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Personality and hearing acuity: Evidence from the Health and Retirement Study and the English Longitudinal Study of Ageing.

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Abstract

Objective.—Several determinants of age-related hearing impairment have been identified, but little is known about the predictive value of psychological factors. The present study examined whether five-factor model personality traits are prospectively associated with hearing acuity in middle-aged and older adults.

Methods.—Participants were adults aged 50 to 97 years (N> 10,000) drawn from the Health and Retirement Study (HRS, 2012-2016) and the English Longitudinal Study of Ageing (ELSA, 2010-2014). In each sample, personality, demographic factors, health-related behaviors, BMI, and memory function were assessed at baseline and objective hearing acuity was measured four years later.

Results.—In both samples, higher conscientiousness and openness were associated with better hearing acuity and lower risk of impairment, whereas neuroticism was associated with a higher risk of hearing impairment. In the HRS and ELSA respectively, 1 SD higher conscientiousness and openness and 1 SD lower neuroticism were related to a 13-10%, 8-6%, and 10-13% lower likelihood of hearing impairment, respectively. In both samples, additional analyses revealed that physical activity and memory mediated the association between personality and hearing.

Conclusions.—The present study provides robust evidence for an association between personality traits and hearing function. The findings broaden knowledge on risk and mitigating factors for age-related hearing impairment, which has implications for the quality of life of middle-aged and older adults.

Keywords

Personality; hearing acuity; impairment; longitudinal

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Hearing impairment is a leading cause of years lived with disability (1,2) and has pervasive effects on social activities (3), isolation (4), loneliness (5), and depressive symptoms (6). Furthermore, hearing loss is related to negative health-related outcomes, including poorer physical functioning (7), cognitive impairment (8), higher risk of incident dementia (9) and mortality (10). Past research has identified a range of risk factors for loss of hearing with age and hearing impairment, from biological to environmental factors (11–13). However, little is known about the role of psychological factors. Therefore, the present study aims to extend existing knowledge by examining whether personality traits are related to hearing acuity.

Personality traits have been implicated in a number of health-related outcomes (14). Among the traits defined by the Five Factor Model (FFM) of personality (15), neuroticism, which refers to a propensity to experience negative emotions and distress, and conscientiousness, which refers to a tendency to be organized and self-disciplined, are consistently related to a range of health indicators. Indeed, high neuroticism and low conscientiousness are related to biological dysfunction (16,17), frailty (18,19), sleeping difficulties (20), cognitive decline (21, 22), dementia (23,24) and higher mortality risk (25, 26). Both traits may also predict individual differences in hearing function, given that neuroticism and conscientiousness are associated with several risk factors for hearing impairment. Higher neuroticism and lower conscientiousness, for example, are associated with smoking (27), alcohol (28) and higher adiposity (29,30), which have been found to increase the risk of hearing loss (11, 31). In addition, these two personality traits are related to lower cognitive functioning (21), which is associated with age-related hearing impairment (32, 33). Finally, high neuroticism and low conscientiousness are associated with worse cardiorespiratory fitness (34) and lower physical activity level (35, 36). In turn, higher physical activity has been found to be protective against hearing loss in prospective research (37). Although the exact biological mechanisms remain unclear, these mediators are hypothesized to relate to hearing loss in part through vascular mechanisms (37–43). Alteration of neurotransmission of auditory stimuli have also been suggested as a potential explanation for these associations (44, 45).

The association between personality traits and hearing acuity, however, has received limited attention. One recent study found that higher neuroticism and lower extraversion, openness, agreeableness and conscientiousness were related to declines in self-reported hearing over time (46). Although promising, there are concerns that self-reports over or under estimate deficits and may also lack sensitivity to detect hearing impairment among older adults (47,48). No research has yet tested whether personality traits predict hearing acuity assessed using objective measures.

Using two large longitudinal samples from the USA and England, the present study examined the prospective relationship between personality and hearing acuity. Building upon evidence for the health correlates of neuroticism and conscientiousness (16–26), it was hypothesized that high neuroticism and low conscientiousness would be associated with lower hearing acuity and higher risk of hearing impairment. Additional analysis were conducted to test the extent to which alcohol, smoking, physical activity, BMI and cognition mediated the association between personality and hearing in both samples.

Method

Participants

Participants were drawn from the Health and Retirement Study (HRS) and the English Longitudinal Study of Ageing (ELSA). In each sample, personality and demographic factors were available at baseline and an objective assessment of hearing was obtained four years later. All participants provided informed consent. Descriptive statistics for the two samples are presented in Table 1.

