**Alzheimer Foundation London and Middlesex Scholarships in Alzheimer's Related Research**

**Research Proposal**

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With the increasing incidence of dementia and Alzheimer's disease in our aging population, there is a growing need for easily implemented interventions that can enhance cognitive functioning in aging adults. The use of music and music therapies in patients with dementia has been gaining popularity as a cost-effective method to improve quality of life, and recently, researchers have explored its cognitive benefits.

There is evidence that music is related to cognitive functioning. For example, there are cognitive functioning differences between musicians and non-musicians. One study showed that musicians are faster at updating their working memory than non musicians (George & Coch, 2011)⁠. These differences in cognitive functions are mirrored in anatomical changes in the brain. The training of musical skills over the lifetime of a musician produces changes that affect the amount of gray matter in motor, auditory, and visuospatial areas, white matter architecture, asymmetry of the planum temporale, and increase the size of the corpus callosum (Gaser & Schlaug, 2001; G Schlaug, 1995; Gottfried Schlaug, Jancke, Huang, & Steinmetz, 1995; Schmithorst & Wilke, 2002)⁠. Together, these studies indicate that music can have a profound and lasting effect on the brain.

However, music does not only affect the brains of musicians. In non-musicians, studies have shown that music listening engages large-scale networks within the brain that are associated with executive functioning such as attention and working memory (Janata, Tillmann, & Bharucha, 2002)⁠, and regular music activities, like singing and instrument playing, are associated with enhanced cognitive functions in healthy older adults (Bugos, Perlstein, McCrae, Brophy, & Bedenbaugh, 2007; Hanna-Pladdy & MacKay, 2011)⁠. In a music intervention study, Seinfeld et al., (2013)⁠ showed that older adults placed in a piano training program saw increases in cognitive function more than a control group who participated in physical exercise activities.

One of the limitations of a music production intervention, such as piano playing, is the requirement for participants to have strong attention and motor functions in order to learn a new instrument. Patients with dementia or Alzheimer's may not be as strong in these functions, and a less intensive approach may be necessary to have patients participate successfully in the intervention. A recent study of the cognitive benefits of music found that both singing and music listening improved cognition in early dementia patients (Sarkamo et al., 2014)⁠. This is a promising development as music listening may be easier than the complicated task of learning a new instrument making it a possible intervention strategy for patients with dementia or Alzheimer’s.

The above mentioned studies discuss the effects of music on cognitive functions however, the mechanism by which music alters cognition is unknown. The proposed project aims to characterize the relationship between music and executive functioning and ultimately to apply this knowledge to create better interventions for patients living with dementia and Alzheimer's disease.

My supervisors, Dr. Jessica A. Grahn and Dr. Adrian M. Owen, work with a series of web-based cognitive tests called *Cambridge Brain Sciences* (CBS). The tests are scientifically validated tools that assess cognitive functions, including memory, reasoning, attention, planning, and problem solving (Hampshire & Owen)⁠. The tests are designed to be accessible, and are thus well suited to use with older participants. Current work in the lab is ongoing to modify the tests to elicit the best performance from older adults. Because they are online, very large numbers of participants can be tested with minimal effort. We propose to examine how music listened to before or during test-taking alters cognitive performance, and to assess the critical features of music that may enhance function. We will manipulate objective acoustic measures (spectral flux, lyrics, instrumentation) and subjective measures (enjoyment, familiarity, etc.) to test their influence on executive functions. It is likely that the results of our experiment will be influenced by factors such as the amount of music training the participants have and the amount of music listened to in daily life and that these factors will vary significantly across individuals. To manage these differences, we will collect demographic information on participants’ musical background, preferences, and habits using the Goldsmiths Musical Sophistication Index (Müllensiefen, Gingras, Musil, & Stewart, 2014)⁠. The results from our experiment on healthy older adults will enable us to optimize the research approach for adults with dementia.

In the previously mentioned study where a music listening intervention resulted in cognitive benefits (Sarkamo et al., 2014)⁠, participants listened to songs that were highly familiar and autobiographically important. The relevance of music familiarity for patients with dementia can not be overlooked. The profound effects of familiar music on patients with dementia and Alzheimer’s have been shown anecdotally in films such as *Alive Inside* and scientifically by researchers exploring how memory for music is uniquely spared and can trigger seemingly lost autobiographical memories in these patients (Baird & Samson, 2009; Belfi, Karlan, & Tranel, 2015; Cuddy et al., 2012; El Haj, Fasotti, & Allain, 2012)⁠. We will capitalize on this unique reaction to understand whether familiar music is important for bolstering cognitive functioning. Using an existing music database created in our lab we will select music that is highly familiar to participants and then select music of a similar style that is unfamiliar. We will have participants listen to these songs before and during testing to determine whether familiar music has a facilitatory effect on cognitive functioning.

Music therapy is a non-pharmacological intervention that may have positive affects on cognitive functioning in patients with dementia and Alzheimer’s. By characterizing the relationship between music and executive functions we can create more effective therapies that target the specific deficits seen in these patients. These interventions will improve quality of life and help patients maintain a high level of cognitive functioning.

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