

**Aging Audiences: Association of Live Performance Attendance and  
Cognitive Decline in a Biracial Sample**

**Kumar B. Rajan, PhD<sup>1</sup>, Rekha S. Rajan, EdD<sup>2</sup>,  
Lydia K. Manning, PhD<sup>2</sup>, and Denis A. Evans, MD<sup>1</sup>**

<sup>1</sup>Rush University Medical Center, Chicago IL, USA

<sup>2</sup>Concordia University Chicago, IL, USA

This project was supported in part or in whole by an award from the *Research: Art Works* program at the National Endowment for the Arts: Grant# 15-3800-7012.

The opinions expressed in this paper are those of the author(s) and do not necessarily represent the views of the Office of Research & Analysis or the National Endowment for the Arts. The NEA does not guarantee the accuracy or completeness of the information included in this report and is not responsible for any consequence of its use.



**National  
Endowment  
for the Arts**  
arts.gov

# Aging Audiences: Association of Live Performance Attendance and Cognitive Decline in a Biracial Sample

Journal of Aging and Health

1-13

© The Author(s) 2016

Reprints and permissions:

sagepub.com/journalsPermissions.nav

DOI: 10.1177/0898264316682907

jah.sagepub.com



Kumar B. Rajan, PhD<sup>1</sup>,  
Rekha S. Rajan, EdD<sup>2</sup>, Lydia K. Manning, PhD<sup>2</sup>,  
and Denis A. Evans, MD<sup>1</sup>

## Abstract

**Objectives:** To examine if attendance in live performances was associated with change in cognition among African Americans (AAs) and European Americans (EAs). **Method:** The study consisted of 5,567 older adults with at least follow-up interview and analyzed using a linear mixed effects regression model adjusting for demographic and health variables. **Results:** We found that frequent performance attendance was associated with slower decline in composite cognitive function among older AAs and EAs. Attending 10 or more performances per year was associated with 23% slower cognitive decline among AAs and 31% slower cognitive decline among EAs compared with those who never attend any performance. However, this difference was not significant ( $p = .56$ ). Attending live performances was also associated with slower decline in individual tests of perceptual speed, episodic memory, and mini-mental state exam (MMSE). **Discussion:** Our findings suggest that live performances form a valuable component of arts engagement and should be encouraged for potential cognitive benefits.

---

<sup>1</sup>Rush University Medical Center, Chicago IL, USA

<sup>2</sup>Concordia University Chicago, IL, USA

## Corresponding Author:

Kumar B. Rajan, Rush Institute for Health Aging, Rush University Medical Center, 1645 W Jackson Blvd, Suite 675, Chicago, IL 60612, USA.

Email: kumar\_rajana@rush.edu

**Keywords**

music, theater, cognitive decline, performing arts, minorities

**Introduction**

A strong interest in translational activities and community-based practices has led to research focusing on how participating in arts activities may be associated with social and cognitive functioning in old age. Arts participation may provide a viable structure for fostering social connections and enhancing life experiences (Carr, 2006; Carr, Wellin, & Reece, 2009; Cohen, 2000, 2006). However, the research examining older adults' attendance at live performances remains relatively scant.

In one of the first national studies to explore arts participation among older adults, the Creativity and Aging Study found positive associations between intensive, participatory arts programs and cognitive function in older adults (Cohen, 2006). Older adults' active participation in theater workshops has also resulted in improved cognitive skills (Noice & Noice, 2006; Tolladay, 2006).

Previous studies suggest that older adults' participation in art programs is associated with improved physical and mental health (Cohen et al., 2006; de Medeiros & Basting, 2014). Older adults with cognitive impairments could sustain attention to music across a listening activity (Gregory, 2002), and listening to music might also improve focus and performance of work-related tasks (Lesiuk, 2005). In a randomized control trial, listening to music helped the recovery of verbal memory and attention domains of cognitive function in older adults after stroke (Särkämö et al., 2008). In terms of broader health outcomes, attending cultural events had a positive association on survival skills (Bygren, Konlaan, & Johansson, 1996), perceptions on the quality of life (Coffman, 2002), and positive emotion (Laukka, 2007).

