Voice Disorders and Personality: New Steps on an Old Path

[*],[†],[1]Ofer Amir, [*],[†],[1]Gaya Noam, [‡],[§]Adi Primov-Fever, [¶]Ruth Epstein, [¶]Marion Alston, and [‖]Idit Gutman, *‡‖*Tel-Aviv, †Tel Hashomer, §Tel-Hashomer, Israel, and ¶London, UK*

Summary: Objectives. This study examined the association between voice disorders and personality by comparing a heterogenic group of dysphonic patients to non-dysphonic speakers using the NEO-FFI big-five personality inventory.

Methods. A group of 100 dysphonic patients diagnosed with 24 different pathologies was compared to 149 non-dysphonic speakers. Inter-group differences on the five NEO-FFI scales were evaluated using three analysis approaches, a general comparison between the dysphonic and non-dysphonic groups and arranging pathologies using a categorical and a continuous approach.

Results. Of the five NEO-FFI scales, Openness emerged as the single personality trait that yielded a statistically significant difference between the dysphonic group and the non-dysphonic group ($P < 0.001$). Moreover, when the 24 pathologies were arranged categorically, people with structural pathologies were lower on the Openness scale than non-dysphonic speakers ($P < 0.001$). Similarly, when pathologies were arranged continuously, people with pathologies characterized by high organicity were low on the Openness scale compared to the non-dysphonic group ($P < 0.001$).

Conclusions. This study represents a new approach to examining the association between voice disorders and personality. Openness emerged as the single personality trait that repeatedly and consistently differentiated between dysphonic and non-dysphonic people and among specific pathologies, using all analysis approaches. Our findings suggest that examining a spectrum of pathologies, rather than focusing on a particular pathology, provides a new perspective and sheds light on the complex association between voice disorders and personality.

Key Words: Voice pathology–Personality–Openness–NEO-FFI.

INTRODUCTION

Voice disorders are a multifactorial phenomenon, as they are affected by various physical and functional mechanisms and because of their multifaceted impacts on the speaker's general health, function, well-being, and quality of life.[1] While most of the research in the field focused on the medico-physical aspects of voice disorders, fewer studies have attended to its psychological and functional aspects. Within this context, the association between personality and voice has always intrigued artists, clinicians and researchers. Accordingly, the voice was referred to as an indicator of personality,[2] a "window to personality" or a "valve of emotions."[3,4] Therefore, while personality is not viewed as the sole factor governing the development of laryngeal pathologies or voice disorders, they are expected to correlate to some extent.

Until the 1920s, the association between voice and the individual's psychological makeup was not examined directly.[2] Then, early studies published between the 1930s and 1970s started to explore the association between *normal* voice and personality.[5–8] Some reported that specific emotional or psychological conditions could be detected in the speaker's voice.[5,6] Others attempted to associate specific personality traits and emotional states with perceptual properties of the voice, using listeners' judgment.[6–8] These early studies mainly relied on subjective evaluation of voice and did not use standardized measures (which had not been developed then) or uniform terminology for describing voice characteristics.

With the development of standardized tools and methodology, both voice and personality research fields have gradually evolved to explore this association from different perspectives. For example, many studies have probed the connection between personality and acoustic properties of the voice.[9–11] Others have attempted to associate voice and personality with other factors, such as ethnicity,[12,13] or examined how artificial voice is perceived to portray personality.[14,15] Nonetheless, research has not yet provided a comprehensive and valid explanation of how different behavioral and psychological traits may lead or contribute to the development of specific voice properties or vocal behaviors.[16,17]

In addition to the body of research on the association between normal (healthy) voice and personality, researchers and clinicians have gradually grown interested in the association between *pathological* voice and personality. The seminal work of Roy and colleagues, published in 2000, marks a significant

step in formulating a preliminary theory for associating personality with voice disorders.[18–20] Their suggested hypothesis was based on the Eysenck personality model, which was developed in the 1960s and defined three central personality dimensions.[18] Roy et al's model provided a basic framework to explain how the speaker's personality might contribute to the specific development of vocal nodules or functional dysphonia.[19] Yet, two follow-up studies provided only partial empirical support to the suggested model, mainly for the emergence of functional dysphonia.[20,21] While these studies provided intriguing insights into the association between voice disorders and personality, significant caveats were left for future research.

Over the last two decades, several attempts have been made to revisit the association between voice disorders and personality. Like Roy et al, these studies have focused on patients with functional dysphonia or vocal nodules and examined differences between these pathologies in the context of specific behavioral tendencies or individual differences.[22–24] This line of research suggested, for example, that people with functional dysphonia were typically more introverted, neurotic, depressed, anxious, and more likely to avoid harm and have health concerns and fears. Compared to them, people with vocal nodules were described as more persistent, novelty-seeking, strict, ambitious, aggressive, and less avoidant of harm.[22,23] Another study concluded that people with functional dysphonia could be described having more perfectionist traits than healthy controls.[24]

