

# Relationships Between Traditional Music Audience Participation And Pro-Social Behaviors

Donald J. Polzella & Jeremy S. Forbis

University of Dayton

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# 12-3800-7012.

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.



*Brief Reports*

**RELATIONSHIPS BETWEEN TRADITIONAL  
MUSIC AUDIENCE PARTICIPATION AND  
PRO-SOCIAL BEHAVIORS\***

**DONALD J. POLZELLA**

**JEREMY S. FORBIS**

*University of Dayton, Ohio*

**ABSTRACT**

In order to investigate the relationship between music audience participation and pro-social behaviors, this study analyzed data from 6239 households who took part in the 2008 U.S. Department of Commerce Current Population Survey: Participation in the Arts Supplement. The data were analyzed using logistic regression, in which three specific pro-social behaviors (i.e., voting in the most recent presidential election, making charitable donations or volunteering time, and attending community meetings) were regressed on participation in music (i.e., attending classical, jazz, or opera music concerts). After controlling for the effects of age, race, sex, income, education, marital status, and occupation class, it was found that the likelihood of pro-social behaviors was greater with increases in music concert attendance.

Research has shown that participation in the arts is associated with a higher degree of intellectual aptitude or achievement (Corrigall & Trainor, 2011; Moreno, Bialystok, Barac, Schellenberg, Cepeda, & Chau, 2011; Schellenberg, 2004, 2011a, 2011b; Schellenberg & Mankarious, 2012; Winner & Hetland, 2000; Winner, Hetland, Veenema, Sheridan, & Palmer, 2006). In addition, interdisciplinary studies in cognitive neuroscience have advanced our understanding of

\*This research was supported by National Endowment for the Arts Grant # 12-3800-7012.

the biological processes that underlie these relationships (Hardiman, Magsamen, McKhann, & Eilber, 2009; Marcus, 2012; Peretz & Zatorre, 2003; Zatorre, 2005). Studies such as these have bolstered arguments by arts advocates for the beneficial effects that result from participating in the arts. A report by McCarthy et al. (2004), for example, provides a useful framework that classifies these benefits as *instrumental* (public) or *intrinsic* (private). Instrumental benefits, such as improved test scores or economic indicators, have received the most attention, but intrinsic benefits, such as captivation and pleasure (private) or the creation of social bonds and other forms of communal expression (public), have also been reported.

A useful strategy for understanding the intrinsic benefits of the arts is to explore its effects on audience members rather than on artists or performers. A good example is the Major University Presenters Value & Impact Study, which was commissioned in 2005 by a consortium of 14 major university performing arts presenters (Brown & Novak, 2007). Employing a survey methodology, the study addressed fundamental questions regarding the intrinsic impacts that result from witnessing live performing arts programs. Data were collected from 19 music, dance, and theater performances. Three hypotheses were tested:

1. the intrinsic impact of a live performance can be measured;
2. the intrinsic impact varies by type of performance; and
3. the intrinsic impact is affected by audience readiness or expectation.

Intrinsic impact was measured along multiple dimensions such as captivation, intellectual stimulation, spiritual value, aesthetic growth, and social bonding. Readiness included such dimensions as prior knowledge, comfort level, and anticipation. Although there was strong support for the first two hypotheses, the third hypothesis was not supported. One dimension of readiness, audience anticipation, was the strongest predictor of captivation, and captivation, in turn, was a precursor to the full range of impacts.

A recent report commissioned by the National Endowment for the Arts (NEA) (Medvedeva, Novak-Leonard, & Brown, 2012) provides a comprehensive review of the literature assessing the intrinsic impacts of arts events. The report helps to clarify these impacts by organizing the literature into three categories. The first category consists of the constructs that have been measured. These include, for example, happiness and affect, engagement, experienced utility, rewards and efforts, physiological correlates, attendance, participation, and creation. The second category consists of commonly used measures of affect, happiness, and well-being, which were obtained from surveys or other qualitative methodologies. The principal focus has been on social well-being, as measured by public activities, interactions with people, values, aspirations, and social institutions and agencies. The third category includes studies that address impact opportunities, particularly those afforded by museums and exhibitions.