In addition, researchers have described how engagement in the visual arts can support creative thinking and self-expression (Hoffman, Greenberg, & Fitzner, 1980; Kinney & Rentz, 2005). Some studies have primarily focused on the associations between music and cognitive function in older adults by improving gait function (Maclean, Brown, & Astell, 2014) and mood (Hars, Herrmann, Gold, Rizzoli, & Trombetti, 2014). Findings from these studies suggest that participating in music activities has a positive association on health outcomes in older adults. As such, arts experiences, particularly those that invite attendance, may hold promise for various interventions and translational programs for people as they age.

Recent evidence suggests that older adults have shown an increase in attendance of performing arts over the last decade (National Endowment for

the Arts [NEA], 2015). Specifically, the survey of public participation in the arts (SPPA) found that older adults' participation in the arts has increased over the last decade (NEA, 2015). Also, when compared with younger counterparts, older adults were more likely to attend a benchmark event, defined as attending jazz, classical music concerts, operas, plays, ballet, or visits to art museums or galleries. The higher attendance rates at arts events suggests that older adults might value various forms of arts engagement as they continue to take advantage of artistic experiences within the community.

Given previous research on how arts participation can support cognitive function in older adults, our interest was to conduct a secondary analysis of data from a longitudinal study to examine the association of live, performance attendance (concert, play, or musical) with composite and individual tests of cognition, using a biracial sample of 5,567 African American (AA) and European American (EA) participants from the Chicago Health and Aging Project (CHAP). Our primary hypothesis was that higher attendance in live performance was associated with slower decline in composite cognitive function test scores among AAs and EAs. Our secondary hypothesis was that live performance attendance was associated with slower decline in individual tests of cognition among AAs and EAs.

## Method

### *Data Source and Sample*

Data for this study came from the CHAP. The goal of the CHAP study (R01-AG11101 [Evans, PI]) was to identify risk and protective factors associated with Alzheimer's disease and related disorders in adults over the age of 65. The CHAP study was designed as a prospective, epidemiological study of all residents of 65 years of age and older from a geographically defined, urban biracial community. The study population consisted of four neighborhoods from the south side of Chicago: Morgan Park, Washington Heights, Mount Greenwood, and Beverly.

The CHAP study had started by conducting a complete census of the community area in 1993. Of the 66,114 residents identified by the census, 8,501 (12.8%) were above 65 years old, of whom 59% were AAs. Of 8,501 eligible participants, 439 had died, and 249 had moved before their participation could be secured, leaving 7,513 age-eligible residents. Of these 7,513 age-eligible residents, 6,158 (78.9%) participated in a baseline population interview (61.6% AAs). The study design consisted of in-person interviews, which were conducted in the participant's homes once every 3 years. Baseline interviews were performed from 1993 to 1996 and were repeated at 3-year

cycles. As of the third cycle (in 2000), CHAP has started to enroll successive age cohorts, consisting of community residents who had turned 65 since the inception of the study. This design feature ensures that the cohort does not become increasingly older and smaller. Members of these successive age cohorts have the same pattern of data collection, with their data efficiently combined with that of the original cohort for the proposed analyses.

### *Performance Attendance*

We examined live performance attendance in 5,567 participants with one or more follow-up interviews, each about 3 years apart. Performance attendance was assessed using the question, "In the past ten years, how many times have attended a concert, play, or musical?" Participants provided the following responses: *never*, *1 to 2 times*, *3 to 9 times*, *10 to 19 times*, and *20 or more times*. Participants who responded *1 to 2 times* and *3 to 9 times* were coded as <10 per year and those who responded *10 to 19 times* and *20 or more* were coded as 10 or more per year.

### *Cognitive Function*

Cognitive function was evaluated using a battery of four tests including two tests of episodic memory (immediate and delayed recall) derived from the East Boston Memory Test (Albert et al., 1991), a test of perceptual speed (the Symbol Digits Modalities Test; Smith, 1982), and a test of general orientation and global cognition using the mini-mental state examination (MMSE) (Folstein, Folstein, & McHugh, 1975). The four tests loaded on a single factor that accounted for about 75% of the variance in a factor analysis. Therefore, we constructed a composite cognitive function test score for the entire study cohort by averaging the four tests together after centering and scaling to the baseline mean and standard deviation of the original cohort (Wilson et al., 2010). A participant whose performance matches the average participant at baseline of the original cohort had a composite cognitive score of 0, and a person who performs one *SD* better than average on every test has a composite cognitive score of +1. Cognitive tests of perceptual speed was based on standardized symbol digits modalities test, episodic memory based on the average of the delayed and immediate recall tests, and global cognition and orientation based on standardized MMSE test scores.