Nevertheless, for many years, the absence of a generally accepted framework for personality has undermined the ability to construct a comprehensive view of the association between personality and voice disorders. Similar to the research on voice disorders, personality research is also challenged by competing strategies to understand, capture, and classify its basic elements.[25,26] While different models have been suggested for describing personality, the most commonly accepted model, for over two decades, describes personality as the combination of five general traits. This was originally presented by Costa and McCrae's widely accepted Five-Factor Model (FFM) of personality, developed in the 1990s.[27,28] The five factors included in this model are (1) Neuroticism—contrasts emotional stability and calmness with negative emotionality, such as anxiety, nervousness, sadness, and tension; (2) Extraversion—sets introversion and individualism against sociality, assertiveness, and activism; (3) Openness—defines mental and experiential depth, originality, and complexity, and contrasts a conservative with a curious approach to the inner and surrounding world; (4) Agreeableness—distinguishes between pro-sociality and antagonism toward others; (5) Conscientiousness—the ability to control impulses in a way that promotes task- and goal-directed behavior.[27,29]

These five traits were repeatedly shown to represent personality at its broadest level. Each trait consists of distinct and specific personality sub-traits.[28,30] The model was evaluated repeatedly and extensively and found reliable and valid for different genders, ages, socio-economic classes, and cultures.[25,31] The Big Five taxonomy enabled

research to identify specific contributions of personality traits to real-life outcomes and to establish connections with other fields.[32] Nevertheless, thus far, the FFM has not been applied to examine the association between voice disorders and personality.

In light of the previous studies conducted in the field, the present study is a preliminary attempt to make new steps on an old path toward understanding the association between voice disorders and personality. To that end, this study used the FFM framework to describe speakers' personalities. In addition, instead of focusing on a single voice pathology, we opted to include a more comprehensive representation of the field of voice disorders.

METHODS

Participants
Participants were recruited for this study after obtaining approval from the Sheba Medical Center's Helsinki Committee (#SMC-8332-21) and the approval of the Tel Aviv University Ethics Committee (#0003648-1). Then, all participants signed a consent form.

Two hundred and forty-nine adults (100 dysphonic, 149 non-dysphonic) participated in the study. All participants in the dysphonic group were examined, evaluated, and diagnosed at the multidisciplinary voice clinic, Sheba Medical Center, Tel-Hashomer. The control group consisted of adults who reported no voice disorders and had no history of speech or voice therapy. Additional exclusion criteria were reading difficulties, physical disabilities that prohibited independently filling out the study questionnaires, and age < 18 years.

Age and gender distribution in both groups are presented in Table 1.

As shown, the gender ratio was similar in both groups, with no significant group difference ($P > 0.05$). In contrast, the mean age of the participants in the dysphonic group was approximately 9 years higher than that of the non-dysphonic group. This age difference was found statistically significant using an independent sample t test ($t_{(247)} = 3.96$, $P < 0.001$). Therefore, all statistical analyses were performed with age as a confounding factor.

Instruments
All participants filled out three questionnaires for this study, requiring 10–15 minutes. The questionnaires were presented to the participants in a random order that was

TABLE 1.
Mean Age and Gender Distribution in the Dysphonic and Non-dysphonic Groups

Group	n	Age (SD)	Women n (%)	Men n (%)
Dysphonic	100	48.96 (18.7)	52 (52%)	48 (48%)
Non-dysphonic	149	40.01 (15.7)	83 (55.7%)	66 (44.3%)
Total	249	43.61 (17.5)	135 (54.2%)	114 (45.8%)

changed between participants. The three questionnaires included (a) an Anamnesis questionnaire—consisting of questions concerning age, gender, occupation, general health, and vocal use; (b) Voice Handicap Index (VHI) (Hebrew version);[33] (c) NEO-FFI (Hebrew version)[34]—this widely used self-administered instrument describes the individual's personality based on the "Five-Factor Model."[31,34] It consists of 60 items describing behaviors, feelings, and beliefs, rated on a 5-point scale from 0 (strongly disagree) to 4 (strongly agree). Each of the five traits is represented by 12 items. Responses are arranged into five scores ranging from 0 to 48, one for each trait: Neuroticism, Extraversion, Openness, Agreeableness, and Conscientiousness.

Procedure

Data were collected over 8 months, between October 2021 and May 2022. During that time, all patients examined at the voice clinic, Sheba Medical Center, were approached by a member of our research team before the examination and invited to participate in the study. One hundred and eight patients were initially approached; of them, eight (7.4%) refused participation. Each participant signed the informed consent form. All participants in the non-dysphonic group were recruited through social media forums using a snowball approach. Participants completed the questionnaires digitally on their mobile phones, computers, or a tablet provided by our team members and were blinded to the study objectives.

After completing the study questionnaires, the voice clinic multidisciplinary team examined each participant in the dysphonic group. In essence, this included taking a medical history, recording a voice sample (prolonged vowels, voiced sentences, phonetically balanced standardized reading passage[35]), perceptual voice evaluation using the GRBAS scale,[36] and video laryngo-stroboscopy using a flexible or rigid endoscope.

RESULTS

NEO-FFI scores and voice disorders

Due to the preliminary nature of this study, results were evaluated in several different ways. For the initial inspection of the data, participants in the dysphonic group were arranged into pathology groups based on the diagnoses made by the voice clinic team. Consequently, 24 laryngeal/voice pathologies were included. The complete list of the included pathologies is presented in Table 2.