The HRS is a national longitudinal study of Americans older than 50 years and their spouses, conducted by the University of Michigan. The current research uses the 2012 wave as the baseline (personality) and the 2016 wave as follow-up (hearing). Baseline personality and demographic data were obtained in 2012 from a total of 5,935 participants. A total of 4,037 participants (59% female, Mean age= 66.10, SD= 9.58) also had complete hearing data four years later. Participants with complete follow-up data were more likely to be female, younger (d= .47), more educated (d= .18), drink less (d= .11), had better memory (d= .38), higher physical activity (d= .34), higher BMI (d= .22), more emotionally stable (d=.06), extraverted (d=.16), open (d= .17), agreeableness (d= .14), and conscientious (d=. 20) than those without complete data. There were no differences on smoking or race.

ELSA is an on-going representative cohort of men and women living in England aged 50 years and over that began in 2002. Personality traits were first assessed in ELSA at Wave 5 in 2010, and the hearing measure was available at Wave 7 in 2014. At baseline, 8,117 participants had complete personality and demographic data. Among these participants, 6,092 participants (56% female, Mean age= 65.47, SD= 8.20) had the hearing measure four years later. Attrition analysis revealed that participants with complete data at follow-up were more likely to be female, younger (d= .28), more educated (d= .27), smoked less (d=.07), drink less (d=.07), had better memory (d=.39), were more physically active (d=.33), more emotionally stable (d=.08), extraverted (d= .14), open (d=.12), and conscientious (d=.20) than individuals without data at follow-up. There were no differences in agreeableness, BMI or race.

Measures

Personality.—The 26-item Midlife Development Inventory (MIDI) (49) was used in both the HRS and the ELSA. Participants rated adjectives that assessed neuroticism (e.g. moody), extraversion (e.g outgoing), agreeableness (e.g. warm), openness (e.g. curious), and conscientiousness (e.g. organized). Participants rated each item on a scale from 1 (*not at all*) to 4 (*a lot*). Cronbach alphas ranged from .67 to .80 across the two samples.

Hearing acuity.—In both samples, objective hearing was assessed using a hearing screening device (HearCheck Screener, Siemens, Germany) used in past research (8, 12). Participants with an ear infection or a cochlear implant were excluded, and those wearing a hearing aid were asked to remove it for the test. The hearing device produced six pure tones: Three decreasing intensities (55, 35, and 20 dB HL) for a mid-frequency sound at 1 kHz, followed by three decreasing intensities (75, 55, and 35 dB HL) for a high frequency sound

at 3kHz. The fixed series were administrated to each ear separately, starting with the left ear. Participants were asked to indicate when they heard a tone. Two indicators were calculated based on this device. First, the scores for each ear were averaged to give an overall hearing acuity mean. Second, consistent with existing research (12), hearing fewer than 6 tones in the best ear was used to define hearing impairment.

Covariates.—Age, sex, education, and race were included as covariates in the two samples. Education was reported in years in the HRS, and on a scale from 1 "No qualification" to "NVQ4/NVQ5/Degree or equivalent" in ELSA. Alcohol, smoking, physical activity, BMI and memory were also included in additional mediational analyses. All of these variables were assessed at baseline, with the exception of BMI in ELSA, which was assessed two years later. Continuous measures of alcohol consumption and smoking were used. Weekly alcohol consumption was computed in the HRS by multiplying the number of drinks a day and the number of days participants reported alcohol consumption. In ELSA, the number of beers, spirits, and wine glasses consumed per weeks were summed. Smoking was defined as the number of cigarettes usually smoked in a day in the HRS and the number of cigarettes and amount of tobacco smoked per weekday and weekend day in ELSA. In both samples, physical activity was the mean of vigorous and moderate activities rated on a scale from 1 (hardly ever or never) to 4 (more than once a week). Staff assessed weight and height were used to calculate BMI as kg/m^2 in both HRS and ELSA. Finally, memory function was the sum of immediate and delayed recall of 10 words in both samples.

Data analysis

In each sample, multiple regression analyses were used to predict hearing acuity at follow-up from baseline personality, adjusting for age, sex, education, and race. Separate analyses were conducted for each personality trait. Additional mediational analyses were conducted using the PROCESS macro (50), using 5,000 bootstrapped samples and 95% bias-corrected confidence intervals. Alcohol, smoking, physical activity, BMI and memory were included simultaneously in the analysis and age, sex, education and race were included as covariates.

