

# The Use of a Novel Neurologic Music Therapy Program to Improve Cognition and Emotional Affect in Individuals with Mild to Severe Dementia: A Research Protocol



URNCST Journal  
"Research in Earnest"

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## Abstract

**Introduction:** Dementia is a prevalent neurodegenerative disorder that interferes with independent and daily functioning. In addition to cognitive decline, individuals with dementia experience behavioural and psychological symptoms of dementia (BPSD), which involves neuropsychiatric disturbances such as agitation. Studies have suggested music therapy to be an effective part of treatment of individuals with dementia as a method to increase both cognitive function and quality of life (QoL). Therefore, this study aims to construct and test a novel neurologic music therapy (NMT) program to optimize the improvement of cognition and emotional affect in those with mild to severe stages of dementia.

**Methods:** This research will be designed as a randomized-controlled crossover study, where two groups of participants will be examined: those with mild to moderate dementia and those with severe dementia. The first eight weeks will consist of a no-treatment control period, and the last eight weeks consist of the treatment period, where both participant groups will undergo cognitive and QoL testing at various times.

**Expected Results:** By comparing the eight-week control period to the eight-week intervention, the results of the study may indicate that NMT benefits individuals with dementia, particularly within the mild to moderate group. Following the intervention, improved cognition, emotional affect, and reduced levels of BPSD in individuals with mild to moderate dementia are anticipated. Participants with severe dementia are expected to have slight improvements within BPSD and emotional affect, and little to no improvement in cognition.

**Discussion:** Few studies have used NMT as an intervention to treat dementia, with no study utilizing a combination of the three NMT techniques proposed in this study. Furthermore, there has been limited literature focusing on individuals with severe dementia. This proposed study will thus allow for further research on this population.

**Conclusion:** The proposed NMT program aims to reduce BPSD, and improve emotional affect and cognition within individuals with mild to severe dementia. Future studies may be conducted to examine whether introducing the proposed NMT program may act as a preventative measure of dementia-related cognitive decline.

**Keywords:** dementia; cognition; emotional affect; music therapy; neurologic music therapy; quality of life

## Introduction

Dementia is a prevalent neurodegenerative disorder, impacting approximately 43.8 million individuals worldwide with this disorder in 2016 [1]. Characterized as a decline in cognition, dementia interferes with independent and daily functioning [2]. Some symptoms of dementia include memory loss, communication and language impairments, as well as object recognition and perception deficits [2]. Additionally, the domains of cognition (attention, executive functioning, learning, and social cognition) are severely impacted [3]. For example, individuals with dementia often get lost in familiar places and have difficulty recalling recent events [3]. These symptoms can vary from mild to severe. Various etiologies of dementia include vascular dementia, dementia with

Lewy bodies, frontotemporal dementia, and most commonly, Alzheimer's disease [2]. These etiologies share similar symptoms, where both memory and executive functioning impairment are exhibited [2].

This dementia-related neurodegeneration is thought to result from an irreversible and gradual loss of neurons [4]. There is currently no cure for dementia, and few treatment options exist that provide satisfactory relief of symptoms [5]. Current treatments include drug and behavioural therapies [4,5], which are used to treat symptoms known as behavioural and psychological symptoms of dementia (BPSD) [6,7]. Some of these symptoms can include agitation, aggression, mood disorders, and psychosis [6]. Potential drug treatments include cholinesterase inhibitors (i.e., donepezil) to prevent loss of cholinergic neurons, and

N-methyl-D-aspartate antagonists (i.e., memantine) to protect neurons from damage due to overactivation of receptors [4,5,7]. These drug treatments are used to alleviate symptoms; however, they cannot reverse the progression of dementia [4]. Although recommended for treating psychosis in individuals with dementia, there is limited evidence to support the efficacy and long-term safety of these antipsychotic medications [7]. These medications are associated with numerous severe adverse events, such as possible worsening of cognition [7].