Preliminary observation

First, we inspected the differences in the scores of the five NEO-FFI factors between the 24 pathologies and those

TABLE 2.
Means and Standard Deviations (in Parentheses) of the NEO-FFI's Five Factors Scores Obtained for the Different Laryngeal/Voice Pathologies

Group	n	NEO-FFI Factors				
		Extraversion	Neuroticism	Openness	Agreeableness	Conscientiousness
Controls	149	30.82 (5.20)	20.35 (8.36)	(5.24) 29.42	(4.29) 32.44	(5.80) 34.95
Polyp	17	30.76 (5.38)	19.82 (8.67)	27.00 (7.52)	32.17 (5.56)	36.88 (7.37)
Hyperfunc	14	31.21 (4.51)	24.21 (5.85)	29.71 (4.16)	32.71 (4.27)	33.64 (6.50)
Edema	10	32.00 (6.83)	19.70 (4.97)	24.00 (4.47)	32.30 (6.36)	36.40 (6.47)
Presbyphon	6	25.17 (6.61)	24.17 (4.71)	25.83 (6.85)	32.67 (2.94)	34.33 (5.05)
Sulcus	5	28.60 (7.70)	17.00 (7.90)	24.00 (1.58)	32.20 (3.35)	32.60 (7.16)
Gap	5	35.00 (3.94)	12.60 (1.95)	34.60 (6.07)	34.40 (6.62)	37.60 (4.72)
Scar	5	31.20 (4.92)	17.60 (3.29)	24.00 (5.15)	33.00 (2.34)	37.60 (2.79)
Rec Para	5	27.80 (3.56)	20.60 (6.80)	24.40 (5.68)	32.20 (5.17)	34.80 (5.07)
Nodules	4	39.00 (2.44)	16.75 (5.38)	29.00 (6.98)	36.75 (6.55)	35.25 (2.63)
MTD	4	28.75 (3.40)	21.25 (6.60)	29.25 (10.21)	30.75 (4.79)	36.25 (6.65)
Cyst	4	37.25 (2.22)	18.50 (5.07)	24.75 (2.75)	32.00 (6.38)	37.00 (1.41)
Add. SD	3	24.67 (9.07)	26.67 (14.98)	33.67 (5.86)	32.33 (3.78)	31.33 (11.59)
Tremor	3	25.00 (7.94)	27.00 (6.24)	26.67 (5.69)	29.00 (5.20)	29.33 (4.72)
Paresis	3	25.33 (2.52)	19.00 (3.60)	24.67 (0.58)	32.33 (1.15)	35.67 (2.52)
Reflux	2	28.00 (5.66)	19.50 (9.19)	21.00 (4.24)	27.00 (1.41)	32.00 (5.66)
Leuko	2	33.00 (9.90)	29.00 (11.31)	24.00 (4.24)	28.50 (4.95)	33.00 (2.83)
Ectasia	1	35.00 (na)	13.00 (na)	20.00 (na)	39.00 (na)	44.00 (na)
Hyperemia	1	23.00 (na)	24.00 (na)	25.00 (na)	31.00 (na)	33.00 (na)
Papilloma	1	33.00 (na)	21.00 (na)	25.00 (na)	33.00 (na)	34.00 (na)
Paradox	1	33.00 (na)	22.00 (na)	29.00 (na)	30.00 (na)	37.00 (na)
Psy Apho	1	29.00 (na)	23.00 (na)	25.00 (na)	30.00 (na)	36.00 (na)
Abd. SD	1	28.00 (na)	10.00 (na)	31.00 (na)	34.00 (na)	31.00 (na)
Vent Phon	1	30.00 (na)	24.00 (na)	24.00 (na)	34.00 (na)	41.00 (na)
Laryngitis	1	24.00 (na)	12.00 (na)	28.00 (na)	38.00 (na)	39.00 (na)

Add. SD, Adductor Spasmodic Dysphonia; Abd. SD, Abductor Spasmodic Dysphonia.

obtained for the non-dysphonic group. These data are summarized in Table 2.

Due to the large number of pathologies, the statistical significance of the observed group differences could not be assessed. Hence, group differences are graphically illustrated in the Appendix for the five NEO-FFI factors. Data demonstrate inter-pathology differences and differences between specific pathologies and the non-dysphonic group. Qualitative inspection of these figures reveals noticeable inter-pathology differences for three NEO-FFI factors: Extraversion, Neuroticism, and Openness. In contrast, only minor differences are shown for the other two factors: Agreeableness and Conscientiousness. Yet, as these raw observations could not be tested statistically, further analyses were performed.

Dysphonic versus non-dysphonic speakers

A general comparison was made between the dysphonic speakers as a unified group (n = 100) and the non-dysphonic group (n = 149) for the five NEO-FFI factors' scores, with age and gender as covariates. Analyses were performed separately for each factor. Preliminary analyses showed that gender did not interact significantly with any of the NEO-FFI factors ($P = 0.41$). Therefore, it was removed from these analyses. Table 3 summarizes mean group scores and statistical analyses.

Results revealed lower scores for Openness in the dysphonic group compared to the non-dysphonic group, with a mean group difference of 2.53 points. This difference was statistically significant ($P < 0.001$). In contrast, no significant differences were found between the dysphonic and non-dysphonic groups for all other factors ($P > 0.05$).

Inter-pathology group differences: Categorical approach

As noted, the large number of pathologies included in the dysphonic group prohibited the use of statistical analysis. Hence, pathologies were arranged into categories using the Verdolini et al scheme.[37] This scheme organizes voice disorders into nine categories. However, the 24 pathologies in our cohort could be allocated to only five of these categories, with no representation of the other categories. Hence, the following analyses included the five pathological

categories and the non-dysphonic group. Table 4 presents group differences for the five NEO-FFI factors, arranged by Verdolini et al's categorical scheme.