Of particular interest for the present study is the second category (i.e., the impact of participation in the arts on social well-being). More specifically, we

have addressed the following question: What is the relationship between participation in the arts and pro-social civic engagement?

## METHOD

### Database

To answer the above question, we analyzed a portion of the data collected as part of the Current Population Survey (CPS) (<http://www.census.gov/cps/>). The CPS, managed jointly by the U.S. Census Bureau and the U.S. Bureau of Labor Statistics, is the principal source of high-profile economic statistics as well as extensive demographic data and behavioral information which, together, provide a comprehensive understanding of labor market conditions in the nation. The CPS is administered monthly to a random sample of 57,000 individuals. It has its origins in the 1930s, when it was used as a means of tracking unemployment during the Great Depression. It has been updated numerous times since then in order to account for significant changes in the national economy.

In certain years, the CPS has included a Public Participation in the Arts supplemental survey. These supplemental surveys are sponsored by the NEA and include items that measure the household member's participation in various artistic activities, for example, frequency of participation, training and exposure, musical and artistic preferences, length of travel for trips to artistic events, school-age socialization, and computer usage related to artistic information.

### Participants

Participants for this study were household members who took part in the *Current Population Survey, May 2008: Public Participation in the Arts Supplement* (U.S. Department of Commerce, Bureau of Census, U.S. Department of Labor, Bureau of Labor Statistics, & National Endowment for the Arts, 2011). Along with the questions normally included in the CPS, this survey also included multiple questions regarding the respondents' participation in various artistic activities between May 1, 2007 and May 1, 2008. The sample comprised 6239 respondents, 3178 males and 3061 females (mean age = 42.86,  $SD = 13.54$ ).

### Data Analysis

Due to the large quantity of data, we restricted our analyses to participation in three types of music, defined as "traditional" by the National Endowment for the Arts (2010): classical, jazz, and opera. The data were analyzed using logistic regression, where three specific pro-social behaviors (considered as the criterion variables) were regressed on participation in music (considered as the predictor variable). The three criterion variables were:

1. voting in the most recent presidential election;
2. making charitable donations or volunteering time; and
3. attending community meetings.

All variables were assigned binary values, such that 1 = *observed* and 0 = *not observed*.

The regression model also included seven control variables, which are known to predict civic engagement. These were: Age, Race, Sex, Income, Education, Marital Status, and Occupation Class. To measure occupational class, we used a conventional six-category scheme (Goldthorpe, 1987; Hout, 1989; Manza, Hout, & Brooks, 1995):

1. business owners and proprietors (including farm owners and the self-employed);
2. managers and administrators;
3. professional and technical workers;
4. clerical workers;
5. skilled and unskilled laborers; and
6. service workers.

To test for occupational class, we created a binary “class gap” measure that contrasted non-working class individuals (those in the first three categories) with working class individuals (those in the last three categories). We included the working class occupations in our analyses and used the non-working class occupations as a reference group of individuals who possess a relatively greater degree of capital autonomy or authority.

The regression model can be stated formally as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k + e,$$

where  $Y$  represents the binary pro-social behavior to be predicted,  $X_1, X_2 \dots X_k$  are the predictor variables,  $\beta_0$  is the intercept,  $\beta_1, \beta_2 \dots \beta_k$ , are the slope coefficients, and  $e$  is the random error.

## RESULTS

Appendix A describes how each variable was measured, and Table 1 provides summary statistics for these variables. We applied logistic regression models to the data in order to analyze the relationship between traditional musical attendance and each of the pro-social civic engagement variables. We set a high threshold for significance in order to reduce the probability of a Type-1 error. The results of each analysis are summarized in Table 2.

Model 1 assessed the relationship between traditional music attendance and presidential voting turnout for the 2004 election. Holding all other variables constant, those who attended a greater number of music performances over the

Table 1. Descriptive Statistics ( $N = 6239$ )