Given the uncertain efficacy and possible high-risk effects of drug treatments, behavioural therapies are thus viewed as safer and are preferred for alleviating BPSD [8,9]. These can include validation therapy, reality orientation, and cognitive-behavioural therapy [7]. However, little is known about which non-pharmacological treatments are most effective for improving BPSD [8]. Music therapy (MT) has become a widely used psychosocial intervention that has consistently shown to be effective for treating symptoms of dementia [8]. Conducted by a trained music therapist, MT involves using music and various aesthetic sounds and harmonic elements to improve one's overall psychological and physiological health [9,10]. MT uses singing, song writing, music listening, and playing musical instruments to impact cognition, emotion, behaviour, and communication [10]. For individuals with dementia, singing during MT may invoke reminiscence and discussions of past memories, while also reducing BPSD [11]. However, few studies have examined the long-term effects of MT interventions in people with dementia [8]. Neurologic music therapy (NMT) is a new method of non-pharmacological treatment for individuals with dementia, that aims to improve quality of life (QoL) and alleviate impaired neurological functions from dementia pathology [8,12]. NMT is the therapeutic application of MT to cognitive, sensory, language and motor dysfunctions that arise due to neurological disease or injury, and is supported by evidence-based practices [8,12].

Although studies have examined MT, few have specifically used NMT as their method of intervention [8]. Therefore, this study aims to construct and test a novel NMT program to optimize the improvement of cognition and emotional affect (particularly BPSD) in those with mild to severe stages of dementia. Notably, as BPSD is one of the most prominent symptoms of dementia, the aim is to investigate whether this novel NMT program can be beneficial to alleviate these symptoms and improve QoL in the long term. Cognitive and QoL assessments will be conducted throughout a period of 12 months to determine long-term effects of this program.

## Methods

### Participants

Eighty participants with dementia between the ages of 65 to 80 will be recruited from nursing homes and outpatient neurology clinics. This sample will be comprised

of 40 participants diagnosed with mild or moderate dementia and 40 participants diagnosed with severe dementia. Participants must be diagnosed according to the International Classification of Diseases, tenth revision (ICD-10) [13]. Based on the Global Deterioration Scale [14], participants will be included if they are classified as mild (stage 4), moderate (stages 5-6), or severe (stage 7) dementia, with all other stages excluded. Individuals with severe dementia must have a caretaker or loved one to aid in study participation; this is not required but highly recommended for mild to moderate participants. Participants will be excluded if they have hearing difficulties or are diagnosed with other major neurological or psychiatric disorders such as epilepsy or schizophrenia. Participants will also be excluded if they are concurrently partaking in another MT program.

### Study Design

This 16-week randomized-controlled crossover study will have three testing sessions denoted A1, A2, and B sessions. The first 8 weeks will consist of the control period (time between A1 and A2), and the last 8 weeks consist of the treatment period (time between A2 and B). Both participant groups will undergo cognitive and QoL testing three times; once at the beginning of the study (session A1), once following the 8-week control period (session A2), and once following the 8-week treatment period (session B). After the initial 8 weeks, participants in both groups will undergo the proposed NMT program 3 times per week for a total of 8 weeks. For each group, improvement in cognition and QoL will be compared between treatment and control periods. Additionally, at each testing session, cognitive performance will be compared between the two groups.

To measure any long-term improvements from the NMT program within the domains of cognition and emotional affect, study participants will undergo a follow-up cognitive and QoL testing session 12 months following the intervention. This follow-up may determine whether the proposed improvements following the intervention are retained longitudinally following the NMT program.

### NMT Program

The proposed NMT program will be a combination of three established techniques: Associative Mood and Memory Training (AMMT), Musical Attention Control Training (MACT), and Musical Executive Function Training (MEFT) [15]. AMMT is a cognitive rehabilitation technique involving music to induce particular mood states to promote memory recall — specifically, to encourage positive emotions to enhance learning and recall function [15]. As individuals with dementia have difficulty with short-term and long-term memory retrieval [15], AMMT can thus be used to improve the recollection of long-term memory by triggering mood and memory networks. MACT involves structured musical exercises using improvisation or prepared performances [15]. Different musical cues will

invoke various musical responses, allowing for the participant to practice sustained, divided, and selective types of attention. MEFT utilizes improvisation and composition exercises to practice different executive functional skills, such as organization and decision making [15].