Data show that Openness was the only NEO-FFI factor that yielded a statistically significant group difference ($P < 0.001$), while all other factors failed to reach statistical significance. Post-hoc analysis, using Tukey's test, revealed significant group differences in Openness between the "structural" and "non-dysphonic" groups and between the "structural" and the "other" groups ($P < 0.001$).

Inter-pathology group difference: Continuous approach

An alternative approach to examining group differences was applied based on a recently presented continuous model for arranging voice disorders.[38] Rather than the "traditional" categorical approach, this classification scheme arranges voice disorders using two continuous scales (Organicity and Tonicity) that form a two-dimensional plane on which all pathologies are presented. This approach also facilitates the arrangement of all pathologies into four clusters, representing the four quadrants of the two-dimensional plane. To examine inter-pathology group differences using the two-dimensional scheme, all 24 pathologies were re-arranged into the four clusters defined by this model. Table 5 presents group differences for the five NEO-FFI factors, arranged by Amir et al's two-dimensional continuous approach.[38]

Statistical analyses revealed that Openness was the only trait that yielded significant differences between the scores obtained from the patients in the four pathology clusters ($P < 0.001$). Post-hoc analysis, using Tukey's test, demonstrated significantly lower Openness scores for pathologies in clusters 1 (high organicity, high tonicity) and 4 (high organicity, low tonicity) compared to the non-dysphonic group ($P < 0.05$). In other words, patients with pathologies with high organicity exhibited lower scores on Openness compared to non-dysphonic speakers.

Association between personality and voice disorders' dimensions

To further examine the associations between personality and specific domains of voice disorders, we compared the scores obtained for the five factors of the NEO-FFI to two

TABLE 3.
Mean NEO-FFI Scores and Standard Deviations (in Parentheses) for the Dysphonic and Non-dysphonic Groups and ANCOVA Group Difference Results

	NEO-FFI Factors				
Group	Extraversion	Neuroticism	Openness	Agreeableness	Conscientiousness
Dysphonic	30.46 (6.02)	20.47 (7.09)	26.89 (6.02)	32.42 (4.76)	35.29 (5.88)
Non-dysphonic	30.82 (5.20)	20.35 (8.36)	(5.24) 29.42	(4.29) 32.44	(5.80) 34.95
Group$_{(df:\ 1246)}$	$F = 0.26$	$F = 0.85$	$F = 13.04$	$F = 0.21$	$F = 0.06$
	$P = 0.613$	$P = 0.358$	$P < 0.001$	$P = 0.643$	$P = 0.811$
Age$_{(df:\ 1246)}$	$F = 15.88$	$F = 10.34$	$F = 0.67$	$F = 3.79$	$F = 0.58$
	$P < 0.001$	$P = 0.001$	$P = 0.413$	$P = 0.053$	$P = 0.446$

TABLE 4.
Mean NEO-FFI Scores and Standard Deviations (in Parentheses) for the Five Voice Pathology Categories Arranged by Verdolini et al[37] and the Non-dysphonic Group and ANCOVA Group Difference Results

Group*	n	NEO-FFI Factors				
		Extraversion	Neuroticism	Openness	Agreeableness	Consciousness
Structural	55	31.49 (6.44)	19.73 (6.88)	25.49 (5.76)	32.65 (5.08)	36.02 (5.83)
Inflammatory	4	25.75 (4.19)	18.75 (7.27)	23.75 (4.19)	30.75 (5.25)	34.00 (4.69)
Psychological	1	29.00 (NA)	23.00 (NA)	25.00 (NA)	30.00 (NA)	36.00 (NA)
Neurological	15	26.13 (5.23)	22.07 (8.70)	27.20 (5.75)	31.73 (3.99)	32.93 (6.09)
Other	25	31.60 (4.37)	21.32 (6.75)	30.36 (5.87)	32.68 (4.65)	35.28 (6.04)
Non-dysphonic	149	30.82 (5.20)	20.35 (8.36)	29.42 (5.24)	32.44 (4.29)	34.95 (5.80)
Group$_{(df: 5238)}$		$F = 1.92$	$F = 0.56$	$F = 5.89$	$F = 0.23$	$F = 0.80$
		$P = 0.091$	$P = 0.731$	$P < 0.001$	$P = .951$	$P = 0.552$
Age$_{(df: 1, 238)}$		$F = 10.54$	$F = 6.98$	$F = 1.66$	$F = 0.54$	$F = 1.75$
		$P = 0.001$	$P = 0.009$	$P = 0.199$	$P = 0.463$	$P = 0.186$
Gender$_{(df: 1, 238)}$		$F = 0.01$	$F = 3.98$	$F = 0.17$	$F = 3.85$	$F = 0.56$
		$P = 0.919$	$P = 0.047$	$P = 0.682$	$P = 0.051$	$P = 0.456$

* For this analysis, the 24 pathologies were arranged into five categories based on Verdolini et al's[37] categorical scheme. Specifically, "Structural" included cyst, ectasia, edema, leukoplakia, nodules, papilloma, polyp, presbyphonia, scar, and sulcus; "Inflammatory" included hyperemia, laryngitis, and reflux; "Psychological" included psychogenic aphonia; "Neurological" included spasmodic dysphonia, paresis, recurrent nerve paralysis, and tremor; "Other" included hyperfunction, muscle tension dysphonia, paradoxical vocal fold movement, ventricular phonation, and vocal folds gap.