Variable	Mean	<i>SD</i>
Age	42.86	13.54
Income	11.69	3.47
Education	10.65	2.54
	Percent	
Gender (female)	49.08%	
Race (Black)	7.94	
Race (Other)	5.42	
Marital status (married)	60.84	
Class (clerical)	13.38	
Class (labor)	20.89	
Class (service)	15.76	
Vote in 2004 presidential election	68.97	
Volunteer or charitable donation	38.48	
Attend community meetings	34.51	
Classical musical attendance	11.51	
Jazz attendance	10.88	
Opera attendance	2.68	
Combined music attendance	25.07	

course of that year had a greater likelihood of voting by a factor of 1.59 ( $p < .001$ ). Consistent with prior research (Leighley & Nagler, 1992; Manza et al., 1995), age, education, and income were predictive also of voting turnout, as was race. While white and black turnout did not differ (cf. Taylor, 2012), the turnout for other races was significantly less than white turnout. This supports previous findings (Hill & Leighley, 1999), although it is important to note that the other races category is heterogeneous and of low observed frequency. As the table shows, music attendance was a strong predictor of voter turnout, lending support to the general hypothesis that music attendance predicts pro-social behavior.

Model 2 assessed the relationship between traditional music attendance and volunteering or charitable contributing. Holding all other variables constant, those who attended a greater number of music performances over the course of the year had a greater likelihood of volunteering or contributing by a factor of 2.01 ( $p < .001$ ). In other words, individuals who attended jazz, opera, or classical

Table 2. Logistic Regression Models of Civic Engagement Using Music Attendance, Odds Ratios (standard errors)

	Civic Engagement Variables		
	Vote Yes Model 1	Volunteer Yes Model 2	Community Yes Model 3
Music attendance	1.598** (0.112)	2.011** (0.105)	2.116** (0.110)
Age (50+)	2.432** (0.165)	1.032 (0.060)	1.169 (0.070)
Female	1.020 (0.067)	1.249** (0.074)	1.122 (0.068)
Black	1.077 (0.115)	0.993 (0.105)	0.949 (0.105)
Other race	0.314** (0.039)	0.755 (0.094)	0.659* (0.087)
College grad	2.262** (0.180)	1.500** (0.098)	1.557** (0.103)
Income (60k+)	1.595 (0.111)	1.538** (0.094)	1.446** (0.091)
Married	1.592** (0.099)	1.122* (0.074)	1.342** (0.084)
Clerical	1.017 (0.099)	0.882 (0.076)	0.793 (0.071)
Labor	0.490** (0.041)	0.533** (0.045)	0.537** (0.047)
Service	0.495** (0.042)	0.676** (0.058)	0.603** (0.055)
Constant	1.142 (0.093)	0.366** (0.028)	0.033** (0.007)
<i>N</i>	6239	6239	6239

\* $p < .005$ ; \*\* $p < .001$ .

concerts were twice as likely to volunteer or contribute as those who did not attend concerts.

Model 3 assessed the relationship between traditional music attendance and participation in community activities. In this case, those who attended a greater number of music performances over the course of the year had a greater likelihood of volunteering or contributing by a factor of 2.11 ( $p < .001$ ). Other theoretically important variables, including age, education, income, and the non-autonomous occupational categories, remained significant predictors of community participation.

Finally, we used logistic regression to analyze the data for each type of music separately, while controlling for the other predictor variables. These results, which are summarized in Table 3, parallel those shown in Table 2. For example, those who attended a classical music performance over the course of the year had a greater likelihood of voting by a factor of 1.73, a greater likelihood of volunteering by a factor 2.82, and a greater likelihood of participating in community activities by a factor of 2.96 (all  $ps < .001$ ). The findings for those who attended a jazz performance and for those who attended an opera performance followed the same pattern.

Taken together, these results demonstrate that traditional music attendance is strongly predictive of certain pro-social behaviors, even when the contribution of other known predictors is controlled for. Across all models in both tables, music attendance remains robust and significant with an average odds likelihood ratio of 1.91.

Table 3. Logistic Regression Models of Civic Engagement Using Music Attendance Type, Odds Ratios (standard errors)

	Civic engagement variables		
	Vote Yes	Volunteer Yes	Community Yes
Classical	1.732** (0.207)	2.825** (0.251)	2.964** (0.261)
Jazz	2.145** (0.260)	2.467** (0.218)	3.054** (0.272)
Opera	1.646 (0.395)	2.353** (0.410)	1.626* (0.269)
<i>N</i>	6239	6239	6239

\* $p < .005$ ; \*\* $p < .001$ .