The proposed 8-week treatment period involves both groups participating in the AMMT technique on Mondays, MACT on Wednesdays, and MEFT on Fridays, all 30 minutes in length. To minimize the emergence of increased BPSD in the late afternoon and evening (also known as the sundowning phenomenon [16]), the program will be conducted during morning hours. The program will take place within the individualized homes of each participant to optimize their comfort and familiarity. The music from the NMT intervention will be played through speakers.

#### Pre-Test Questionnaire

An initial probing test will be conducted during the first session. The pretest questionnaire will probe demographic information, medical history, the specific treatment location (private residence or nursing home), and dementia type for each participant. Specific music-related preferences will be collected from participants or their caregivers (i.e., their preferred genre of music). This will allow for a more individual-based NMT approach. Using this questionnaire, Spotify playlists will be tailored to each participant based on their musical preferences listed, and will be used for the duration of the NMT program.

#### Brief Neuropsychological Tests

The cognitive status of participants will be measured during each of the sessions A1, A2, and B through a combination of the following assessments.

##### *Mini-Mental State Examination (MMSE)*

The MMSE is a brief 10-minute cognitive test of memory, language, and orientation [17]. The maximum score for the MMSE is 30 with a score below 23 indicating cognitive impairment.

##### *Montreal Cognitive Assessment (MoCA)*

The MoCA is a cognitive-based assessment that distinguishes individuals with cognitive impairment from healthy individuals [18]. The 10-minute assessment includes a 30-point test that assesses memory recall, orientation, attention, language, and visuospatial abilities.

##### *General Practitioner Assessment of Cognition (GPCOG)*

The GPCOG is a brief four-minute cognitive screening test that involves two components: a cognitive assessment with the respondent and an informant questionnaire [19]. A maximum score of 9 on the individual assessment indicates no cognitive impairment, and a score less than 4 suggests cognitive impairment. If the individual scores between 5-8, the informant questionnaire is required. A score below 3 on this questionnaire indicates cognitive impairment.

#### Cognitive and Emotional Affect Assessments

Three cognitive domains will be tested during the study: executive functioning (Stroop Test), episodic memory (Recognition Memory Test) and sustained auditory attention (Seashore Rhythm Test). Two additional tests will be used to assess emotional affect: the Dementia Quality of Life Scale (DQoL) and the Cornell-Brown Scale for Quality of Life in Dementia (CBS).

##### *The Stroop Color and Word Test (SCWT)*

The SCWT is a 15-minute cognitive test that has been designed to assess the ability to inhibit cognitive interference [20]. The test consists of colour words in different colours of ink. Individuals are asked to read the colour names, then are asked to name the colour of the ink while ignoring the word itself. An example of this can be the word “red” written in blue ink. Completion time will be measured for both tasks [20,21].

##### *Warrington Recognition Memory Test (WRMT) for Words*

The WRMT-Words is a simple five-minute test where individuals are presented with 50 words in succession [22]. They are then administered trials where they are shown a pair of words: a word previously seen from the list and a distractor word. Participants then decide which of the two words were previously seen. Scores are determined based on how many list words are correctly distinguished from the given distractor words.

##### *Seashore Rhythm Test (SRT)*

The SRT is a subtest of the Halstead-Reitan neurological assessment battery [23]. This test evaluates auditory memory, sensory discrimination, and sustained attention. Participants will listen to three sets of 10 pairs of rhythmic sounds and must determine whether the sound was the same or different. The scoring is based on the number of correct items, where less impairment is indicated by higher scores.

##### *Quality of Life (QoL) Questionnaires*

To capture the effects of NMT on BPSD, participants and/or primary caregivers will complete the DQoL and the CBS [24]. The DQoL measures self-esteem, negative and positive affect, feelings of belonging, and sense of aesthetics [25]. The CBS additionally examines mood-related and physical signs of depression, and behavioural and ideational disturbances [24].