Logistic regressions were conducted in each sample to examine whether personality traits were related to the likelihood of hearing impairment at follow-up, adjusting for the demographic covariates. Standardized scores were used for each trait. Alcohol, smoking, physical activity, BMI, and memory were included in an additional model.

Results

As expected, adjusting for demographic factors, conscientiousness was associated with better hearing in both HRS and ELSA, and neuroticism was associated with lower hearing acuity in ELSA (Table 2). Unexpectedly, higher openness was also associated with higher hearing acuity in both samples, and higher agreeableness and higher extraversion were associated with higher hearing acuity in HRS and ELSA, respectively (see Table 2). The effect sizes for personality traits were generally smaller than those of the demographic factors (age, sex, and education).

The mediation analysis indicated that the association between conscientiousness and hearing acuity was mediated by physical activity and memory in both HRS and ELSA, and by smoking in the HRS. These results suggest that higher conscientiousness is related to better hearing in part because it is associated with more physical activity, better memory, and less smoking. In the HRS and ELSA, respectively, physical activity explained 13% and 10% and memory explained 18% and 4% of this association and smoking explained 9% in the HRS. Higher neuroticism was related to worse hearing through its link with lower physical activity (10% proportion mediated) and memory (13% proportion mediated) in ELSA. Higher physical activity and memory were also found to mediate the association between higher openness and higher hearing acuity in both samples. The proportion of mediation explained was 20% and 13% for physical activity and 25% and 10% for memory in HRS and ELSA, respectively. Physical activity mediated the link between agreeableness (6%) and extraversion (19%) and hearing respectively in HRS and ELSA. No mediating role of alcohol or BMI was found across the two samples.

Logistic regression revealed that neuroticism, conscientiousness and openness were related to hearing impairment in both HRS and ELSA (see Table 3). For every standard deviation increase in neuroticism, the likelihood of hearing impairment increased by 10-13%. In contrast, a one standard deviation increase in conscientiousness and openness was related to a 10-13% and 6-8%, respectively, lower likelihood of hearing impairment. Alcohol, smoking, physical activity, BMI and memory partly accounted for these associations in both samples. However, neuroticism and conscientiousness remained significantly associated with hearing impairment in the ELSA even when these variables were included in the model (Model 2, Table 3).

Additional logistic regression analysis were conducted without adjusting for covariates. Neuroticism was not related to hearing impairment in the HRS (OR=0.99, 95% CI=0.91-1.07, p=.75) and ELSA (OR=0.96, 95% CI=0.92-1.02, p=.17). Extraversion was associated with lower risk of hearing impairment in both HRS (OR=0.93, 95% CI=0.88-1.00, p<.05) and ELSA (OR=0.89, 95% CI=0.85-0.94, p<.001). Openness was related to a lower likelihood of impairment in HRS (OR=0.82, 95% CI=0.76-0.87, p<.001) and ELSA (OR=0.87, 95% CI=0.82-0.92, p<.001). Agreeableness was associated with a lower likelihood of impaired hearing in HRS (OR=0.93, 95% CI=0.87-0.99, p<.05) but not in ELSA (OR=0.99, 95% CI=0.95-1.03, p= .64). Finally, conscientiousness was associated with a lower risk of hearing impairment in both HRS (OR=0.81, 95% CI=0.76-0.87, p<.001) and ELSA (OR=0.79, 95% CI=0.75-0.83, p<.001).

Discussion

Based upon two large longitudinal samples of middle-aged and older adults, the present study revealed that personality is prospectively related to hearing acuity. As hypothesized, higher conscientiousness was associated with better acuity and lower risk of hearing impairment, whereas higher neuroticism was related to a higher risk of impairment assessed four years later. Unexpectedly, higher openness was also associated with better hearing function. These associations were relatively modest, with 1 SD differences on the personality traits accounting for roughly 10% increased risk of hearing impairment.

However, these associations were robust and replicated across two samples. Less consistent effects were found for extraversion and agreeableness. This study adds to existing knowledge by providing the first evidence of a prospective relationship between personality and hearing acuity.