TABLE 5.
Mean NEO-FFI Scores and Standard Deviations (in Parentheses) for the Four Clusters of Voice Pathologies Arranged by Amir et al[38] and the Non-dysphonic Group and ANCOVA Group Difference Results

Cluster*	n	NEO-FFI Factors				
		Extraversion	Neuroticism	Openness	Agreeableness	Conscientiousness
High organicity High tonicity	60	31.02 (6.53)	19.77 (7.61)	25.90 (5.79)	32.35 (5.15)	35.40 (6.23)
Low Organicity High tonicity	20	30.75 (4.13)	23.50 (5.64)	29.30 (5.47)	32.25 (4.14)	34.70 (6.29)
Low organicity Low tonicity	6	34.00 (4.29)	14.33 (4.59)	33.00 (6.69)	33.67 (6.19)	37.33 (4.27)
High organicity Low tonicity	14	26.14 (4.83)	21.79 (5.45)	25.07 (5.34)	32.43 (3.43)	34.79 (4.35)
Non-dysphonic	149	30.82 (5.20)	20.35 (8.36)	29.42 (5.24)	32.44 (4.29)	34.95 (5.80)
Group$_{(df: 4, 238)}$		$F = 2.05$	$F = 1.78$	$F = 7.32$	$F = 0.20$	$F = 0.10$
		$P = 0.088$	$P = 0.134$	$P < 0.001$	$P = 0.938$	$P = 0.981$
Age$_{(df: 1.238)}$		$F = 13.99$	$F = 5.64$	$F = 1.74$	$F = 1.27$	$F = 0.86$
		$P < 0.001$	$P = 0.018$	$P = 0.188$	$P = 0.261$	$P = 0.355$
Gender$_{(df: 1238)}$		$F = 0.02$	$F = 2.21$	$F = 0.15$	$F = 1.88$	$F = 0.76$
		$P = 0.898$	$P = 0.139$	$P = 0.702$	$P = 0.172$	$P = 0.385$

* For this analysis, the 24 pathologies included in this study were arranged into four clusters based on Amir et al's two-dimensional continuous scheme.[38] Specifically, cluster 1 (high organicity, high tonicity) included spasmodic dysphonia, cyst, nodules, polyp, papilloma, hyperemia, scar, sulcus, ectasia, laryngitis, leukoplakia, tremor, edema, reflux; cluster 2 (low organicity, high tonicity) included: hyperfunction, ventricular phonation, muscle tension dysphonia, and paradoxical vocal folds movement; cluster 3 (low organicity, low tonicity) included psychogenic aphonia and vocal folds gap; and cluster 4 (high organicity, low tonicity) included presbyphonia, paresis, and recurrent nerve paralysis.

subjective measures: self-evaluation of voice handicap (quantified by VHI scores) and perceptual evaluation of voice quality (quantified by the GRBAS scale). As noted, all participants completed the VHI questionnaire as part of this study. Perceptual assessment of the participants' voices using the GRBAS was also performed by the voice clinic team as part of the routine evaluation.

Pearson correlation coefficients were calculated to examine the associations between the scores obtained from the three study instruments (NEO-FFI, VHI, and GRBAS). A Benjamini-Hochberg correction for multiple comparisons[39] was performed for these analyses, with the false discovery rate set at 10%, and final critical value of $P = 0.024$. A summary matrix of these analyses is presented in Table 6.

Results reveal a statistically significant negative correlation between Openness (on the NEO-FFI) and Breathiness (on the GRBAS) ($r = -0.25$). In addition, a statistically significant

TABLE 6.
Pearson Correlation Coefficients Matrix for Comparisons Between the Scores Obtained From the NEO-FFI, VHI, and GRBAS

		NEO-FFI Factors					VHI				GRBAS				
		E	N	O	A	C	F	P	E	T	G	R	B	A	S
NEO-FFI factors	E	-	−0.32*	0.18	0.26*	0.41*	−0.18	−0.07	−0.25*	−0.19	−0.08	−0.01	−0.01	−0.14	−0.07
	N		-	0.16	−0.46*	−0.58*	0.05	0.01	0.14	0.07	−0.13	−0.12	−0.12	−0.04	−0.03
	O			-	0.03	−0.12	−0.08	−0.08	−0.09	−0.09	−0.15	−0.05	−0.20*	−0.18	−0.09
	A				-	0.38*	−0.02	−0.03	−0.03	−0.03	0.05	0.13	0.10	0.07	−0.02
	C					-	−0.03	−0.01	−0.09	−0.05	0.13	0.17	0.02	0.06	0.03
VHI	F						-	0.70*	0.85*	0.93*	0.33*	0.17	0.23*	0.42*	0.32*
	P							-	0.72*	0.87*	0.36*	0.18	0.32*	0.38*	0.27*
	E								-	0.94*	0.33*	0.17	0.17	0.43*	0.29*
	T									-	0.37*	0.19	0.26*	0.45*	0.32*
GRBAS	G										-	0.51*	0.58*	0.62*	0.78*
	R											-	0.07	0.19	0.53*
	B												-	0.62*	0.48*
	A													-	0.44*
	S														-

Abbreviations: NEO-FFI factors, E (extraversion), N (Neuroticism), O (Openness), A (Agreeableness), C (Conscientiousness); Voice Handicap Index (VHI) sections, F (Functional), P (Physical), E (Emotional), T (Total score); GRBAS, G (Grade), R (Roughness), B (Breathiness), A (Asthenia), S (Strain).
* Corrected $P < 0.10$.

negative correlation was found between Extraversion (on the NEO-FFI) and the Emotional score (on the VHI) ($r = −0.25$).