## DISCUSSION

It is clear from previous studies that experiences in or with the arts, especially music, are associated with a higher degree intellectual aptitude or achievement. Our study broadens these findings, indicating that experiencing music as an audience member is also associated with a greater likelihood of exhibiting certain pro-social behaviors. But how plausible is the notion that experiencing music as an audience member *leads to* pro-social behavior, either directly or indirectly? Unfortunately, the pertinent literature is not conclusive.

Previous empirical findings show that collective experiences in the performing arts can exert powerful effects on participants. Furthermore, it is apparent that these effects are varied and far-reaching. Bygren, Konlaan, and Johansson (1996) interviewed a random sample of over 12,000 Swedish adults aged 16-74 years in order to investigate the possible influence of attendance at cultural events, reading books or periodicals, and making music or singing in a choir on survival. After controlling for eight confounding variables—age, sex, education level, income, long-term disease, social network, smoking, and physical exercise—the investigators found a difference in mortality between people who rarely attended events compared to those attending most often. The investigators hypothesized that attendance may elicit emotional states that affect immunoregulatory mechanisms.

Based on responses from a nationally representative sample of 13,000 high school seniors, Youniss, McLellan, Su, and Yates (1999) found that high school students who had participated in organized performing arts activities (e.g., acting in plays or musical performances), were inclined to engage, either presently or in the future, in various pro-social political behaviors (e.g., voting, working on a political campaign, contributing money to a political candidate, or writing a letter to an office holder). In contrast, those who had participated in organized activities classified as “fun” (e.g., going to parties, rock concerts, or visiting friends), showed no such inclination.

Kwak, Shah, and Holbert (2004) analyzed data from Doyle Dane Bernbach Life Styles Study (DDB, 1997), an annual standing-panel mail survey of approximately 5000 adult Americans. The analysis focused on the interactive relationships between different types of social activities (e.g., informal socializing, visiting an art gallery or museum, religious participation, and generalized interpersonal trust). The investigators found that each type of activity contributed strongly to pro-social civic engagement, particularly when the activity also increased interpersonal trust. The investigators suggested that generalized trust may act as a “civic catalyst.”

More recently, Larsen et al. (2012) conducted an anonymous survey to assess the impact of a piano concert series and jazz reception program organized at the New York University College of Dentistry. Faculty, staff, and students responded to questions relating to stress and relaxation, productivity and performance, the music itself, the venue, and feelings of identity with the academic community.

The results were overwhelmingly positive, and the investigators concluded that concert audience participation has significant benefits for work-life balance. That the assessment was conducted 3 to 4 years following the concerts suggests that such benefits persist.

The present study extends these findings by showing that exposure to “traditional” music in a concert setting predicts certain types of pro-social behavior. However, an important question remains unanswered, involving the relative impacts of listening to the music versus being part of an audience. We know that psychological responses to music and other arts vary as a function of personality and preference (Ladinig & Schellenberg, 2012; Nantais & Schellenberg, 1999; Silvia & Nusbaum, 2011). We know also that listening to music activates autonomic, subcortical, and cortical systems in a manner similar to other emotional stimuli (Trainor & Schmidt, 2003), and can affect various types of human performance (Angel, Polzella, & Elvers, 2010; Polzella & Schoeling, 2004). In turn, it is also clear that groups exert powerful effects on its members (Hackman & Katz, 2010), suggesting that being part of an audience might be key. However, there are no studies to date that permit a comparison of the relative impact of music exposure versus being part of an audience, nor are there studies that address the question of whether these two variables interact and, if so, to what degree. An experimental study is required to address both questions.

#### **APPENDIX A: Measurement of Variables**

**Voting Turnout** was measured as a dummy variable (1 = yes; 0 = no) based on the question: “Which of the following statements best describes you: . . . I am sure I voted.”

**Volunteer/Charitable Donation** was measured as a dummy variable (1 = yes; 0 = no) based on the question: “During the last 12 months, did . . . do any volunteer or charity work?”

**Community** was measured as a dummy variable (1 = yes; 0 = no) based on the question: “During the last 12 months, did . . . participate in any community activities, meetings, or events?”

**Classical** was measured as a dummy variable (1 = Yes; 0 = No) for the following CPS question: “With the exception of elementary or high school performances, Did . . . go to a live classical music performance such as symphony, chamber, or choral music during the last 12 months?”