#### Statistical Analysis

A two-way analysis of variance (ANOVA) with a between-subjects factor of Group (mild to moderate dementia, severe dementia) and a within-subjects factor of Time Period (control period, treatment period) will be used to test for differences. Sidak-corrected paired t-tests will be used for post-hoc analyses. These analyses will provide evidence for a difference between the control period and the

NMT treatment period, in terms of cognitive performance and emotional affect between groups and within groups. For the 12-month follow-up of the study, a mixed effect regression model will be used to identify any significant longitudinal changes in these variables. This regression model will examine whether predictors such as the level of improvement during the treatment period, age of participant, and dementia severity could significantly predict a measure of cognition at 12 months.

## Results

In general, a main effect of Time is expected, where there is improvement in cognitive and emotional assessments within all dementia groups. In terms of cognitive measures, an improvement in the treatment period compared to the control period is anticipated, but more so for the mild to moderate dementia group than the severe group. This will be demonstrated through the brief neuropsychological tests and cognitive assessments. In terms of emotional affect, all dementia groups are predicted to have a reduced BPSD and increased positive emotional behaviours, particularly in the mild to moderate group.

For each of the cognitive assessments (SWCT, WRMT-Words, SRT), a Group by Time interaction is expected, where the mild to moderate group has a significant increase on the three cognitive domains (executive function, memory, and attention) compared to their baseline results in the control period; this increase in the mild to moderate group is expected to be higher than that of the severe dementia group. This is supported by Gregory [26] where MACT improved attention in older adults with cognitive impairments. In addition, Impellizzeri et al. [27] demonstrated that AMMT improves memory for individuals with multiple sclerosis. Furthermore, MEFT was found to improve executive function in individuals with brain injury from a study by Thaut et al. [28]. Therefore, these studies suggest that the aforementioned NMT techniques may also improve various domains of cognition and QoL in individuals with dementia. Relative to the mild to moderate group, the severe dementia group is predicted to have less improvement in cognition within these three aforementioned cognitive domains.

The emotional questionnaire scores are expected to improve after the NMT treatment, with each questionnaire contributing insights to both short- and long-term improvements. Specifically, within the mild to moderate group, the CBS scores are expected to improve more substantially in the short term than the long term [29]. Conversely, research has also shown that the effects of MT on DQoL scores are expected to be more prominent in the long term than short term [29]. Within the severe group, baseline results are expected, with only slight improvement of QoL, if any. These findings are based on a MT study by Moreno-Morales who also found positive effects of intervention in individuals with mild to moderate

dementia, and less so in individuals with severe dementia [30]. Symptoms that have been suggested to improve the most with NMT include anxiety, depression, and agitation [31].

In a study focusing on individuals with severe dementia, MT was able to induce relaxation and reduce BPSD shortly after the intervention period [32]. A randomized controlled trial (RCT) observed immediate short-term positive effects on mood and reduced BPSD during the MT, yet no long-term effects were evident [33]. However, this RCT did not find cognitive improvements in individuals with severe dementia after an individualized MT intervention [33]. The severe group is predicted to experience lesser improvements of emotional affect and BPSD, compared to the mild to moderate group. Furthermore, there are few studies that evaluate cognitive status within individuals with severe dementia [34], where the majority of these studies have found no cognitive benefit [35,36]. It may be unlikely that long-term effects will be observed following the end of the program. Given these findings in the literature [32,33], little to no cognitive improvements within the severe dementia group are similarly anticipated.

Therefore, the proposed NMT program is expected to reduce BPSD and induce positive emotional behaviours within all dementia groups, yet more so for the mild to moderate group. Furthermore, cognition is expected to improve within the mild to moderate group and less so for the severe group. Long-term effects are expected to be more prominent within the mild to moderate group following the study, with only short-term effects expected within the severe dementia group.