Finally, an inspection of the correlation matrix also shows multiple significant correlations among the different sections of the VHI questionnaire and the five scales of the GRBAS scale,[33,40] in agreement with previous research.

DISCUSSION

The present study was a preliminary attempt to re-examine the association between personality and voice disorders. Previous studies have examined this association using various approaches, relying on different personality models and mainly focusing on two voice/laryngeal pathologies: vocal nodules and functional dysphonia. To refresh and advance this line of research, the current study included patients with a broad representation of pathologies and applied the Five-Factor Model of personality.[31]

The primary finding of this study was that a single personality trait, Openness, was found to be repeatedly and consistently associated with voice disorders. Specifically, when all voice disorders were combined into a single heterogenic group, the Openness scale scores were lower in that group than in the non-dysphonic group. When voice disorders were arranged using the Verdolini et al categorical scheme,[37] patients with structural laryngeal pathologies were lower on Openness compared to the non-dysphonic group. Then, a similar result was found when voice disorders were arranged continuously, using the Amir et al new two-dimensional scheme.[38] In this analysis, people with pathologies with high "organicity" were lower on Openness than non-dysphonic speakers.

This consistent association between Openness and voice disorders, found using all models, may be explained differently, highlighting varying aspects of the mechanism underlying the occurrence and development of voice disorders. Three possible explanations are suggested. First, Openness is highly correlated with "flexibility" and negatively correlated with "tough-mindedness."[28,31] Therefore, in the presence of a physiological predisposition to voice disorders, people low in Openness are prone to experience difficulties adjusting or moderating themselves and reducing harmful vocal behavior. This may lead to the development of a voice disorder or the aggravation of an existing one. In contrast, people high on the Openness scale are more flexible in their communication attributes and vocal behavior and, thus, are less likely to inflict harm on their voice. This explanation is particularly relevant, as Openness is vital to adaptive behavior.[31] Therefore, people low on Openness could have difficulties in self-regulation[41] and adjusting to the physiological and functional changes associated with voice disorders.

Second, of the five basic personality traits comprising the FFI, Openness most strongly correlates with IQ, which, in turn, negatively correlates with "aggressiveness."[42,43] In other words, people with lower scores on the Openness scale are more likely to exhibit aggressive behaviors. Therefore, adverse vocal behaviors can be seen as aggressive behavior and self-inflicted harm,[26,47] which could explain why people low on the Openness scale are at a greater risk for developing voice disorders.

Third, Openness is closely related to lexical and communication skills.[44] Therefore, people low on Openness may experience difficulties expressing themselves in interpersonal or social situations, especially during emotionally loaded interactions. Due to this limited capability, they may raise their voice to make a point or merely draw attention. This compensatory behavior may lead to vocal

overuse or misuse, increasing the risk of developing a voice disorder.

In addition to these three possible explanations, recent research on vocal congruence may provide an alternative perspective on this association. Vocal congruence is the degree of alignment between one's voice and sense of self. Accordingly, people with lower levels of communicative congruence were shown to be more negatively affected by voice disorders than people with higher levels of communicative congruence.[45] Moreover, Openness predicts high levels of interoceptive awareness among people with dysphonia.[46] Therefore, lower levels of interoceptive awareness (ie, incongruence), associated with lower scores on Openness, may contribute to developing voice disorders. Nevertheless, as this hypothesis was not examined directly, further research on this association is warranted.

These suggested explanations provide possible alternatives for understanding the nature of the association between Openness and voice disorders and may be viewed separately or in conjunction. Yet, while these explanations demonstrate how low Openness can contribute to the development of voice disorders, the reverse association cannot be ruled out. This means that having a chronic voice disorder for a long time could affect the individual's psycho-social makeup and eventually personality; specifically, in this case, gradually reducing Openness. Nevertheless, this study was not designed to examine the direction of the association between voice disorders and personality. Therefore, our data cannot resolve this question directly, and future research is required.

Interestingly, the finding of Openness as the single trait that significantly differentiates between groups was obtained consistently using the two approaches for arranging voice disorders. Specifically, using Verdolini's categorical approach,[37] the "structural pathologies" group was significantly lower on Openness than the non-dysphonic group. Similarly, using the continuous approach,[38] people with pathologies with "high organicity" were lower on Openness than the non-dysphonic group. This similarity could be attributed, at least in part, to the distribution of the patients in the 24 pathological groups in our study. As shown, 55 of the 100 dysphonic patients were assigned to the "structural pathologies" category, while the other categories comprised fewer patients. Similarly, using Amir et al's continuous approach, pathologies with "high organicity" comprised the majority of cases in our cohort (74 of 100). This unbalanced representation of the different voice pathologies reflects the relative prevalence of the various voice disorders. It also highlights the necessity of examining the association between voice disorders and personality on the full spectrum of pathologies. Probing this association on a homogeneous group of patients, as done previously with a single pathology, could bias the results and present findings that would not necessarily apply to patients with other pathologies. Therefore, in light of the consistency of these findings, future research should provide a more balanced representation of laryngeal pathologies, in which the association between voice disorders and personality will be

examined. This point is particularly relevant to developing a comprehensive model of the association between personality and voice disorders. As personality is not the sole factor, nor is it the primary factor that leads to the occurrence of voice disorders, we suggest that studying it in a homogenous group of a single pathology could be misleading. It is possible, for example, that groups of patients with functional or psychogenic voice disorders would show smaller intra-group variability in their personality traits, while groups of patients with organic voice disorders would show greater intra-group personality variability. Yet, examining such a hypothesis requires further research with various pathologies and sufficient patients in each study group.