**Jazz** was measured as a dummy variable (1 = Yes; 0 = No) for the following CPS question: “With the exception of elementary or high school performances, Did . . . go to a live jazz during the last 12 months?”

**Opera** was measured as a dummy variable (1 = Yes; 0 = No) for the following CPS question: “With the exception of elementary or high school performances, Did ... go to a live opera during the last 12 months?”

**Music Attendance** was measured as a count variable of the sum of positive responses to classical, jazz, and opera performances.

**Age** was measured in years. Recoded to 50+ year dummy variable for analysis.

**Household Income** was measured in thousands of dollars ranging from low (\$1 to \$21) to high (over \$21).

**Education** was based on the number of years of schooling.

**College Grad** recoded from Education (1 = Bachelor degree or higher; 0 = No).

**Gender** was recoded into a dummy variable for Female (1 = Yes; 0 = No).

**Race** was recoded from a multi-response nominal variable into a dummy variable for Black (1 = yes; 0 = no), and Other (1 = yes; 0 = no).

**Marital Status** was recoded into a dummy variable for Married (1 = Yes; 0 = No).

**Class Position** was coded as a series of dummy variables (1 = yes; 0 = no) based on the occupational codes cited in the text, i.e., Business: Proprietors and all self-employed workers; Managers: All managers; Professional and technical: Professional and technical workers, high level sales workers and protective service workers; Labor: All manual workers; Clerical and Sales Workers: All clerical and sales workers (except high level sales); Service Workers: All service workers (except protective service).

## REFERENCES

- Angel, L. A., Polzella, D. J., & Elvers, G. C. (2010). Background music and cognitive performance. *Perceptual and Motor Skills, 110*, 1059-1064.
- Brown, A. S., & Novak, J. L. (2007). *Assessing the intrinsic impacts of a live performance*. Fairfield, CT: WolfBrown.
- 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 Journal of Medicine, 313*, 1577-1580.
- Corrigall, K. A., & Trainor, L. J. (2011). Associations between length of music training and reading skills in children. *Music Perception, 29*, 147-155.
- DDB Needham Life Styles Study*. (1997). Chicago, IL: DDB Needham Worldwide.
- Goldthorpe, J. H. (1987). *Social mobility and class structure in modern Britain* (2nd ed.). Oxford, UK: Clarendon Press.

- Hackman, J. R., & Katz, N. (2010). Group behavior and performance. In S. T. Fiske, D. T. Gilbert, & G. Lindzey (Eds.), *Handbook of social psychology* (Vol. 2, 5th ed., pp. 1208-1251). Hoboken, NJ: John Wiley & Sons, Inc.
- Hardiman, M., Magsamen, S., McKhann, G., & Eilber, J. (2009). *Neuroeducation: Learning, arts, and the brain: Findings and challenges for educators and researchers from the 2009 Johns Hopkins University Summit*. New York, NY: Dana Press.
- Hill, K. Q., & Leighley, J. E. (1999). Racial diversity, voter turnout, and mobilizing institutions in the United States. *American Politics Research*, 27, 275-295.
- Hout, M. (1989). *Following in father's footsteps: Social mobility in Ireland*. Cambridge, MA: Harvard University Press.
- Kwak, N., Shah, D. V., & Holbert, R. L. (2004). Connecting, trusting, and participating: The direct and interactive effects of social associations. *Political Research Quarterly*, 57, 643-652.
- Ladinig, O., & Schellenberg, E. G. (2012). Effects of felt emotion and individual differences. *Psychology of Aesthetics, Creativity, and the Arts*, 6, 146-154.
- Larsen, C. D., Larsen, M., Larsen, M. D., Im, C., Moursi, A. M., & Nonken, M. (2012). Impact of an interdisciplinary concert series on stress and work-life balance in a dental college. *Music and Medicine*, 4, 177-187.
- Leighley, J. E., & Nagler, J. (1992). Socioeconomic class bias in turnout, 1964-1988: The voters remain the same. *The American Political Science Review*, 86, 725-736.
- Manza, J., Hout, M., & Brooks, C. (1995). Class voting in capitalist democracies since World War II: Dealignment, realignment, or trendless fluctuation? *Annual Review of Sociology*, 21, 137-162.
- Marcus, G. F. (2012). Musicality: Instinct or acquired skill? *Topics in Cognitive Science*, 4, 498-512.
- McCarthy, K. F., Ondaatje, E. H., Zakaras, L., & Brooks, A. (2004). *Gifts of the muse: Reframing the debate about the benefit of the arts*. Santa Monica, CA: RAND Corporation.
- Medvedeva, M., Novak-Leonard, J., & Brown, A. (2012). *Audience impact study: Literature review*. Washington, DC: National Endowment for the Arts.
- Moreno, S., Bialystok, E., Barac, R., Schellenberg, E. G., Cepeda, N. J., & Chau, T. (2011). Short-term music training enhances verbal intelligence and executive function. *Psychological Science*, 22, 1425-1433.
- Nantais, K. M., & Schellenberg, E. G. (1999). The Mozart effect: An artifact of preference. *Psychological Science*, 10, 370-373.
- National Endowment for the Arts. (2010). *Art works for America (Strategic Plan 2012-2016)*. Washington, DC: National Endowment for the Arts.
- Peretz, I., & Zatorre, R. J. (Eds.). (2003). *The cognitive neuroscience of music*. New York, NY: Oxford University Press.
- Polzella, D. J., & Schoeling, S. (2004, November). *Effects of familiar background music on working memory and motor tracking*. Poster session presented at the meeting of the Psychonomic Society, Minneapolis, MN.
- Schellenberg, E. G. (2004). Music lessons enhance IQ. *Psychological Science*, 14, 511-514.
- Schellenberg, E. G. (2011a). Examining the association between music lessons and intelligence. *British Journal of Psychology*, 102, 283-302.
- Schellenberg, E. G. (2011b). Music lessons, emotional intelligence, and IQ. *Music Perception*, 29, 185-194.

