Online Proceedings

POSTER SESSION 1

Commons West, Easel 29

11:00 AM to 1:00 PM

Investigating the Role of the Basal Ganglia in Language

Heather Renee Wessel, Senior, English (Creative Writing), Psychology
UW Honors Program
Mentor: Chantel Prat, Psychology

The basal ganglia, evolutionarily old subcortical brain structures, are not commonly considered to be part of the 'language network' despite mounting evidence of their involvement. The current experiment explores two existing hypothesised roles for the basal ganglia in language, based on their known neurocomputations. These hypotheses characterize basal ganglia function as "control" - (prioritization of competing, stable-valued responses), or as "anticipitory" - (ongoing semantical organization based upon syntactic rules). The current experiment aims to adjudicate between these hypotheses by investigating the role of the basal ganglia using an individual differences approach. We utilize two neuroimaging paradigms targeting these hypotheses via lexical-semantic selection under uncertainty and sentence comprehension under varying syntactic complexities, completed by the same subjects. By correlating the neural responses to these tasks with individual differences in vocabulary and working memory capacity, we will explore the predictions made by two hypotheses. Specifically, if the basal ganglia nuclei are involved in controlling compteting linguistic responses, we expect to see greater levels of activation in the left caudate head when subjects are prompted with ambiguous lexical-semantic word choices, as well as 'spillover' activation in the right caudate nucleus negatively correlated with vocabulary percentile and accuracy; if the basal ganglia nuclei are involved in anticipating meaning via syntactic cues, we anticipate higher levels of activation in the left caudate with more syntactically complex sentences in lower-working-memory-capacity readers.

POSTER SESSION 1

Commons West, Easel 28

11:00 AM to 1:00 PM

The Role of the Basal Ganglia in Bilingual Semantic Ambiguity Resolution

Yinan Xu, Senior, Psychology
UW Honors Program
Mentor: Chantel Prat, Psychology
Mentor: Jose Ceballos, Psychology

Semantic ambiguity arises in language when a word or sentence can take on multiple meanings. The resolution process can not only greatly inform theories of language processing, but can also provide novel insights into human general cognitive abilities. There is evidence for basal ganglia (BG) involvement in semantic ambiguity resolution from a breadth of neuroimaging research and clinical populations. The current project focuses on bilingualism, which creates the higher cognitive demand of selecting, shifting, and inhibition information that is co-activated in two language systems. Our study tested 73 proficient bilinguals using a self-paced reading task that contained a lexical ambiguity manipulation. A probabilistic learning task was used as an index of BG functioning. We anticipate that bilinguals with a more balanced use of their two languages train their BG due to frequently managing interference between multiple languages, in comparison to bilinguals who have an imbalanced use of their languages. This should result in a better performance in resolving semantic ambiguities that arise due to low frequency word meanings. Specifically, we expect this better performance to result in smaller increases in reading speed, which reflect interference, for sentences containing low frequency word meanings, relative to control trials. Better understanding of the role of the BG in semantic ambiguity resolution in various bilingual populations will provide novel insights into the neurocognitive bases of human language processing and executive functioning. We see this as an exciting foundation for studies looking into bilingualism as a form of executive function training.

POSTER SESSION 1

Commons West, Easel 27

11:00 AM to 1:00 PM

Relating Individual Differences in Foreign Music Comprehension to Neurocognitive Aspects of Second Language Aptitude

Jiafei Li, Senior, Psychology
UW Honors Program
Mentor: Chantel Prat, Psychology
Mentor: Steven Morrison, Music

Music, like language, is considered a human universal. However, like language, individuals learn particular genres of music based on their cultural exposure. Recent behavioral and neuroimaging research on music cognition has shown that individuals can more easily process and remember music that is culturally familiar to them than music that is culturally novel. The goal of this research is to investigate whether individual differences in the ability to learn novel musical structures (or music aptitude) relates to individual differences in the ability to learn new languages, or language aptitude. Our study includes 5 minute eyes-closed resting-state electroencephalography (EEG), language aptitude tests (LLAMA D&F) of phonological awareness (tests participants' memory of a series of words in a foreign language) and grammatical inferencing (ability to extract underlying rules), and a music learning test in which participants learn a form of foreign music. We predict that phonological awareness will positively correlate with overall memory for foreign music, as it relates to the ability to remember sequences of sounds. In contrast, we predict that grammatical inferencing will positively correlate with the extent to which individuals learn to distinguish between different types of foreign music through statistical learning. This study provides evidence of the connection of individual differences in foreign music comprehension to individual differences in second language acquisition at both a behavioral and neurological level.

SESSION 1T

BRAIN FUNCTION, DYSFUNCTION AND REPAIR

Session Moderator: Kathleen Millen, Pediatrics
JHN 175
12:30 PM to 2:15 PM

* Note: Titles in order of presentation.