Initial support for this view can be found in the raw data of this study (Table 2 and Appendix). Noticeable differences are observed in Extraversion, Neuroticism, and Openness among people with specific voice disorders and between these pathological groups and non-dysphonic people. For example, people diagnosed with a polyp (n = 17) were found low on Openness and high on Conscientiousness compared to people with other pathologies. In contrast, people with hyperfunction dysphonia (n = 14) were higher on Neuroticism and lower on Conscientiousness. While these differences are intriguing, drawing conclusions from these preliminary observations is beyond the scope of this study. Hence, further research is needed to elaborate on this direction before any theoretical or clinical interpretations can be made.

Finally, although this was not the primary focus of this study, significant correlations were found between specific personality traits and voice, in accordance with previous studies in the field. Specifically, a statistically significant negative correlation was found between Extraversion and the emotional scale of the VHI. In other words, people described as more introverted are more concerned about the emotional aspects of their voice disorder. In addition, a significant negative correlation was found between Openness and "Breathiness" (using the GRBAS scale). This finding suggests that the voices of people low on Openness are perceived as more breathy. This result is reminiscent of previous studies that associated breathiness with fear, emotionality, and timidity.[12,47,48] These anecdotal results demonstrate the complex association between voice disorders and personality and highlight the importance of inspecting this association from different perspectives, as applying a single approach might lead to a limited interpretation of this complex association.

CONCLUSION

This study represents a new attempt to re-examine the association between voice disorders and personality. In contrast with previous studies that focused on a single or a limited number of pathologies, we examined a heterogeneous cohort of 24 pathologies. In addition, the NEO-FFI questionnaire was used to provide an updated view and a valid representation of the participants' personality.

Openness emerged as the single personality trait that significantly differentiated between dysphonic and non-dysphonic people and between specific pathological groups or categories of disorders. These findings highlight the importance of examining a wide variety of voice disorders instead of focusing on a single pathology for deciphering the association between voice disorders and personality.

Appendix A. Mean group scores and standard error bars for the five NEO-FFI factors

The following figures illustrate mean scores and standard error (SE) bars separately for the five NEO-FFI factors. In all figures, the non-dysphonic group is presented as the first group from the left. The light gray horizontal bar represents the non-dysphonic group mean score ± 1SE. The 24 pathological groups are arranged by the number of patients included, and the unfilled markers denote groups with a single patient.
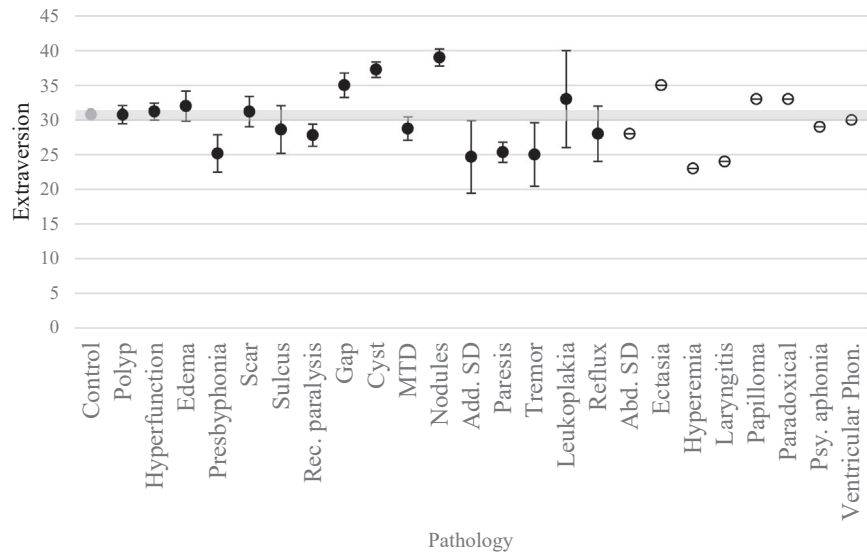
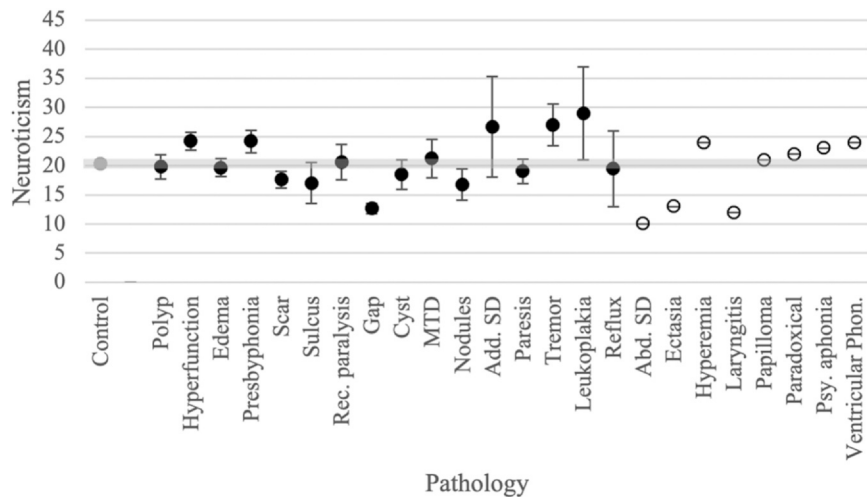**FIGURE A1.** Group means and ± 1SE bars for Extraversion.

