Investigating the Neural Correlates of Social and Individual Singing in Persons with Dementia Using

Functional Near-Infrared Spectroscopy

by

Nicholas Tamburri

B.Sc., University of Victoria, 2019

A Thesis Proposal Submitted in Partial Fulfillment of the Requirements for the Degree of

MASTER OF SCIENCE

in the Department of Psychology

©Nicholas Tamburri, 2022
University of Victoria

I acknowledge and respect the Ləkʷəŋən peoples on whose traditional territory the university stands

and the Songhees, Esquimalt and W̱SÁNEĆ peoples whose historical relationships with

the land continue to this day.

Supervisory Committee

Dr. Stuart W. S. MacDonald, Co-Supervisor
Department of Psychology

Dr. Jim Tanaka, Co-Supervisor
Department of Psychology

Abstract

Introduction: While music interventions for persons with Alzheimer's Disease and related dementias (ADRD) are increasingly utilized due to their documented cognitive and behavioral benefits, the neurological correlates underlying these advantages are largely unknown and under-researched. Using the advantages of functional near infrared spectroscopy (fNIRS), this study provided a preliminary investigation of the neural correlates and functional connectivity (FC) patterns associated with musical performance in both choral and individual contexts for persons with ADRD. **Objectives:** The objectives were to i) identify within-person patterns of cortical oxygenation in choral and individual singing, ii) explore how singing context (i.e., choral and individual) modulates patterns of functional connectivity (FC) within and across frontal and parietal cortices, and iii) leverage these neurological data as individual differences predictors of cognitive function in a series of discriminant function analyses (DFA). **Methods:** Participants included 13 persons with ADRD who volunteered from a larger, ongoing social-cognitive choir intervention. fNIRS data was collected via the TechEn Cw6 system, using a sampling frequency of 50 Hz, during both choral and individual singing. Paired sample t-tests were used to evaluate changes in neurological patterns observed across conditions and DFA were used to determine whether these neurological data, when used in conjunction with other gold-standard individual differences predictors, were predictive of between-person differences in cognitive impairment (proxied by performance on the Mini-Mental State Examination [MMSE]). **Results:** Significant differences in cerebral oxygenation were identified in the right anterior PFC (BA10), corresponding to one channel of the fNIRS frontal array; specifically, individual singing was associated with significantly greater oxygenation relative to social singing. Moreover, though not significant, individual singing was associated with broad bilateral increases in cortical oxygenation across the majority of fNIRS channels, and increased FC, relative to choral singing. Planned DFA were not significantly predictive

of cognitive impairment status. **Conclusion:** These findings yield tentative support for the notion that individual singing necessitates greater neocortical recruitment for persons with ADRD, and potentially increased FC, which is consistent with a body of literature detailing how increased stress and executive processing – likely enhanced in individual singing – facilitates greater neocortical recruitment. This is the first study to investigate differences in music cognition correlates across environmental contexts for persons with ADRD and may provide preliminary neurological evidence behind the advantages of group music interventions for persons with ADRD. That is, choral singing environments may alleviate the extraneous recruitment of neocortical systems found in individual performance systems which become increasingly impaired with dementia. This study motivates increasing utilization of fNIRS in music neuroscience research, especially in persons with ADRD, aimed at exploring the neurological mechanisms underlying the well-noted benefits of music interventions.