### *Demographic, Health, and Engagement Covariates*

Our study collected demographic characteristics, such as age at baseline (in years), sex (males or females), race (AAs or EAs), and education (measured

in number of years of schooling completed). Also, physical function, depressive symptoms, and social engagement were also collected during the baseline assessment. Physical function was based on three performance tests of measured walk, tandem stand, and repeated chair stand, with recorded times categorized into quintiles and assigned scores ranging from 1 to 5, with a higher score indicating better physical function (Guralnik et al., 2000). Social engagement was based on four questions—“How often do you go to religious services?” “Do you participate in any activities or groups outside the house, such as a senior center, public service, etc.?” and “Are you currently working at a job part-time or full-time?” (Mendes de Leon & Rajan, 2014). Depressive symptoms were measured using a short version of the Center for Epidemiological Studies Depression Scale (CES-D), which was scored from 0 to 10 with higher scores indicative of higher number of depressive symptoms (Rajan et al., 2014).

### *Statistical Analysis*

The descriptive measures were computed using mean and standard deviation for continuous variables and percentages for categorical variables. To test our hypothesis, we used a regression-based approach with a main effect for baseline performance attendance score and an interaction of baseline performance attendance score with time since baseline to examine cognitive decline process. Our hypothesis is that as the frequency of attendance increased, the baseline association with cognitive function score (from main effect) and the rate of cognitive decline (from the interaction term) will both decrease in magnitude. Our regression model was adjusted for demographic variables—age (centered at 75), male sex, and AA race/ethnicity, as well as education (centered at 12)—and health variables—physical function, depressive symptoms, and engagement. A linear mixed effects regression model with random intercepts, random slopes, and fixed effects for frequency of musical attendance, and an interaction of this term with time since baseline that also included demographic, health, and lifestyle confounders were fitted in SAS program (SAS, 2011).

### **Results**

The study sample consisted of 5,567 participants who provided frequency of concert, musical, or play attendance and had one or more follow-up interviews, each about 3 years apart. The average length of follow-up was about 6.1 years ( $SD = 2.3$  years), which was slightly higher among AAs than EAs (6.2 vs. 5.9;  $p = .004$ ). Of the 5,567 participants, 1,463 (26%) never attended any performances in the last year, 2,141 (38%) attended less than 10 performances per year, and 1,963 (36%) attended more than 10 performances per year.

**Table 1.** Demographic and Health Characteristics of 5,567 Participants From a Biracial Sample.

	All participants	African Americans	European Americans
	M (SD)	M (SD)	M (SD)
Age, years	73.6 (6.7)	72.6 (6.2)	75.4 (7.4)
Education, years	12.7 (3.4)	11.9 (3.3)	14.3 (3.2)
Composite cognition	0.359 (0.690)	0.223 (0.689)	0.625 (0.611)
Perceptual speed	0.438 (0.896)	0.203 (0.836)	0.895 (0.830)
Episodic memory	0.379 (0.804)	0.274 (0.816)	0.584 (0.740)
MMSE	0.300 (0.634)	0.195 (0.679)	0.504 (0.475)
Physical function	10.4 (3.6)	10.0 (3.6)	11.2 (3.5)
Social engagement	2.5 (1.7)	2.4 (1.6)	2.7 (1.7)
Depressive symptoms	1.4 (1.9)	1.7 (2.0)	0.9 (1.4)
	n, %	n, %	n, %
Frequency of attendance			
Never	1,463, 26	1,228, 33	235, 12
<10 per year	2,141, 38	1,462, 40	679, 36
≥10 per year	1,963, 36	992, 27	971, 51
Females, %	3,547, 64	2,350, 64	1,197, 64

Note. Cognitive function measured in standard deviation units (SDU). MMSE=Mini-mental state examination.

Demographic and cognitive characteristics of 5,567 AAs and EAs are shown in Table 1. In general, AAs were younger by about 3 years, had less education, and lower composite cognitive function and individual tests of cognition compared with EAs. Frequency of arts attendance was different between EAs and AAs—about 25% higher proportion of EAs had attended 10 or more performances per year compared with AAs ( $p < .001$ ), and about 20% higher proportion of AAs had never attended a performance compared with EAs ( $p < .001$ ).