## Discussion

### Summary

Few studies have investigated NMT treatment on dementia, with no study utilizing a combination of AMMT, MACT, and MEFT. By comparing eight weeks of no NMT (i.e., control period) to eight weeks of implemented NMT (i.e., treatment period), the findings of the study may indicate that NMT has a substantial influence on cognition and emotional affect for people with mild to moderate dementia. Within the severe dementia group, improvements in emotional affect and BPSD are expected but at lower levels than the mild to moderate group. Furthermore, little to no cognitive improvement is expected in comparison to the mild to moderate group. As individuals with severe dementia experience acute cognitive dysfunction, any level of cognitive improvement at this stage of dementia is expected to be limited. Furthermore, these individuals may also have impairments when engaging in the NMT program and reporting perceived emotions [32]. This may explain why MT studies primarily focus on individuals with mild to moderate dementia, leaving little literature with severe dementia.

### Strengths of NMT

NMT implemented in a home setting can have various beneficial effects for both the participant and their caregiver. A home treatment setting provides convenience, comfort, and familiarity to both parties. Moving individuals with dementia from their homes may increase the risk of BPSD [8]. By performing the treatment in a familiar area, participants may react better to the therapy, providing amplified results through decreased BPSD and increased QoL and cognition.

Listening to music can evoke both a physiological and emotional response, particularly when listening to familiar music [37]. Associations with specific song genres, melodies, and lyrics can trigger unique memories for each individual, thereby prompting the emotions associated with such memories [37,38]. BPSD can be triggered when the individual is unfamiliar with their surroundings [37]. By listening to familiar music, these individuals may feel more relaxed and comfortable within their environment, and this musical familiarity may elicit long-term memory recall [37,38]. Studies have found that individuals with dementia are still able to recall and sing lyrics that they have memorized from years past [38]. Furthermore, singing familiar songs during MT can improve speech content and fluency in individuals with dementia [38].

### Limitations

A loss to follow-up from participants withdrawing from the study due to severe declines in health status or physical difficulties required for the program may occur, thereby reducing sample size. An increased sample size may help combat the potential loss of participants. The QoL questionnaires are recommended to be completed by the individual with dementia, with slight assistance from the caregiver. Therefore, participants in the severe dementia group will need more assistance from their caregivers, potentially biasing data. Recruiting individuals for this study may be difficult due to the specific inclusion and exclusion criteria, and the potential presence of additional neurological disorders and comorbidities. Sourcing participants from additional clinics in an expanded geographical area may potentially address this recruiting limitation.

### **Conclusion**

Dementia places considerable physical, emotional, and financial burdens on individuals diagnosed with this disorder as well as their families and caregivers. The proposed NMT program which incorporates multiple NMT techniques may improve cognitive decline within the mild to moderate dementia group and improve emotional affect and BPSD within all severities of dementia at varying magnitudes. In the future, this NMT program is anticipated to be potentially used as part of a treatment for dementia. Future research using this proposed NMT program could be conducted in individuals who have an increased risk of

cognitive decline (i.e., family history of dementia) to determine whether NMT is also useful as a preventative measure. On the basis of this research protocol, future studies could introduce the proposed NMT program in the treatment plans of other neurodegenerative conditions to examine any improvements in cognition and emotional affect.

### **List of Abbreviations Used**

BPSD: behavioural and psychological symptoms of dementia  
MT: music therapy  
NMT: neurologic music therapy  
AMMT: associative mood and memory training  
MACT: musical attention control training  
MEFT: musical executive function training  
QoL: quality of life  
MMSE: mini-mental state examination  
MoCA: Montreal cognitive assessment  
GPCOG: general practitioner assessment of cognition  
SCWT: Stroop color and word test  
WRMT: Warrington recognition memory test  
SRT: Seashore rhythm test  
DQoL: dementia quality of life scale  
CBS: Cornell-Brown scale for quality of life  
RCT: randomized controlled trial

### **Conflicts of Interest**

The authors Raymond Tolentino, Aoife McMahon, and Erika Coward declare that they have no conflict of interests.

### **Ethics Approval and/or Participant Consent**

Research ethics approval will be obtained prior to data collection.

### **Authors' Contributions**

RT: made contributions to the design of the study, collected and analyzed data, drafted the manuscript, and gave final approval of the version to be published.