Evaluating the Presence of Microglia Progenitor Cells in the Adult Mouse Brain

Chloe Netania Winston, Sophomore, Pre-Sciences
Mentor: Gwenn Garden, Neurology
Mentor: Katherine Prater, Neurology

Microglia, the immune cells of the central nervous system, are long lived. In mice, microglia have an average lifespan of 15.5 months. When microglia are experimentally depleted from the mouse brain, microglia populations quickly return to steady state levels. The mechanisms of this observed repopulation are unclear. More importantly, the mechanisms of microglia replenishment in the healthy brain are not well understood. The literature supports two competing hypotheses. One is that microglia proliferate simply by dividing. Another possibility is that pools of microglia progenitor cells within the central nervous system divide and differentiate into microglia. I hypothesize that microglia proliferate primarily through the differentiation of progenitor cells. Available data to date suggest CD133 as a potential marker for microglia progenitor cells. In order to study these putative progenitor populations, I used a genetic reporter mouse line in which administration of tamoxifen induces TdTomato expression specifically in CD133-expressing cells. TdTomato, a red fluorescent protein, allows these cells to be visualized under a fluorescence microscope. Importantly, all the progeny of these cells also express TdTomato, allowing us to determine whether CD133 cells generate new microglia over time. After tamoxifen treatment at the age of 10 weeks, mice were sacrificed at three and nine months of age. Brains were fixed, sectioned, and labeled with antibodies to a microglia specific protein and to TdTomato. Daughter microglia that differentiated from CD133-expressing cells express both markers. Using a fluorescence microscope, I identified several microglia daughter cells of CD133-expressing cells. This suggests that microglia populations replenish in the healthy brain at least in part through the division of CD133-expressing cells. We can apply this new knowledge about how new microglia are generated in the healthy mouse brain to further our understanding of how microglia population dynamics are affected in both health and disease.

POSTER SESSION 4

MGH 258, Easel 186
4:00 PM to 6:00 PM

Late Behavioral Effects of Early Neonatal Injury in Rats

Simar Virk, Senior, Psychology
Mentor: Pratik Parikh
Mentor: Kylie Corry, Pediatrics

Hypoxic-ischemic encephalopathy (HIE) and inflammatory responses are commonly seen in premature infants which can lead to cognitive delay and behavioral problems. A novel rodent preterm brain injury model is being developed to simulate histological and behavioral changes seen in preterm brain injury. It was hypothesized that injured pups [(*in-utero* hypoxia-ischemia followed by post-natal inflammation with lipopolysaccharide (LPS) + hypoxia + hyperoxia] will have a significant late behavioral deficit compared to controls. The rodent model of preterm brain injury includes: intrauterine hypoxia at embryological day 18, with LPS administration on Postnatal (P) day 2 followed by hypoxia (8% oxygen) and

hyperoxia (80% oxygen). In order to assess late behavioral effect of early neonatal injury, I conducted motor tests on rats. The motor testing included: gait analysis via CatWalk XT and Rotarod analysis. For the Rotarod analysis, I performed testing on both, the injured rats and controls, on P28 to test their locomotor ability. Gait analysis was performed on P35. The results will be tested for significant differences between the groups. Future research will be conducted by repeating this experiment to verify these results and clarify what aspects of late behavior are impacted most by this injury model.

POSTER SESSION 4

MGH 241, Easel 164

4:00 PM to 6:00 PM

Call Center Design with Limited Resources for Populations in Need

Thanika Painruttanasukho, Senior, Industrial Engineering
Mary Gates Scholar
Mentor: Zelda Zabinsky, Industrial & Systems Engineering
Mentor: Larissa Prates Guimaraes Petroianu, Industrial and Systems Engineering

A national organization named 2-1-1 provides assistance to populations with basic needs, mainly informing and answering questions, and researching resources covering 50 states. Not only is the demand for information growing, but also the complexity of calls is increasing. For example, a person may need information on shelters, medical issues, legal assistance, debt management and other services. Consequently, calls are taking longer, and with limited resources, wait times are increasing and even critical calls are sometimes abandoned. Assigning more staff to a call center is not realistic under limited budgets. Hence, an efficient call center system must be designed. Our research seeks to address the efficiency of the WA 2-1-1 call center system, in Washington State. We hypothesize that the application of call prioritization and skill-based routing can reduce the holding-call time, and eliminate call abandonment for those with urgent needs. We will identify classifications of calls, and evaluate how automation can be used to navigate or direct callers to a correct resource and expedite the whole process. Appropriate classification of calls and prioritization may not only decrease the waiting time but also help training operators with an appropriate skill set. We will apply the concept of operations research to forecast seasonal demand using available data within Washington State, and will estimate the number and allocation of resources the organization should provide. The anticipated result of the research is a call center design that will decrease the number of abandoned calls, provide an immediate response to an urgent call, decrease waiting time, and assign calls to available operators to exploit the limited resources. The WA 2-1-1 call center is important to provide assistance to efficiently serve populations in need. Increasing the efficiency of call centers with limited resources will enable WA 2-1-1 to reach more people in need.