### *Association of Attendance and Composite Cognitive Function*

Using a linear mixed model, we examined the association of frequency of attendance in live performances with composite cognitive function among AAs and EAs after adjusting for demographic and health confounders (Table 2). In general, attendance was not associated with higher composite cognitive

**Table 2.** Parameter Estimates of Average Levels of Cognition and Change in Cognitive Function Among African Americans and European Americans, by Frequency of Arts Attendance.

Frequency of arts attendance	African Americans	European Americans
	Coefficient (SE)	Coefficient (SE)
<b>Baseline</b>		
Average level (Never)	0.192 (0.018)**	0.279 (0.032)**
Change in level (<10 per year)	0.057 (0.024)*	0.059 (0.038)
Change in level (≥10 per year)	0.025 (0.027)	0.058 (0.039)
<b>Follow-up</b>		
Annual Cog. Dec. (Never)	0.062 (0.003)**	0.061 (0.008)**
Change in CD (<10 per year)	0.012 (0.004)*	0.006 (0.009)
Change in CD (≥10 per year)	0.014 (0.004)**	0.019 (0.008)*

Note. Parameter estimates adjusted for age, sex, education, physical function, social engagement, and depressive symptoms. CD = cognitive decline.

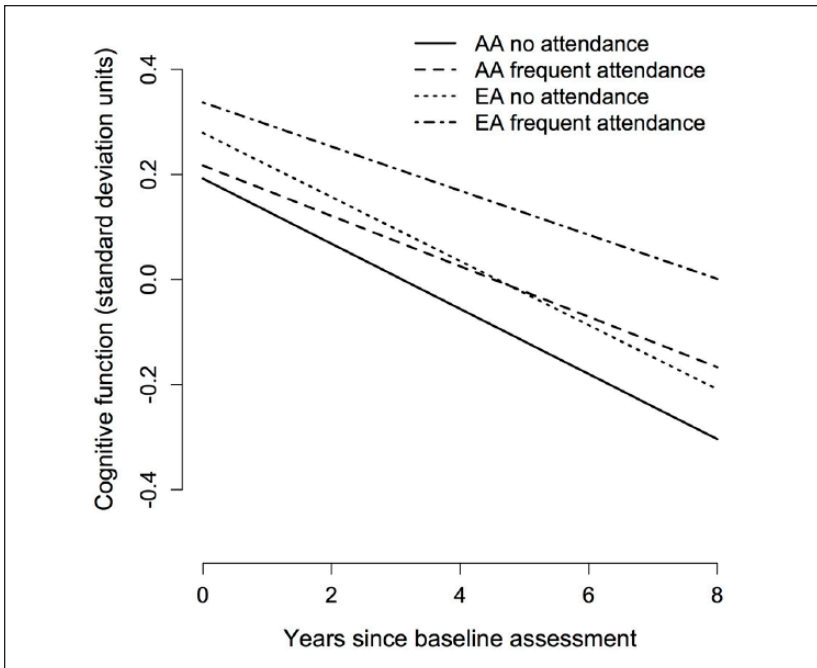
\* $p < .05$ . \*\* $p < .001$ .

function at baseline, with the exception being AAs with frequency less than 10 per year compared with AAs who never attended any performances.

In terms of cognitive decline, among AAs who never attended any performances, cognitive function declined by 0.062 standard deviation units (SDU) per year. For AAs who attended less than 10 arts performances, cognitive decline was slower by 0.012 SDU per year, from 0.062 SDU per year to 0.050 SDU per year, a 19% decrease in cognitive decline compared with AAs who never attend performances. As the attendance increased to 10 or more performances, cognitive function declined by 0.048 SDU units per year, a 23% decrease in cognitive decline compared with AAs who never attend performances. A significant trend in slowing of cognitive decline was observed ( $p = .016$ ).