AM: made contributions to the design of the study, collected and analyzed data, drafted the manuscript, and gave final approval of the version to be published.

EC: made contributions to the design of the study, collected and analyzed data, drafted the manuscript, and gave final approval of the version to be published.

### **Acknowledgements**

The authors gratefully acknowledge their mentor, Ricky Chow, for his utmost support and continuous guidance.

### **Funding**

This study was not funded.

## References

- [1] Nichols E, Szoek CE, Vollset SE, Abbasi N, Abd-Allah F, Abdela J, et al. Global, regional, and national burden of Alzheimer's disease and other dementias, 1990–2016: A systematic analysis for the Global Burden of Disease Study 2016. *The Lancet Neurology*. 2019;18(1):88–106. [https://doi.org/10.1016/S1474-4422\(18\)30403-4](https://doi.org/10.1016/S1474-4422(18)30403-4)
- [2] Duong S, Patel T, Chang F. Dementia: What pharmacists need to know. *Canadian Pharmacists Journal/Revue des Pharmaciens du Canada*. 2017 Mar;150(2):118–29. <https://doi.org/10.1177%2F1715163517690745>
- [3] Hugo J, Ganguli M. Dementia and cognitive impairment: Epidemiology, diagnosis, and treatment. *Clinics in Geriatric Medicine*. 2014 Aug 1;30(3):421–42. <https://doi.org/10.1016/j.cger.2014.04.001>
- [4] Yiannopoulou KG, Papageorgiou SG. Current and future treatments for Alzheimer's disease. *Therapeutic Advances in Neurological Disorders*. 2013 Jan;6(1):19–33. <https://doi.org/10.1177%2F1756285612461679>
- [5] Briggs R, Kennelly SP, O'Neill D. Drug treatments in Alzheimer's disease. *Clinical Medicine*. 2016 Jun;16(3):247. <https://doi.org/10.7861/clinmedicine.16-3-247>
- [6] Douglas S, James I, Ballard C. Non-pharmacological interventions in dementia. *Advances in Psychiatric Treatment*. 2004 May;10(3):171–7. <https://doi.org/10.1192/apt.10.3.171>
- [7] Rabins PV, McIntyre JS. Treatment of patients with Alzheimer's disease and other dementias. *American Psychiatric Association, Guidelines*; 2010 Oct.
- [8] Holden SK, Sheffler J, Stewart R, Thompson S, Persson J, Finseth T, Sillau S, Kluger BM. Feasibility of home-based neurologic music therapy for behavioral and psychological symptoms of dementia: A pilot study. *Journal of Music Therapy*. 2019 Aug 13;56(3):265–86. <https://doi.org/10.1093/jmt/thz009>
- [9] Aleixo MA, Santos RL, Dourado MC. Efficacy of music therapy in the neuropsychiatric symptoms of dementia: Systematic review. *Jornal Brasileiro de Psiquiatria*. 2017 Mar;66(1):52–61. <https://doi.org/10.1590/0047-208500000150>
- [10] Koelsch S. A neuroscientific perspective on music therapy. *Annals of the New York Academy of Sciences*. 2009;1169:374–84. <https://doi.org/10.1111/j.1749-6632.2009.04592.x>
