetition, the images were reinforced and induced into his memory. He was also told to remember the words which formed the two striking images, and think about them at other times. This resulted in his thinking about the strong images when he would not have anything to do. Being so rooted in his memory – one of which is of a skeleton – he was not only able to fill up his nervousness, but also counter his fear (as he would be consciously thinking of the skeleton image instead of fearing it). The memory is filled with good and exciting emotions – he takes this as a jolly exercise (instead of a school lesson for exams and marks) – and so, in its recollection and conversing on the phone about it, dopamine is released from the limbic system, close to the thalamus, which would go to the frontal lobe, generating a feeling satisfaction (indeed, he was quite in a good mood when speaking over the phone!).

However, this poses a serious question – would this work only when the person is thinking of the lines of Shakespeare, and would the problem come when he is thinking about something else? So, if he talks with his friend about going to see a movie, would he face the same difficulty? Surprisingly, the answer is no. The feeling of goodness, once generated, would last for some time in their effect, and he would not fall back. To test this, he was made to talk to one of his friends about going to see a movie. In fact, he was made to talk twice – once, before reading the lines of Shakespeare, and next, after reading it. He showed the same benefits as reported earlier.

However, it goes without saying that he would have to think of some lines from time to time to make the brain peak up from time to time, so that the effects last. In other words, the lines act as medicine works – a medicine which needs to be taken regularly. But unlike real tablets or capsules, these should not be too difficult to swallow!

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Author Biography

Nilanko Mallik is a researcher in the fields of Neurolinguistics and Shakespeare. He is the author of *Compact English Prosody and Figures of Speech* (Macmillan, India), and several other academic books and papers on linguistics, Shakespeare and poetry, some of which are studied by undergraduate students in various universities across India. He is affiliated to the Indian Board of Alternative Medicines for his research on Indians suffering from language disorder. He is interested in treatment of aphasia; language acquisition; Shakespeare in performance. Nilanko Mallik has also involved in running MOOCs on Neurolinguistics and other topics of literature and language, which can be accessed at <http://nilankomallik.eduongo.com/profile/nilanko.mallik>