Among EAs who never attend performances, cognitive function declined by 0.061 SDU per year. For EAs who attended less than 10 performances, no significant slowing of cognitive decline was observed. However, as the number of attendance increased to 10 or more performances, cognitive decline was slower by 0.019 SDU per year, from 0.061 SDU per year to 0.042 SDU per year, a 31% slower decline in composite cognition compared with those who never attended any performances. The difference in cognitive decline between AAs and EAs was not significant for participants who never attended ( $p = .49$ ), attended less than 10 performances ( $p = .57$ ), and attended 10 or more performances ( $p = .56$ ).





**Figure 1.** Eight-year course of change in composite cognitive function by frequency of live performances and race/ethnicity.

Note. Solid line shows cognitive decline in AAs who never attended live performance, dashed line AAs with high frequency of attendance, dotted line EAs who never attended, and dotted and dashed line EAs with high frequency of attendance. AAs = African Americans; EAs = European Americans.

The initial level and change in composite cognitive function for AAs who never attended (solid line) and attended 10 or more (dashed line) performances and EAs who never attended (dotted line) and attended 10 or more (dotted and dashed line) are shown in Figure 1.

### *Association of Attendance and Individual Tests of Cognition*

Because no significant difference between AAs and EAs was observed for frequency of live performance attendance and composite cognitive function, we examined the association of arts attendance with individual tests of cognition in a combined sample (Table 3). Participants who attended fewer than 10 performances had higher levels of episodic memory and MMSE, whereas participants

**Table 3.** Parameter Estimates of Level and Change in Individual Tests of Cognition, by Frequency of Arts Attendance.

Baseline	Perceptual speed	Episodic memory	MMSE
	Coefficient (SE)	Coefficient (SE)	Coefficient (SE)
Baseline			
Average level (Never)	0.516 (0.036)**	0.324 (0.038)**	0.258 (0.031)**
Change in level (<10 per year)	0.015 (0.024)	0.050 (0.025)*	0.065 (0.020)**
Change in level (≥10 per year)	0.067 (0.026)*	0.016 (0.028)	0.027 (0.022)
Follow-up			
Annual CD (Never)	0.069 (0.003)**	0.047 (0.003)**	0.081 (0.004)**
Change in CD (<10 per year)	0.008 (0.003)*	0.011 (0.005)*	0.016 (0.005)*
Change in CD (≥10 per year)	0.007 (0.003)*	0.017 (0.005)*	0.032 (0.004)**

Note. Parameter estimates adjusted for age, sex, education, physical function, social engagement, and depressive symptoms. CD = cognitive decline. MMSE=mini-mental state examination.

\* $p < .05$ . \*\* $p < .001$ .

who attended 10 or more performances had higher levels of perceptual speed, compared with participants who never attended any performances.

Higher attendance in live performances was consistently associated with slower cognitive decline for perceptual speed, episodic memory, and MMSE. A significant trend for frequency of live performance attendance and cognitive decline was also observed for perceptual speed ( $p = .026$ ), episodic memory ( $p = .002$ ), and MMSE ( $p < .0001$ ).

## Discussion

In this article, we examined the association of live performance attendance and cognitive function in a longitudinal sample of older adults. We hypothesized that attending live musical performances would have a positive association with cognitive function after adjusting for demographic and health confounders. While making a significant contribution to the existing literature, our findings suggest an important association between attending a live performance (concert, play, or musical) and a slower decline in composite

and individual tests of cognition. While studies have shown that the act of listening to music has the potential to positively influence cognitive function (Särkämö et al., 2008), our study looked at the broader experience of attending a live performance. This augments the value of listening and responding to the performing arts in various contexts and settings.

The frequency of performance attendance was also a factor that was associated with cognitive decline. For both AAs and EAs, attending more than 10 performances was positively associated with cognitive decline. While researchers have argued for more translational programs that invite active engagement in the arts (Cohen, 2006), our findings demonstrate a need for encouraging more community-based performance activities for older adults that do not necessarily have to require active participation (i.e., making or creating art) and instead encourage the process of responding to live performance experiences.

The racial disparities among those who attended more than 10 performances are also of interest. The benefits of live performance attendance was observed among AAs as well as EAs, even though a much smaller proportion of AAs attended 10 or more performances compared with EAs. The disproportionate attendance rates are of concern, because a smaller proportion of AAs are experiencing performances with cognitive benefits. The reasons for this discrepancy need further investigation but suggest a need for more community involvement to increase attendance in arts-based activities among minorities.