- Schellenberg, E. G., & Mankarious, M. (2012). Music training and emotional comprehension in childhood. *Emotion, 12*, 887-891.
- Silvia, P. J., & Nusbaum, E. C. (2011). On personality and piloerection: Individual differences in aesthetic chills and other unusual aesthetic experiences. *Psychology of Aesthetics, Creativity, and the Arts, 5*, 208-214.
- Taylor, P. (2012, December 26). *The growing electoral clout of blacks is driven by turnout, not demographics*. Pew Social & Demographic trends. Retrieved October 3, 2013, from [http://www.pewsocialtrends.org/files/2013/01/2012\\_Black\\_Voter\\_Project\\_revised\\_1-.pdf](http://www.pewsocialtrends.org/files/2013/01/2012_Black_Voter_Project_revised_1-.pdf)
- Trainor, L. J., & Schmidt, L. A. (2003). Processing emotions induced by music. In I. Peretz & R. Zatorre (Eds.), *The cognitive neuroscience of music* (pp. 311-324). New York, NY: Oxford University Press.
- U.S. Department of Commerce. Bureau of Census, U.S. Department of Labor, Bureau of Labor Statistics, & National Endowment for the Arts. (2011). *Current Population Survey, May 2008: Public Participation in the Arts Supplement*. (doi: 10.3886/ICPSR29641.v1). Ann Arbor, MI: Inter-university Consortium for Political and Social Research [distributor], 2011-04-15.
- Winner, E., & Hetland, L. (Eds.). (2000). The arts and academic achievement: What the evidence shows. *Journal of Aesthetic Education, 34*(3/4), 2-307.
- Winner, E., Hetland, L., Veenema, S., Sheridan, K., & Palmer, P. (2006). *New directions in aesthetics* (pp. 189-205). P. Locher, C. Martindale, & L. Dorfman (Eds.). Amityville, NY: Baywood.
- Youniss, J., McLellan, J. A., Su, Y., & Yates, M. (1999). The role of community service in identity development: Normative, unconventional, and deviant orientations. *Journal of Adolescent Research, 14*, 248-261.
- Zatorre, R. (2005). Music, the food of neuroscience? *Nature, 434*, 312-315.

Direct reprint requests to:

Donald J. Polzella  
College of Arts and Sciences  
University of Dayton  
300 College Park  
Dayton, OH 45469-0800  
e-mail: polzella@udayton.edu