- [11] Van der Steen JT, Smaling HJ, Van der Wouden JC, Bruinsma MS, Scholten RJ, Vink AC. Music-based therapeutic interventions for people with dementia. *Cochrane Database of Systematic Reviews*. 2018 Jul 23;(7). <https://doi.org/10.1002/14651858.CD003477.pub4>
- [12] Thaut MH, McIntosh GC, Hoemberg V. Neurologic music therapy: From social science to neuroscience. *Handbook of Neurologic Music Therapy*. 2014 Jul 17:1–6. Available from: <https://psycnet.apa.org/record/2014-42500-001>
- [13] Boller F, Traykov L. Classification and Diagnosis of Dementias. *Dementias*. 1999: 51–76. [https://doi.org/10.1007/978-88-470-2149-5\\_3](https://doi.org/10.1007/978-88-470-2149-5_3)
- [14] Reisberg B, Ferris SH, De Leon MJ, Crook T. The global deterioration scale for assessment of primary degenerative dementia. *American Journal of Psychiatry*. 1982;139(9):1136–9. <https://doi.org/10.1176/ajp.139.9.1136>
- [15] Thaut MH. Neurologic music therapy techniques and definitions. *Rhythm, Music and the Brain: Scientific Foundations and Clinical Applications*. 2005. Available from: <https://nmtacademy.files.wordpress.com/2015/07/nmt-definitions.pdf>
- [16] Khachiyants N, Trinkle D, Son SJ, Kim KY. Sundown syndrome in persons with dementia: An update. *Psychiatry Investigation*. 2011 Dec;8(4):275. <https://doi.org/10.4306%2Fpi.2011.8.4.275>
- [17] Arevalo-Rodriguez I, Smailagic N, Roqué i Figuls M, Ciapponi A, Sanchez-Perez E, Giannakou A, et al. Mini-mental state examination (MMSE) for the detection of Alzheimer's disease and other dementias in people with mild cognitive impairment (MCI). *Cochrane Database of Systematic Reviews*. 2015. <https://doi.org/10.1002%2F14651858.CD010783>
- [18] Hobson J. The Montreal cognitive assessment (MoCA). *Occupational Medicine*. 2015;65(9):764–5. <https://doi.org/10.1093/occmed/kqv078>
- [19] Seeher KM, Brodaty H. The general practitioner assessment of cognition (GPCOG). *Cognitive Screening Instruments*. 2017;231–9. [https://doi.org/10.1007/978-3-319-44775-9\\_10](https://doi.org/10.1007/978-3-319-44775-9_10)
- [20] Scarpina F, Tagini S. The Stroop color and word test. *Frontiers in Psychology*. 2017;8. <https://doi.org/10.3389%2Ffpsyg.2017.00557>
- [21] Bell MA, Meza TG. Executive function. *Encyclopedia of Infant and Early Childhood Development*. 2020; 568–74. <https://doi.org/10.1016/B978-0-12-809324-5.23748-6>
- [22] Kim MS, Boone KB, Victor T, Marion SD, Amano S, Cottingham ME, et al. The Warrington recognition memory test for words as a measure of response bias: Total score and response time cutoffs developed on "real world" credible and noncredible subjects. *Archives of Clinical Neuropsychology*. 2009;25(1):60–70. <https://doi.org/10.1093/arclin/acp088>
- [23] Mazur-Mosiewicz A, Dean RS. Halstead-Reitan Neuropsychological test battery. *Encyclopedia of Child Behavior and Development*. 2011;727–31. [https://doi.org/10.1007/978-0-387-79061-9\\_1311](https://doi.org/10.1007/978-0-387-79061-9_1311)