The findings of this study argue for deeper investigations on the associations between attending live performances and the cognitive and social functioning of older adults. Although there is evidence of a positive association between attending a live concert, play, or musical, and a slower cognitive decline among both AAs and EAs, there is also a need for more research to investigate the potential association of continued attendance across races and contexts.

This study provides preliminary evidence regarding the role attending live arts performances has on cognitive function. Several limitations of our study also need to be noted. Participants who frequently attended performances might have better health. Even though our analysis adjusted for demographic and health measures, reverse causation can occur with more participants with better cognition participating more frequently in performances. However, because participants at baseline had cognition intact, and our analysis adjusted for baseline cognitive values, reverse causation is highly unlikely. Live performance measure was based on a single item, which may be less than ideal. Studies with a larger battery of questions on arts participation, particularly arts attendance, are needed to confirm our findings. In addition, our performance question was based on recall, which might be susceptible to recall

bias. To test this, we removed participants below the 10th percentile and reran our analysis. Our sensitivity analysis showed that our findings were not adversely influenced by people with lesser cognitive function after removing 10% of participants with lowest cognition.

The opportunity to attend of live performances may also be closely related to socioeconomic status arguing for greater access to attending arts events for older populations. Our analysis adjusted education that is a strong indicator of socioeconomic status that is highly correlated with income. More mechanistic studies are needed to understand how arts attendance slows cognitive decline process, and future research needs to investigate a more diverse cross-section of older adults. It may be promising for future studies to draw on longitudinal data with additional measurements examining attitudes and experiences of how older adults engage with the arts.

There is growing evidence of the importance of arts-based experiences and interventions in old age as federal agencies continue to promote translational research (see Hanna, Noelker, & Bienvenu, 2014). However, the findings from our study also argue for a greater focus on making live performances accessible for all older adults, both within their own communities and in diverse settings, and exploring the cognitive and social benefits of these experiences on the aging process.

The findings from our study support the value of arts experiences in later life, particularly the cognitive benefits of being in the audience of a live performance. While older adults may find challenges in attending live performances due to limited mobility or physical disabilities, there needs to be greater access for individuals to attend live performances in old age. Live performances at local community and senior centers and low-cost or free performances geared toward older adults may continue to encourage this population to attend live performances, particularly given the potential cognitive benefits.

In conclusion, we argue that engagement with the live performances is mutually beneficial for older adults as well as our aging society. It is plausible that older adults can benefit from engagement with the arts in social, psychological, and physical ways, and we encourage future researchers to further examine the benefits that arts attendance might have on the various aspects of aging. Finally, we advocate for ways that all individuals can remain actively engaged through the arts, may it be through creating, observing, or critiquing art, especially in old age.

### **Declaration of Conflicting Interests**

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## Funding

The authors disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This work was supported by the National Endowment for the Arts (NEA) 15-3800-7012 to R.S.R., and the National Institutes of Health (NIH) Grant R01-AG051635 to K.B.R., and R01-AG11101 to D.A.E.

## References

- Albert, M., Smith, L. A., Scherr, P. A., Taylor, J. O., Evans, D. A., & Funkenstein, H. H. (1991). Use of brief cognitive tests to identify individuals in the community with clinically diagnosed Alzheimer's disease. *International Journal of Neuroscience*, *57*, 167-178.
- Bygren, L. O., Konlaan, B. B., & Johansson, S. E. (1996). Attendance at cultural events, reading books or periodicals, and making music or singing in a choir as determinants for survival: Swedish interview survey of living conditions. *British Medical Journal*, *313*, 1577-1580.
- Carr, D. C. (2006). Music, socializing, performance, and the web of social ties. *Activities, Adaptation & Aging*, *30*(3), 1-24. doi:10.1300/J016v30n03\_01
- Carr, D. C., Wellin, C., & Reece, H. (2009). A review of arts and aging research: Revealing an elusive but promising direction for the era of the third age. *Journal of Aging, Humanities, and the Arts*, *3*, 199-221.
- Coffman, D. D. (2002). Music and quality of life in older adults. *Psychomusicology*, *18*, 76-88.
- Cohen, G. D. (2000). *The creative age*. New York, NY: Avon Books
- Cohen, G. D. (2006). Research on creativity and aging: The positive impact of the arts on health and illness. *Generations*, *30*(1), 7-15.
- Cohen, G. D., Perlstein, S., Chapline, J., Kelly, J., Firth, K. M., & Simmens, S. (2006). The impact of professionally conducted cultural programs on the physical health, mental health, and social functioning of older adults. *The Gerontologist*, *46*, 726-734.
- de Medeiros, K., & Basting, A. (2014). "Shall I compare thee to a dose of donepezil?" Cultural arts interventions in dementia care research. *The Gerontologist*, *54*, 344-353. doi:10.1093/geront/gnt055
- Folstein, M. F., Folstein, S. E., & McHugh, T. R. (1975). "Mini-mental state." A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research*, *12*, 189-198.
- Gregory, D. (2002). Music listening for maintaining attention of older adults with cognitive impairments. *Journal of Music Therapy*, *39*, 244-264.
- Guralnik, J. M., Ferrucci, L., Pieper, C. F., Leveille, S. G., Markides, K. S., Ostir, G. V., . . . Wallace, R. B. (2000). Lower extremity function and subsequent disability: Consistency across studies, predictive models, and value of gait speed alone compared with the short physical performance battery. *The Journals of Gerontology, Series A: Biological Sciences & Medical Science*, *55*, M221-M231.