The present study indicated that conscientious and open individuals have behavioral and cognitive profiles that are beneficial for hearing function, including greater physical activity and better memory. In contrast, individuals who score high on neuroticism have riskier profiles. This overall pattern is consistent with existing evidence on the health-related behaviors and cognitive function associated with conscientiousness, openness, neuroticism (21, 27, 35) and reports of an association between physical activity and cognition and hearing impairment (33, 37). Lower smoking was also found to mediate the link between higher conscientiousness and higher hearing in the HRS. There was no evidence for a mediating role of alcohol or BMI in either sample.

Other pathways may also operate in the link between personality and hearing. Indeed, conscientiousness is related to engagement in preventive behaviors (28, 35), which may include avoiding injuries and loud noises in recreational or occupational activities, which in turn would protect hearing acuity. Negative affectivity, a component of neuroticism, has been related to hyperacusis (51), which could be accompanied by hearing loss (52). Openness to experience may contribute to better hearing through its association with a better ability to process low-level stimuli (53). At the biological level, higher conscientiousness and openness are related to lower systemic inflammation (16) which is linked to lower risk of hearing impairment (54). Low conscientiousness and higher neuroticism contribute to higher risk of metabolic syndrome (17) that is found among individuals with hearing loss (55).

To our knowledge, the present study is the first to identify a link between personality traits and objective measures of hearing function. It thus contributes to existing knowledge in several ways. First, it adds personality to the list of factors related to hearing function in old age. Indeed, evidence exists about a range of influences, from genetic to environmental (13, 56), and the present study is the first to identify a role of characteristic ways of thinking, feeling, and behaving. Complementary, this study contributes to knowledge on the relationship between personality and health across adulthood (14, 16–26) by identifying a new health-related outcome associated with individual differences in personality traits. Hearing function could be one factor through which personality contributes to a range of health and cognitive outcomes across adulthood. Given that hearing impairment is related to worsening physical health and disability (7), incident dementia (9) and mortality (10), hearing function could be one factor through which personality is related to lower physical functioning and frailty (18), higher risk of dementia (23), and higher mortality (25).

The present study has several strengths including the prospective examination of the association between personality and objective hearing function over four years in two large population-based samples from the US and Europe. Most assessment tools in the two samples were the same, including the personality questionnaire and the measurement of hearing, which facilitated comparisons across the two samples. The inclusion of several

covariates and the test for a range or mediators are other strengths of the study. However, there are also several limitations. There was a positive selection effect in both samples, which raises the issue of the generalizability of the findings. However, it is also likely that the size of the associations may be underestimated because of such selection. Furthermore, the present study did not control for the exposure to noise related to participants location and occupational activity, which should be a focus of future research. The possibility of determining causal relationships was limited by the design of the study. Although personality was considered as a predictor of hearing, it is also likely that hearing may lead to personality changes. Although recent research provided support for reciprocal relationships between personality and self-reported hearing (46), more research is needed to test for such reciprocity using objective measures. The lack of baseline assessment of hearing acuity did not allow to test for the relationship between personality and changes in hearing function over time.

Despite these limitations, the present study provides new and consistent evidence for a relationship between personality and hearing acuity across adulthood. Across two samples, the findings suggest that higher conscientiousness and openness are protective of hearing function, whereas higher neuroticism may be a risk factor of hearing impairment. Personality assessment may prove useful to identify individuals who are at risk of decline in hearing and may be targeted by interventions designed to alleviate hearing loss and ultimately to reduce social isolation and worsening health and cognition.

Abbreviations:

HRS	Health and Retirement Study
ELSA	English Longitudinal Study of Ageing

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Table 1.

Characteristics of the Samples

	HRS		ELSA	
Age at baseline (years)	66.10	±9.58	65.47	±8.20
Sex, female, n (%)	2400	(59.4)	3401	(55.8)
Race, white, n (%)	3168	(78.5)	5950	(97.7)
Education	13.21	±2.83	4.32	±2.19
Memory[a]	10.26	±3.01	11.14	±3.29
BMI, kg/m^2[a]	29.98	±6.25	28.25	±5.14
Smoking[a]	1.63	±5.44	3.01	±11.33
Physical activity[a]	2.57	±1.08	2.66	±0.94
Alcohol (weekly consumption)[a]	2.81	±6.18	5.88	±7.91
Neuroticism	2.00	±0.61	2.09	±0.59
Extraversion	3.19	±0.56	3.17	±0.55
Openness	2.95	±0.56	2.90	±0.55
Agreeableness	3.53	±0.49	3.51	±0.47
Conscientiousness	3.40	±0.47	3.32	±0.48
Hearing	4.50	±1.35	5.00	±1.30
Hearing, impaired, n (%)	2455	(60.8)	2240	(36.8)

Note. HRS: N= 4037; ELSA: N= 6092

[a]Due to missing data, N*s* differ for memory, BMI, smoking, and physical activity

See method section for differences in measures used in the two samples

Table 2.

