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**Ali O’Daffer, *EEG Investigation of Putative Link between Mu-Waves and Mirror Neuron Activity***

**Faculty advisor: Professor David Andresen**

Have you ever wondered about why, when you see someone else get hurt, your immediate reaction is to recoil in sympathy? Why seeing a kid getting teased on the playground looking sad makes you feel pain and empathy for them?  These reactions are due to a network of brain cells called mirror neurons that fire when a person experiences a sensation and when they see someone else experiencing it. The mirror neuron system is likely the reason for the immense human capacity for empathy and understanding of the experiences of other people.

Many neuroscience researchers have been using mu waves, a specific type of electrical brain wave, to study the mirror neuron system. Mu waves repeat at a frequency of about 7.5-12.5 Hz and are found in the motor cortex at the rear of the frontal lobe, the section of the brain that controls voluntary movement. This electrical brain activity can be measured in Hertz by an electroencephalogram (EEG) machine.

In the past few decades, studies have shown that changes in mu wave activity not only occur in instances of performed motor movements, but also when subjects observe the movements of others. (Cochin et. al., 1998; Gastaut & Bert, 1954; Pineda et. al., 2000) This breakthrough discovery suggests that mu wave activity is tied to empathy, social understanding and more. Spurred by this idea, researchers immediately began associating mu wave activity to the mirror neuron system, using changes in mu wave activity as the response variable in studies looking at mirror neuron activity. However, these members of the research community have made enormous assumptions about mu waves. There is no direct evidence connecting mu wave activity to mirror neurons, and no study has ever directly compared mu wave activity during stimuli shown to produce mu wave activity and that shown to produce mirror neuron activity.

The goal of this study was to explore the link between mu wave production related to motor planning and movement and higher level social cognitive experiments, validating the mirror neuron research that already makes this assumption or providing evidence against this connection. The study involved viewing videos of familiar and unfamiliar hand movements in randomized order and then reproducing the movements depicted immediately after viewing. A baseline trial was also included, which involved watching numerous static images played in rapid procession. EEG data was collected from 25 participants.

Preliminary analysis of the data shows that, in all regions of the brain (frontal, central, lateral, posterior regions) except visual cortex (occipital region), both performing and viewing trials caused mu-wave suppression. In occipital regions, viewing and baseline trials had the most mu suppression compared to performing an action, because during performing trials there was not much on the screen to cause suppression. Also, posterior regions had almost equal mu suppression for both watching and performing trials. All other regions (frontal, central, lateral) had more suppression for performing than viewing a movement. The data also showed that performing familiar movements causes more suppression than unfamiliar movements, but there is no difference in suppression for watching familiar and unfamiliar movements.

The study replicated prior results showing that performing and watching both cause mu suppression, with more suppression for performing compared to watching a movement. However, suppression during performing was modulated by familiarity of the movement, whereas this had little impact on suppression during watching a movement. These results suggest that mu suppression is affected by motor memory and motor planning, but watching a movement may not engage these systems in the same way. Additionally, the data indicates that mu-wave suppression does not appear to be directly caused by alpha-suppression in visual cortex. These preliminary findings are promising, and in-depth analysis of the data will continue throughout the course of the 2016-2017 school year.

**Rachel Anderson, *Seen through Steam: Narratives of Victorian Steam Technology***

**Faculty advisor: Professor Amy Fisher**

The question I based my research on—did steam power represent optimistic progress or oppressive imperialism—focused on the paradoxical narratives of Victorian steam technology that existed in the nineteenth century and persist into modern Victoriana and Steampunk genres. More specifically, my research has revealed that modern narratives of steam technology reflect the shifts in technological optimism and pessimism expressed by the Victorians themselves as the Victorian perception of the relationship between steam technology and suffering changed. Between 1837 and 1851, Victorian accounts and (modern narratives addressing this period) expressed social anxiety—the Chartist movement for more representative government, for example, drew attention to working conditions, but technological optimism remained pervasive, as exemplified by the Great Exhibition of 1851, which showcased new and established technologies. In contrast, between 1852 and 1879, Victorian (and modern) narratives expressed strong technological pessimism. Industrial novels like Dickens’ *Hard Times* and Gaskell’s *North and South* drew attention to the direct correlation between steam technology and suffering in Britain. For the period between 1880 and 1901, Victorian (and modern) narratives reflected renewed technological optimism as steam technology was no longer considered sensational or foreign and the suffering previously associated with it was displaced to parts of the British Empire like India and China.