- Hanna, G. P., Noelker, L. S., & Bienvenu, B. (2014). The arts, health, and aging in America: 2005-2015. *The Gerontologist, 55*, 271-277.
- Hars, M., Herrmann, F. R., Gold, G., Rizzoli, R., & Trombetti, A. (2013). Effect of music-based multitask training on cognition and mood in older adults. *Age Ageing, 43*, 196-200.
- Hoffman, D. H., Greenberg, P., & Fitzner, D. H. (1980). *Lifelong learning and the visual arts: A book of readings*. Reston, VA: National Art Education Association.
- Kinney, J. M., & Rentz, C. A. (2005). Observed well-being among individuals with dementia: Memories in the Making, an art program, versus other structured activity. *American Journal of Alzheimer's Disease & Other Dementias, 20*, 220-227.
- Laukka, P. (2007). Uses of music and psychological well-being among the elderly. *Journal of Happiness Studies, 8*, 215-241.
- Lesiuk, T. (2005). The effect of music listening on work performance. *Psychology of Music, 33*, 173-191.
- Maclean, L. M., Brown, L. J., & Astell, A. J. (2014). The effect of rhythmic musical training on healthy older adults' gait and cognitive function. *The Gerontologist, 54*, 624-633.
- Mendes de Leon, C. F., & Rajan, K. B. (2014). Psychosocial influences in onset and progression of late life disability. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 69*, 287-302.
- National Endowment for the Arts. (2015). *A decade of arts engagement: Findings from the Survey of Public Participation in the Arts, 2002-2012*. Retrieved from <https://www.arts.gov/sites/default/files/2012-sppa-jan2015-rev.pdf>
- Noice, H., & Noice, T. (2006). What studies of actors and acting can tell us about memory and cognitive functioning. *Current Directions in Psychological Science, 15*, 14-18.
- Rajan, K. B., Wilson, R. S., Skarupski, S. A., Mendes de Leon, C. F., & Evans, D. (2014). Gene-behavior interaction of depressive symptoms and the apolipoprotein E4 allele on cognitive decline. *Psychosomatic Medicine, 76*, 101-108.
- Särkämö, T., Tervaniemi, M., Laitinen, S., Forsblom, A., Soynila, S., Mikkonen, M., . . . Hietanen, M. (2008). Music listening enhances cognitive recovery and mood after middle cerebral artery stroke. *Brain, 131*(1), 866-876.
- SAS Institute Inc. (2011). *SAS 9.4 Help and Documentation*. Cary, NC: SAS Institute Inc.
- Smith, A. (1982). *Symbol Digit Modalities Test Manual—Revised*. Los Angeles, CA: Western Psychological.
- Tolladay, M. (2006, May-June). Older-adult theatre promotes active aging. *The Journal on Active Aging, 3*, 30-32.
- Wilson, R. S., Aggarwal, N. T., Barnes, L. L., Mendes de Leon, C. F., Hebert, L. E., & Evans, D. A. (2010). Cognitive decline in incident Alzheimer disease in a community population. *Neurology, 74*, 951-955.