Summary of Regression Analysis and Bootstrap Analysis in the HRS and the ELSA

Variables	Regression Analysis	Bootstrap Analysis[b]					
	Hearing mean[a]	Smoking	Alcohol	Physical activity	BMI	Memory	Direct effect of Personality Traits[c]
HRS							
Neuroticism	−.02	−.006(−.013; −.001)	.000(−.0008;.003)	−.013 (−.023;−.004)	−.000(−.002;.001)	−.015(−.025;−.006)	−.01
Extraversion	.02	.009 (.003;.018)	.001(−.001; .004)	.023(.007;.041)	.002(−.001;.006)	.011(.002;.021)	−.00
Openness	.03*	.004(−.002;.011)	.002(−.001;.005)	.016(.004;.028)	.000 (−.002;.002)	.020(.010;.031)	.01
Agreeableness	.03*	.007 (−.0003;.016)	−.0003(−.003;.002)	.006(.001;.013)	−.000(−.004;.001)	.009(−.001;.021)	.02
Conscientiousness	.05***	.012(.004;.022)	−.0006(−.004;.001)	.018(.004;.032)	.003(−.003;.011)	.024(.012;.038)	.03
ELSA							
Neuroticism	−.03**	−.000(−.002; .002)	−.000(−.001;.001)	−.008(−.013;−.003)	.001(−.000;.004)	−.01(−.017;−.004)	−.02
Extraversion	.04***	.001 (−.001;.004)	.001(−.002;.004)	.020(.008;.032)	.002(.000;.006)	.005(−.001;.011)	.04**
Openness	.04**	−.002(−.005;.000)	.001(−.002;.005)	.011(.005;.018)	−.000(−.003;.001)	.009(.003;.016)	.03*
Agreeableness	−.01	−.000(−.004;.004)	−.001(−.005;.002)	.002(−.002;.006)	−.003(−.007;.000)	−.002(−.009;.005)	−.01
Conscientiousness	.06***	.003(.000;.006)	−.000(−.003;.0009)	.017(.007;.028)	.005(−.0001;.012)	.007(.0001;.014)	.04***

Note.

*p<.05,

**p<.01,

***p< .001

[a]Regression analysis controlling for age, sex, education and race. HRS: N= 4037; ELSA: N= 6092. Coefficients are standardized regression coefficient

[b]Bootstrap estimates and 95% bias-corrected confidence interval for indirect effects of personality traits on hearing through alcohol, smoking, physical activity, BMI and memory, controlling for age, sex, education and race. HRS: N= 3635; ELSA: N= 4955

[c]Direct effect is calculated with adjustment for mediators, age, sex, education, and race; Coefficients are standardized regression coefficient

Table 3.

Summary of Logistic Regression Predicting Hearing Impairment from Personality Traits

	HRS		ELSA	
	Model 1[a]	**Model 2[b]**	**Model 1[c]**	**Model 2[d]**
Predictors	**Odds ratio (95%CI)**	**Odds ratio (95%CI)**	**Odds ratio (95%CI)**	**Odds ratio (95%CI)**
Neuroticism	1.10 (1.02-1.18) *	1.05(.98-1.14)	1.13(1.06-1.19) ***	1.11(1.04-1.19) **
Extraversion	.94(.88-1.01)	1.01(.94-.1.09)	.95 (.89-1.00)	.95(.89-1.02)
Openness	.92(.86-.99) *	.98(.90-1.06)	.94(.89-1.00) *	.94(.88-1.01)
Agreeableness	.96(.90-1.04)	1.01(.93-1.09)	1.04 (.98-1.11)	1.05(.98-1.12)
Conscientiousness	.87(.81-.94) ***	.94(.87-1.02)	.90(.85-.95) ***	.93(.87-1.00) *

Note.

* p<.05,

** p<.01,

*** p< .001.

Model 1 is the association between each trait and hearing impairment controlling for age, sex, education, and race. Model 2 is Model 1 plus the inclusion of alcohol, smoking, BMI, physical activity, and memory as additional covariates.

[a] N= 4,037,

[b] N= 3,635,

[c] N= 6,092,

[d] N= 4,955