- [24] Ready RE, Ott BR. Quality of life measures for dementia. *Health and Quality of Life Outcomes*. 2003 Dec;1(1):1-9. <https://doi.org/10.1186/1477-7525-1-11>
- [25] Brod M, Stewart AL, Sands L, Walton P. Conceptualization and measurement of quality of life in dementia: The dementia quality of life instrument (DQoL). *The Gerontologist*. 1999 Feb 1;39(1):25-36. <https://doi.org/10.1093/geront/39.1.25>
- [26] Gregory D. Music listening for maintaining attention of older adults with cognitive impairments. *Journal of Music Therapy*. 2002;39(4):244–64. <https://doi.org/10.1093/jmt/39.4.244>
- [27] Impellizzeri F, Leonardi S, Latella D, Maggio MG, Cuzzola MF, Russo M, Sessa E, Bramanti P, De Luca R, Calabrò RS. An integrative cognitive rehabilitation using neurologic music therapy in multiple sclerosis: A pilot study. *Medicine*. 2020 Jan;99(4). <https://doi.org/10.1097%2FMD.00000000000018866>
- [28] Thaut M, Gardiner J, Holmberg D, Horwitz J, Kent L, Andrews G, Donelan B, Mcintosh G. Neurologic music therapy improves executive function and emotional adjustment in traumatic brain injury rehabilitation. *Annals of the New York Academy of Sciences*. 2009 Jul 1;1169(1):406-16. <https://doi.org/10.1111/j.1749-6632.2009.04585.x>
- [29] Särkämö T, Tervaniemi M, Laitinen S, Numminen A, Kurki M, Johnson JK, Rantanen P. Cognitive, emotional, and social benefits of regular musical activities in early dementia: Randomized controlled study. *The Gerontologist*. 2014 Aug 1;54(4):634-50. <https://doi.org/10.1093/geront/gnt100>
- [30] Moreno-Morales C, Calero R, Moreno-Morales P, Pintado C. Music therapy in the treatment of dementia: A systematic review and meta-analysis. *Frontiers in medicine*. 2020 May 19;7:160. <https://doi.org/10.3389%2Ffmed.2020.00160>
- [31] Raglio A, Bellelli G, Traficante D, Gianotti M, Ubezio MC, Villani D, Trabucchi M. Efficacy of music therapy in the treatment of behavioral and psychiatric symptoms of dementia. *Alzheimer Disease & Associated Disorders*. 2008 Apr 1;22(2):158-62. <https://doi.org/10.1097/wad.0b013e3181630b6f>
- [32] Sakamoto M, Ando H, Tsutou A. Comparing the effects of different individualized music interventions for elderly individuals with severe dementia. *International Psychogeriatrics*. 2013 May;25(5):775-84. <https://doi.org/10.1017%2FS1041610212002256>
- [33] Sánchez A, Maseda A, Marante-Moar MP, De Labra C, Lorenzo-López L, Millán-Calenti JC. Comparing the effects of multisensory stimulation and individualized music sessions on elderly people with severe dementia: A randomized controlled trial. *Journal of Alzheimer's Disease*. 2016 Jan 1;52(1):303-15. <https://doi.org/10.3233/jad-151150>
- [34] Moreno-Morales C, Calero R, Moreno-Morales P, Pintado C. Music therapy in the treatment of dementia: A systematic review and meta-analysis. *Frontiers in medicine*. 2020 May 19;7:160. <https://doi.org/10.3389%2Ffmed.2020.00160>
- [35] Fang R, Ye S, Huangfu J, Calimag DP. Music therapy is a potential intervention for cognition of Alzheimer's disease: A mini-review. *Translational Neurodegeneration*. 2017;6(1). <https://doi.org/10.1186%2Fs40035-017-0073-9>
- [36] Narme P, Clément S, Ehrlé N, Schiaratura L, Vachez S, Courtaigne B, Munsch F, Samson S. Efficacy of musical interventions in dementia: Evidence from a randomized controlled trial. *Journal of Alzheimer's disease*. 2014 Jan 1;38(2):359-69. <https://doi.org/10.3233/jad-130893>
- [37] Clements-Cortes A, Bartel L. Are we doing more than we know? Possible mechanisms of response to music therapy. *Frontiers in Medicine*. 2018 Sep 11;5:255. <https://doi.org/10.3389%2Ffmed.2018.00255>
- [38] Dassa A, Amir D. The role of singing familiar songs in encouraging conversation among people with middle to late-stage Alzheimer's disease. *Journal of Music Therapy*. 2014 Jul 1;51(2):131-53. <https://doi.org/10.1093/jmt/thu007>

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### Article Information

Managing Editor: Jeremy Y. Ng

Peer Reviewers: Ricky Chow, Bi-Ru Amy Yeung

Article Dates: Received Aug 06 21; Accepted Oct 08 21; Published Oct 22 21

### Citation

Please cite this article as follows:

Tolentino R, McMahon A, Coward E. The use of a novel neurologic music therapy program to improve cognition and emotional affect in individuals with mild to severe dementia: A research protocol. *URNCST Journal*. 2021 Oct 22: 5(10).

<https://urncst.com/index.php/urncst/article/view/309>

DOI Link: <https://doi.org/10.26685/urncst.309>

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