Investigating this paradox involved selecting and analyzing representative primary-source readings from the Victorian, Victoriana, and Steampunk corpuses as well as interviewing Victoriana and Steampunk enthusiasts. For example, the technologically optimistic tone of Sydney Padua’s Steampunk-style comic *The Thrilling Adventures of Lovelace and Babbage* matches the tone of the original writings of Charles Babbage and Ada Lovelace from the early Victorian era. The Victorian industrial novels like *Hard Times* and *North and South* represent the Victorian view of technology after 1851, presenting a pessimistic view of steam power that is mimicked by modern Steampunk writers in works like *The Difference Engine*. The last part of the Victorian era (1880-1901) sees the most enthusiasm from modernity. H.G. Wells’ *The Time Machine* is commented on by K.W. Jeter’s *Morlock Night*. *Sherlock Holmes* is mimicked in *The House of Silk*. The Victoriana perspective is extensively addressed by Sarah and Gabriel Chrisman who live an as-close-to-Victorian-as-possible lifestyle. Although Steampunk-fantasy works like *The Beast Hunter* by Lindsay Schopfer don’t adhere to a specific era, their role in reflecting narratives of Victorian steam technology is addressed in terms of modern technology.

To contextualize these primary sources, I used the works of historians of technology and the Victorian era like Emmanuel Mesthene, Thomas Hughes, Ian Barbour, Thomas Misa, Herbert Sussman, Tamara Ketabgian, A.N. Wilson, and Vaclav Smil. These secondary source commentaries provided the framework for understanding the relationship between technology and values and situating the narratives regarding technology within broader societal commentaries.

With this combination of primary and secondary sources, and my background as a student in the Science, Technology and Society program, I addressed the paradox frequently associated with narratives of Victorian steam technology. You may find, as I did, that this project provides insight into both Victorian and modern perceptions of technology and suffering.

**Kathryn Stutz, *Qatar at the Crossroads: Transnational Museum Networks and the Balance of Communication, Curation, and Culture***

**Faculty advisor: Professor Andrew Gardner**

My project examines how museums in different contexts communicate national identity on an international stage, and, ultimately, how museum professionals of different national backgrounds work to communicate these localizing and globalizing narratives. The museum, a historically Western, imperialist institution, has been modified in recent decades to suit the needs of non-Western communities and nations, such as Native American and First Nations groups in the USA and Canada, as well as developing nations abroad, including Qatar, a small, prosperous country among the Arabian Gulf states.

My research has focused on Qatar in a museological ‘hotspot’ for several reasons: an oil-based economic power since the 1970s, Qatar has recently expressed an intention to develop its knowledge/information economy as an alternative to provide support in case of depleting oil resources. This newly conceived knowledge/information economy includes many institutions including higher education (Doha, Qatar’s capital, has a complex of many satellite universities from other countries, collectively known as Education City), the well-established Qatar-based news network Al Jazeera, and, prominently, museums. As Qatar has been developing these new resources in recent years, foreign professionals have been brought in to consult on many design projects, including the new national museum of Qatar, which is set to open later this year. Museum consultants from England’s major institutions have played a particularly notable role, as have American researchers.

Though many other Middle Eastern nations such as Egypt and Turkey are rich with their own archaeological material (‘collection-supply’ nations), Qatar has only one major archaeological site, and relatively few of its own artifacts. Rather than following the path of countries who have designed their museological programs around significant local collections, Qatar must jump into the role of a ‘collection-demand’ nation, where museums must obtain artifacts and other museum collection objects elsewhere. Most Western imperialist countries (Britain, France, the United States) have historically been ‘collection-demand’ nations, occasionally looting archaeologically rich nations to fill their own national or ‘encyclopedic’ museums, such as the British Museum, the Louvre, or the Metropolitan Museum of Art in New York. Furthermore, in several significant ways, the government-run Qatari Museum Authority (QMA) has been following British museum models (as distinct from, for instance, American or French museological conventions) in the construction of new state museums such as the Museum of Islamic Art, Mathaf: the Arab Modern Art Museum, and the Msheirib Museums, a series of small historic house museums. These British museum tropes can often be confirmed by way of the assistance of British museum consultants and by connections between Qatar and specific British collections (for instance, the Sheikha Amna Bint Mohammed Al Thani Gallery at the Victoria & Albert Museum in London.)

During the course of my research, I have traveled to Doha, the capital of Qatar, as well as to several major cities in Europe which have notable museums and collections, including London, Paris, and Athens. By conducting interviews with museum curators, designers, and consultants, I have examined how the design choices made for museums in Qatar are based in museological trends from other countries, and ultimately, how these choices affect the communicative efficacy of Qatari museum narratives. Though a British museological style clearly had advantages in the UK, the question of the ideal museum for Qatar as a nation does not yet have an answer.