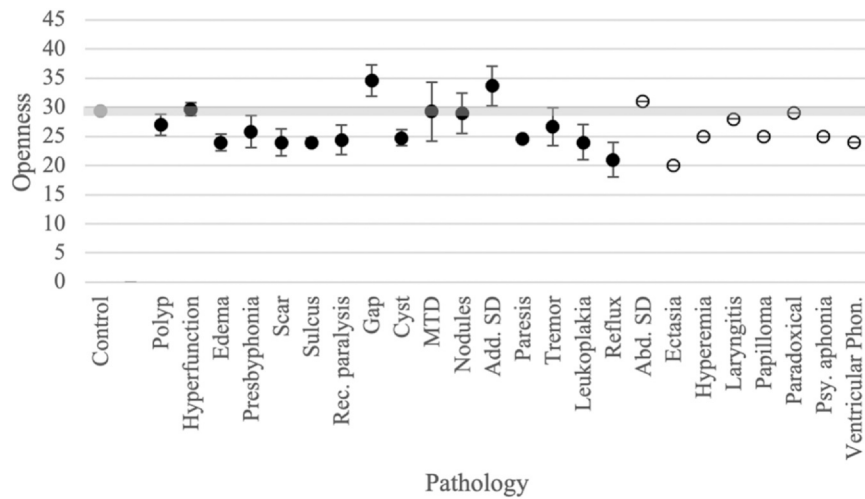**FIGURE A2.** Group means and ± 1SE bars for Neuroticism.

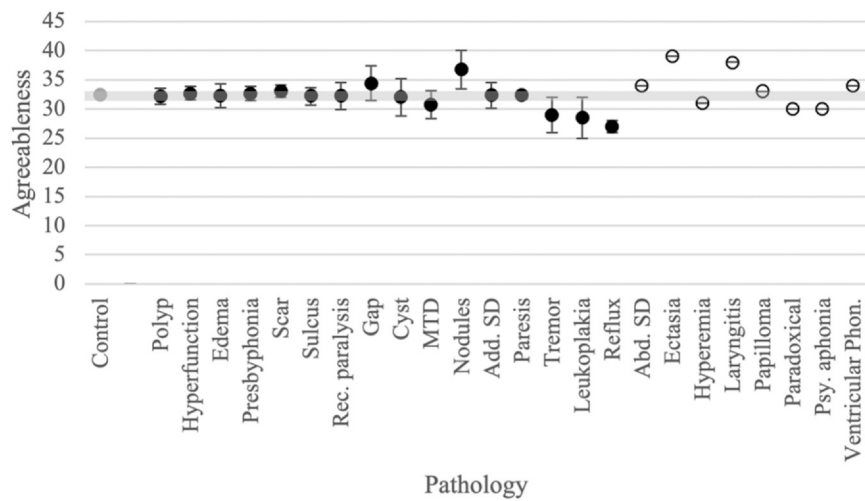**FIGURE A3.** Group means and ± 1SE bars for Openness.

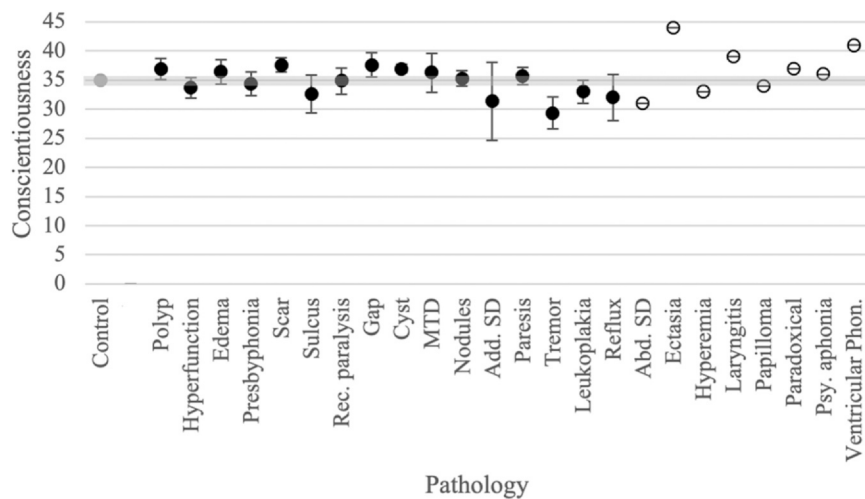**FIGURE A4.** Group means and ± 1SE bars for Agreeableness.

FIGURE A5. Group means and ± 1SE bars for Conscientiousness.

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